Embracing environmental challenges

Effectively balancing offshore licensing issues against global wind energy demand

Add value.
Inspire trust.

White paper

Abstract

A rapidly-growing offshore wind power sector reflects global governments' quest to develop a sustainable carbon-alternative energy source. While there are many environmental, political and economic benefits derived from wind power, this relatively immature market still presents significant licensing challenges for investors, owners and developers of offshore wind projects.

To facilitate the delivery of renewable energy objectives, the licensing process should ideally deliver consents for offshore wind projects in a timely and effective manner. However, stakeholders must effectively mitigate against environmental conflict of interests to de-risk and expedite the process. This white paper will explore how those challenges can be effectively managed to deliver against the global demand for wind energy.

TÜV SÜD

TÜV®

Contents

About the TÜV SÜD expert

Steve Freeman
Director of Environment, TÜV SÜD PMSS

Steve has over 20 years' experience in coastal and marine energy projects globally, holding a number of senior positions with a strong technical and commercial focus on developing offshore wind, wave and tidal power projects. Consequently he has an excellent understanding of the strategic, policy and development challenges associated with the delivery of renewable energy projects. With specialist knowledge in energy law and policy, Steve provides technical support to clients seeking strategic advice and negotiations in relation to permitting and commercialisation.

Formerly a regulator with a consultancy career in oil & gas, he has played key management roles in numerous major energy infrastructure projects, and supported clients in bid preparation, project feasibility, market analysis and due diligence. He is Vice-Chair of RUK CLG, member of Marine Industries Liaison Group, and methodology developer for cumulative and strategic assessments, including authorship of several influential papers supporting the offshore renewables industry.

1. Introduction

Offshore wind is a crucial element of global governments' plans to reduce the carbon intensity of the power sector, increase energy security and provide affordable energy to consumers.

However, developing offshore wind projects is a complex process, particularly when attempting to secure statutory consent while balancing development requirements against environmental impacts and constraints.

Growth of wind power

The growth of offshore wind projects reflects the global need for an alternative source of energy that reduces carbon footprint, increase energy security and stimulates economic investment.

Figures from the US Department of Energy (DoE)[1] show that in 2013, more than 1,700 megawatts (MW) of offshore wind power capacity was added globally, bringing the cumulative global total to 7,031 MW. Of that new capacity, most is attributable to four countries – Belgium (192 MW of new capacity), Denmark (400 MW), Germany (230 MW) and the United Kingdom (812 MW). The United Kingdom continues to lead the market, with more than half the global installed capacity, comprising 47 percent of 2013 additions globally.

Research from the Global Wind Energy Council (GWEC)[2] supports the DoE's findings, revealing that more than 90% of offshore wind is installed off northern Europe. Most of the rest is off China's east coast and major deployment is expected elsewhere in Japan, Korea, the United States, Canada, Taiwan and India. Figure 1 summarises the current global offshore market in number of projects, cumulative capacity, and number of turbines by country.

FIGURE 1: SUMMARY OF CUMULATIVE INSTALLED GLOBAL OFFSHORE CAPACITY THROUGH 2013

REGION	COUNTRY	NUMBER OF OPERATIONAL PROJECTS	TOTAL CAPACITY (MW)	TOTAL NUMBER OF TURBINES INSTALLED
Asia	China	15	404	158
	Japan	9	50	27
	South Korea	2	5	2
Europe	Belgium	6	571	135
	Denmark	17	1,274	517
	Finland	3	32	11
	Germany	8	516	115
	Ireland	1	25	7
	Netherlands	4	247	128
	Norway	1	2	1
	Portugal	1	2	1
	Spain	1	5	1
	Sweden	6	212	91
	United Kingdom	30	3,686	1,083
	Total	**104**	**7,031**	**2,277**

Note: Includes commercial and test projects. Individual phases of projects at a single site may be counted as separate projects

Source: Navigant analysis of data provided by NREL and Navigant Research

Environmental benefits

Offshore wind farms have a positive impact on the environment in several ways. First of all, they contribute to reduce CO_2 emissions, which is a major threat to biodiversity. Secondly, they can provide regeneration areas for marine wildlife.

Greenhouse gases

Offshore wind power is potentially a huge source of CO_2-free clean energy and is regarded as the most cost-effective and promising solution to reducing CO_2 emissions. This is because the overall level of greenhouse gases emitted in the process of generating electricity from wind turbines is low. Emissions occurring during the production of electricity are close to zero.

The European Wind Energy Association forecasts[3] that by 2020 40 gigawatts (GW) offshore wind capacity will be online in European seas, which will offset 102 metric tons (Mt) of CO_2 emissions annually. By 2030, 150GW installed capacity will offset 315Mt of CO_2 annually.

However, it is important to consider overall projected carbon emissions at the planning stage as there are still carbon losses associated with the development and installation of wind farms.

Wildlife

Some smaller wind farms have excluded fishing, resulting in increased local fish populations. However, as wind farm sites increase in size to meet energy demands, this is a less realistic solution. Many are therefore now promoting fishing, with a focus on sustainability. For example, excessive trawling, which is a severe threat to fish and invertebrates, is prohibited or limited inside wind farms in most European Union (EU) countries.

Research suggests that offshore wind farms could have a positive impact on species living beneath the waves. Certain fish species shelter inside the farm and there are indications that the wind farm acts as a suitable habitat with a higher biodiversity of benthic organisms.

Wind farm foundations may act as artificial reefs that locally enhance the biomass of a number of sessile and motile organisms. Moorings or foundations also function as fish aggregating devices for large predatory and pelagic fish. Indeed, monitoring by the European Wind Energy Association at two Swedish wind farms indicated that total fish numbers were higher at the bottom of wind turbines than in surrounding areas.

Political and economic benefits

Fuel dependency

Replacing energy generation from fossil fuels with wind energy reduces both dependency on domestic and imported fuel, lowering both the fuel import bill and greenhouse gas emissions. For example, Europe imports over half of its energy in the form of fossil fuels, resulting in exposure to volatile prices[4]. According to the European Commission, this dependency is set to increase, if decarbonisation of the power sector is not accelerated[5].

Wind power does not require costly fuel to produce energy, and therefore its electricity generation is not exposed to these fuel price increases and volatility. Wind power also supports global nations' goals of energy security as it reduces their reliance on foreign energy sources, and particularly on oil from less stable parts of the world. In the long term, wind power will also stabilise energy prices as the fuel source is free.

Economic boost

It is generally agreed that wind power stimulates investment and contributes to a country's economic wealth. This is because it generates a new industry which creates new economic opportunities, boosting economic development related to the manufacturing and supply chain, as well as creating thousands of jobs for highly-skilled, local workers.

2. Stakeholder challenges

Investors, owners and developers of offshore wind projects need to address issues as early as possible in the project lifecycle in order to mitigate environmental impacts throughout the lifetime of the wind farm, beyond achieving permit/licensing success. These projects therefore require in-depth environmental expertise to minimise the impact on both stakeholders and wildlife.

Offshore wind effects

Despite the positives associated with wind energy as a renewable source, there is still uncertainty over the potential effects of offshore wind, which consequently impacts a project's ability to achieve licensing consent.

Depending on the region where the wind farm is located, these effects represents significant challenges for stakeholders:

Habitat and seabed disturbance

Wind turbine installation and operation causes habitat disturbance. For example, the disturbance of the seabed will primarily take place during the construction phase. Minimising this requires a precise understanding of the potential impacts and a clear decision making process to prevent, mitigate or compensate for such effects on habitats.

Threat to biodiversity

Poorly designed wind farms can threaten both vulnerable species and their habitats. To avoid this, stakeholders must engage early in a planning and mapping strategy that specifically identifies potential negative impacts to the biodiversity of an area.

Increased noise

Underwater noise from the construction of offshore wind farms causes significant disturbance to marine life, particularly mammals. Stakeholders must therefore adopt a mitigation hierarchy to prevent or minimise the impact of noise.

Impacts on birds

Both displacement of and collisions with certain species of birds have been documented. However, another layer of complexity is added as these effects are highly variable, according to the location of the wind farm and the bird species that are involved.

Once again, this necessitates early planning, with the potential impacts on seabirds studied during the Environmental Impact Assessment (EIA). If mitigation measures are foreseen, they should be supervised by a specific public authority department with responsibility for the analysis, selection and implementation of the most appropriate measures.

Conflicts of interest

Sites that are considered suitable for a wind farm will still be faced with a number of potential conflicts of interests with other uses and users of the locations. These could include:

- Interference with both maritime and air traffic
- Military area restrictions
- Disturbance of radio and radar signals
- Fishermen losing trawling ground

However, severe conflicts of interest, which could stop a project, can be avoided through careful planning.

Ship collision/accidents

Accidents between ships and wind farms could result in damage to both, as well as the local environment. Stakeholders must therefore carry out collision risk analyses.

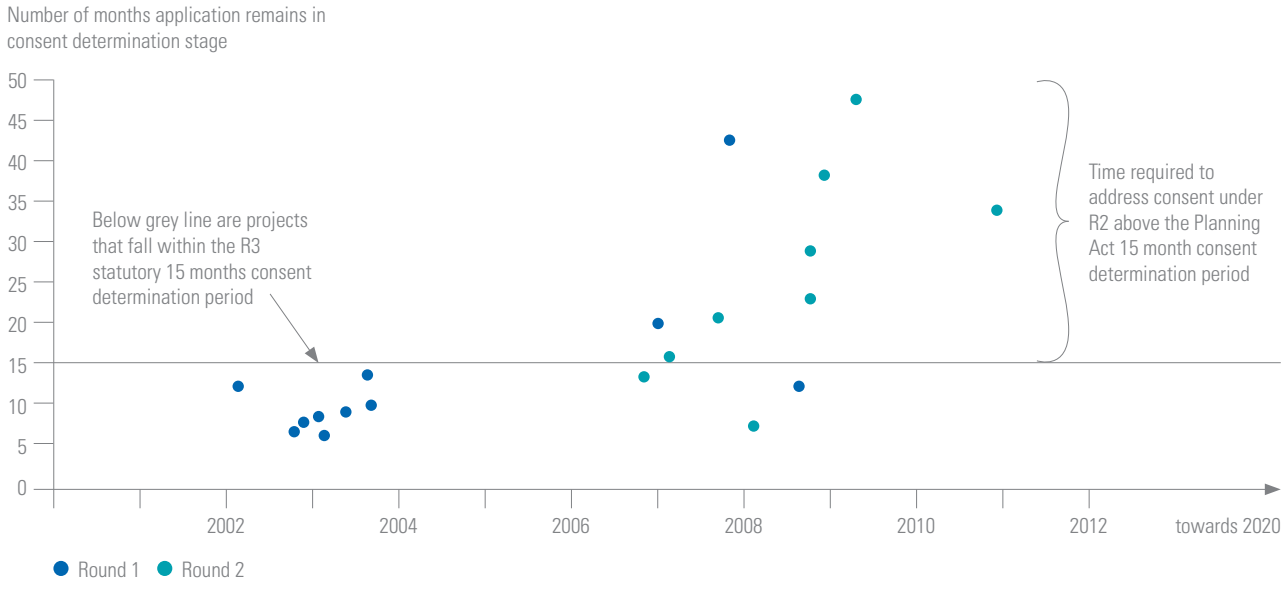
Cumulative effects

The increase in proposed and operational turbines mean that a greater consideration of cumulative impacts is required. Therefore, a challenge facing wind farm developers, regulators and environmental practitioners is how best to assess the cumulative impacts of major offshore developments. The two most significant cumulative issues are bird mortality associated with collision and marine mammal injury or disturbance associated with piling noise. There are also significant cumulative issues regarding protected species in relation to protected European sites.

Lessons learnt from wind farm developments so far, particularly Round 1 and 2 development phases in the UK, have indicated that the time required to achieve consent increased substantially (Figure 2), largely due to the cumulative effects of increased project size.

The challenge faced across the world is how best to use these lessons learnt in the mature UK wind energy market to effectively assess the cumulative effects of major offshore developments. Failure to find a pragmatic approach to assessing cumulative effects will be detrimental to achieving renewable energy targets incorporated into national policies worldwide.

FIGURE 2: CONSENT DETERMINATION TIME FOR DEVELOPMENT ROUNDS 1 AND 2 IN THE UK



Source: Reynolds, P., Vella, G., Freeman, S., May, J., Savage, A., and Jenner C. (2011). Consenting Lessons Learned: An offshore wind industry review of past concerns, lessons learned and future challenges. RenewableUK October 2011.

3. Meeting the challenge

To address and successfully overcome these challenges, stakeholders should consider the following actions:

Develop a Project Design Statement (PDS)

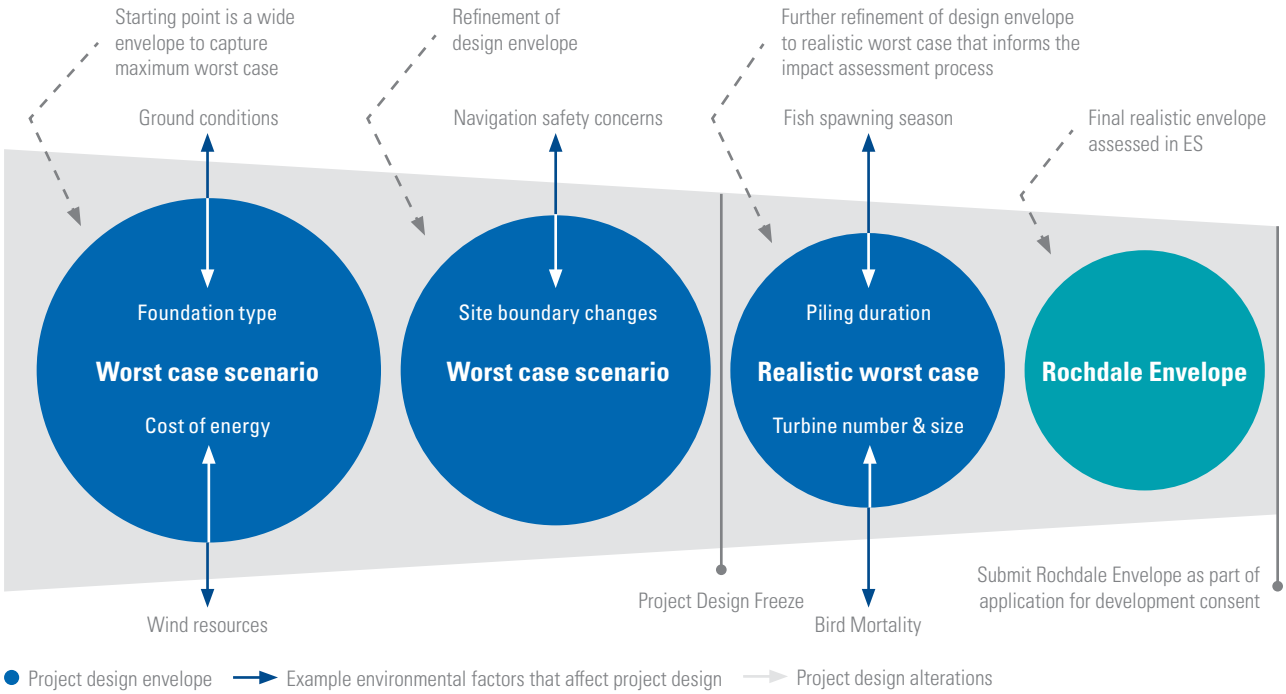
This examines the options that are available for the wind farm development, and can be used as an engineering tool that evolves through an iterative process to inform the EIA. This evolution is shaped by many competing factors, including engineering design, commercial partnerships, levelised cost of energy (LCOE) and environmental constraints (Figure 3).

The objective of the PDS is to refine the maximum worst case scenarios towards a more realistic worst-case scenario that can be assessed under EIA. Because designing an offshore wind farm project is a complex process, it is unrealistic to finalise design at the time an application for development consent is made. These are only finalised once further geotechnical investigations and detailed engineering and procurement exercises take place post-consent.

Adopt an early planning and mapping strategy

Time spent on developing a clear and front-loaded engineering design process ensures greater clarity on the assessment of potential cumulative impacts. Without it, projects can experience significant

FIGURE 3: PROJECT DESIGN EVOLUTION



Source: TÜV SÜD. Adopted from Freeman & Hawkins. Rochdale: Are we pushing the envelope too far? Energy Engineering, May 2013

delays. For example, in the UK the Humber Gateway was delayed by 35 months due to cumulative effects associated with aviation and the Ministry of Defence.

> Before entering planning, developers should continue design evolution, while mitigating environmental impacts.

Before entering planning, developers should continue design evolution, while mitigating environmental impacts. This will ensure that their worst case scenario of the environmental impact of a project is as realistic as possible, which will reduce the complexity of the consenting process.

Implement and closely analyse a mitigation hierarchy

A mitigation hierarchy should be closely analysed and implemented in three successive steps:

1. Preventing negative effects through spatial planning and targeted location approaches
2. Minimising unavoidable impacts through technical mitigation or flexible operating practices
3. Repairing any residual effects and restoring negatively affected areas

Any residual adverse effects should be addressed by compensation or offsetting measures. For example, creating alternative attractive habitats for vulnerable species nearby an affected area has shown promising results.

Develop a collaborative approach between developers and regulators

The relevance and success of this depends on factors such as the size of the market in a country, alongside the maturity of the consenting regime.

Learn from non-renewable industries

The challenge facing stakeholders is how best to assess the cumulative effects of offshore development, when there is no recognised industry standard to guide them. However, many non-renewable industries have faced similar challenges from which the offshore wind power industry can learn.

These industries have already introduced a regional approach to the assessment of cumulative effects, which has facilitated the consenting process for single and multiple development. For example, in the UK the offshore marine aggregate industry has pioneered the use of Regional Environmental Assessments (REAs) to assess past, present and future cumulative effects of multiple developments. Taking up to three years to complete, they follow a standardised approach that has been built on previous lessons learnt and collaboration with regulators. Similar regional approaches are also common in other countries, such as Canada (to manage both the oil & gas, and mining sectors) and Australia (to manage the liquefied natural gas industries).

A REA is designed to brief regulators and stakeholders on the potential cumulative impact of development plans. Such an approach delivers the following benefits:

- Early engagement with regulators and stakeholders
- Encouragement of partnerships between industry and regulators through shared resources
- Consideration of relevant larger-scale issues that are often poorly addressed at the EIA stage
- Scientifically robust assessment criteria discussed in advance with regulators
- Promotion of sustainable management through targeted monitoring
- A legacy of knowledge within the public domain
- Accountable decision making

In previous leasing rounds for offshore wind consenting in the UK, difficulties were largely associated with cumulative impacts, which caused significant delays and increased development costs. Round 3 consent is therefore being approached more strategically, including the introduction of a non-regulatory tool called the Zone Environmental Assessment (ZEA), which is similar to the REA approach. However, ZEA has yet to be tested under the consenting process, but such non-statutory tools have considerable advantages as they promote innovation while adhering to best practice.

4. Unrivalled international industry experience

Stakeholders need support from specialists who fully understand the licensing and operational constraints that they operate in on an international scale. TÜV SÜD delivers against this as it is not a standard 'turn-the-handle' consultancy, and stands apart from mainstream environmental consultancies as we:

- Work solely within the power sector, delivering a specialist commercial and technical focus that is unrivalled and which can support you throughout the entire asset lifecycle.
- Have experience from a wide range of projects in multiple geographies, which enables us to identify risks and appropriate mitigation measures early in the development process to effectively manage your project for pre and post-consenting, regulatory compliance and environmental management.
- Benefit from long-standing relationships with regulators, and have proven success in coordinating multi-stakeholder dialogue.
- Use our specialist analysis capabilities to tackle challenges that are unique to each project in order to ensure that consent conditions can be successfully discharged.

5. Business benefits

Working with TÜV SÜD safeguards your investment through a realistic assessment of project risk, delivery and performance, while ensuring that your designs are compliant with environmental regulations and in line with good environmental practices.

By developing and implementing an Environmental Management System, both contractors and developers can ensure that environmental risk factors are identified, regulations are complied with and any environmental impacts are minimised or prevented. Meanwhile, you can be assured that multiple project contractors are delivering the correct technical specifications.

Working with TÜV SÜD, you will benefit from comprehensive one-stop solutions that identify areas for cost savings whilst avoiding delays as projects progress smoothly through construction to operation and maintenance.

6. Conclusion

Improving the efficiency, and consequently the speed, of the consenting process is crucial for the sustainable growth of offshore wind. However, to successfully achieve licensing consent, investors, owners and developers of offshore wind projects face multiple environmental challenges. De-risking the consenting process in any offshore project should therefore be inherent in the pre-consent process, with environmental issues addressed as early as possible in the project lifecycle

Time spent on developing a clear and front-loaded engineering design process ensures greater clarity on the assessment of potential cumulative impacts.

Proper information sharing between developers and informing regulators/ stakeholders of the scheme parameters early in the pre-consent stage is also vital.

Harnessing knowledge from lessons learnt from the offshore wind industry so far will also lead to a more streamlined planning process, meaning less time from site lease to planning consent, and eventually to operation.

Offshore wind projects therefore require in-depth environmental expertise to minimise the impact on both stakeholders and wildlife. With the correct support you can overcome issues to effectively balance legislation against

Offshore wind projects therefore require in-depth environmental expertise to minimise the impact on both stakeholders and wildlife.

sustainable energy targets worldwide. Making use of TÜV SÜD's licensing, consenting and environment services from the onset will optimise the licensing process and maximise your return on investment.

GLOSSARY OF ACRONYMS

DoE	- US Department of Energy
MW	- megawatts
GWEC	- Global Wind Energy Council
GW	- gigawatts
Mt	- metric ton
EU	- European Union
EIA	- Environmental Impact Assessment
LCOE	- levelised cost of energy
REA	- Regional Environmental Assessment
ZEA	- Zone Environmental Assessment

FOOTNOTES

[1] Navigant - Offshore Wind Market and Economic Analysis, 2014 Annual Market Assessment, Prepared for: U.S. Department of Energy
[2] Global Wind Energy Council - Global Offshore: Current Status and Future Prospects
[3] European Wind Energy Association, Positive environmental impacts of offshore wind farms
[4] European Wind Energy Association, Avoiding Fossil Fuel Costs with Wind Energy
[5] European Commission Energy Roadmap 2050

COPYRIGHT NOTICE

The information contained in this document represents the current view of TÜV SÜD on the issues discussed as of the date of publication. Because TÜV SÜD must respond to changing market conditions, it should not be interpreted to be a commitment on the part of TÜV SÜD, and TÜV SÜD cannot guarantee the accuracy of any information presented after the date of publication.

This White Paper is for informational purposes only. TÜV SÜD makes no warranties, express, implied or statutory, as to the information in this document. Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced, stored in or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), or for any purpose, without the express written permission of TÜV SÜD. TÜV SÜD may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from TÜV SÜD, the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property. ANY REPRODUCTION, ADAPTATION OR TRANSLATION OF THIS DOCUMENT WITHOUT PRIOR WRITTEN PERMISSION IS PROHIBITED, EXCEPT AS ALLOWED UNDER THE COPYRIGHT LAWS. © TÜV SÜD Group – 2018 – All rights reserved - TÜV SÜD is a registered trademark of TÜV SÜD Group

DISCLAIMER

All reasonable measures have been taken to ensure the quality, reliability, and accuracy of the information in the content. However, TÜV SÜD is not responsible for the third-party content contained in this publication. TÜV SÜD makes no warranties or representations, expressed or implied, as to the accuracy or completeness of information contained in this publication. This publication is intended to provide general information on a particular subject or subjects and is not an exhaustive treatment of such subject(s). Accordingly, the information in this publication is not intended to constitute consulting or professional advice or services. If you are seeking advice on any matters relating to information in this publication, you should – where appropriate – contact us directly with your specific query or seek advice from qualified professional people. TÜV SÜD ensures that the provision of its services meets independence, impartiality and objectivity requirements. The information contained in this publication may not be copied, quoted, or referred to in any other publication or materials without the prior written consent of TÜV SÜD. All rights reserved © 2018 TÜV SÜD.

Find out more about TÜV SÜD's offshore licensing services for the renewable sector

www.tuvsud.com/windpower
windpower@tuvsud.com

Add value. Inspire trust.
TÜV SÜD is a trusted partner of choice for safety, security and sustainability solutions. It specialises in testing, certification, auditing and advisory services. Since 1866, the company has remained committed to its founding principle of enabling progress by protecting people, the environment and assets from technology-related risks. Through 24,000 employees across 1,000 locations, it adds tangible value to customers and partners by enabling market access and managing risks. By anticipating technological developments and facilitating change, TÜV SÜD inspires trust in the physical and digital world to create a safer and more sustainable future.

GLOBAL HEADQUARTERS
TÜV SÜD AG
Westendstr. 199
80686 Munich Germany
+49 89 5791 0
www.tuvsud.com

GLOBAL WIND HUB
TÜV SÜD Industrie Service GmbH
Westendstr. 199
Munich 80686
Germany
+49 89 5791 0

GLOBAL WIND HUB
TÜV SÜD PMSS
5-8 Latimer Walk
Romsey, Hampshire, SO51 8LA,
United Kingdom
+44 1794 526 560

2018 © TÜV SÜD AG | MKG/PWS/40.1/en/SG