Delft University of Technology

Document Version
Final published version

Licence
CC BY-NC-ND

Citation (APA)
Vreugdenhil, H., Ellen, G. J., & de Vries, J. (2023). Knowledge Management Dynamics in Offshore Wind Farms in the Netherlands. In F. Matos, & A. Rosa (Eds.), *Proceedings of the 24th European Conference on Knowledge Management, ECKM 2023* (pp. 1440-1445). (Proceedings of the European Conference on Knowledge Management, ECKM; Vol. 2). Academic Conferences and Publishing International. https://doi.org/10.34190/eckm.24.2.1301

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
In case the licence states “Dutch Copyright Act (Article 25fa)”, this publication was made available Green Open Access via the TU Delft Institutional Repository pursuant to Dutch Copyright Act (Article 25fa, the Taverne amendment). This provision does not affect copyright ownership.
Unless copyright is transferred by contract or statute, it remains with the copyright holder.

Sharing and reuse
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

This work is downloaded from Delft University of Technology.

Knowledge Management Dynamics in Offshore Wind Farms in the Netherlands

Heleen Vreugdenhil[1,2], Gerald Jan Ellen[1] and Jort de Vries[1,3]
[1]Deltares, Delft, The Netherlands
[2]Delft University of Technology, Faculty of Technology, Policy and Management, The Netherlands
[3]University of Groningen, Faculty of Spatial Sciences, The Netherlands

Heleen.vreugdenhil@deltares.nl

Abstract: Offshore wind farm development is a is a highly complex process. The societal and political pressure to implement is high while environmental responses and future developments in the global energy network are uncertain. Moreover, many interests in maritime space are at stake. The dependency on knowledge for decision-making is high, but the capacity to use knowledge is limited. In this paper we investigate the role of ecosystem knowledge in offshore wind farm planning and management. We have identified 4 types of research arenas: (1) government driven (e.g., monitoring programs) (2) subsidized research (national or EU), (3) industrial or PPS (Public-private partnerships), and (4) research by universities. This study considers the way in which knowledge from different arenas is or could be taken up and used in policy. We identify that particularly government-driven research (monitoring) is used in policymaking. The analysis of policy documents, in-depth expert interviews and focus groups reveals that the distance between knowledge developers and knowledge users may differentiate from purely transactional relations to co-production-relations. However, co-production is rare beyond the monitoring programs directly initiated by the government agencies.

Keywords: Research arenas, Impact pathways, Science-policy interactions

1. Introduction

Most North Sea countries are heavily investing in offshore wind farms (OWF) to comply with the Paris Climate Agreement and energy-security goals (WindEurope, 2021). The process of planning, installation, operation and decommissioning of offshore wind farms is highly complex. Many interests are at stake, including fisheries, sandmining and nature protection, and there is limited knowledge about the North-Sea's Biophysical system leading to uncertainties concerning environmental responses and future developments in the global energy network (Ansong *et al.,* 2021). To support the OWF decision-making process in the Netherlands, the so-called North-Sea Agreement has recently been developed (OFL, 2020). The agreement specifically states that knowledge from the knowledge programs must be considered in the decision-making process and that these programs and other monitoring operations are to be cooperated with to make smart combinations and prevent double work (OFL, 2020). The knowledge programs encompass (i) a monitoring programme called WOZEP in which ecological knowledge concerning the development of OWFs is gathered, (ii) a program called KEC considering the cumulative effects of wind farms (Noordzeeloket, 2016; Noordzeeloket, 2020) and (iii) a program called MONS, in which a more integral perspective is taken by including other activities besides OWF development and operation (OFL, 2021).

Next to WOZEP and MONS, many other research projects are in progress, initiated by authorities, universities or the industry. Together, the studies cover a broad range of knowledge development relevant for decision-making concerning OWFs, including ecology, abiotic dynamics and hydrodynamics, technology and engineering, and economics and law. Yet, within these fields and beyond, not everything can be studied and a limited capacity of authorities to consider the broad array of newly produced knowledge, most knowledge is not formally and explicitly coupled to governance processes (Keijser et al. 2020; Paez et al. 2020).

This paper aims to shed light on the ways in which newly developed knowledge from different arenas is taken up and used in the governance of OWF planning and operation, and how this can be improved. We aim to develop understanding of knowledge development dynamics and knowledge use in decision-making and governance by studying the systems of knowledge users and developers and in particular their interactions. Moreover, we discuss relevant impact pathways and interactions that could support, structure, and formalize knowledge-uptake.

2. Producers and Users of Knowledge

Knowledge is a free-flowing commodity, differing from physical objects in its dependence on a knower and their subjective interpretations. It can be seen as information, context, skills, values, insight, experiences, a social construct, a tool of influence or a combination of these concepts (Nagel, 2014). In understanding the dynamics around knowledge use in decision-making for OWFs, we use a producer-user perspective, based on

the sender-receiver model by Tromp (2019), and Tromp et al. (2022) (Figure 1). This model builds on the idea that there are research arenas and policy arenas within which separate endeavours operate at geographically dispersed locations (Wiewiora et al. 2009). Their primary task is either knowledge development or policy/decision making, both having different goals and incentives, and operating in different networks. The research arena consists mainly of universities and research institutes, engaged with scientific development, discussing with peers in conferences and scientific journals (Spaapen and van Drooge, 2011). The policy arena mainly consists of ministries and authorities dealing with policymaking, implementing said policy, maintaining and controlling public services, and regulating the conduct of other parties (Liefferink, 2006). These organisations and people involved meet at the interface, for example when performing specifically requested studies or when jointly doing projects, but the emergence of a gap is inevitable (Bradshaw & Borchers, 2000). This so so-called science- policy gap needs to be bridged.

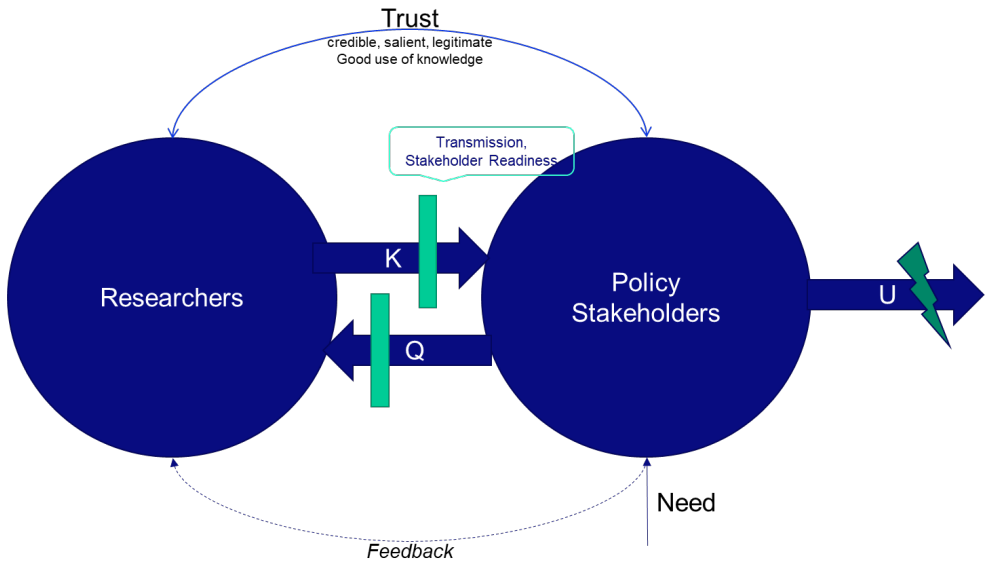


Figure 1: A Knowledge Developer-User Model (Adapted from Tromp et al. 2022). K=Knowledge, Q=Questions, U=Utilization

3. Productive Interactions and Knowledge Impact Pathways

For the co-production and transfer of knowledge between disciplines and across actors, there is a need for close and continuous interaction (Janssen *et al.,* 2014). Spaapen and Van Drooge (2011) defined productive interactions as: 'exchanges between researchers and stakeholders in which knowledge is produced and valued that is both scientifically robust and socially relevant'. The interaction is productive when it leads to efforts by stakeholders to somehow use or apply research results, practical information or experiences in practice. Based on Spaapen and Van Drooge (2011), Muhonen et al. (2020) have identified mechanisms through which impact of research is generated. They identify 12 pathways based on (1) dissemination, (2) co-creation, (3) reacting to societal change and (4) driving societal change. The concepts of productive interaction and impact pathways constitute a comprehensive framework for assessing the manner and effectiveness of knowledge transfer between different parties in the OWF domain.

4. Methods

The research is designed around the distinction of a governance arena, several knowledge arenas, and the interactions between them. To understand the governance system, we have reviewed policy documents that are available on official websites of the Dutch ministries of Economic Affairs (EZK), Agriculture, Nature, and Food quality (LNV), Infrastructure and Water management (IenW). Secondly, we interviewed 4 policy makers from these ministries involved in the planning, decision making and operational management of OWFs. Additionally, we interviewed 10 scientists involved in 6 knowledge development programs and projects about the impact of OWFs on biophysical systems, notably 1) WOZEP, 2) Dutch national scientific agenda (NWO/NWA) "effects of windfarms at sea and implications for governance", 3) Joint Industry Project HASPRO, 4) Joint Industry Project Road2SID, as well as offshore wind energy research at 5) Delft University of Technology and 6) the University of Groningen. Lastly, we organized an interactive session during the NWO

thematic day May 3rd 2022 in Scheveningen, the Netherlands and a workshop with researchers and policy makers (June 28th, 2022) to discuss the results, outcomes, and dynamics.

5. Knowledge Production and Policy Making Landscape in Offshore Wind Farms

Considering the science-policy interface we distinguish between knowledge producers (universities, research institutes and consultancies) and knowledge users (ministries, government agencies and industry). They may use knowledge in different phases of OWF: planning, construction, operation and decommissioning. Four types of knowledge production arenas can be identified: (1) government funded research, primarily related to monitoring (e.g. WOZEP and MONS), (2) Research subsidy funded, with a wider focus on diverse drivers, longer-term and larger-scale cumulative ecological impacts (e.g. NWO/NWA, EU Horizon), (3) Industry/PPS funded, primarily focusing on direct industry needs, often to meet tender requirements and (4) university funded research with a focus on more fundamental knowledge, technological innovation and governance (Figure 2).

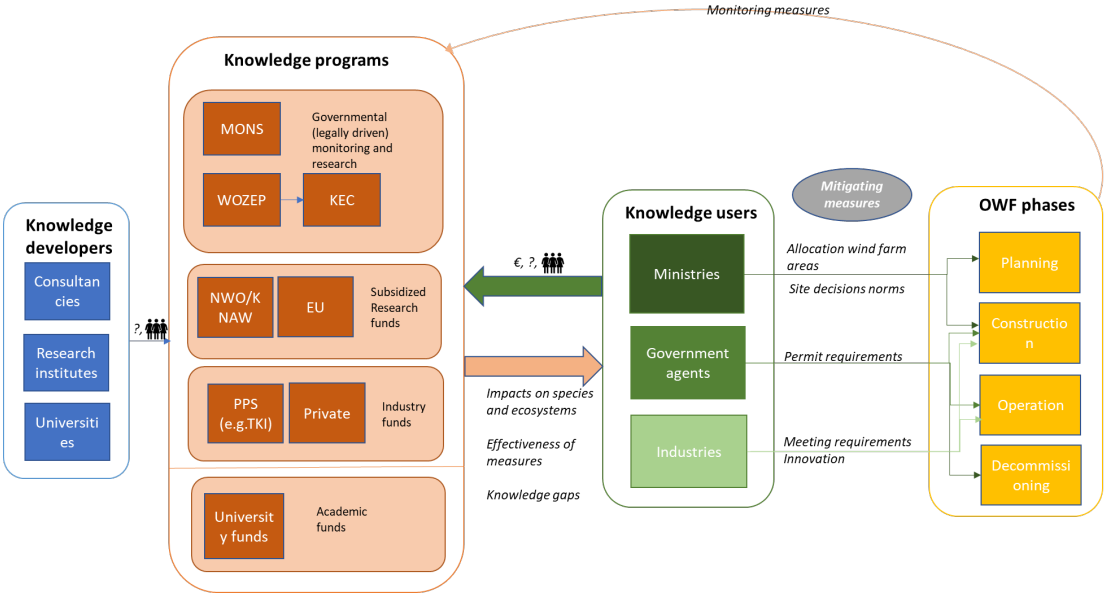


Figure 2: Knowledge Production and Policy Making Landscape of Offshore Wind Farms in the Netherlands

The four different knowledge arenas all have different objectives, research foci, primary methods and origin of the question. The government driven programs aim to support policy and management, focus on ecosystem knowledge relevant for legislation like protected species. Examples are birds and bat collision and a digital twin. The main method used is monitoring and the origin of the question is either a legal requirement or derived from the North Sea stakeholder group NZO. The subsidized research more generally aims to support OWF development and understanding of the North Sea, so the focus is on more fundamental knowledge concerning the physical-ecological interactions of OWFs and governance. Industry-based research intends to increase the competitiveness of the industry, by increasing efficiency and meeting tender requirements. The research focus is usually of a technical nature such as on construction techniques or more nature-based solutions. Research is done by modelling or testing in the field or laboratories. Lastly, university funds have the broadest perspective. Their objectives are first to deepen system understanding, to innovate beyond wind farms, for example on multi-energy generation, but also governance issues like Marine Spatial Planning. Universities also aim to include new knowledge in education, influencing the next generation of workers and researchers. Figure 3 gives a more detailed overview of the different research systems.

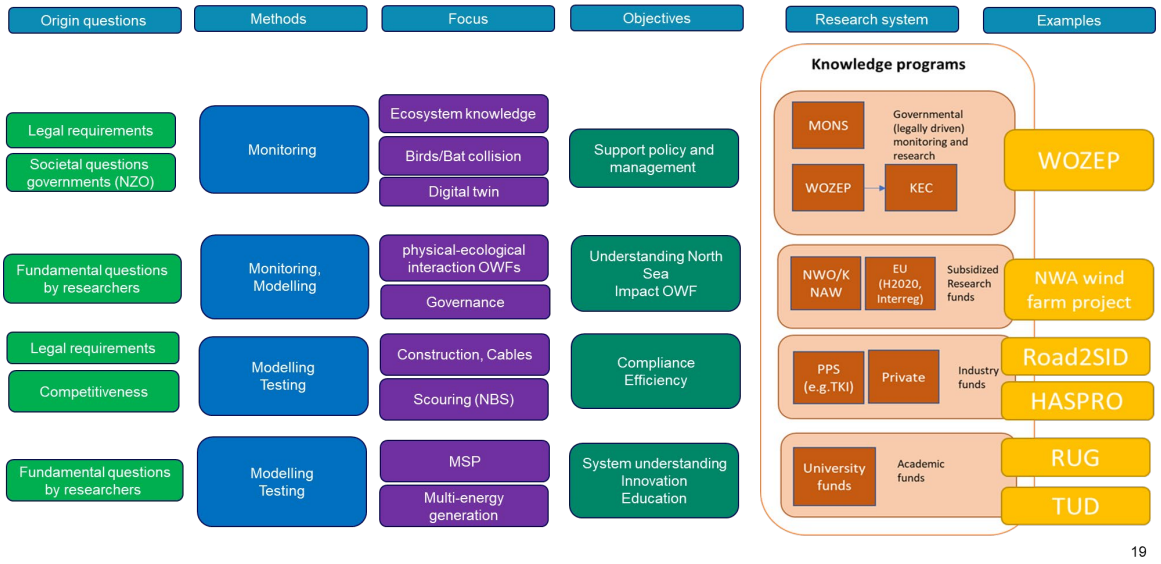


Figure 3. The Objectives, Knowledge Focus, Methods and the Origin of the Questions of the Different Research Arena

6. Science-Policy Interactions

The interactions between the knowledge arenas and the policy arenas (see Table 1)give an indication of the manner of knowledge uptake, and why certain knowledge is better adopted in policy than others. To specify the policy arena further, we follow the four phases relevant to offshore wind farm development. The knowledge arenas are relevant to different phases of decision-making, the nature of decision-making alters as well as the dominance of stakeholders. For example, the ministry of Economic Affairs is mostly dominant in planning, but Rijkswaterstaat is in charge of monitoring during operation. To describe the science-policy interactions we identify the 'intensity' of the relation between the knowledge arenas and the policy arena as well as the most relevant impact pathways. The intensity of the relation is a subjective measure (high-low) of the actors in both arenas, indicated by interviewees during the interviews and workshops. It refers to (i) how often they meet with actors from research or policy respectively during different phases of a research or policy process (i.e. question articulation, modelling/testing, validation, policy formulation), and (ii) nature of interactions (e.g. formal project moments such as advisory board meetings, do they call each other on a regular basis) and (iii) perceived influence on each other (e.g. is research adjusted based on interactions?). The relevant impact pathways (dissemination, co-creation, reacting to societal change and driving societal change) are also based on the interviews and workshops.

Table 1: Interactions between Different Knowledge Arenas and Policy Arenas

Knowledge arena	**Policy arena**				**Intensity of relation**	**Most relevant impact pathways**
	Planning	**Construction**	**Operation**	**Decommissioning**		
Governmental research			x		High	Co-creation Dissemination
Subsidized research	x		x		Low	Dissemination Reacting to societal change

Industry funded research		x	x		High	Co-creation Reacting to societal change Dissemination
University funded research	x				Low	Dissemination Driving societal change Co-creation

The results show that governmental research is primarily used for operational purposes, and because the distance is low, and used impact pathways include co-creation and dissemination, the knowledge uptake is relatively high. Subsidized research takes more place at a distance of policy making, the results could however be beneficial for operation and to a lesser extent for planning (e.g. on area selection taking into account cumulative effects on the sea ecology). The primary impact pathway is dissemination, co-creation is limited and takes primarily place at the level of call development, and in later instances through expertise and mobility pathways. Industry funded research is mostly relevant for construction and operation, to comply with tender requirements. The interaction between users and researchers is high and mobility of researchers is of relevance. University research is mostly relevant for planning, for example on including innovative approaches, or balancing interests. The primary impact pathway is publishing, but on the long term driving societal change is highly relevant.

7. Concluding Remarks

Both knowledge producers and knowledge users are very active in the OWF knowledge arena. However, the productive interactions differentiate across the four knowledge arenas and policy arenas identified in Dutch OWF development. Users are more involved in government driven and industrial research. In subsidized research the users are at a distance, whereas in university driven research the users are mainly reached on the long term, through education and building an epistemic community. So, knowledge use is primarily achieved in the arenas where there is a direct client.

Acknowledgements

This paper is developed under the NWO/NWA project 'Effect of Windfarms on marine ecosystem and implications for governance'. The authors wish to thank the interviewees and workshop participants for their active contribution to this research.

References

Ansong, J., Calado, H. and Gilliland, P. M. (2021). 'A multifaceted approach to building capacity for marine/maritime spatial planning based on European experience', *Marine Policy*. Elsevier Ltd, 132. pp. 103422

Bradshaw, G. A. and Borchers, J. G. (2000). "Uncertainty as information: Narrowing the science-policy gap". *Conservation Ecology*, Vol 4, No 1. Pp. 7.

Janssen, S., Mol, A., Van Tatenhove, J., and Otter, H. (2014). 'The role of knowledge in greening flood protection. Lessons from the Dutch case study future Afsluitdijk'. *Ocean & Coastal Management*, *95*, pp. 219-232.

Keijser, X. Toonen, H. and van Tatenhove, J. (2020) "a "learning paradox" in maritime spatial planning". *Maritime Studies*, Vol, 19 No, 3. pp. 333–346.

Liefferink, D. (2006). 'The dynamics of policy arrangements: turning round the tetrahedron'. In: Arts, B., Leroy, P. (Eds.), Institutional Dynamics in Environmental Governance. Springer, Dordrecht, pp. 45-68.

Muhonen, R. Benneworth, P. and Olmos-Peñuela, J. (2020) *From productive interactions to impact pathways*. University of Twente, Enschede.

Nagel, J. (2014) *A very short introduction to Knowledge* Oxford university press, Oxford.

Noordzeeloket. (2021) Kader Ecologie en Cumulatie. Available at: https://www.noordzeeloket.nl/functiesgebruik/windenergie/ecologie/cumulatie/kader-ecologie/. (Accessed: 29/11/2022).

Noordzeeloket (2016). 'Wind Op Zee Ecologisch Programma.' Available at: https://www.noordzeeloket.nl/functiesgebruik/windenergie/ecologie/wind-zee-ecologisch-programma-wozep/(Accessed: 01/02/2023)

OFL. (2020) Het akkoord voor de Noordzee. Den Haag. Available at: https://www.overlegorgaanfysiekeleefomgeving.nl/actuele+projecten/actuele+projecten+overzicht/noordzeeoverleg/doc umenten+noordzeeakkoord/handlerdownloadfiles.ashx?idnv=1901025 (Accessed: 03/01/2023)

OFL., (2021). 'Monitoring en Onderzoek Natuurversterking en Soortenbescherming (MONS)'. OFL: Den Haag. Available at: https://www.informatiehuismarien.nl/projecten/monitoring-onderzoek-natuurversterking/ (Accessed: 09/03/2023).

Páez, D. P. Bojórquez-Tapia, L. A. Ramos, G. C. D. & Chavero, E. L. (2020) "Understanding translation: Co-production of knowledge in marine spatial planning". *Ocean & Coastal Management*, Vol *190*. Pp 105163.

Spaapen, J. And Van Drooge, L. (2011) "Introducing 'productive interactions' in social impact assessment". *Research evaluation*, Vol *20*, No. 3. pp 211-218.

Tromp, E. (2019). Enhancing Knowledge Transfer and Uptake in the Design Processes of Flood Defences. *Delft: TU Delft*.

Tromp, E. te Nijenhuis, A. Knoeff, H. (2022) "The Dutch Flood Protection Programme: Taking Innovations to the Next Level*".* Water. Vol 14. No 9. Pp. 1460*.*

Wiewiora, A. Trigunarsyah, B. Murphy, G. and Liang, C. (2009) "Barriers to effective knowledge transfer in project-based organisations" *international conference on global innovation in construction*. pp. 220–230. Loughborough, United Kingdom

WindEurope. (2021) "2050 vision", Available at: https://windeurope.org/about-wind/reports/our-energy-our-future/(Accessed: 06/01/2023).