

## Supplementary Material

**Table 1.** Parameters used in the calculation of hydrogen demand [1–3].

Country	Population (million)	Car Ownership (%)	Annual Driving Distance (km/a)
Belgium	11.21	50.86	12941
France	66.42	51.09	14942
Germany	81.20	54.07	12397
Italy	60.80	64.70	11429
Luxemburg	0.56	71.30	12167
Netherlands	16.90	48.62	12453
Switzerland	8.24	54.86	12882

**Table 2.** Cost parameters used in the analysis.

Technology	Investment Cost	OPEX (% CAPEX)	Economic Lifetime	Source
Pipeline <sup>1</sup>	0.12 €/kW/km	5	40	[4]
Salt Cavern	0.5 €/kWh	2	30	[5,6]
Vessel	7.5 €/kWh		20	[7]
Electrolyzer	500 €/kW	3	10	[8]
Onshore WT <sup>2</sup>	1100 €/kW	5	20	[9,10]
Offshore WT <sup>3</sup>	2300 €/kW	5	25	[9]

<sup>1</sup> Once the pipeline is chosen to be built, an additional cost of 0.2 million EUR is also added to the investment cost independent of the capacity and length of the pipeline.

<sup>2</sup> The investment cost of onshore wind turbines changes in each region. Average turbine investment cost is calculated by using the cost model suggested by Ryberg et al. [11].

<sup>3</sup> The investment cost of onshore wind turbine changes in each region. Average turbine investment cost is calculated by using the cost model suggested by Caglayan et al. [12].

**Table 3.** Maximum capacities of onshore and offshore wind energy in each region in GW.

<b>Region</b>	<b>Onshore</b>	<b>Offshore</b>
BE_LU	22.5	4.7
CH	54.5	n.a.
DE_Northeast	114.3	5.7
DE_Northwest	150.3	76.4
DE_Southeast	220.6	n.a.
DE_Southwest	135.2	n.a.
FR_West	583.5	425.0
FR_East	515.6	n.a.
FR_South	321.0	29.8
FR_North	213.7	36.1
FR_Corsica	10.0	n.a.
IT_Sardinia	88.0	70.4
IT_North	111.2	19.3
IT_South	227.4	286.7
IT_Mid	174.8	125.8
NL	79.9	149.7

**Table 4.** Average investment cost of onshore and offshore wind energy in each region in €/kW.

<b>Region</b>	<b>Onshore</b>	<b>Offshore</b>
BE_LU	1130	2000
CH	1200	n.a.
DE_Northeast	1130	1980
DE_Northwest	1120	2810
DE_Southeast	1180	n.a.
DE_Southwest	1190	n.a.
FR_West	1120	2910
FR_East	1140	n.a.
FR_South	1130	2110
FR_North	1100	2040
FR_Corsica	1240	n.a.
IT_Sardinia	1150	2430
IT_North	1280	2130
IT_South	1160	2700
IT_Mid	1210	2510
NL	1090	2710

## References

- [1] United Nations. World population prospects: The 2015 Revision 2015. <https://esa.un.org/unpd/wpp/> (accessed December 9, 2016).
- [2] European Commission. EU Transport in figures: Statistical Pocketbook 2015. 2015.
- [3] Papadimitriou G, Ntziachristos L, Wüthrich P, Notter B, Keller M, Fridell E, et al. Transport data collection supporting the quantitative analysis of measures relating to transport and climate change Project acronym: TRACCS. 2013.
- [4] Mischner J. Gas2energy.net : systemplanerische Grundlagen der Gasversorgung. 2., überar. München: DIV, Deutscher Industrieverlag; 2015.
- [5] Stolzenburg K, Wietschel M, Geneose F, Michaelis J, Lehmann J, Miede A, Krause S, Donadei S, Crotogino F, Acht A, Horvath P-L. HR, Stolzenburg K, Wietschel M, Geneose F, Michaelis J, Lehmann J, Miede A, Krause S, Donadei S, Crotogino F, Acht A, Horvath P-L. HR, Stolzenburg K, Wietschel M, Geneose F, Michaelis J, Lehmann J, Miede A, Krause S, Donadei S, Crotogino F, Acht A, Horvath P-L. HR. Integration von Wind-Wasserstoff-Systemen in das Energiesystem: Abschlussbericht. Berlin: 2014.
- [6] Elsner P, Uwe D, Hrsg S. Energiespeicher Technologiesteckbrief zur Analyse „Flexibilitätskonzepte für die Stromversorgung 2050“. 2015.
- [7] Beccali M, Brunone S, Finocchiaro P, Galletto JM. Method for size optimisation of large wind–hydrogen systems with high penetration on power grids. *Appl Energy* 2013;102:534–44. doi:10.1016/j.apenergy.2012.08.037.
- [8] Reuß M, Grube T, Robinius M, Preuster P, Wasserscheid P, Stolten D. Seasonal storage and alternative carriers: A flexible hydrogen supply chain model. *Appl Energy* 2017;200:290–302. doi:10.1016/j.apenergy.2017.05.050.
- [9] J. Carlsson, M. del Mar Perez Fortes, G. de Marco, J. Giuntoli, M. Jakubcionis, A. Jäger-Waldau, R. Lacal-Arantequi S, Lazarou, D. Magagna, C. Moles, B. Sigfusson, A. Spisto, M. Vallei, EW. ETRI 2014 - Energy Technology Reference Indicator projections for 2010-2050. 2014. doi:10.2790/057687.
- [10] Foundation EC. Roadmap 2050: A Practical Guide to a Prosperous Low Carbon Europe. 2011.
- [11] Ryberg DS, Caglayan DG, Schmitt S, Linßen J, Stolten D, Robinius M. The Future of European Onshore Wind Energy Potential : Detailed Distribution and Simulation of Advanced Turbine Designs. Preprints 2018. doi:10.20944/preprints201812.0196.v1.
- [12] Caglayan DG, Ryberg DS, Heinrichs H, Linßen J, Stolten D, Robinius M. The techno-economic potential of offshore wind energy with optimized future turbine designs in Europe. 2019.