The atom-molecules dilemma of a whole-energy system with low local renewable potentials:

deterministic and global sensitivity analyses

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To respect the +1.5°C by the end of the century, the urgency of transitioning our energy system becomes more and more pressing. Succeeding this transition requires drastic actions to massively deploy renewable energy sources as well as changes of paradigm. Among others like electrification or sufficiency measures, fuel switch or new nuclear energy are often presented as potential keystones for the energy transition. Importing renewable electrofuels or Small Modular Reactors (SMRs) could be real game changers, especially for countries with limited renewable potentials compared to their levels of demand. Using EnergyScope Pathway, this study addresses the relevance of these two options in the case of the Belgian energy transition, considering the impact of uncertainties. Where electrofuels and SMRs compete, especially in the power sector, they both support the deployment of local wind and solar capacities.

Energy system optimization model, electrofuels, nuclear energy, whole-energy systems, EnergyScope, Uncertainty Quantification, Polynomial Chaos Expansion

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**REFERENCES\***

1. *(Journal article)* Guo, C., Ran, J., Vasileff, A., and Qiao, S.Z. (2018). Rational design of electrocatalysts and photo(electro)catalysts for nitrogen reduction to ammonia (NH3) under ambient conditions. Energy Environ. Sci. *11*, 45–56.
2. *(Journal article with 10+ authors)* Tao, H., Choi, C., Ding, L.-X., Jiang, Z., Han, Z., Jia, M., Fan, Q., Gao, Y., Wang, H., Robertson, A.W., et al. (2019). Nitrogen fixation by Ru single-atom electrocatalytic reduction. Chem *5*, 204–214.
3. *(Book)* McRee, D.E. (1999). Practical Protein Crystallography (Elsevier).
4. *(Book chapter)* McPherson, A. (2017). Protein crystallization. In Protein Crystallography: Methods and Protocols, A. Wlodawer, Z. Dauter, and M. Jaskolski, eds. (Springer), pp. 17–50.
5. *(Note with reference)* For a review, see: Abe, M. (2013). Diradicals Chem. Rev. 113, 7011–7088.
6. *(Standalone note)* However, in challenging cases, the final two steps might not afford high yields (91% and 54%, respectively).

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