

## Sabine Fuss

### Curriculum Vitae



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### Employment History

#### **Professor for “Nachhaltiges Ressourcenmanagement und Globalen Wandel”**

Humboldt-University of Berlin, Mathematisch-Naturwissenschaftliches Fakultät,  
Geographisches Institut

July 2018 – current

#### **Head of working group "Sustainable Resource Management & Global Change"**

Mercator Research Institute on Global Commons and Climate Change, Berlin

April 2013 – current

#### **Jubilee Professor 2019**

Chalmers University of Technology, Physical Resource Theory, Gothenburg,  
Sweden.

2019

#### **Research Scholar at the Ecosystems Services and Management Program**

International Institute for Applied Systems Analysis, Laxenburg, Austria

September 2007 – April 2013

#### **Research Scholar at the Forestry Program**

International Institute for Applied Systems Analysis, Laxenburg, Austria

November 2006 – December 2006

#### **Junior Researcher (Assistant in Onderzoek) at the Economics Faculty**

University of Maastricht, Maastricht, The Netherlands

September 2003 – September 2007

### Education

#### **PhD Defense**

University of Maastricht, Maastricht, The Netherlands  
April 2008

### **Young Scientist Summer Program**

International Institute for Applied Systems Analysis, Laxenburg, Austria  
June – August 2006

### **Ph.D. candidate**

*Thesis topic: 'Sustainable Energy Development under Uncertainty'*  
University of Maastricht /UNU-MERIT, The Netherlands  
September 2003 – September 2007

### **M.Sc. in Economics**

*Thesis topic: 'Technical Change in the Electricity Sector: Optimum Portfolios in a Vintage Framework'*  
University of Maastricht, The Netherlands  
August 2003

### **Education Abroad Program**

University of California, Santa Barbara  
Fall/winter 2002

### **Doctoral Education**

- 09/2003-09/2007 - NAKE diploma (Network of General and Quantitative Economics, see [www.nake.nl](http://www.nake.nl))
- 08/2005 - METEOR (Maastricht Research School of Economics of Technology and Organizations) PhD training with macroeconomics, microeconomics and econometrics courses (special courses in Bayesian modeling, overlapping generations models, economic growth, environmental economics and evolutionary economics).

**Abitur:** 1999 (grade: "sehr gut")

### **Computer Skills**

- MS Office, Matlab, GAMS, Mathematica, LATEX

### **Languages**

- German (native)
- English (fluent)
- Dutch (good)
- French (good)
- Spanish (good)

### **Research Interests**

- Natural resource management, energy and agricultural economics (bioenergy, land use implications, water-food-GHG nexus, ESS valuation and tradeoffs)
- Decision-making under uncertainty: portfolio selection, real options theory, stochastic optimization, robustness.
- Integrated assessment with focus on climate change mitigation (focus on the role of negative emission and interaction with other policy goals)
- Reconciling top-down and bottom-up assessments
- Mechanisms for carbon management, climate-compatible development, policy instruments (focus on emissions trading)
- Sustainable development (focus so far on infrastructure investments and food security)

## **Additional positions**

- Guest research scholar at the [Ecosystems Services and Management Program](#) at the [International Institute for Applied Systems Analysis](#).
- Scientific Steering Committee member of the [Global Carbon Project](#)
- Guest Editor for [Special Feature on negative emissions](#) at *Environmental Research Letters*
- Lead author for [IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-industrial Levels and related Global Greenhouse Gas Emission Pathways](#).
- [Austrian Panel on Climate Change](#)
- Contributing author for the [Emissions Gap Report 2017](#), UN Environment.

## **Current PhD Student Supervision**

- Since 2017 Sebastian Kraus (TU Berlin, MCC)
  - PhD project connected to RESTORE+ project
  - Expected date of completion: end of 2020
- Since 2019 Valentin Guye (co-supervision HU-Berlin and INRA, France)
- Since 2019 Ingrid Schulte (HU Berlin, MCC)

## **Teaching**

- Stadtwirtschaft, WiSe 2019/2020 HU-Berlin, Geographical Institute (Masters level)
- Urbanisierung und Nachhaltigkeit – die Stadt im Spannungsfeld des globalen Wandels, SoSe 2020 HU-Berlin, Geographical Institute (Masters level)

## **Reviewer (selected)**

- Expert for 7th Framework Program/H2020 Reviews and ERC grants (proposals and projects)
- Reviewer for journals such as ERL, Climatic Change, Nature Climate Change, Nature Energy, Energy Economics, Journal of Environmental Economics and Management, Renewable and Sustainable Energy Reviews, Energy Policy, Applied Energy, Climate Policy, Journal of Environmental Management
- Reviewer for national projects and evaluations (e.g. UKERC, EPA Ireland, Research Council Norway)
- Review Editor Austrian Panel On Climate Change (APCC) 2014
- [Reviewer for the Convention on Biological Diversity \(CBD\)](#)

## **Projects (ongoing)**

- Delivering Incentives to End Deforestation: Global Ambition, Private/Public Finance and Zero-Deforestation Supply Chains (funding: NORAD, Norway; partners: Environmental Defense Fund (lead), IIASA, London School of Economics) [until 2021]
- RESTORE+: Addressing Landscape Restoration on Degraded Land in Indonesia and Brazil (funding: International Climate Initiative 2016, Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB); partners: IIASA (lead), International Centre for Research in Agroforestry; SELPER Brazil; UNEP-WCMC; WRI Indonesia; WWF Indonesia; LANDMAPP; EDF; LSE; Ministry of National Development Planning/National Development Planning Agency; Ministry of Energy and Mineral Resources; Ministry of Environment and Forestry, Agência Brasileira de Cooperação, Ministerio de Relaciones Exteriores; Ministério do Meio Ambiente. [until 2021]
- START: 'Strategic Scenario Analysis' (funding: German Ministry of Research and Education; partners: PIK (lead), Univ. of Melbourne, Canberra, ANU, etc.), Grant reference: 03EK3046B [until 2020]
- Comparative assessment and region-specific optimisation of GGR (funding NERC, UK; partners: Imperial College (lead), Oxford University, LSE, IIASA)

## Publications

### Peer-reviewed articles

- Hepburn, C., Adlen, E., Beddington, J., Carter, E.A., Fuss, S., MacDowell, N., Minx, J.C., Smith, P. and Williams, C.K. (2019). The technological and economic prospects for CO<sub>2</sub> utilization and removal, *Nature* **575** 87–97 Online: <https://doi.org/10.1038/s41586-019-1681-6>
- Smith, P., Adams, J., Beerling, D.J., Beringer, T., Calvin, K.V., Fuss, S., Griscom, B., Hagemann, N., Kammann, C., Kraxner, F., Minx, J.C., Popp, A., Renforth, P., Vicente-Vicente, J.L. and Keesstra, S. (2019). Land-Management Options for Greenhouse Gas Removal and Their Impacts on Ecosystem Services and the Sustainable Development Goals. *Annu. Rev. Environ. Resour.* **44** 255–86 Online: <https://doi.org/10.1146/annurev-environ-101718-033129>
- Vicente-Vicente, J.L.; Fuss, S.; Song, C.; Lee, J.; Kim, M.; Lee, W.-K.; Son, Y. (2019). A Holistic View of Soils in Delivering Ecosystem Services in Forests: A Case Study in South Korea. *Forests* **10**, 487.
- Creutzig, F., Bren d'Amour, C., Weddige, U., Fuss, S., Beringer, T., Gläser, A., . . . Edenhofer, O. (2019). Assessing human and environmental pressures of global land-use change 2000–2010. *Global Sustainability* **2**, E1. doi:10.1017/sus.2018.15
- Patrizio, P., Leduc, S., Kraxner, F., Fuss, S., Kindermann, G., Mesfun, S., Spokas, K., Mendoza, A., MacDowell, N., Wetterlund, E., Lundgren, J., Dotzauer, E., Yowargana, P. and Obersteiner, M. (2018). Reducing US coal emissions can boost employment. *Joule* **2**: 1-16 Online: <https://doi.org/10.1016/j.joule.2018.10.004>
- Fuss, S., Flachsland, C., Koch, N., Kornek, U., Knopf, B., Edenhofer, O. (2018). An assessment framework for intertemporal economic performance of cap-and-trade systems: lessons from the EU-ETS, *Review of Environmental Economics and Policy* **12**(2): 220–241.
- Minx, J.C. et al. (2017). Negative emissions: Part 1 – research landscape and synthesis. *Environmental Research Letters* **13** 063001.
- Fuss, S. et al. (2018): Negative emissions - Part 2: Costs, potentials and side effects. *Environmental Research Letters* **13** 063002.
- Nemet, G.F. et al. (2018). Negative emissions -Part 3: Innovation and upscaling. *Environmental Research Letters* **13** 063003.
- Bui, M.; Adjiman, C.S.; Bardow, A.; Anthony, E.J.; Boston, A.; Brown, S.; Fennel, P.S.; Fuss, S.; ... Dowell, N.M. (2018). Carbon capture and storage (CCS): the way forward. *Energy & Environmental Science*, DOI: 10.1039/C7EE02342A.
- Golub, A.A., Fuss, S.; Lubowski, R.; Hiller, J.; Khabarov, N.; Koch, N.; ... Wehkamp, J. (2018). Escaping the climate policy uncertainty trap: options contracts for REDD+, *Climate Policy*, DOI: 10.1080/14693062.2017.1422478.
- Wehkamp, J.; Pietsch, S.A.; Fuss, S.; Gusti, M.; Reuter, W.H.; Koch, N.; Kindermann, G.; Kraxner, F. (2018). Accounting for institutional quality in global forest modeling. *Environmental Modelling & Software* **102**:250-259.
- Jackson, R.B., Canadell, J.G., Fuss, S., Milne, J.L., Nakicenovic, N., Tavoni, M. (2017). Focus on negative emissions. *Environmental Research Letters* **12**(11):110201; DOI10.1088/1748-9326/aa94ff
- Koch, N., Reuter, W., Fuss, S., Grosjean, G. (2017): Permits vs. offsets under investment uncertainty, *Resource and Energy Economics*, **49**, 33-47.
- Kraxner, F., Schepaschenko, D., Fuss, S., Lunnan, A., Kindermann, G., Aoki, K., Dürauer, M., Shvidenko, A. See, L. (2017). Mapping certified forests for sustainable management - A global tool for information improvement through participatory and collaborative mapping. *Forest Policy and Economics* **83**:10–18, doi:10.1016/j.forpol.2017.04.014.
- Wehkamp, J., Koch, N., Lübbers, S., Fuss, S., (2017). Governance and deforestation - A meta-analysis in economics, *Ecological Economics*, **144**,

- Fuss, S. (2017). *The 1.5°C Target, Political Implications, and the Role of BECCS*. Oxford University Press, <http://climatescience.oxfordre.com/view/10.1093/acrefore/9780190228620.001.0001/acrefore-9780190228620-e-585> (Accessed September 4, 2017).
- Peters, G.P., Andrew, R.M., Canadell, J.G., Fuss, S., Jackson, R.B., Korsbakken, J.I., Le Quéré, C., Nakicenovic, N. (2017): Key indicators to track current progress and future ambition of the Paris Agreement. *Nature Climate Change* 7:118–122.
- Knopf, B., Fuss, S., Hansen, G., Creutzig, F., Minx, J., Edenhofer, O. (2017). From Targets to Action: Rolling up our Sleeves after Paris. *Global Challenges* 1(2), <https://doi.org/10.1002/gch2.201600007>.
- Minx, J., Lamb, W.F., Callaghan, M.W., Bornmann, L., Fuss, S. (2017). Fast growing research on negative emissions. *Environmental Research Letters* at press: <https://doi.org/10.1088/1748-9326/aa5ee5>.
- Fuss, S., Jones, C., Kraxner, F., Peters, G., Smith, P., Tavoni, M., Van Vuuren, D., Canadell, J.G., Jackson, R., Milne, J., Moreira, J., Nakicenovic, N., Sharifi, A., Yamagata, Y. (2016). Research priorities for negative emissions. *Environmental Research Letters* 11(11).
- Grosjean, G., Fuss, S., Koch, N., Acworth, W., De Cara, S. (2016). Options to overcome the barriers to pricing European agricultural emissions. *Climate Policy* <http://dx.doi.org/10.1080/14693062.2016.1258630>.
- Szolgayová, J., Fuss, S., Kaminski, T., Scholze, M., Gusti, M., Heimann, M., Tavoni, M. (2016). The benefits of investing into improved carbon flux monitoring. *Cogent Economics & Finance* 4: 1239672 <http://dx.doi.org/10.1080/23322039.2016.1239672>
- Tietjen, O., Pahle, M., Fuss, S. (2016). Investment risks in power generation: A comparison of fossil fuel and renewable energy dominated markets. *Energy Economics* 58: 174–185.
- Schueler, V., Fuss, S., Steckel, J.C., Weddige, U., Beringer, T. (2016). Productivity ranges of sustainable biomass potentials from non-agricultural land. *Environmental Research Letters* 11:074026.
- Fuss, S., Chen, C., Jakob, M., Marxen, A., Rao, N.D., Edenhofer, O. (2016). Could resource rents finance universal access to infrastructure? A first exploration of needs and rents. *Environment and Development Economics* 21(6): 691-712.
- Koch, N., Grosjean, G., Fuss, S., Edenhofer, O. (2016). Politics matters: Regulatory events as catalysts for price formation under cap-and-trade. *Journal of Environmental Economics and Management* 8: 121–139.
- Jakob, M., Chen, C., Fuss, S., Marxen, A., Rao, N.D., Edenhofer, O. (2016). Carbon Pricing Revenues Could Close Infrastructure Access Gaps. *World Development* 84: 254–265.
- Fuss, S. (2016). Climate economics: Substantial risk for financial assets. *Nature Climate Change*, DOI: 10.1038/nclimate2989.
- Smith, P., Davis, S., Creutzig, F., Fuss, S. et al. (2016). Biophysical and economic limits to negative CO<sub>2</sub> emissions. *Nature Climate Change* doi:10.1038/nclimate2870.
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- Wehkamp, J., Aquino, A., Fuss, S., Reed, E.W. (2015). Analyzing the perception of deforestation drivers by African policy makers in the perspective of possible

- REDD+ policy responses. *Forest Policy and Economics* 59: 7–18.
- Fuss, S., Havlík, P., Szolgayová, J., Schmid, E., Reuter, W.-H., Khabarov, N., Obersteiner, M., Ermoliev, Y., Ermolieva, T., Kraxner, F. (2015). Global food security & adaptation under crop yield volatility. *Technological Forecasting and Social Change* 98: 223–233.
- Jäger, J., Nakicenovic, N., Fuss, S., KC, S. Rovenskaya E., Wagner, F. (2015). Special Issue based on IIASA's 40th Anniversary Conference Guest Editorial. *Technological Forecasting and Social Change* 98: 211-212.
- Edenhofer, O., Jakob, M., Creutzig, F., Flachsland, C., Fuss, S., Kowarsch, M., Lessmann, K., Mattauch, L., Siegmeier, J., Steckel, J.C. (2015). Closing the emissions price gap. *Global Environmental Change* 31: 132–143.
- Fuss, S., Canadell, J.G., Peters, G.P., Tavoni, M., Andrew, R.M., Ciais, P., Jackson, R.B., Jones, C.D., Kraxner, F., Nakicenovic, N., Le Quéré, C., Raupach, M.R., Sharifi, A., Smith, P., Yamagata, Y. (2014). Betting on Negative Emissions. *Nature Climate Change* 850–853 (2014)  
doi:10.1038/nclimate2392.
- Leclère, D., Havlík, P., Fuss, S., Schmid, E., Mosnier, A., Walsh, B., Valin, H., Hererro, M., Khabarov, N., Obersteiner, M. (2014). Climate change induced transformations of agricultural systems: insights from a global model. *Environmental Research Letters* 12/2014; 9(12). DOI:10.1088/1748-9326/9/12/124018
- Gschwind, B., Lefevre, M., Blanc, I., Ranchin, T., Wyrwa, A., Drebszok, K., Cofala, J., Fuss, S. (2014). Including the temporal change in PM2.5 concentration in the assessment of human health impact: Illustration with renewable energy scenarios to 2050. *Environmental Impact Assessment Review* 52: 62–68.
- Koch, N.T., Fuss, S., Grosjean, G., Edenhofer, O. (2014). Causes of the EU ETS price drop: Recession, CDM, renewable policies or a bit of everything?—New evidence. *Energy Policy* 73: 676–685.
- Szolgayová, J., Golub, A., Fuss, S. (2014). Innovation & risk-averse firms: options on carbon allowances as a hedging tool. *Energy Policy* 70: 227-235.
- Havlík, P., Valin, H., Herrero, M., Obersteiner, M., Schmid, E., Rufino, M.C., Mosnier, A., Thornton, P.K., Bottcher, H., Conant, R.T., Frank, S., Fritz, S., Fuss, S., Kraxner, F., Notenbaert, A. (2014). Climate change mitigation through livestock system transitions. *PNAS* 111(10):3709-3714.
- Kraxner, F., Leduc, S., Fuss, S., Aoki, K., Kindermann, G., Yamagata, Y. (2014). Energy resilient solutions for Japan—a BECCS case study. *Energy Procedia* 61: 2791-2796.
- Andersson, A.M., Elverhøi, M., Fleten, S.E., Fuss, S., Szolgayová, J., Troland, O.C. (2014). Upgrading hydropower plants with storage: timing and capacity choice. *Energy Systems* 5(2): 233-252.
- Kraxner, F., Aoki, K., Leduc, S., Kindermann, G., Fuss, S., Yang, J., Yamagata, Y., Tak, K., Obersteiner, M. (2014). BECCS in South Korea - Analyzing the negative emissions potential of bioenergy as a mitigation tool, *Renewable Energy* 61:102-108.
- Swart, R., Fuss, S., Obersteiner, M., Ruti, P., Teichmann, C., Vautard, R. (2013). Beyond vulnerability assessment. *Nature Climate Change* 3:942–943.
- Sanders, M., Fuss, S., Engelen, P.J. (2013). Mobilizing private funds for carbon capture and storage: An exploratory field study in the Netherlands. *International Journal of Greenhouse Gas Control* 19: 595–605.
- Kraxner, F., Nordström, E., Havlík, P., Gusti, M., Mosnier, A., Frank, S., Valin, H., Fritz, S., Fuss, S., Kindermann, G., McCallum, I., Khabarov, N., Böttcher, H., See, L., Aoki, K., Schmid, E., Máthe, L., Obersteiner, M. (2013). Global bioenergy scenarios - Future forest development, land-use implications, and trade-offs. *Biomass and Bioenergy* 57: 86–96.
- Svadlenak-Gomez, K., Walzer, C., Badura, M., Kraxner, F., Fuss, S. (2013).

Valuing Alpine ecosystems: the recharge.green project will help decision-makers to reconcile renewable energy production and biodiversity conservation in the Alps; *Journal on Protected Mountain Areas Research* 05/2013; DOI:10.1553/ecomont-5-1s59.

Fuss, S., Reuter, W.H., Szolgayová, J., Obersteiner, M. (2013). Optimal mitigation strategies with negative emission technologies and carbon sinks under uncertainty, *Climatic Change* 118(1): 73-87.

Heumesser, C., Fuss, S., Szolgayová, J., Strauss, F., Schmid, E. (2012). Investment in irrigation systems under precipitation uncertainty, *Water Resources Management*, 26(11):3113-3137.

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Reuter, W.H., Szolgayová, J., Fuss, S., Obersteiner, M. (2012). Renewable energy investment: Policy and market impacts, *Applied Energy* 97:249-254.

Reuter, W.H., Fuss, S., Szolgayová, J., Obersteiner, M. (2012). Investment in wind power and pumped storage in a real options model, *Renewable and Sustainable Energy Reviews* 16(4):2242-2248.

Szolgayová J, Fuss S, Khabarov N, Obersteiner M (2012). Robust energy portfolios under climate policy and socioeconomic uncertainty, *Environmental Modeling and Assessment* 17(1-2):39-49.

Fuss, S., Szolgayová, J., Khabarov, N., Obersteiner, M. (2012). Renewables and climate change mitigation: Irreversible energy investment under uncertainty and portfolio effects *Energy Policy*, 40:59-68.

Strauss, F., Heumesser, C., Fuss, S., Szolgayová, J., Schmid, E. (2011). Optimal irrigation management strategies under weather uncertainty and risk, *Journal of the Austrian Society of Agricultural Economics* 20(2):45-54.

Szolgayová, J., Fuss, S., Khabarov, N., Obersteiner, M. (2011). A dynamic CVaR-portfolio approach using real options: An application to energy investments, *European Transactions on Electrical Power* 21(6):1825-1841.

Fuss, S., Szolgayová, J., Golub, A., Obersteiner, M. (2011). Options on low-cost abatement and investment in the energy sector: New perspectives on REDD, *Environment and Development Economics* 16(4):507-525.

Fuss, S., Szolgayová, J. (2010). Fuel price and technological uncertainty in a real options model for electricity planning, *Applied Energy* 87(9):2938-2944.

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Fuss, S., Szolgayová, J., Obersteiner, M. (2008). A real options approach to satellite mission planning, *Space Policy* 24(4):199-207.

Szolgayová, J., Fuss, S., Obersteiner, M. (2008). Assessing the effects of CO2 price caps on electricity investments - A real options analysis, *Energy Policy* 36(10):3974-3981.

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Fuss, S., Szolgayová, J., Obersteiner, M., Gusti, M. (2008). Investment under market and climate policy uncertainty, *Applied Energy* 85(8):708-721.

### Book chapters

Fuss, S. (2019). Implications of deep decarbonization pathways for sustainable development, In: *What Next for Sustainable Development? Our Common Future at Thirty*, eds. G Meadowcroft, J., Banister, D., Holden, E., Langhelle, O., Linnerud, K., Gilpin, Edward Elgar Publishing: 76–95.

Patrizio, P., Leduc, S., Kraxner, F., Fuss, S., Kindermann, G., Spokas, K., Wetterlund, E., Lundgren, J., Yowargana, P. and Obersteiner, M. (2019) Chapter 11 - Killing two birds with one stone: a negative emissions strategy for a soft landing of the US coal sector. In: J.C. Magalhães Pires et al. (eds.) (Academic Press) pp 219–36. Online: <http://www.sciencedirect.com/science/article/pii/B9780128162293000119>

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Schepaschenko, D., Kraxner, F., See, L., Fuss, S., McCallum, I., Fritz, S., Perger, C., Shvidenko, A., Kindermann, G., Frank, S., Tum, M., Schmid, E., Balkovic, J., Günther, K. Global biomass information: from data generation to application. Vol. 1. Pp. 11-33. In: Yan J (Ed) 2015, *The Handbook of Clean Energy Systems*. John Wiley & Sons, Ltd.

See, L., Kraxner, F., Fuss, S., Perger, C., Schill, C., Aoki, K., Leduc, S., McCallum, I., Forsell, N., Fritz, S. The potential of crowdsourcing for the renewable energy sector. V.1. P. 721-735. In: Yan J (Ed) 2015, *The Handbook of Clean Energy Systems*. John Wiley & Sons, Ltd.

Grubler, A. and Fuss, S. (2013). Technology portfolios: modeling technological uncertainty and innovation risks. Chapter 7 (pp. 89-102) In: Grubler, A. and C. Wilson (eds), *Energy Technology Innovation: Learning from Historical Successes and Failures*, Cambridge University Press.

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