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## Master Thesis: Industrial Demand and Biomass in a Fossil-Free European Energy System

Institute	Institute for Automation and Applied Informatics (IAI)
Research Group	Energy System Modelling (ESM)
Contact	Tom Brown, tom.brown@kit.edu
Duration	6 months
Start Date	Immediate start possible, or whatever is suitable

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### Topic

Fulfilling the Paris climate accords means reaching net-zero carbon dioxide emissions by mid-century. Emissions from industry arise indirectly through electricity consumption and directly through the burning of fossil fuels for process heat and emissions from chemical processes (such as calcination in the production of cement, or from iron ore reduction with coke). In this thesis you will add industrial energy usage and emissions to an existing open-source model of the European energy system<sup>1</sup> (which include electricity, space and water heating, and transport) and investigate optimal ways to reduce carbon dioxide emissions in the industrial sector. Providing process heat in a fossil-free way will require a detailed analysis of biomass potentials in Europe and of the competition with direct electrification and synthetic fuels based on electrolysed hydrogen.

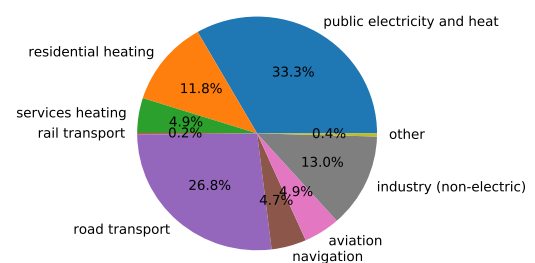


Figure 1: EU28 CO<sub>2</sub> emissions in 2015.

### Objectives

- Collect sustainable biomass potentials for each European country by fuel type (forest residues, agricultural residues, municipal waste, etc.) based on existing sources<sup>2</sup>.
- Collect energy use and emissions per country per industry from standard statistical sources<sup>3</sup>.
- Build the different energy pathways into an existing model of the European energy system.
- Simulate the optimal mix of energy sources and technologies to eliminate CO<sub>2</sub> emissions from the industrial sector.

### Personal Qualifications

We are looking for motivated students interested in energy systems, data processing and numerical optimisation. Basic knowledge in these topics is desirable, as well as experience with object-oriented programming (the project will be carried out in Python and/or Julia; it will be open source).

### Energy System Modelling Group

We are a young, international and friendly research group that is committed to preventing catastrophic global warming. We look forward to working with you!

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<sup>1</sup>T. Brown, D. Schlachtberger, A. Kies, S. Schramm, M. Greiner, Synergies of sector coupling and transmission extension in a cost-optimised, highly renewable European energy system, 2018

<sup>2</sup>E.g. Hotmaps project, 2018

<sup>3</sup>Eurostat, Energy Balances, 2018; European Environment Agency for emissions