IEooc_Background2_Exercise1: System-wide effects of renewable energy deployment

Goal: *Apply systems thinking to renewable energy technologies; read a scientific review.*

In its latest assessment report, the Intergovernmental Panel on Climate Change (IPCC) reviews the state of the art of the science on climate change (working group I), climate change costs and adaptation (working group II), and climate change mitigation (working group III).

With a share of about 35% of total anthropogenic GHG emissions, the energy sector is the largest man-made GHG emitter and thus receives special attention in the assessment report (Bashmakov et al., 2014).

Renewable energy (RE) technologies are a key contributor to reducing GHG emissions in the energy sector.

Reading: IPCC 5TH Assessment Report, Working Group III (Climate Change Mitigation), chapter 7 (Energy Systems) (Bashmakov et al., 2014), link provided on the course home page.

The following questions are to be answered (bullet points are sufficient, with reference to the corresponding subsection in the IPCC report)

1) **What types of renewable energy are included in the IPCC 5AR?**

2) **What are the main reasons for the projected large scale deployment of RE, compared to the other low-carbon technologies CCS and nuclear energy?**

3) **What are the main barriers and concerns regarding renewable energy deployment and how are these barriers addressed?**

4) **What system linkages determine the deployment of RE and thus their future contribution to climate change mitigation, and how would you exploit or address these system linkages, for example, during your MSc thesis?**
   Example: In section 7.5.3 it is mentioned, that “the ultimate contribution of RE to overall energy supply may be dictated in part by the future electrification of transportation and heating / cooling or by using RE to produce other energy carriers, e. g., hydrogen”. Hence the success of RE depends in part on developments in other parts of the industrial system. To understand this system linkage and give advice to engineers and policy makers one needs to enlarge the system boundary to not only study the RE technologies themselves but include energy storage and the use of energy (electric vehicles, heat pumps) in the assessments. Such assessments can become part of MSc theses.

Background 2: Climate, sustainability, and the contribution of industrial ecology

http://www.teaching.industrialecology.uni-freiburg.de/

Reference:

Bashmakov, I., Bruckner, T., Mulugetta, Y., Chum, H., Navarro, A.D.L. V, Edmonds, J. a., Faaij, A., Fungtammasan, B., Garg, A., Hertwich, E.G., Honnery, D., Infield, D., Kainuma, M., Khennas, S., Kim, S., Nimir, H.B., Riahi, K., Strachan, N., Wiser, R., Zhang, X., 2014. Energy systems. In Working Group III contribution to the IPCC 5th Assessment Report "Climate Change 2014: Mitigation of Climate Change", edited by O. Edenhofer, et al. Intergovernmental panel on climate change (IPCC), Genevea.