

FFR170 Sustainable Energy Futures 2019

Student Debates

As part of the course we arrange four debates over important issues in the energy and environment discussion. In each debate two groups will be asked to prepare a brief presentation (ten minutes) in favor or against a certain point of view. After both groups have presented their arguments, each team will have a chance to ask the other team two questions and the other team will have one minute to respond to each question. These questions can be prepared in advance or as responses to the arguments presented. After the panel discussion, the floor will be open to the audience for further questions and discussions.

We adopt the debate format modified based on the Inforum at the Commonwealth Club. Before the debate, your audience will first vote for their views on the debate topic. After the debate is concluded, your audience will vote again on the debate topic. The team who manages to win the most people changing their positions wins the debate. For the audience, please make sure to bring your smartphones or computers so you can cast your votes.

In order to prepare for these debate topics, you will go deeper into one of the topics. Some of the debate topics require you to do some calculations and to read through relevant articles and select/create evidence that support your arguments. Your job would be to review the literature critically and summarize the arguments that support your side as clearly as possible for your audience. The debate topics vary in design so you have the opportunity to learn different debate skills.

Debate #1 is connected to the lecture on climate crash course, and negative emissions lectures; #2 is connected to renewable energy, nuclear and system analysis (Method I), and grid integration lectures; #3 is connected to transportation and hydrogen lectures; and #4 is currently the hottest debate topic in Sweden and connects to fossil fuel, bioenergy, CCS and policy lectures. All of these topics will require you to acquire new knowledge beyond what's covered from the lectures.

I estimate that each student should spend roughly 10-15 hours (i.e. don't spend 3 times that amount!) doing research, preparing for the debate, and practice with your teammates. When you prepare for the debate, make sure to think about how to counter your opponents' arguments, and their potential counterarguments to your case. You can also prepare in advance tough questions for your opponents to respond. Be very clear about the distinction between "facts" versus "values." Please remember, be collegial and be respectful. Most importantly, HAVE FUN!

1 Can we achieve the “below 2-degree target” without negative emissions?

On 13 December 2015 in Paris, the Parties (state signatories) to the United Nations Framework Convention on Climate Change (UNFCCC) reached an agreement to limit global warming to well below 2°C. Emission pathways and system transitions consistent with 1.5°C global warming above pre-industrial levels would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems. The IPCC Special Report Global Warming of 1.5°C suggests that “pathways that limit global warming to 1.5°C with limited or no overshoot project the use of carbon dioxide removal (CDR) on the order of 100–1000 GtCO₂ over the 21st century.”

For example, Carbon capture and storage is often put forward as a key technology to reduce greenhouse gas emissions. It is relatively cheap (compared with other technology options, such as electric vehicles), based on mainly known technology and has a large potential. There are, however, concerns about its technology readiness, feasibility, public acceptance, capital requirement, etc.

Group 1A: Explain why negative-emission technologies are necessary to achieve the below 2 degree target.

Group 1B: Explain how the below 2-degree target may be met without use of negative-emission technologies.

Useful references on this topic:

- “A hard look at negative emissions” (this link provides a good starting point to lots of information and many links to other good sources)
- Grubler, A. et al. (2018) A low energy demand scenario for meeting the 1.5°C target and sustainable development goals without negative emission technologies. *Nature Energy* 3, 515–527, doi:10.1038/s41560-018-0172-6.
- Fuss, S. et al. Betting on negative emissions. *Nature Clim. Change* 4, 850–853, doi:10.1038/nclimate2392 (2014).
- McLaren, D. A comparative global assessment of potential negative emissions technologies. *Process Safety and Environmental Protection* 90, 489–500 (2012).
- Also the most recent authoritative three-part review of negative emissions technologies: Minx et al. (2018), Fuss et al (2018) and Nemet et al (2018).

2 Can the world rely upon 100% renewable electricity without nuclear?

Recent nuclear power accident at Fukushima led to a quick backlash against nuclear power in many western governments. Sweden has official phase-out plans since 1980, although actual decommissioning tends to get postponed. Germany recently enacted laws committing to a complete phase-out by 2022 (a significant step, considering that 23% of their current electricity is nuclear). Switzerland has decided to avoid building new nuclear power plants, and a referendum in Italy blocked nuclear expansion plans. California closed its last nuclear plant in the summer of 2016, and new plants were cancelled. Renewable experts, notably Mark Jacobson a professor at Stanford University in the department of civil & environmental engineering who has a huge number of followers, believe that we can power the world with 100% renewables. The Green New Deal (GND), a proposed stimulus program by the U.S. Congress that aims to address climate change and economic inequality, aims for a massive investment in renewable energy production and would not include creating new nuclear plants. On the other hand, many experts have argued in favor of nuclear power as a way to solve the climate problem, or at least contribute to solving it more cheaply.

Group 2A: Make your case why nuclear is needed in a world with 100% renewables.

Group 2B: Explain how the world can meet its electricity demand from only renewable energy sources without the use of nuclear.

Useful references on this topic:

- Clack, C. T. M. et al. Evaluation of a proposal for reliable low-cost grid power with 100% wind, water, and solar. *Proceedings of the National Academy of Sciences* 114, 6722-6727, doi:10.1073/pnas.1610381114 (2017). <https://www.pnas.org/content/114/26/6722>.
- Jenkins, J. D. et al. The benefits of nuclear flexibility in power system operations with renewable energy. *Applied Energy* 222, 872-884, doi: <https://doi.org/10.1016/j.apenergy.2018.03.002> (2018).
- Sepulveda, N.A., et al., The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation. *Joule*, 2018. 2(11): p. 2403-2420.
- Pathways to Zero Carbon Electricity Systems(video recording)

3 The future of rail is hydrogen

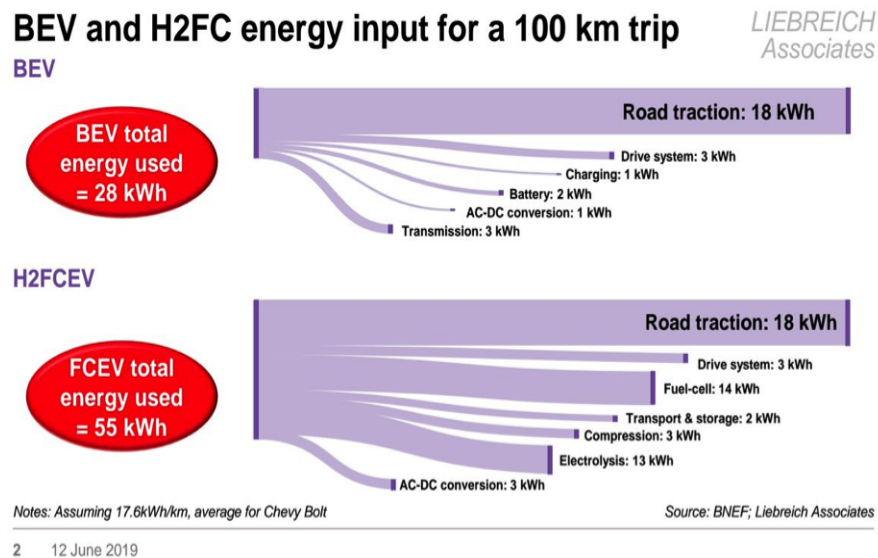
Two hydrogen-powered trains entered service in northern Germany, which according to the news report, “offering an environmentally friendly alternative to conventional diesel locomotives.” Companies such as Alstom and some officials believe that hydrogen trains are good alternatives to replace diesel trains in Germany.

Figure 1: Germany’s new hydrogen-powered trains point the way to sustainable rail travel
<https://www.nbcnews.com/mach/science/germany-s-new-hydrogen-powered-trains-point-way-sustainable-rail-ncna912086>



However, it is clear that hydrogen is less efficient than electric trains.

Figure 2:



Group 3A: You are of the view that hydrogen trains are good options to replace diesel trains for non-electrified train lines in Germany. Consider the sources for producing hydrogen

and justify why it is a good idea to replace non-electrified rails with hydrogen trains. Consider factors such as resource availability, costs and benefits.

Group 3B: You are of the view that hydrogen trains would not work in Germany due potential barriers such as technology, costs, infrastructure, or higher environmental impacts compared with electric trains. You favor other solutions such as electrifying the current non-electrified rails.

4 Should Preem be allowed to expand their refinery plant?

The following text is translated from the article here

Preem accounts for 80 percent of the Swedish refinery capacity and 30 percent of the Nordic refinery capacity. In total, nearly 18 million cubic meters of crude oil are refined every year at both of our wholly owned refineries Preemraff Göteborg and Preemraff Lysekil. This provides a total refining capacity of around 345,000 barrels per calendar day, which corresponds to 15 percent of Sweden's total energy consumption. About two-thirds of the products are exported. The crude oil arrives at the refineries by vessel, is processed and exported or delivered to our depots throughout Sweden, also by sea. The plants in Lysekil and Gothenburg work in a common organization.

The company wants to expand the refinery and in a new plant convert 2.5 million tonnes of oil into gasoline and diesel, an investment of around SEK 15 billion. Preem estimates that the planned expansion will increase their greenhouse gas emissions, from 1.7 million tonnes to 3.4 tonnes per year. This corresponds to 17 percent of today's total emissions from all industry in Sweden - or more than six times the annual domestic (inrikesflygets) emissions. At the same time, Preem believes that they can do what they can to reduce their emissions, among other things by increasing use of renewable fuels in production and by investing in carbon dioxide capture, so-called CCS technology.

There is a great debate whether the company should be allowed to expand. Some people feel that there is no place for a (new) fossil plant in Sweden given the decision by the Swedish parliament to make Sweden climate neutral by 2045. However, jobs and billion-dollar investments are important for the local economy.

Group 4A: Explain why the expansion of Preem at Lysekil is beneficial to Sweden and the world.

Group 4B: Explain why the expansion of Preem at Lysekil is detrimental to Sweden and the world.

Useful references on this topic:

- Klimatexpert ger grönt ljus för Preemraff i Lysekil (in Swedish. If you don't speak Swedish, make good use of Google translate!)