*HIA – Module 2*

Read the instructions and each question carefully and write your answer in the respective green box. **Remember to always cite your sources to the information you provide, both in your text and in the reference list!** You’ll find a reference box after each answer box. Please use the Harvard referencing style.

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For this assignment you are supposed to analyze the energy system of a country of your choice from the list of the IEA: [Countries & Regions - IEA](https://www.iea.org/countries). You can choose your home country or any other country you are interested in. Follow the instructions below and please read all questions before starting. There are even “country reports” from IEA about most of the countries, where you can find more detailed information (You will find them further down on the page of your country). Make sure you can find that report for your country to get the best out of the assignment. Please stick to the same country throughout the assignment.

1. Describe the energy system of your country of choice thoroughly. In your description answer also the following questions: What are the energy sources? What sources are used to produce  
electricity? What are the overall shares of renewable energy and fossil energy sources? What  
sectors are the biggest energy consumers? Note that question 2 below is about the emissions of the energy system. Write 800 (+/- 20%) words.

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| **Answer:** | Let us start with an overview of the energy production and consumption in Sweden. Then I will focus on electricity supply and demand. Finally, it’s important to touch upon the differences between the four bidding zones in Sweden, which differ greatly both in the distribution of electricity sources and in end-user prices.  **Energy**  In 2023, two dominant energy sources were nuclear (36.8% or 527 PJ) and biofuels and waste (35.3% or 509 PJ). Other two major sources were hydro (16.5% or 239 PJ) and geothermal, solar, wind etc. (10.9% or 158 PJ) [4].  Total final electricity consumption in 2022 was 1249 PJ. 40% of the usage is attributed to industry, 38% to buildings and 22% to transport [2, p. 18].  Sweden is the European leader in renewable energy consumption in nearly every metric analysed by Eurostat [1]. In 2023, 66.4% gross final energy consumption came from renewables, already meeting the EU’s 2030 target of 42.5%. The share of renewable energy used by transport was 33.6%, making Sweden the only country in Europe already meeting the 2030 target of 29%. In yet another sector – heating and cooling – Sweden also led the EU ranking with the renewable energy share of 67.1%.  Fossil fuels account for just 24% of total energy supply, which is the lowest share among IEA member countries, and much lower than IEA average of 78% (data from 2022, [2, p. 32]).  **Electricity**  In 2023, the electricity production of Sweden was dominated by hydro (40%, or 66336 GWh), nuclear (29% or 48289 GWh) and wind (20.5% or 34074 GWh) [4]. Sweden exported 17.2% of net electricity produce for that year. 63% of electricity generation in Sweden is controlled by 3 largest producers: Vattenfall, Fortum and Uniper [2, p. 31].  In 2022, Sweden was the largest net exporter of electricity in Europe [5, p. 21], having exported 33 TWh (or 19% of total electricity output) [2, p.30]; and the second largest total exporter (without substracting imports) after Germany [4].  Electricity demand of Sweden has been stable at around 140 TWh since 1990 [2, p. 30]. Electricity final consumption in 2022 was split: 37.1% in industry sector, 33.1% for residential use, 3.3% in transport sector, 25.2% in commercial and public services, and remaining 1.3% in agriculture and forestry.  As reported by Eurostat [1], 87.5% of gross final electricity consumption in Sweden was sourced from renewables in 2023, marking the second highest score in EU after Austria.  **Regional differences between bidding zones**  Sweden’s electricity market is divided into four bidding zones: SE1, SE2, SE3, SE4 (respectively from north to south).  All nuclear power production is located in SE3 (elområde Stockholm), and it accounts for the majority of production in that region. In SE1 (elområde Luleå) and SE2 (elområde Sundsvall), most electricity is produced from hydro with the second biggest source being wind power. Finally, in SE4 (elområde Malmö), wind accounts for the majority of production, followed by wind, thermal and solar [2, p. 48].  Electricity prices differ a lot between bidding zones, especially during high demand hours during the day. At the moment of writing this paragraph (4th of February 2025, 16:30), 1 kWh costed: 7 öre in SE1 and SE2, 39 öre in SE3 and 190 öre in SE4 [3].  Changes in electricity prices between bidding zones are a symptom of congestion in the transmission grid (the price goes up in the zone with electricity deficit and down in the zone with electricity surplus)[5]. The current imports and exports between bidding zones in Sweden and neighboring countries can be viewed live at Svenska Kraftnäts website Kontrollrummet[6]. At the time of writing this (as well as most of the time, at least since the energy crisis of 2022), SE1 and SE2 have energy surplus while SE3 and SE4 have energy deficits. |

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| **References:** | [1] <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics>  [2] IEA rapport Sweden 2024 [3] <https://spotprices.eu/se>  [4] <https://www.iea.org/countries/sweden>  [5] <https://www.riksbank.se/globalassets/media/rapporter/pov/artiklar/engelska/2023/230512/2023_1-the-swedish-electricity-market--today-and-in-the-future.pdf>  [6] https://www.svk.se/om-kraftsystemet/kontrollrummet/ |

2. Try to find information about the emissions of the energy system of your country. Be aware of the difference between the energy and electrical system of your country. There are many sources that misuse these words and share with that misleading information. You are asked here to find your own sources and reference accordingly. Write ca. 500 (+/- 20%) words.

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| **Answer:** | - Energy-related emissions:  - Total CO2 emissions 32 Mt [2, p. 18]  - split: 43% transport, 18% buildings, 28% industry, 11% other (fx refineries) [2. p 18]  - Electricity-related emissions:  GHG emmissions (page 11):  - industry 36%  - transport 31%  - agriculture 15%  - electricity and heat generation 8%  - 99% low-emissions electricity, 1% fossil fuel electricity (page 6)  - 3rd lowest carbon intensity among IEA countries at 3.1 tonnes CO2 per capita |

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| **References:** | [1] IEA rapport Sweden 2024 |

3. Do a quick search about your country’s plans to decarbonize its energy system as a whole or just the electricity system if information is difficult to find. Answer at least the following questions in your text:

* What are the country’s strategies?
* Have they already achieved decarbonization? How?
* Do you think their plans are ambitious enough?

Keep also in mind to use valuable and reliable sources and **do not only** base your answers on newspaper articles. Look out for official governmental documents or NGO reports. Write ca. 500 (+/- 20%) words.

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| **Answer:** | Notes: - Decommissioning nuclear reactors [1]  - Policy recommendations are on page 9 in IEA report  - Sweden has included in law the target to achieve net zero GHG emmissions by 2045 (page 11) - Sweden has plans for 2.5GW of new nuclear power by 2035 (page 5)). current nuclear capacity is 7 GW  - <https://www.regeringen.se/rattsliga-dokument/skrivelse/2023/12/skr.-20232459>  - <https://www.klimatpolitiskaradet.se/rapport-2024/>  - <https://fossilfrittsverige.se/en/start-english/>  - <https://www.riksdagen.se/en/news/articles/2023/jun/20/yes-to-the-governments-spring-amending-budget-_cmsff94b926-2480-4016-a66a-74e624cf4cdden/> -- under the Spring 2023 budget, the government revised the goal to 100% fossil-free electricity by 2040, to include nuclear power  - big growth in wind power  - grid expansion s 49  - SVK Grid development plan 2024–2033  - Industrial leap programme: https://www.energimyndigheten.se/en/innovations-r--d/energyintensive-industry/the-industrial-leap/  - 2024 energy bill: <https://www.riksdagen.se/sv/dokument-och-lagar/dokument/proposition/energipolitikens-langsiktiga-inriktning_hb03105/html/>  - Sweden has plans for 2.5GW of new nuclear power by 2035 (page 5)). current nuclear capacity is 7 GW |

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| **References:** | [1] https://www.uniper.energy/sweden/about-uniper-sweden/nuclear-power-sweden/decommissioning |

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| **AI**  **Declaration:** | (List all the generative AI tools used in this assignment, if you have used any, and the purpose for using it. If you have not used generative AI, you should say that) |