Introduction to energy transitions

This document provides the context and main elements you will need for successful deliberation during the Academic Citizens' Assembly. **Please plan around 90 min to prepare**.

Energy is the most fundamental property in physics and is the basis for all human and non-human activity. Every ecosystem is shaped by energy availability, as is our society. The last 150 years of commoditized, abundant, and cheap coal, oil, and gas has disconnected most humans from this fundamental fact and has led to unprecedented, wasteful, and totally unsustainable energy use - leading to today's climate crisis.

As participants of the Academic Citizen's Assembly, we aim to find solutions to rapidly decarbonize the energy system, making it more resilient and inclusive at the same time.

Make sure you understand the key messages below; follow the links to learn more:

1. The 9 Planetary Boundaries define a "safe operating space" for humanity[1], ensuring stability of the Earth system and ultimately our survival. Read the summary, page 736
2. The aggregate annual human primary energy use is around 600 EJ [2], or 2400 W continuous per capita. At the point of use, the corresponding final energy consumption is around 400 EJ, or 1600 W continuous per capita. On a consumption level, i.e. including embodied energy needed to produce all imported products and services, rich countries use well over 5000 W per capita, with some like the USA over 10 kW per capita. The vast majority of this energy is fossil: 84%
3. Past "Energy Transitions" were only additions to previous sources: coal was added to wood, then oil was added to coal and wood, then natural gas, nuclear, hydropower, wind etc. all added to previous (still growing) sources. Explore ourworldindata.org/grapher/global-energy-substitution
4. The climate crisis is rapidly getting worse, the time to act is running out, and there is a strong case to do everything to limit warming to 1.5°C[3]. If unfamiliar, read: IPCC SR15 summary for policymakers.
5. Fossil fuel pollution is directly killing 9m people each year[4], mainly through PM2.5 inhalation. Additionally, indoor burning of dirty cooking fuels kills 4m p.a.[5]. All this is before climate effects.
6. Theoretically, if a sufficient part of sunlight could be harnessed, even wasteful energy consumption could be satisfied. The 2-billionth of the Sun's output reaching the Earth is still 4 orders of magnitude more than all energy used by humanity. In practice, however, replacing today's fossil use by deploying 100-TW-scale PV will take many decades, much longer than the timescale to exit fossil fuels, meaning total energy use will need to decrease, at least in the transition period.
7. Other than food, humans use energy for the energy services it provides, such as for cooking, lighting, communication, transportation etc. The resulting wellbeing depends on access to energy services. Ongoing academic work on "Decent Living Energy" establishes how much energy is needed to provide a decent life for all [6–8], adjusting for climate, technology, inequality etc. Explore the gaps to decent living by clicking on the shaded countries: decentlivingenergy.org
8. Imbalance of power has created many hard-to-break arrangements, "lock-ins", obstructing the energy transition[9]. Read "The political economy of car dependence", chapter 7, including table 3
9. The free market cannot simultaneously reach the two goals of a good energy system: universal access (needs low price) and consumption limited to available clean energy (needs high price).
10. Large inequalities in energy use reflect income and consumption categories, with basic needs showing low elasticity, and "luxury high intensity" high elasticity. To avoid deprivation, luxury use must not limit decent living energy for all, nor exceed available clean energy[10]. There is a lot of scope for experimenting and specific local solutions. Review Fig.4, Elasticity versus energy intensity.

Think about how a **good energy system** would look like, as a basis for your group work:

- Provide energy services needed for decent living to all, regardless of the ability to pay
- Stop emitting CO_2 and generating air and water pollution
- Reduce its impact and stay within Planetary Boundaries - this means exiting fossil fuels
- Reduce the aggregate energy consumption to what available clean sources can deliver
- Create decent working conditions for all people working in energy
- Establish resilience, combining energy self-sufficiency in most regions with sharing when needed

Also, let's not forget what an **energy system does not need**:

- Cheap energy: providing adequate clean energy will naturally be a good part of any economy
- Investor returns or special protection: energy is an essential need, not a profit opportunuty
- Concentration of power and profits: this has led to most of current problems

General recommendations:

- The energy system is linked to everything else, but do not try to solve poverty, education, health and all other topics at the same time, please remain focused on energy.
- There are many good reasons to question capitalism (and associated consumerism, economic growth, commoditization of human and natural resources, accumulation of capital), but it is not the objective of this ACA. However, energy markets, regulation, and governance are perfectly within the scope of our work.
- Focus on actions and policy recommendations that can be implemented in Switzerland, without requiring immediate worldwide changes.

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