Conclusions and wrap ups

Energy transition

2025

A short not on the examen

Wednesday 2.07.2025, 1515-1715

CE 1 2, PO 01

- 2 hours written exam/no material allowed, except a memento sheet which you can take with you and will also be distributed during the exam

- Use of non-programmable calculator
- Need a sound understanding and feeling for what has been discussed and presented in the lecture (but no need to know all details)
- Questions in the forms of QCM, with one or possible answers

Christophe Ballif / Philippe Thalmann / Claudia Binder

« CO2 EMISSION AND ENERGY SUPPLY IN 14 POINTS »

- With >50 Gt CO_2 , including 38 Gt direct CO_2 annually, we are dramatically changing the world, 19 years left for 2° scenario…
- Primary energy usage (in the substitution method) will still grow, because of countries developing their economy. **All oil/gas producers want to exploit as much as they can their reserves.** If no decarbonized sources of energy**, fossile fuel will further increase because there is no energy crisis and plenty of fossil…**
- **ONLY realistic scenarios to decarbonize the world are based** on a strong increase of electrification, and massive deployment of wind and solar (and partly biomass). Improved electricity management, with strong flexibility (forecast, storage, on-demand usage or reduction) and reserve capacity are essential. Over 100'000 TWh of electricity worldwide by 2050 (?)
- All other energy and electricity sources will help (geothermal, nuclear fission, solar heat)
- Increased efficiency (in particular in buildings), tracking losses are a must to speed up
- **Sufficiency and less absurd consumption** will help make transition more quickly
- **Green economy works**, but requires massive efforts of industrialization, with mostly China bringing manufacturing to the scale required. If you do not push renewable (or nuclear) it will be made by fossile….

Conclusion first part in 14 points

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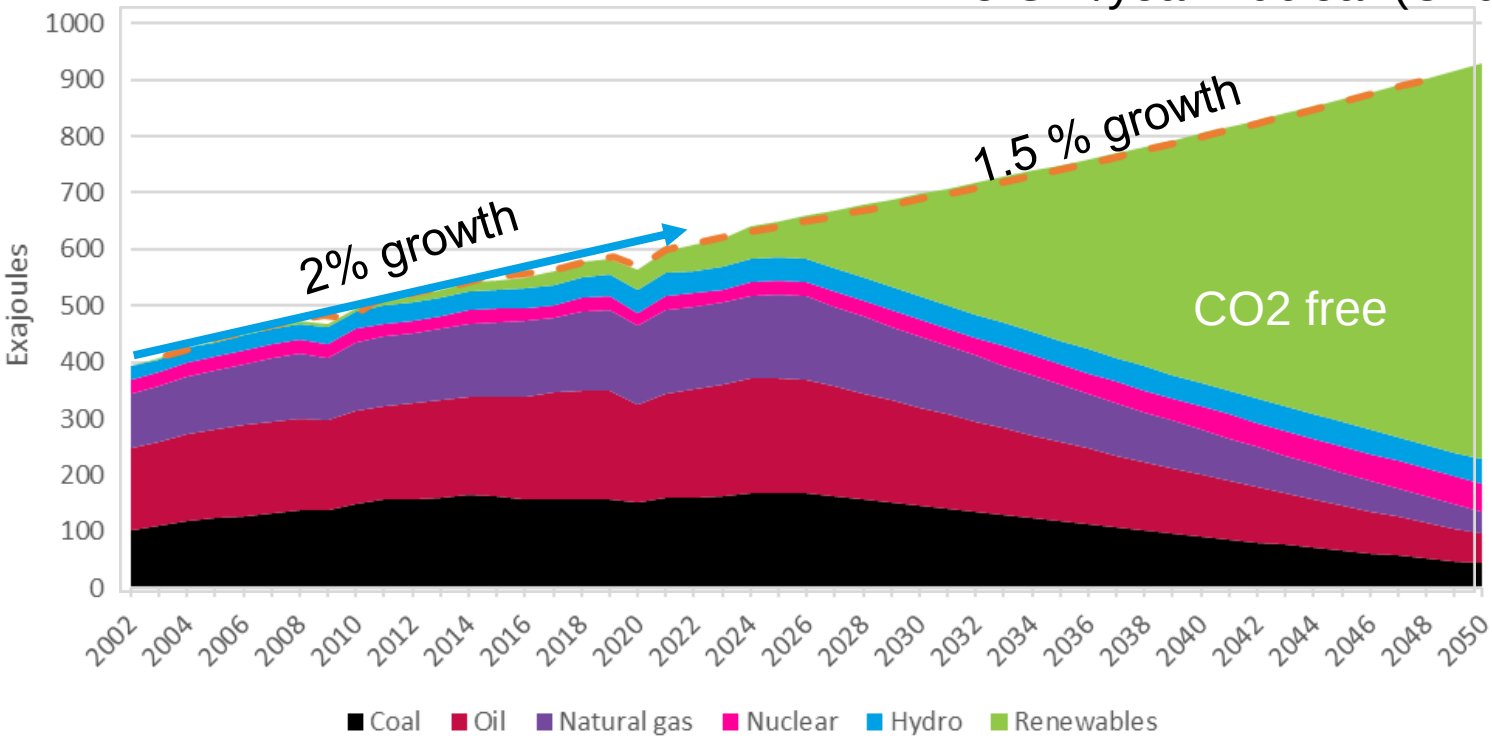
- Agriculture needs to reduce emission, lands and forest can contribute through CO_2 capture
- Instead of pushing consumptions of «futile» products (including Bitcoin, huge cars, 6G, AI ?), green deals should animate economy with clear goals and targets
- A few individual, companies, countries have to loose from the energy transition and will fight against it, by ignoring reality, by denying facts, truth or by being cynical (from a car mechanic, to a local oil reseller, to oil traders, to coal company, to fossil fuel exporting countries, to president of countries authorizing new oil fields).
- Most people, societies, and the planet ecosystem have to gain from transition
- Some countries are going actively for net zero emission, including CH…(to a large extent) current (unsufficient) pledges and actions, as well as plans for fossil fuel extraction plans will not help…. What will likely happen is a mixed scenario with partial decarbonisation, a 2.5-3° temperature increase dramatic overshoots, followed by stronger actions…..
- **If you make clean-tech ultra-low cost, you have a chance to subvert even the "energy-climate idiots", and possibly even to restore to 2° and 1.5° when you start recapture**….

PRIMARY ENERGY CONSUMPTION: EXAMPLE (SUBSTITUTION METHOD - BP)

1000 GW/year solar (CF 0.18)
and 500 GW/year wind (CF 0.3)
15 GW/year Nuclear (CF0.9)

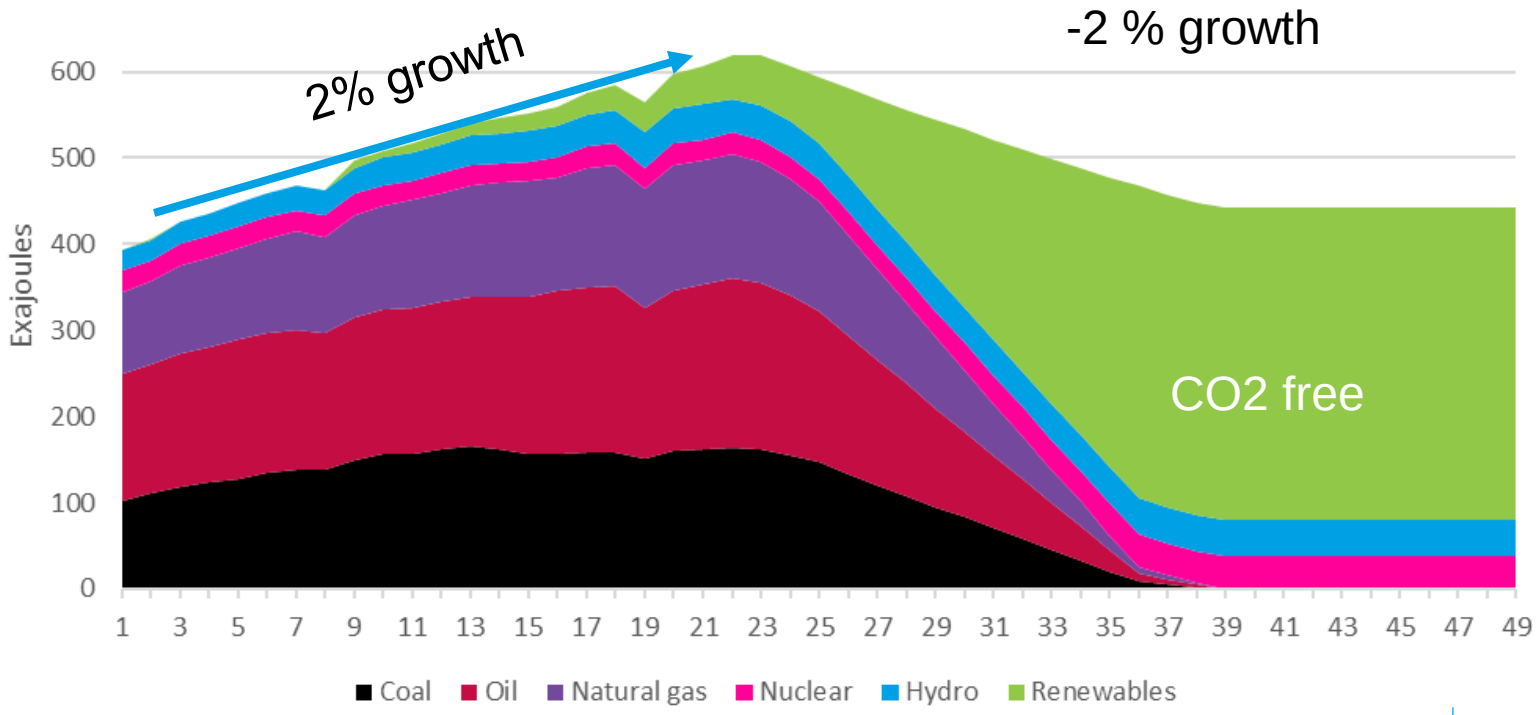


https://files.investis.com/bp_acc_ia/stat_review_2008/htdocs/reports/report_19.html

csem

PRIMARY ENERGY CONSUMPTION: WORLWIDE SUFFICIENCY (SUBSTITUTION METHOD - BP)

1000 GW/year solar (CF 0.18)
and 500 GW/year wind (CF 0.3)
15 GW/year Nuclear (CF0.9)



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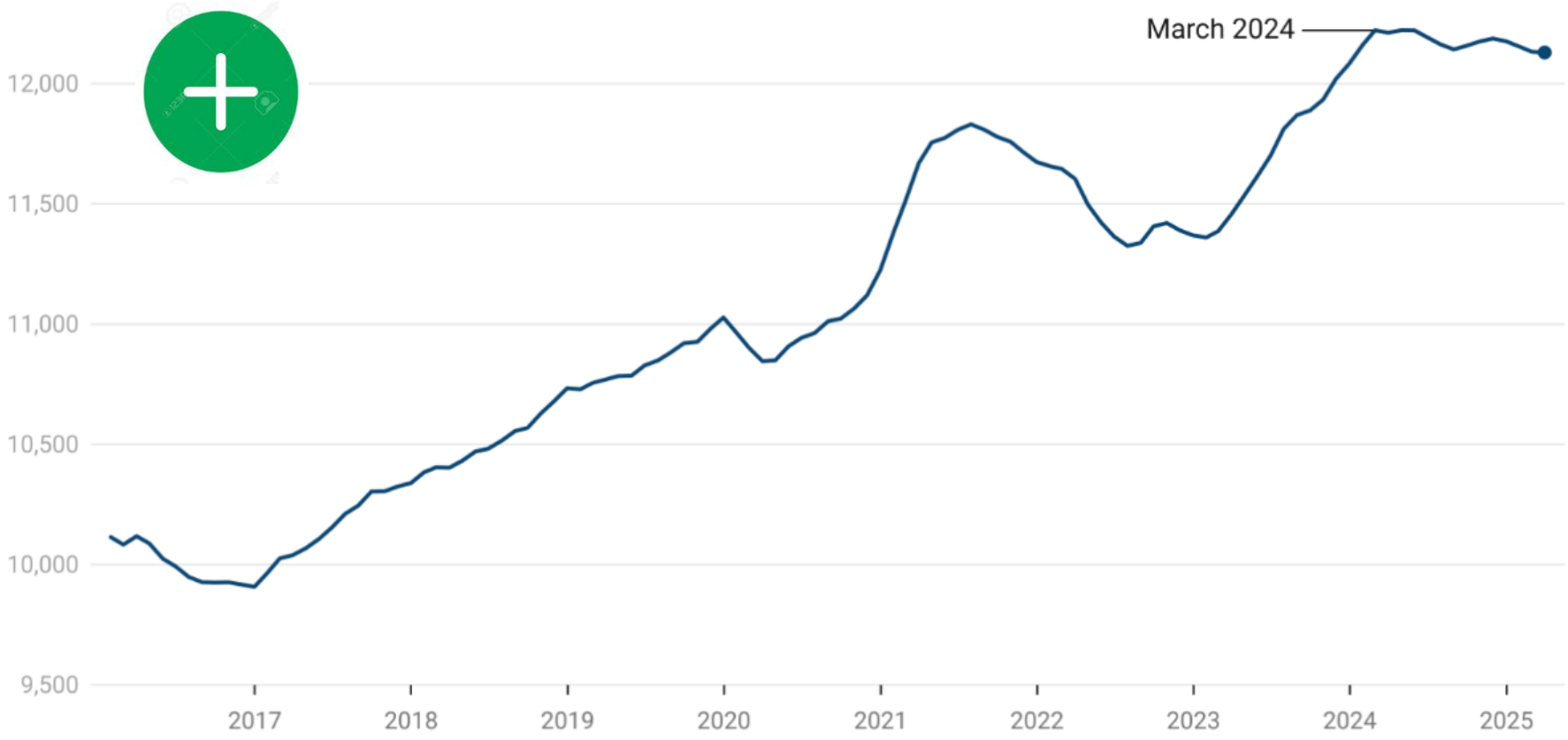
China's CO2 emissions drop due to clean energy for first time

Emissions from fossil fuels and cement, MtCO2, rolling 12-month totals



Source: Analysis by Lauri Myllyvirta for Carbon Brief

CarbonBrief
CLEAR ON CLIMATE

“Economics”

Course 1, "Decoupling"

- Relative and absolute decoupling
- Decoupling – efficiency – IPAT and Kaya
- Sufficiency, efficiency, substitution
- Limitations of IPAT and Kaya
- Green growth
- Rebound effect
- More evidence on decoupling
- Conditions and potentials for sustainable decoupling

Course 2, "Energy economics"

- Unburnable carbon, stranded assets, lock-in effect
- Introduction to financial calculation, NPV, IRR, payback period
- Hurdle rate
- LCOE
- Merit order curve

Course 3, "Energy, Human Needs and Wellbeing"

- Needs and satsifiers, wellbeing and sufficiency
- Who uses energy for what purpose, who decides?
- How much energy is enough? → Decent Living Standards
- Solving RE and biodiversity together

Course 4, "Limits to using markets for energy allocation"

- Characteristics of markets and market failures
- Fundamental limitations of markets beyond failures
- Towards a governance combining quotas, regulated markets, internalization of external costs, and differentiation according to who uses energy and for what purpose

“Navigating the complexity of the energy transition”

Energy transitions involve more than technologies and markets - they are deeply embedded in societal, institutional, and material contexts.

- **Socio-technical perspective:** Multi-level perspective on transitions; interactions between niche innovations, regimes, and landscapes
- **Behavioral perspective:** Drivers and barriers of technology acceptance and adoption; role of social networks for technology diffusion
- **Actors' perspective:** Mapping key stakeholders in the Swiss energy landscape
- **Material perspective:** Geopolitical and environmental implications of a low-carbon system

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And you