Tfy-56-4311 Uudet energiatekniikat (5 op L) /New energy sources (5 p, G)
PHYS-C6370 Fundamentals of New Energy Sources (5 cr)

Tentti 16.12.2013 / Exam 16.12.2013; You may write your answers in English, Finnish, German, Swedish
Indicate which course you choose!
You are allowed to use a calculator in the exam (Peter Lund 0405150144)

1. Describe the physical principles, performance (energy output) and technology concepts of wave power. (6p)

2. Explain the process chain steps of bio-methanol production. (6p)

3. Short answers only (each 1p):
   a) IPAT
   b) Hotelling's rule
   c) How much need CO_2 emissions be reduced by 2050 globally to stabilize climate change (max 2-2.5 C)?
   d) In which situation could the theoretical efficiency of a fuel cell exceed 100%?
   e) How much electricity produces 1 kWp of photovoltaics per year in Southern Finland?
   f) Bioenergy potential (%) of world energy production

4. Short analysis (each 2 p)
   a) How does the power of 1 MW wind power change when wind speed rises from 6 to 12 m/s?
   b) How does the power of a 1 MW photovoltaic power plant change when the solar radiation intensity increased from 500 to 1000 W/m^2?
   c) Up to how much biogas could you get from biomass (crop, plants) from 1 ha of land area?

5. The figure on left describes the realized and predicted wind power penetration in Germany (a). The figure on right describes the price and volume of photovoltaics (PV) and wind power (b).

   a) Analyze the German wind power penetration curve from a technology diffusion point of view. What qualitative and quantitative information does the curve contain? (3p)
   b) Analyze the global PV and wind power development from a technology learning point of view. What can you tell about the progress in PV and wind? (3p)