LUT/Ente
BH61A0201 Energy Economics
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EXAM
2.11.2026

Student is not allowed to bring along any written material! Calculator is allowed.

1.
   a) What does power purchase agreement (PPA) mean and where it has been used? What role does it play in financing the investment? (2p)
   b) When do fine particulate emissions emerge in energy production? What are the ways to reduce these emissions? (2p)
   c) What are the key differences between the ETS sector and the effort-sharing sector? How to achieve carbon neutrality goals in the emissions trading sector (ETS) and the effort sharing sector? 2p)

2.
   a) How does the district heating market interact with the electricity market, and what factors affect its competitiveness and sustainability in Finland? (2p)
   b) Explain what is meant by carbon neutrality in the context of Finland's energy system. What are the main ways to achieve this in Finland? (2p)
   c) Compare policy effectiveness of (a) fuel excise taxes, (b) distribution obligation, (c) vehicle taxation, for decarbonizing transport. What challenges will they face in the future? (2p)

3. A detached house consumes light fuel oil 800 l/year for heating. Light fuel oil price is 1,90 €/l. Fuel price includes Excise Duty (27,23 cents/l) and strategic stockpile fee (0,35cents/l) as well as value added tax VAT (arvonlisävero ALV in Finnish). VAT is 25,5 % and it is paid also on excise duty and strategic stockpile fee. How much are the excise duty, strategic stockpile fee and VAT for the detached house per year? (6p)

4. A detached house with electric heating has annual electricity consumption of 16 MWh and it is bought according to the electricity tariff in table 1. The prices include value added tax 25,5%. The house owner is considering investing in a 6kW photovoltaic system to replace part of the electricity bought. The solar system costs 1050 €/kW including installation work. In the Lappeenranta region annual full-capacity operating hours are estimated to be 930 hours/year. 5000 kWh of the electricity that solar panels produce is used in the house, and the rest is sold to the local energy company at average price of 5 cents/kWh. Electricity tax is not paid on the electricity produced by the solar system. For this investment, the bank offers a loan for 60 months with fixed interest of 5% for the whole investment. The whole investment is paid with the loan.
   a. How much does a photovoltaic system cost in total with a loan? (2p)
   b. Calculate annual savings after photovoltaic investment. (2p)
   c. Photovoltaic system is considered profitable if repayment time is between 7-10 years. Is the project profitable? (2p)

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Table 1: Energy fees and taxes

VAT	25,5%
Electricity distribution fees:	
Basic payment	8,11 €/month
Energy fee	4,09 cents/kWh
Electricity supply	
Basic payment	3,99 €/month
Energy charge	8,9 €/kWh
Electricity tax	2,79372 cents/kWh

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Energy Economics Fundamentals

Present value factor $v_{n,i}$

Every payment is assumed to happen in the end of the year at issue.

Equation: $v_{n,i} = \frac{1}{(1+i)^n}$

Example: The present value of one monetary unit ten years from now with 8 % rate of interest is about 0,46.

n/i	5 %	6 %	7 %	8 %	10 %	12 %	15 %	20 %
1	0,95238	0,94340	0,93458	0,92593	0,90909	0,89286	0,86957	0,83333
2	0,90703	0,89000	0,87344	0,85734	0,82645	0,79719	0,75614	0,69444
5	0,78353	0,74726	0,71299	0,68058	0,62092	0,56743	0,49718	0,40188
10	0,61391	0,55839	0,50835	0,46319	0,38554	0,32197	0,24718	0,16151
20	0,37689	0,31180	0,25842	0,21455	0,14864	0,10367	0,06110	0,02608

Present value factor of periodic payments $a_{n,i}$

Every payment is assumed to happen in the end of the year at issue.

Equation: $a_{n,i} = \frac{(1+i)^n - 1}{i(1+i)^n}$

Example: The combined present value of the series of one monetary unit annual payments for 10 years based on a 5 % rate of interest is about 6,7.

n/i	5 %	6 %	7 %	8 %	10 %	12 %	15 %	20 %
1	0,95238	0,94340	0,93458	0,92593	0,90909	0,89286	0,86957	0,83333
2	1,85941	1,83339	1,80802	1,78326	1,73554	1,69005	1,62571	1,52778
5	4,32948	4,21236	4,10020	3,99271	3,79079	3,60478	3,35216	2,99061
10	7,72173	7,36009	7,02358	6,71008	6,14457	5,65022	5,01877	4,19247
20	12,46221	11,46992	10,59401	9,81815	8,51356	7,46944	6,25933	4,86958

Annuity factor $c_{n,i}$

The value of payment at present is changed to annual payments.

Equation: $c_{n,i} = \frac{i(1+i)^n}{(1+i)^n - 1}$

Example: If one monetary unit present payment is changed to annual payments for 10 years using 8 % rate of interest the annual loan payment and interest make together about 0,149 annually.

n/i	5 %	6 %	7 %	8 %	10 %	12 %	15 %	20 %
1	1,05000	1,06000	1,07000	1,08000	1,10000	1,12000	1,15000	1,20000
2	0,53780	0,54544	0,55309	0,56077	0,57619	0,59170	0,61512	0,65455
5	0,23097	0,23740	0,24389	0,25046	0,26380	0,27741	0,29832	0,33438
10	0,12950	0,13587	0,14238	0,14903	0,16275	0,17698	0,19925	0,23852
20	0,08024	0,08718	0,09439	0,10185	0,11746	0,13388	0,15976	0,20536

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