LUT/Ente
BH61A0201 Energy Economics EXAM
Professor Tapio Ranta 28.4.2026

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) Name the main anthropogenic greenhouse gases? Which sectors are primarily responsible for each greenhouse gas emission? (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) What is meant by power-based electricity pricing? What impact does it have on different customer groups? Why do energy companies want to introduce such a tariff? (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. Wood pellet heating plant with capacity of 25 MW has the underlying performance and cost information:

Investment	8	M€
Annual fixed operation and maintenance costs	3 %	of investment
Variable operation and maintenance costs	2	€/MWh
Wood pellet price	32	€/MWh
Annual efficiency	90	%
Economic lifetime	20	years
Rate of interest	5	%

Variable operation and maintenance costs are reported per heat energy generation.

   a. Calculate the linear cost function (**in €/kWh, year + €/MWh**) of the heating plant. (2p)
   b. If the plant was to supply the heat to an industrial client all year round (without maintenance break), what would be the unit cost (**in €/MWh**) of full-capacity operation? (2p)
   c. At 4000h yearly operating hours, which of these alternatives would have higher heat production cost? (2p)
      i. at 6% interest rate
      ii. 10% rise in fuel price

LUT Group Confidential - Other information (3Y)

4. Table 1 shows production capacities and their variable costs. Table 2 shows electricity demand (MW) forecast for the next morning.

    a. What are the electricity prices (in €/MWh) between 03:00–04:00 and between 08:00–9:00? (3p)
    b. If the variable cost of wind power is 15 €/MWh and 60 MW production capacity is added to the grid (Table 1), how much would the price of electricity be between 8:00 to 9:00? (3p)

Table 1: Electricity production capacity and variable costs

	Hydro power	CHP	Condensing power	Engine power	Engine power	Engine power
Fuel		gas	coal	gas	fuel oil	fuel oil
Max power MW	150	100	80	70	60	50
Variable costs €/MWh	10	30	40	50	70	80

Table 2: Next morning's electricity demand forecast by the hour (MW)

Time	Demand (MW)	Time	Demand (MW)
00-1:00	260	5:00-6:00	320
1:00-2:00	260	6:00-7:00	350
2:00-3:00	260	7:00-8:00	360
3:00-4:00	275	8:00-9:00	415
4:00-5:00	315	9:00-10:00	315

LUT Group Confidential - Other information (3Y)

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

LUT Group Confidential - Other information (3Y)