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UNIVERSITY OF PETROLEUM & ENERGY STUDIES
DEHRADUN
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Program/course: MA – Economics **Semester : IV**
Subject: Renewable Energy and Efficiency Economics **Max. Marks : 100**
Code : **Duration : 3 Hrs**
No. of page/s: 0

Group A: Multiple Choice and Objective questions.

Q1. A. Choose the correct answer. **02X05 = 10**

a. The term energy demand means
(i) Energy needs for cooking heating, travelling, etc.
(ii) Energy products are used as fuel
(iii) Generate demand for energy purposes
(iv) Energy products are also used as raw material
b. Energy demand describes
(i) A relationship between price and quantity of energy
(ii) It exists before the purchasing decision is made
(iii) Indicates what quantities will be purchased at a given price
(iv) How price changes will affect the quantities sought
C. Consumption of energy takes place
(i) Once the decision is made to purchase
(ii) Once the decision is made to consume
(iii) Refers to the manifestation of satisfied demand
(iv) Demand and consumption are used interchangeably
d. Energy demand is
(i) A derived demand
(ii) Is consumed through equipment
(iii) Consumed for an ulterior purpose
(iv) All of the above

e. Energy demand decision include the stages of
(i) The house hold has to decide whether to switch or not
(ii) It decides about the types of appliances to be used
(iii) Consumption decision is made by deciding the usage pattern of each appliance
(iv) All of the above.

Q1. B. Answer all the objective questions. 02X05 = 10

(i) Write the cost function with respect to energy input and mention the two conditions to be satisfied for cost optimization
(ii) Write the utility function of a consumer with respect to energy consumption and mention what are the two conditions for utility maximization of the consumer.
(iii) Define energy intensity
(iv) Define energy efficiency

Group B: Short questions 5 X 4 = 20

(i) Discuss different types of load management with respect to demand side management (DSM).
(ii) Discuss the direct and indirect load control methods.
(iii) Analyse the cost effectiveness of demand side management (DSM).
(iv) What is the debate of energy efficiency versus economic efficiency?

Group C: Short questions 15 X 2 = 30

(i) Analyse the energy demand analysis using factor analysis and econometric approach.
(ii) Analyse the market barriers of energy efficiency. What is the nature of government intervention in case of market failure? Discuss.
(iii) Critically analyse the energy demand at disaggregated level of (i) house hold sector (ii) commercial sector and (iii) transportation sector.

Group D: Case study/ Analytical questions

Answer all the questions. 5 X 2 = 30

<u>Key challenges of Renewable energy and actions taken:</u>

The distribution network connects about 200 million consumers with a total load of over 400 GW. It is served by 73 distribution companies, of which 17 are privately owned. Several of the distribution utilities suffer large volumetric losses and are financially distressed. This raises a significant counterparty risk which is manifested in delayed payments to generators and other suppliers. The cost under-recovery of state utilities is estimated at an accumulated 24,000 billion

INR (2012), prompting the government to focus on severely distressed utilities for a turnaround programme.

Regulatory reforms are proposed in the amendments to the Act, such as mandatory tariff determination on an annual basis to cover cost escalation. Further, utilities are required to file for tariff requests on a timely basis. Transmission, particularly, for renewable energy projects, is a challenge, given the low capacity factors and congestion on existing networks. To bring green power to the national market, and minimize curtailment, the government has announced a green energy corridor project to handle 33 GW and 22 GW of renewable energy in two phases of development. The 765 kV corridor traverses all the prominent renewable states and will have suitable mechanisms for the integration of large-scale renewable energy, such as energy storage, real-time monitoring, and a renewable energy management centre. In addition, the South Asia grid is gradually taking shape, with enhanced connectivity with Bhutan and a new transmission corridor established with Nepal and Bangladesh. This provides investors and large consumers new opportunities for build and power sourcing.

Investment in coal-fired generation has come to a stasis on account of changes in procurement models. Competitive bids for fuel-linked power plants moved from BOO to DBFOT and those for domestic coal-based plants moved back to a modified version of the earlier model. These changes, besides other conditions—demand-supply balance and utilities purchase plateauing—have put many conventional power generation investments on hold. A number of power plants are stranded or operate under capacity due to fuel shortages. For example, PLFs of gas-based power plants have come down from 67.5% (2010) to 20.8% (2015), with declining production from local gas fields. Domestic manufacturing in renewable energy is under-equipped to serve the ambitious growth target. Solar PV manufacturing is fragmented with many small players (total capacity is a mere 1.38 GW of solar cells and 2.75 GW solar modules) and lacks vertical integration. The government programmes for electronics manufacturing have attracted manufacturing tie-ups in recent months. These include China’s Hareon Solar with Dalmia Group (1 GW), Adani with Softbank and Foxconn (3 billion USD proposal), and China’s JA Solar with Essel Group (200 million USD proposal).

The renewable energy sector in India has made remarkable progress growing from 3.3% (2002) of the total generation capacity to 13.4% (2015). Production rose from 0.4% to 5.6% in this period. Of this, about two-third is from wind, and the balance is from small hydro, solar, biomass and waste to energy, and other sources.

Scale and technology developments:

The wind power sector has undergone a major shift in India, from tax-credit driven investment to mainstream IPPs. This has led to the setting up of large wind farms that deploy the latest technology and practices—larger MW class wind turbines, inclusive O&M practices for plant life, use of logistics tools for construction and maintenance, and seamless grid integration.

Further, the industry has gained from improvements in drivetrain technology, tower structure and use of advance power electronics, which add to overall cost effectiveness. Turbine costs declined in late 1990s, but have since risen. This is due to a variety of factors—greater turbine dimensions and higher material costs. However, with design technology maturing and production stabilizing, costs have started to decline from 2010. Further gains are expected from the use of lightweight materials such as carbon-fibre reinforced plastic, better aerodynamic profile, on-site manufacturing, segmented blades, and variable diameter rotor can reduce costs and increase the capacity factor. An US DOE study suggests that the adoption of advanced technology can increase the energy output between 21 to 61% with smaller changes (-36% to 21%) in capital cost.

In India, in the last two decades, the hub height and rotor diameter of wind projects have increased fourfold, and the average WTG rating increased almost tenfold. This enhances the energy generated per turbine, thus reducing the overall levellised cost of electricity. Still, the top-end rotor and hub height installed for WTGs in India are 20-30% lower than the global standards, and have scope for improvement. In solar, the vast majority of Indian projects have adopted crystalline silicon technology, with an average efficiency of 16-17%. The thin-film technologies of cadmium-telluride and copper-indium-gallium-selenide, with 14-15% efficiency, have been used selectively. The expectation is that ongoing scientific research will continue to increase the efficiency in the coming years.

Q (i). In the light of the above paragraphs discuss the challenges of renewable energy sector in India

Q (ii). Analyse the futuristic road map of renewable energy and renewable energy policy of government of India.