National Certification Examination for Energy Managers and Energy Auditors
(Under Energy Conservation Act, 2001)

24-25 April 2004
Saturday, Sunday

Bureau of Energy Efficiency (BEE)
(A statutory body under Ministry of Power, Government of India)

National Certifying Agency
National Productivity Council, India
(Under the Department of Industrial Policy & Promotion, Government of India)
"What we know is only handful
What we don’t know is oceanful"

- Avvaiyar, Tamil poet, 2 AD.

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Foreword

The magnitude of energy consumption has always been taken as an indicator of development status of any economy. However, what actually a country requires is not energy per se but the services that energy provides. A nation can increase the service by keeping the same inefficient device and pump in more energy. More energy will positively not accelerate the economic growth as long as economy has high-energy intensity. India’s energy intensity per unit of GDP is higher by 3.7 times of Japan, 1.4 times of Asia and 1.5 times of USA, indicating to very high energy wastage. In the globalized economy, countries with high energy intensity may become uncompetitive due to high energy input cost. Therefore, energy cost reduction must become one of the important benchmarks for economic success. Efficiency in consumption of energy and its conservation would be one of the most important means of energy cost reduction and also for meeting future energy demand.

There is a huge scope of energy saving in the country. Various studies undertaken suggest substantial energy saving potential in industrial, commercial and domestic sector. Efficient use of energy provides the least cost and environmentally friendly option for capacity creation in the shortest time frame. Energy efficiency also assumes further importance as “one unit of energy saved at consumer end, avoids 3 units of fresh capacity addition”.

With the background of high energy saving potential and its benefits, bridging the gap between demand and supply, reducing environmental emissions through energy saving, and to effectively overcome the barrier, the Government of India has enacted the Energy Conservation Act 2001. The Act provides the much-needed legal framework and institutional arrangement for embarking on an energy efficiency drive.

Under the provisions of the Act, Bureau of Energy Efficiency has been established with effect from 1st March, 2002. The Bureau would be responsible for implementation of policy, programmes and coordination of energy conservation activities in the country.

Bureau is in the process of accrediting Energy Audit firms who would provide quality energy auditing services to the industry. Energy audit involves a systematic study undertaken on major energy consuming sections and equipment including construction of heat and mass balance with a view to identify the flow of energy, utilization efficiency of energy in each of the steps and pin-point energy wastages. A well-conducted energy audit would reveal the areas of wastage of energy and it would be possible to suggest countermeasures for saving of energy. The EC Act requires that energy audit report to contain recommendations for improving energy efficiency with cost- benefit analysis and an action plan to reduce energy consumption (Clause 2(i)). The conduct of energy audit through an accredited energy auditing firm (having a pool of certified energy auditors) and implementation of its recommendations on cost-benefit basis is expected to help the industry to achieve significant reduction in their energy consumption levels.

Bureau of Energy Efficiency is also strengthening the capabilities of Energy Managers to be appointed by the energy intensive industry under the EC Act. Energy manager occupies an important position and is a focal point of all the activities pertaining
to energy management in the organization. Energy Manager provides leadership in the
development of policy on Energy Management Action Plan and plays a key role in the
formulation of corporate energy policy. Energy Managers also perform the activities
related with Plant Energy Management; Project Management; Personnel Management and
Financial Management at plant level. He also prepares the information to be submitted to
the Designated Agency with regard to the energy consumed and action taken on the
recommendation of the Accredited Energy Auditing firm.

The BEE will make every endeavor to develop adequate technical capacity in the
Energy Managers to enable them to effectively discharge the mandatory duties &
responsibilities assigned under the Regulation to the Act. The Bureau is developing
manuals and codes for conduct of energy audit of different equipment and appliances to get
optimal performance result. Further, the BEE will periodically collect the best energy
saving practices followed in different industries and post the same on its website
www.energymanagertraining.com to enable the Energy Manager to know the innovative
approaches adopted elsewhere and try out the same. The website will also have the format
of supply of mandatory information relating to energy consumption of key activities.
Furnishing the information will help the industrial unit to know its position in term of
energy consumption in different activities vis-à-vis other industries in the same sector.
Energy Manager may as well test their knowledge through an interactive self test at the
website. In other words, this will help the industry an automatic access to benchmarking
within the sector.

Taking into consideration the important role that an Energy Manager and an Energy
Auditor will play, BEE is specifying qualification procedures for a person to become a
qualified Energy Manager and Energy Auditor under the EC Act, 2001, will be passing of a
National level Certification Examination under the aegis of BEE. To facilitate conduct of
the National level certification examination, BEE has designated National Productivity
Council (NPC) as the national certifying agency. In order to facilitate the conduct of the
certification examination, the Bureau of Energy Efficiency (BEE) has developed a
comprehensive syllabus and course material. The details of the certification procedure,
contents and other guidance have been laid down in this Prospectus. The certification
programme helps you and the Indian industries in achieving our national objective of
increasing the efficient use of energy.

I trust that the implementation of mandatory energy audit and energy management
programme by the designated consumers would contribute towards building an energy
efficient economy.

(SHASHI SHEKHAR)
Director General
Bureau of Energy Efficiency
1. Background

The Government of India has enforced *The Energy Conservation Act, 2001* (No 52 of 2001, 29th September 2001) with effect from 1st March 2002. The Act provides mainly for efficient use of energy and its conservation and for matters connected therewith or incidental thereto. As per the Energy Conservation Act 2001, it is mandatory for all the designated energy consumers to get energy audit conducted by an Accredited Energy Auditor [under clause 14(h) and 14(i)] and to designate or appoint an Energy Manager [under clause 14(l)]. The designated energy consumers as covered in the Schedule to the Energy Conservation Act are given in item No17 of this prospectus.

**Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India**, is empowered to specify the regulations and mechanism to meet the above objectives. BEE has retained the **National Productivity Council (NPC)** as the National Certifying Agency, which would conduct the National Level Certification Examination for Energy Managers & Energy Auditors under the aegis of Bureau.

2. Need for National Level Certification Examination

The essential qualification for a certified energy manager and certified energy auditor would be the passing of a National Level Certification Examination which will be conducted under the aegis of Bureau of Energy Efficiency. The national level certification examination, conducted by a National Certifying Agency, will establish a uniform criterion for the certification of energy managers/energy auditors and will also ensure that services of qualified persons, having the requisite knowledge on the subject, are available to the industry.

The Certification examination will be conducted based on the syllabus/curriculum approved by the Bureau. The proposed syllabus will go under modifications from time to time based on the feedback received and future new developments. The requisite modifications will be incorporated by the national level certification agency in the syllabus in consultation with the Bureau from time to time.

3. Energy Auditor – Role and importance

Energy audit involves a systematic study undertaken on major energy consuming sections and equipments including construction of heat and mass balance with a view to identify the flow of energy, utilization efficiency of energy in each of the steps and pin-point wasteful energy used. A well-conducted energy audit would reveal the areas of wastage of energy and it would be possible to suggest saving of energy.

The Energy Conservation Act requires the energy audit report to contain recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption [Clause 14(i)]. The conduct of energy audit and implementation of its recommendations on cost-benefit basis through accredited energy auditors is expected to help the designated energy consumers to achieve significant reduction in their energy consumption levels.
Responsibilities and duties of Energy Auditor are highlighted below

- Carry out a detailed energy audit
- Quantify energy consumption and establish base line energy information
- Construct energy and material balance
- Perform efficiency evaluation of energy & utility systems
- Compare energy norms with existing energy consumption levels
- Identify and prioritization of energy saving measures
- Analysis of technical and financial feasibility of energy saving measures
- Recommend energy efficient technologies and alternate energy sources
- Report writing, presentation and follow up for implementation

4. Energy Manager – Role & Importance

Energy manager occupies an important position and is a focal point of all the activities pertaining to energy management in the organization. The energy manager provides leadership in the development of policy on Energy Management Action Plan and plays a key role in the formulation of corporate energy policy. Energy managers also perform the activities related with Plant Energy Management, Project Management, Personnel Management and Financial Management at the plant level. He also prepares the information to be submitted to the Designated Agency with regard to the energy consumed and action taken on the recommendation of the accredited energy auditor [Clause 14(k)].

Responsibilities and duties of Energy manager are highlighted below

- Establish an energy conservation cell & prepare an annual activity plan
- Develop and manage training programme for energy efficiency at operating levels.
- Develop integrated system of energy efficiency and environmental improvement.
- Initiate activities to improve monitoring and process control to reduce energy costs.
- Co-ordinate implementation of energy audit/efficiency improvement projects through external agencies.
- Establish / participate in information exchange with other energy managers of the same sector through association.
- Provide information to BEE and Designated Agency of the respective states as demanded in the Act

5. Eligibility Criteria for the Candidates.

The candidates appearing for this examination should have the following eligibility criteria and requisite work experience to write the Certification examination:

a) For Energy Managers:

Candidates appearing for Energy Managers certification examination should possess any one of the following qualifications:

i. Graduate Engineer (B.E / B.Tech) or equivalent with 3 years of work experience,
ii. Post Graduate Engineer (M.E / M.Tech) or equivalent with 2 years of work experience
iii. **Graduate Engineer with Post Graduate degree in Management** or equivalent with **2 years** of work experience

iv. **Diploma Engineer** or equivalent with **6 years** of work experience

v. **Post Graduate in Science** with **5 years** of work experience.

b) **For Energy Auditors:**
Candidates appearing for Energy Auditors certification examination should possess any one of the following qualifications:

i. **Graduate Engineer** (B.E / B.Tech) or equivalent with **3 years** of work experience.

ii. **Post Graduate Engineer** (M.E / M.Tech) or equivalent with **2 years** of work experience

iii. **Graduate Engineer** with **Post Graduate degree in Management** or equivalent with **2 years** of work experience.

c) **For candidates without requisite work experiences**

i. The candidates possessing the requisite qualification but **without requisite experiences** are also eligible for appearing in written examination for **Energy Manager** or **Energy Auditor** as applicable.

ii. Certification of Energy Manager will be done only on successful passing of the examination and acquiring relevant experience and submission of experience certificate.

iii. Certification of Energy Auditor will be done on successful passing of the theory examination and acquiring relevant experience. These candidates will have to first pass the theory papers and Viva-voce examination will be conducted once the proof for work experience is submitted. There will be no extra fee required to be paid for the Viva-voce examination.

iv. The requisite experiences as applicable should be acquired within 6 years from the date of appearing in the first examination.

6. **Examination Papers and Scheme**

The examination Papers for energy managers and Energy Auditors are given below:

a) **For Certification of Energy Managers**

<table>
<thead>
<tr>
<th>Paper No</th>
<th>Name of the Paper</th>
<th>Duration</th>
<th>Max Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM-1</td>
<td>General Aspects of Energy Management &amp; Energy Audit.</td>
<td>3 Hrs</td>
<td>150</td>
</tr>
<tr>
<td>EM-2</td>
<td>Energy Efficiency in Thermal Utilities</td>
<td>3 Hrs</td>
<td>150</td>
</tr>
<tr>
<td>EM-3</td>
<td>Energy Efficiency in Electrical Utilities</td>
<td>3 Hrs</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td><strong>Total Marks</strong></td>
<td></td>
<td><strong>450</strong></td>
</tr>
</tbody>
</table>

The candidate has to pass all the above **THREE papers**, viz., EM-1, EM-2 and EM-3 and obtain a minimum of **50%** of the maximum marks in each paper.
b) For Certification of Energy Auditors

<table>
<thead>
<tr>
<th>Paper No</th>
<th>Name of the Paper</th>
<th>Duration</th>
<th>Max Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA-1</td>
<td>General Aspects of Energy Management &amp; Energy Audit.</td>
<td>3 Hrs</td>
<td>150</td>
</tr>
<tr>
<td>EA-2</td>
<td>Energy Efficiency in Thermal Utilities</td>
<td>3 Hrs</td>
<td>150</td>
</tr>
<tr>
<td>EA-3</td>
<td>Energy Efficiency in Electrical Utilities</td>
<td>3 Hrs</td>
<td>150</td>
</tr>
<tr>
<td>EA-4</td>
<td>Energy Performance Assessment for Equipment and Utility systems (Open Book Examination)</td>
<td>2 Hrs.</td>
<td>100</td>
</tr>
<tr>
<td>Viva Voce</td>
<td></td>
<td>15 Mts.</td>
<td>50</td>
</tr>
</tbody>
</table>

Total Marks: 600

The candidate has to pass all the above **FOUR papers** and obtain a minimum of 50% of the maximum marks in each paper. In addition, the candidate should also appear for a **Viva Voce** Examination and obtain a minimum of 50% of the maximum marks.

c) Medium of examination is English.
d) The examination type is comprised of both objective and descriptive types.
e) **Question Paper for Energy Manager is different from that for the Energy Auditors and degree of difficulty level for Energy Auditors is higher than Energy Manager examination.**
f) The EA-4 paper for Energy Auditors will be an open book examination and the candidates can refer to books during the examination.
g) Viva-voce examination for Energy Auditors will be conducted only for those candidates who have obtained minimum of 50% of the maximum marks in all the papers viz. EA1, EA2, EA3 & EA4. Proposed date for Viva-voce examination to such candidates will be intimated later.
h) The **syllabus** for all the papers is given in **Annexure – I**.

7. Minimum Marks for Award of Certificates

a) **For Certification of Energy Managers:**

i. 50% of the maximum marks in each paper in EM-1, EM-2 and EM-3.

b) **For Certification of Energy Auditors:**

i. 50% of the maximum marks in each paper in EA-1, EA-2 and EA-3 & EA-4

ii. A candidate appearing for Energy Auditor examination is also required to appear for a **Viva Voce** Examination and obtain a minimum of 50% of the maximum marks.

**Note:** A candidate qualifying as Certified Energy Auditor automatically qualifies for Certified Energy Manager as well. Such persons can be appointed or
designated as Energy Manager under the EC Act, 2001 by the Designated Consumers.

8. Supplementary Candidates

Those candidates who could not appear /pass in any paper or viva-voce are eligible to write the supplementary examination within a period of two years from the date of conduct of first examination. Exemption to the candidate is given for a particular paper, if he/she secures equal or more than 50% of the maximum marks in that paper. The validity of the exemption is for three attempts or for two years whichever is earlier. In the supplementary examination, the candidate has to secure a minimum of 50% of the maximum marks for qualifying in the examination.

9. Validity of Certificates

The certificate is valid for life time, subject to the condition of attending of an authorized refresher training course of short term duration (5days) by the candidate in a designated /approved institute or organization (to be announced by the Bureau) once in a 5 year time period, commencing from the date of award of certificate. A six- month’s grace period will also be provided to the certified energy manager and energy auditors after the expiry of 5 year period. The Candidate will be required to inform the BEE about the attendance of the refresher course on a specified format so that a fresh certificate is issued to the candidate for another 5-year period.

10. Revocation of Certificates

The Certificate can be revoked on the ground of proved instances of unprofessional / unethical practices followed by a Certified Energy Manager. The Bureau shall constitute a Committee for this purpose, which will investigate the matter. The concerned Certified Energy Manager will be informed of the charges against him and given a reasonable opportunity of being heard in respect of such charges.

11. Examination Centres

a) The proposed centers for conduct of the written examination are: –

    Ahmedabad, Bangalore, Bhopal, Bhubaneswar, Chandigarh, Chennai, Dehradun, New Delhi, Goa, Guwahati, Hyderabad, Jaipur, Kanpur, Kolkatta, Mumbai, Nagpur, Patna, Raipur, Thiruvananthapuram and Vadodara.

b) Proposed centers for Viva-voce examination for Energy Auditors are:

    - New Delhi, Mumbai, Kolkatta & Chennai

c) The applicants will have to give three choices of examination centers in order of their Preference.

d) If the number of applicants for a particular center is found to be less than the minimum required number, the examination center for those applicants can be shifted to next preferred centers.
12. Examination Schedule

Schedule of Examination for Energy Managers

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Examination Paper</th>
<th>Examination Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM-1</td>
<td>General Aspects of Energy Management &amp; Energy Audit.</td>
<td>24th April 2004</td>
<td>0930-1230 Hrs</td>
</tr>
<tr>
<td>EM-2</td>
<td>Energy Efficiency in Thermal Utilities</td>
<td>24th April 2004</td>
<td>1400-1700 Hrs</td>
</tr>
<tr>
<td>EM-3</td>
<td>Energy Efficiency in Electrical Utilities</td>
<td>25th April 2004</td>
<td>0930-1230 Hrs</td>
</tr>
</tbody>
</table>

Schedule of Examination for Energy Auditors

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Examination Paper</th>
<th>Examination Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA-1</td>
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</tr>
<tr>
<td>EA-3</td>
<td>Energy Efficiency in Electrical Utilities</td>
<td>25th April 2004</td>
<td>0930-1230 Hrs</td>
</tr>
<tr>
<td>Viva-voce</td>
<td>Viva voce Examination*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

* The date, timings and venue for Viva-voce examination will be intimated later on to the successful candidates of the written examinations.

13. Fee

Fee for Certification examination of Energy Managers or Energy Auditors are given below:

Prospectus and application fee (for sponsored and Self-Sponsored individual candidate) = Rs.500/

*Self-sponsored candidates (individual in the category of SC/ST/OBC & having annual income not more than Rs. 1.0 Lakh/annum) = Rs. 250/

* The candidate will be required to submit the copies of the necessary supporting documents.
Certification Fee for Energy Managers & Energy Auditors (Non-refundable)

a) Sponsored candidates by the company = Rs.20,000/- (Twenty Thousand only)
b) Self-sponsored candidates (individual) = Rs.10,000/- (Ten Thousand only)

c) Self-sponsored candidates (individual in the category of SC/ST/OBC & having annual income not more than Rs. 1.0 Lakh/annum) = Rs. 5,000/- (Five Thousand only)

(The certification fee includes the cost of Course Books, examination fee, viva-voce fee & Certification.)

*The candidate will be required to submit the copies of the necessary supporting documents.

- Application and Prospectus can be downloaded from the website also. However, filled up application form should be sent along with the application fee of Rs.500/- (Five Hundred only) or as applicable in addition to Certification Examination Fee as mentioned above.

- **Certification Examination Fee** is to be paid by DD drawn in favour of **“Bureau of Energy Efficiency”** payable at **“Chennai”** along with Application Form for Registration.

- **Supplementary Examination & Viva-voce fee structure:**

<table>
<thead>
<tr>
<th>Fee for each paper (written examination)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Sponsored candidates by the company  = Rs.3,000/- (Three Thousand only)</td>
</tr>
<tr>
<td>b) Self-sponsored candidates (individual) = Rs.2,000/- (Two Thousand only)</td>
</tr>
<tr>
<td>c) Self-sponsored candidates (individual in the category of SC/ST/OBC &amp; having annual income not more than Rs. 1.0 Lakh/annum) = Rs. 1,000/- (One Thousand only)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fee for Viva-voce examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Both for company &amp; self-sponsored candidates = Rs.1,000/- (One Thousand only)</td>
</tr>
<tr>
<td>b) Self-sponsored candidates (individual in the category of SC/ST/OBC &amp; having annual income not more than Rs. 1.0 Lakh/annum) = Rs. 500/- (Five Hundred only)</td>
</tr>
</tbody>
</table>

14. Course Book

The following Course Books are specially developed for the candidates appearing for the examination.

Paper-1: General Aspects of Energy Management & Energy Audit
Paper-2: Energy Efficiency in Thermal Utilities
Paper-3: Energy Efficiency in Electrical Utilities

The Course books for Energy Auditors and Energy Managers will be sent to all candidates on registration.

15. Registrations and Certification Process

- Registration for the certification Examination will be done on receipt of the filled up application form along with requisite fees from the candidates
• Registration No. will be allotted on scrutiny of application form and the same will be intimated through Acknowledgement Card.
• Course Books will be dispatched by post or courier to all the registered candidates.
• Hall Tickets will be issued to the candidates one month before the commencement of the examination.
• The results of the written examination will be communicated to all the candidates.
• Intimation letters for Viva-voce examination will be sent separately for the successful candidates of the Energy auditor written examination.
• Certificates and credentials will be awarded to the successfully passed eligible candidates.

16. Role of NPC as The National Certifying Agency

The Bureau of Energy Efficiency has retained the National Productivity Council (NPC) as the National Certifying Agency, which would conduct the National Level Certification Examination for Energy Managers & Energy Auditors.

NPC will carry out the following activities as a National Certifying Agency:-

1) A Board of Examinations will be constituted for the overall supervision and administration of the conduct of the Certifying Examinations for the Certification of Energy Auditors and Energy Managers.

2) Dr. Ambedkar Institute of Productivity (AIP), Chennai, the Training Institute of NPC, will carry out all the activities for the conduct of the Certifying Examinations. A team of Officers and Staff will be located at Chennai and the Examinations will be administered and coordinated from Chennai. The Director (AIP) will be the Controller of Examination.

3) NPC will receive and process the applications from the candidates and register them as per the laid down procedures.

4) NPC will send all necessary instructions in respect of the Certifying Examination and other details such as the Venue of examination, timings, code of conduct for the candidates who are registered for the examination for Energy Managers as well as Energy Auditors.

5) NPC will administer the examination in all the centers.

6) NPC would issue the Certificates and Credentials under the seal of Bureau of Energy Efficiency, a statutory body under Ministry of Power, Government of India to the successfully passed eligible candidates.

1. Aluminium  
2. Fertilizers  
3. Iron and Steel  
4. Cement  
5. Pulp and paper  
6. Chlor Akali  
7. Sugar  
8. Textile  
9. Chemicals  
10. Railways  
11. Port Trust  
12. Transport Sector (industries and services)  
13. Petrochemicals, Gas Crackers, Naphtha Crackers and Petroleum Refineries  
14. Thermal Power Stations, hydel power stations, electricity transmission companies and distribution companies  
15. Commercial buildings or establishment  

18. Instructions to the Candidates

1. Read the prospectus and application form completely.
2. All entries should be neatly filled. Please tick (√) at the appropriate boxes.
3. Attach proof of date of birth.
4. Attach proof of work experience certificate as per the eligibility criteria.
5. Attach a Photostat copy of Degree/Diploma certificate as per the eligibility criteria.
6. Affix self-attested recent passport size photograph in application form and hall ticket in duplicate.
7. Enclose Demand draft towards examination fee in favor of Bureau of Energy Efficiency payable at Chennai.
8. Self-sponsored candidates (individual in the category of SC/ST/OBC & having annual income not more than Rs. 1.0 Lakh/annum) will be required to submit the attested copies of the necessary supporting documents.
9. Filled application form along with requisite fee should reach on or before 30th September 2003 to:

   Director  
   Dr. Ambedkar Institute of Productivity  
   National Productivity Council  
   6, SIDCO Industrial Estate, Ambattur,  
   Chennai – 600 098  

   Fax No. 044 – 26254904  
   Tel No. 044 – 26251808/26255216
Email: aipnpc@vsnl.com

**Note:** All correspondence related with Certification Examination should be made on this address only.

10. Course book prepared based on the syllabus will be sent to all the registered candidates for either Energy Managers or Energy Auditors examination.
11. Use the course book for the Preparation of examination
12. The candidates can also undergo training organized by the competent agencies, if needed. However, it is totally optional and not binding on the part of candidate to undergo training before appearing in the examination.
12 Last date for getting the application: **30th September 2003**
13. Last date for submitting the filled in application: **30th September 2003**
14. For more details visit website [wwwnpcindia.org](http://wwwnpcindia.org); [www.bee-india.com](http://www.bee-india.com), [www.energymanagertraining.com](http://www.energymanagertraining.com), and [www.em-ea.org](http://www.em-ea.org)
Annexure-I: Syllabus for Energy Managers and Energy Auditors Certification Examination

Paper-1: General Aspects of Energy Management and Energy Audit

1.1 **Energy Scenario**: Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

1.2 **Basics of Energy and its various forms**: Electricity basics- DC & AC currents, electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

1.3 **Energy Management & Audit**: Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.

1.4 **Material and Energy balance**: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

1.5 **Energy Action Planning**: Key elements, force field analysis, Energy policy purpose, perspective, contents, formulation, ratification, Organizing — location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability. Motivating—motivation of employees: Information system-designing barriers, strategies; Marketing and communicating-training and planning.

1.6 **Financial Management**: Investment-need, appraisal and criteria, financial analysis techniques-simple pay back period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of ESCOs.

1.7 **Project Management**: Definition and scope of project, technical design, financing, contracting, implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification.

1.8 **Energy Monitoring and Targeting**: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques -energy consumption, production, cumulative sum of differences (CUSUM).

1.9 **Global environmental concerns**: United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon fund (PCF).
Paper 2: ENERGY EFFICIENCY IN THERMAL UTILITIES

2.1 Boilers: Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities.

2.2 Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings.

2.3 Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.

2.4 Insulation and Refractories: Insulation-types and application, economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss.

2.5 FBC boilers: Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, retrofitting FBC system to conventional boilers, saving potential.

2.6 Cogeneration: Definition, need, application, advantages, classification, saving potentials.

2.7 Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential.

Paper 3: ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

3.1 Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses.

3.2 Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

3.3 Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities

3.4 HVAC and Refrigeration System: Vapor compression refrigeration cycle, refrigerants, coefficient of performance, capacity, factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system, saving potential

3.5 Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.
3.6 **Pumps and Pumping System**: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

3.7 **Cooling Tower**: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities assessment of cooling towers.

3.8 **Lighting System**: Light source, choice of lighting, luminance requirements, and energy conservation avenues.

3.9 **Diesel Generating system**: Factors affecting selection, energy performance assessment of diesel conservation avenues.

3.10 **Energy Efficient Technologies in Electrical Systems**: Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

**Paper-4: ENERGY PERFORMANCE ASSESSMENT FOR EQUIPMENT AND UTILITY SYSTEMS**

Open Book examination on the following energy performance assessments for equipment and utility systems:

4.1 Boilers, Furnaces
4.2 Cogeneration, Turbines (gas, steam),
4.3 Heat Exchangers,
4.4 Electric Motors, Variable Speed Drives,
4.5 Fans and Blowers, Water Pumps, Compressors,
4.6 HVAC systems
4.7 Lighting Systems,
4.8 Performing Financial Analysis.
4.9 Applications of Non-conventional & Renewable Energy Sources (NRES)
4.10 Waste minimization and resource conservation
The National Productivity Council is a national level organization, founded in 1958 by the Government of India. NPC is an autonomous, tri-partite, non-profit organization with equal representation from the government, employers and workers’ organizations, apart from technical and professional institutions and other interests on its governing council. Besides its headquarters at New Delhi, NPC operates through 12 offices in India with 250 Full Time, highly qualified and experienced specialists representing various disciplines.

Training Institute: Dr. Ambedkar Institute of Productivity (AIP) is a long term training wing of the National Productivity Council of India. The Institute plays a wider role of running 2 years P.G Programmes and Short-term programmes in Managerial & Technical areas.

Mission: Development, Dissemination and Application of knowledge and experience in productivity, for promoting consciousness and improvement in productivity, with the objective of strengthening the performance and competitiveness of the national economy as well as of improving the working conditions and quality of working life.

Objectives: NPC is aiming to promote the cause of productivity in industry, agriculture, service, infrastructure and other sectors of the economy. It aims to help in achieving sustained all round development in India, leading to enhancement of quality of life of people in general. The concept of productivity as perceived by NPC encompasses not only a more efficient use of resources, but also of quality, environmental protection and integrated economic and social development. NPC aims at promoting these as a part of its objectives and activities. NPC posses a well-equipped Library-cum-Documentation centre.

Services: Besides providing training, consultancy and undertaking research in the area of productivity, NPC also implements the productivity promotion plans and programmes of the Tokyo based Asian Productivity Organization (APO) an inter-governmental body of which the Government of India is a founder member.


NPC aims at propagating productivity as an evolving concept, which includes attention to special issues, and concerns relating to quality, environment, energy, integrated rural and community development, women workers etc. NPC’s thrust is on providing modern and high quality productivity-related services to sectors not adequately addressed by others, especially the small-scale industry and informal sector.

NPC has been active in the area of Energy Conservation & Management for over three decades and has undertaken numerous studies at macro, sectoral and unit levels through its team of committed professionals. It promotes rational use of energy through: Optimization of Methods Improvement, Technology Up gradation and Application of alternative energy sources.
Under the provisions of the Act, Bureau of Energy Efficiency has been established with effect from 1st March 2002. The Bureau would be responsible for spearheading the improvement of energy efficiency of the economy through various regulatory and promotional instruments. The mission of Bureau of Energy Efficiency (BEE) is to institutionalize energy efficiency services, promote energy efficiency delivery mechanisms, and provide leadership to improvement of energy efficiency in all sectors of the economy.

The Primary objective of BEE is to reduce energy intensity in the Indian economy. The broad objectives are:

- to provide policy framework and direction to national energy efficiency and conservation efforts and programmes
- to coordinate policies and programmes on efficient use of energy and its conservation with the involvement of stakeholders
- to establish systems and procedures to measure, monitor and verify energy efficiency results in individual sectors as well as at national level,
- to leverage multi-lateral, bi-lateral and private sector support in implementation of the Energy Conservation Act and programmes for efficient use of energy.
- to demonstrate energy efficiency delivery mechanisms through private-public partnerships,
- to plan, manage and implement energy conservation programmes as envisaged in the Energy Conservation Act.

A Director-General heads Bureau of Energy Efficiency. Union Minister of Power heads the Governing Council and it consists of Secretaries of various line Ministries, heads of various technical agencies under the Ministries, members representing industry, equipment and appliance manufacturers, architects, and consumers, and members from each of the five power regions representing the states of the region.

**BEE would initially focus on the following ten thrust areas:**

1. Indian Industry Programme for Energy Conservation: Sharing of best practices and conduct of energy audit among the notified designated consumers by accredited energy auditors.
2. Demand Side Management
3. Standards and Labeling Programme for notified equipment and appliances
4. Energy Efficiency in Buildings and Establishments
5. Energy Conservation Building Codes
6. Professional Certification and Accreditation
7. Manuals and Codes
9. School Education
10. Delivery Mechanisms for Energy Efficiency Services