ORISSA ELECTRICITY REGULATORY COMMISSION
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Ref. No.: Dated : 3rd December, 2008

Sir/Madam,

Sub : Quotation for Consultancy Service on Development of Renewable Energy Policy in the State of Orissa and Determination of Tariff for Renewable Sources of Energy including Co-generation.

1. Orissa Electricity Regulatory Commission proposes to appoint a consultant on the aforementioned subject. The Terms of Reference (TOR) of the proposed studies including format of application are **enclosed**.
2. Techno Commercial offers are invited for above work from reputed Consultants. Two separate sealed bids clearly marked as **"Technical"** and **"Financial"** are required to be submitted which may be placed in one outer envelop clearly mentioning in bold letters on top of the envelope **"Quotation for consultancy on Renewable Energy.". The bids may be addressed to Secretary, OERC, Bidyut Niyamak Bhavan, Unit-VIII, Bhubaneswar- 751012** so as to reach by 1500 hours on 10th December, 2008. **"Technical"** bids will be opened by OERC on 15th December, 2008 at 1545 hours for preparing the list of bidders. Bidders may send their authorized representative to note the name and number of bidders.
3. It may kindly be noted that the proposal would be evaluated by the OERC. Selection of the Consultant will be based on two-stage-evaluation process. In the first stage, "**Technical"** evaluation will be done based on the parameters as mentioned in the Terms of Reference (TOR). The **"Financial"** bids of only those bidders who qualify in **"Technical"** evaluation will be opened for final evaluation.

Yours faithfully,

Encl: As stated.

Sd/-
Secretary I/c

TERMS OF REFERENCE (TOR)

Consultancy for Developing Renewable Energy Policy in the State of Orissa and Determination of Tariff for Renewable Sources of Energy including Co-generation

1.0 Introduction and Objective:

The Electricity Act, 2003 has addressed Tariff related issues for the Renewable Sources for Energy under following provisions.

Section 61: The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely:-

– *(h) the promotion of co-generation and generation of electricity from renewable sources of energy;*

Section 86(1): The State Commission shall discharge the following functions, namely:

– *(e) promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee;*

National Electricity Policy (NEP) issued by Ministry of Power has also issued guidelines towards harnessing of power from co-generation and non-conventional sources of energy in the following manner:-

5.12.1 Non-conventional sources of energy being the most environment friendly there is an urgent need to promote generation of electricity based on such sources of energy. For this purpose, efforts need to be made to reduce the capital cost of projects based on non-conventional and renewable sources of energy. Cost of energy can also be reduced by promoting competition within such projects. At the same time, adequate promotional measures would also have to be taken for development of technologies and a sustained growth of these sources.

5.12.2 The Electricity Act 2003 provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by providing suitable measures for connectivity with grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. Such percentage for purchase of power from non-conventional sources should be made applicable for the tariffs to be determined by the SERCs at the earliest. Progressively the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the

Commission may determine an appropriate differential in prices to promote these technologies.

5.12.3 Industries in which both process heat and electricity are needed are well suited for cogeneration of electricity. A significant potential for cogeneration exists in the country, particularly in the sugar industry. SERCs may promote arrangements between the co-generator and the concerned distribution licensee for purchase of surplus power from such plants. Cogeneration system also needs to be encouraged in the overall interest of energy efficiency and also grid stability.

National Tariff Policy provides guidelines for procurement of power from non-conventional Energy Sources and Tariff related issues under following provisions:

Clause 6.4 of NTP States:

(1) Pursuant to provisions of section 86(1)(e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentage for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by April 1, 2006.

It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at ***preferential tariffs*** *determined by the Appropriate Commission.*

In exercise of the power conferred under subsection (3) of the Section 81 of the Electricity Act, 2003, Commission issued a Consultative paper on Harnessing of Power from Renewable Energy Sources including Co-generation from all the stakeholders and general public at large. Commission in response to such a paper have received response and inputs from various stakeholders and conducted hearing on such proceedings.

In accordance to the provisions of the Electricity Act, 2003 and guidelines assumed under National Electricity Policy and National Tariff Policy Commission desires to formulate a policy on Renewable Energy/Co-generation for the State of Orissa and determination of tariff for various Renewable Energy Technology like SHP, Wind, Solar, Co-generation and Bio-mass.

2.0 Scope of work:

The OERC consultative paper, issued earlier (Annexure-III), outlines the policies and approaches followed by other Electricity Regulatory Commissions for development of Renewable Energy. Commission in order to notify a policy on Renewable Energy requires an agency to work on following aspects.

– To develop a methodology to ascertain appropriate power mix of renewable and non-renewable under Renewable Purchase Obligation (RPO) in line with Electricity Act, 2003, National Electricity Policy and National Tariff Policy.

- To study and confirm potential of power generation capacities of various RE /Co-generation power projects within State of Orissa in co-ordination with State Renewable agency, OREDA.
- To analyze proportionate consumption from each Renewable energy source out of the total consumption from these resources.
- To study appropriate policy for grid connectivity form various RE sources including national and international standard practices.
- To study and fix operating and financial parameters for different RE technologies and to work out the reasonable cost per MW in respect of wind, solar, Biomass and Co-generation utilizing different technology.
- Tariff determination issues such as suitability of price cap fixation or case to case determination of Renewable Energy sources including Co-generation.
- To study various incentives available for grid connected renewable power projects under guidelines of Ministry of Renewable Energy, Govt. of India and recommend incentive structure for harnessing Renewable Energy Sources and Co-generation.
- The consultant team are required to make field visits inside Orissa as necessary to carry out the study within the scope of work.

3.0 Deliverables and Duration of Assignment:

The following are the deliverables:

a) The study shall be completed within a period of 6 months from the date of award of consultancy;

b) The consultant will be required to submit
   - Draft Report at the end of three months from the date of commencement of the assignment.
   - Final Report at the end of six months from the date of commencement of the assignment, after incorporating the views and comments of the Commission.
   - Periodic presentations on status of assignment and key findings at the end of each month.

4.0 Qualification Criteria:

The Consultant should have in-depth knowledge and adequate experience of consultancy in development of Renewable Energy in India, support policies for renewable projects, incentives, tariff determination of various renewable sources and Regulatory frame work. The Consultant should submit documentary evidence of having handled similar assignments and contracts, if any.

5.0 **Application and Evaluation Criteria:**

5.1 The format of application is at Annexure-I and Annexure-II

5.2 The Consultant is required **to submit separate bids for Technical and Financial Offers, duly sealed in separate envelopes**.

5.3 **Technical** component will carry 70% weightage and **Financial** component 30% weightage.

- Within the Technical component, weights will be assigned in the following manner for different technical parameters :-

Technical Parameters	Weights
The Consultants relevant experience in the field of Renewable Energy	0.5
The qualifications and experience of the key staff proposed	0.3
The quality of the plan and methodology proposed	0.2

- **Weight for Financial parameters:-** Proposal with the lowest cost will be given a financial score of 100 and other proposals given financial scores that are inversely proportional to their prices.
- **The total score will be obtained by weighting the Technical and Financial scores and adding them.**

/ ANNEXURE – I /

DETAILED PROPOSAL FOR STUDY

(TECHNICAL)

The proposal along with project summary to be submitted to Secretary, OERC.

I. GENERAL INFORMATION:

01. Title of the Proposed Study:

02. Name and address of the Organization/: Institution

03. Name & Designation of the Key Person:

04. Contact address of the Key Person: (e-mail/fax/telephone)

05. Net-worth/Turnover of the Organization/: Institution

II. TECHNICAL SPECIFICATIONS:

06. i. Department(s) of the organization/Institution(s) where the study will be carried out

ii. Other department(s), if any, which will collaborate in this study

07. Brief review of the state-of-art technology in the field (National and International)

08. Detailed Approach & Methodology for undertaking the assignment

09. Facilities available for the proposed work in the applicant's organization/ institution

10. Previous experience of the proposer in this or related field

11. Biographical sketch of the Consultancy Team

(i) Name

(ii) Designation

(iii) Date of Birth

(iv) Education and Experience

(a) Academic Qualifications

Degree	University	Field(s)	Year

(b) Experience

Institution	Topic of work done	Period

(v) Field of major interest

(vi) Additional information (if any)

12. Capacity to impart training/transfer of knowledge

/ ANNEXURE – II /

DETAILED PROPOSAL FOR STUDY

(FINANCIAL)

I. GENERAL INFORMATION:

01. Title of the Proposed Study:

02. Name and address of the Organization/: Institution

03. Name & Designation of the Key Person:

04. Contact address of the Key Person: (e-mail/fax/telephone)

05. Net-worth/Turnover of the Organization/: Institution

06. Certificate of authorization in case of Institutes/other organizations (Format enclosed at **Appendix-'A'**).

II. FINANCIAL SUPPORT:

07. Amount proposed for :

Sl No.	Activity(Refer Scope of Work in TOR)	Duration (In weeks)	Cost (in Rs.)
			Total

Note: Statutory fees or taxes, if any, to be specified in the offer.

(RUPEES _____)

Signature of the Head of the Consultancy Team

/ Appendix-'A' /

CERTIFICATE

The undersigned agree to abide by the conditions of the grants and certify that available facilities for proposed work shall be extended to the investigator/study team.

Signature of Executive Authority of the Organization

Name and Designation
Date

Signature of the Head of Consultancy Team

Name and Designation
Date

Signature of Co-consultant
Name and Designation
Date

Official stamp of Organization/Institution

/ ANNEXURE – III /

ORISSA ELECTRICITY REGULATORY COMMISSION
BIDYUT NIYAMAK BHAWAN,
UNIT – VIII, BHUBANESWAR – 751 012

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Draft Consultative Paper on Harnessing of Power from Renewable Energy Sources including co-generation

1. Introduction:

All sources of energy that of use in our everyday life are divided into two categories i.e. Conventional & Non-conventional Sources of Energy or Non-Renewable Energy and Renewable Energy.

(a) The Conventional or Non-Renewable Energy Sources include the fossil-fuels viz oil, Natural Gas, Coal etc.

(b) Non-conventional and Renewable Energy Sources include Solar Energy, Wind Energy, Geothermal, Tidal Energy, Hydroelectric, Fuel Cells, Bio fuels etc.

The Power sector of India is currently in the process of a major change. From an installed capacity of 1362 MW at the time of independence, the installed capacity as on 31.03.2007 and 29.02.2008 are 1,32,329.91 MW & 1,42,194.84 MW respectively. The mix of India's installed capacity as on 31.03.2007 & 29.02.2008 are given in the Table-1 below:

Table-1

Total Installed Capacity of India

	As on 31.03.2007		As on 29.02.2008	
Fuel	**MW**	**%**	**MW**	**%**
Total Thermal	86,014.84	65.00	91,145.84	64.10
Coal	71,121.38	53.74	75,252.38	52.92
Gas	13,691.71	10.34	14,691.71	10.33
Oil	1,201.75	0.92	1,201.75	0.85
Hydro	34,653.77	26.20	35,378.76	24.88

Nuclear	3,900.00	2.94	4,120.00	2.92
Renewable	7,760.00	5.86	11,550.00	8.10
Total	**1,32,329.21**	**100.00**	**1,42,194.84**	**100**

Source – MOP

The actual Power Supply Position for the FY 2006-07 and the Power Supply Position during March, 2007 and January, 2008 are shown in Table-2 below:

Table-2

Actual Power Supply Position for FY 2006-07 and for the months of

March 2007, January, 2008, March, 2008 & FY 2007-08

Period	Item	Requirement	Availability	Deficit
April 2006 to March, 2007	Energy	690,587 MU	624,495 MU	(-) 66092 MU (-) 9.6%
March, 2007	Peak Demand	100,715 MW	86,818 MW	(-1) 13,897 MW (-) 13.8%
March, 2007	Energy	61,564 MU	55,184 MU	(-) 6380 MU (-) 10.4%
Jan, 2008	Peak Demand	1,08,106 MW	89,620MW	(-) 18,486 MW (-) 17.1%
Jan, 2008	Energy	69,187 MU	60,331 MU	(-) 8856 MU (-) 12.8%
April 2007 to March 2008	Energy	737,052 MU	664,660 MU	(-) 72,392 MU (-) 9.8%
March, 2008	Energy	63,867 MU	56,180 MU	(-) 7687 MU (-) 12%

Source - CEA

The Original Capacity addition envisaged in X^{th} Plan (2002-2007) was 41,110 MW, but actual addition during X^{th} Plan was 21,280 MW which is about 52% of the original target. Similarly as against capacity addition of 17000 MW during 2007-08 (1^{st} Year of XI Plan), the capacity addition was only 9263 MW which is about 54.50%. Due to this slippage in capacity addition, the Energy shortage has gone upto 12.8% and peak shortage upto 17.1% during January, 2008 as per report complied by CEA.

In order to stick to the objective of "POWER ON DEMAND" in 2012 under "MISSION – 2012" Programme as well as to effect power supply to 100% households by 2012 under RGGVY and to sustain a GDP growth @ 8% per annum, the Working Group on Power

constituted by MOP Power as well as CEA has finalized the following likely capacity addition from conventional sources during 11th and 12th Plan as shown in Table –3 below:

Table-3
Likely Capacity Addition During XI AND XII Plan

(All in MW)

Plan	Hydro	Thermal	Nuclear	Total
XI	16553	58644	3300	78577
XII	30,000	40,200	12000	82200

Source – CEA

12th Plan and Beyond

Based on estimated GDP growth @ 8% and @ 9%, MOP under "VISION – 2032" has projected as under:-

Table -4
MOP projections till 2031-32

Year	Billion kWh		Installed Capacity (GW)	
	8%	9%	8%	9%
2006-07	700	700	140	140
2011-12	1029	1077	206	215
2016-17	1511	1657	303	331
2021-22	2221	2550	445	510
2026-27	3263	3923	655	785
2031-32	4793	6036	962	1207

Source: MOP

Installed Capacity of Orissa

The mix of Orissa's installed capacity as on 29.02.2008 is given in Table-5 below:

Table – 5
Installed Capacity of Orissa as on 29.02.2008

(All in MW)

Sectoral Contribution	Thermal	Hydro	Renewable	Total
State	880.00	1992.23	7.30	2879.53
Private	0	0	0	0
Central	928.08	35.67	0	963.75
Total	**1808.08**	**2028.60**	**7.30**	**3843.98**

Source : MOP

Growth of Renewable Energy

Renewable Energy started its jouney during 7th Plan period but there was major thrust during 10th and 11th Plan as shown in Table-6 below:

Table - 6

Plan/year	Renewable Energy (MW)	Total Installed Capacity (MW)	Percentage of Total Installed capacity
End of 6th Plan (31.03.85)	0.00	42584.72	0.000
End of 7th Plan (31.03.90)	18.14	63636.34	0.028
End of 2 Annual Plans (31.03.92)	31.88	69065.19	0.046
End of 8th Plan (31.03.97)	902.01	85795.37	1.05
End of 9th Plan (31.03.2002)	1628.39	105045.96	1.55
March, 2003	1628.39	107877.37	1.56
March, 2004	2488.13	112683.50	2.21
March, 2005	3811.01	118425.70	3.22
March, 2006	6190.86	124287.17	4.98
End of 10th Plan (31.03.2007)	7760.60	132329.21	5.86
February, 2008	11,550	1,42,194.84	8.10

Ministry of New and Renewable Energy (MNRE) has formulated the tentative target for Grid interactive Renewable Power as shown in Table–7 below so as to reach 10% of total installed Capacity i.e. about 24,000 MW by the end of XI Plan.

Table -7

(In MW)

Renewable Sources	Target for XI Plan	Cumulative Achievement expected by end of XI Plan
Wind Power	10,500	17,592
Biomass Power (Bagassee, Cogeneration & Biomass Gasifier)	2,100	3,284
Small Hydro (Unit 25 MW)	1,400	3,376
Total	**14,000**	**24,252**

Source: MNRE

The country has significant potential for generation of power from Non-Conventional Energy Sources such as Wind, Small Hydro, Bio-mass and Solar Energy. The total estimated medium-term potential (2032) for power generation from Renewable Energy Sources as estimated by MNRE viz. Wind, Small Hydro, Solar, Waste to energy and

biomass etc in the country is about 1,83,000 MW. The details are given in Table- 8 below:

Table – 8
MNRE Projections till 2031-32

(Figure in MW)

Sources	Estimated Potential
Wind Power	45,000
Bio-Power (Agro Residues & Plantations)	61,000
Co-generation Baggasse	5,000
Small Hydro (up to 25 MW)	15,000
Waste to Energy	7,000
Solar Photovoltaic	50,000
Total	**1,83,000**

Source: MNRE

2. Impact Assessment of Alternative Sources of Energy

The National Electricity Policy envisages "Power for all by 2012" and per capita availability of power to be increased to over 1000 units by 2011-12. To achieve this, a total capacity addition of about 100000 MW is required during 10^{th} and 11^{th} Plan period. To meet the energy generation requirement of 1029 MU and a peak load of 152746 MW with diversity and 5% spinning reserve, a capacity of 83000 MW is required during 11^{th} Plan. Meeting the additional requirement of 83000 MW would entail taking advantage of all economically viable sources of energy and working out a suitable strategy of energy mix with a view to gain the optimum advantage. The mix of India's current installed capacity of 142195 MW of power is approximately 64% Thermal, 25% Hydro, 8% Renewable and 3% Nuclear.

At the global level 86% of primary energy comes from fossil fuel i.e. mineral fuel. Burning of this fossil fuels produce energy as well as carbon dioxide and other gases harmful for the humanity. Energy from Non-fossil fuels is around 6.3%, nuclear another 6% and only 0.9% is estimated to come from geothermal, solar and wind etc. Burning of the fossil fuel generates 603 billion metric tones of carbon dioxide alone in addition to producing sulpher dioxide, nitrous-oxide etc. Conventional fuel burning leads to acid rain and has the effect of global warming. Only half of the harmful gases get absorbed in the

atmosphere. Balance results in global warming which can lead to a rise of average temperature.

Besides above, the natural resources like coal, oil and gas have got limited reserve and they cannot sustain the supply of energy for all time to come. Time has come for preventing or controlling depletion of the natural resources. From Finance front, India has to face the problem due to import of coal and oil which may affect country's foreign exchange reserve. Today also we need to electrify around one lakh twenty five thousand villages of the country many of them are located in hilly and intractable areas sparsely populated for which grid extension does not appear to be a cost effective means of power supply.

Keeping this in view, the Electricity Act, 2003 have a provision of distributed generation to cater to local needs, does not require much investment in distribution network and has mandated that the Electricity Regulatory Commissions shall encourage development of renewable sources of energy including cogeneration.

Hence, there is an urgent need to resort to more environmentally sound and less hazardous technologies to counter the menace of environmental pollution. The projected increase in population coupled with rapid industrialization of the next two decades will result in a significant rise in the consumption of energy and, if not addressed, the production of harmful emissions cannot be avoided. Thus, a shift is required towards environmentally benign energy resources that can fuel the developmental process without adding to the harmful emissions not only at the global level but also at local and regional levels.

In this backdrop the role of new and renewable energy assumes added significance, irrespective of whether it replaces coal or oil. In this regard, Integrated Energy Policy (IEP) recognizes *'the need to maximally develop domestic supply options as well as the need to diversify energy sources ...'* although renewable are likely to account for only around 5-6 per cent of the primary commercial energy-mix by 2032. It is an imperative of the development process that this energy in the longer term will substantially increase its share in the fuel-mix.

Continuing to support the growth of new and renewable energy is in the country's long-term interest. Although, the development process may warrant selection of least-cost energy options, strategic and environmental concerns may, on the other hand, demand a greater share for new and renewable energy even though in the medium-term this option might appear somewhat costlier. Thus, a polity of balanced approach for new and renewable energy to develop domestic and inexhaustible sources of energy has to be adopted.

Alternate Energy Sources:

Our ancients value nature and they worship the God of light, wind and water which fortunately could be harnessed to give us our requirement of energy and yet could have much less damaging impact on our environment. Here are some possible alternatives:

- Solar Energy
- Wind Power
- Geothermal
- Tidal Power
- Small Hydro (upto 25 MW)
- Fuel Cells
- Bio Fuels

Solar Power:

Sun is referred in our prayers as SARBATEJOMAYA DEBAA, or the source of energy for survival of plant and life on earth. We use sunlight through photovoltaic mechanism to convert sunlight to electricity or utilize the photovoltaic effect to heat a fluid for steam generation for running a generator. Solar collectors normally utilize the process of continuous electroplating of black chrome over nickel substrate on copper sheet.

As for solar PV, the global market is expanding at a fast clip, at 30% per annum albeit from a rather small base. The rapid expansion means constantly rising economies of scale, which in turn is smartly pushing down prices by an average of 5% each year. Given that PV technology generates electricity from light, it's 'green' and environment-friendly. Note that PV panels have at least two layers of

semiconductors: one that is positively charged and one that is 'negative.' When light shines on the semiconductor, the electric field across the junction between these two layers causes electricity, (read electrons), to flow — the greater the intensity of the light, the greater the flow of electricity.

Besides, as it was revealed at the inaugural World Future Energy Summit (WFES) in Abu Dhabi in January, 2008, path-breaking technical change is underway in chip making. Referring to scribbled notes, one is reminded of the recent discovery that solid silica can be directly transformed into pure silicon by electrolysis in a molten salt bath, apparently at a "fairly mild" temperature. It could considerably reduce the cost of producing silicon of the purity required for solar PV modules. In parallel, various "thin-film" technologies under development promise to further reduce the production costs of solar cells, by using up to 99% less silicon than wafer-based solar panels. No wonder the mavens gathered at the WFES did talk of "grid-parity" within five years. By that time, experts perceive, solar power would be quite comparable with the price of conventional power from the electricity grid.

Another promising field is solar power via inexpensive plastics. The use of "conductive polymers" may well lead to the development of far cheaper solar cells based on economical plastic panels, instead of semiconductor-grade silicon. Also, "fluorescent concentrators" can absorb sunlight over a large range of wavelengths and focus it on a single wavelength. The technique can be used to hike the amount of radiation available for transformation by PV cells. The fact remains though that solar power accounts for a minuscule part of total power generation. But the potential is simply massive. One got some inkling of it at the WFES. It is estimated, for instance, that solar PV generated power could provide 10,000 times more energy than the world currently uses. Further, given rising costs of energy and fossil fuels, and the added risks associated with green-house gas emissions and global warming, the prospects for solar power seem bright indeed. Which is why domestic corporates appear bullish on semiconductor units, PV cells and production of polysilicon.

But while the supply situation in silicon chips and the like does look sanguine, what seems lacking is holistic policy to rev up demand. For example, there appears no attempt to integrate housing with PV technology. Yet solar products built into tiles and roofing could save the exchequer tens of thousands of crore each year in misspent subsidies on kerosene and rural power supply. Also needed are attractive mortgage and borrowing options for the purchase and installation of solar PV panels. On the face of it, building-integrated PV modules would be thoroughly cost-effective and save on conventional products like roofing and canopy, which they would replace during construction.

There's solid investment on the anvil in semiconductors and silicon chips, or so it seems. Reports say that a clutch of corporates has drawn up long-term business plans — that add up to Rs 65,000 crore — to foray into the frontier, high-tech areas. Tandem, solar photovoltaics (PV), which are really semi-conducting material, appear poised for a capital boost. It suggests notable response to the recent semiconductor policy, which has built-in investment incentives. Also, the economics of chip manufacture looks set for an overhaul, with substantial reductions in costs likely. But to fast-forward the panoply of favourable effects, what's required are proactive measures, particularly on the demand side.

The total installed capacity for solar module manufacturing in India is currently around 75 MW. However, this capacity is underutilized; the average annual production of solar cells is only about 25 MW and that of modules about 40 MW. There are eight companies producing solar cells, 14 companies producing and several others that only assemble systems and components. Tata BP Solar, which has a module manufacturing capacity of 45 MW per annum, has announced an investment of $ 100 million for augmenting its capacity to 300 MW over several years, which will make it one of the largest global module manufacturers. Some of the established players in this segment are Central Electronics limited, Bharat Electronics Limited, Rajasthan Electronics and Instruments Limited, Udhaya Semiconductors, Maharishi Solar, Webel SL Energy System and Moser Baer.

Webel SL Energy Systems

A leading producer of solar photovoltaic cells and modules, Webel SL Energy' solar-based equipment manufacturing capacity is expected to rise from 10 MW to 42 MW by FY 08 and to 102 MW by FY 10. With this expansion, the management is targeting revenues of Rs 1,300 crore, as against revenues of Rs 107 crore in FY07. However, analysts conservatively estimate the company to clock revenues of Rs 625-650 crore by FY10. At present, Webel generates over 90 per cent of its revenue by exporting to markets like the US, Europe, Africa and Australia hence, it may get marginally impacted due to the weak dollar. The global solar industry is witnessing strong demand from countries like the US, Germany and Japan on account of high oil prices, government subsidies and environmental issues. On the back of this demand, players like Webel are expected to maintain a 30 per cent growth over the next five years. For Webel, its share price has tanked to Rs 241 after touching a 52-week high of Rs 846 in January 2008. At the current price, the stock trades at 17 and 11 times its estimated earnings for FY08 and FY09, respectively, and can deliver decent returns.

Moser Baer

Among key emerging players in the solar power space is optical storage disk maker Moser Baer. The company has forayed into manufacturing of solar photovoltaic (PV) cells in a big way, through its 100 per cent subsidiary (Moser Baer Photo Voltaic-MBPV). MBPV is investing about $1.5 billion to increase its photovoltaic cell manufacturing capacity to 600 mw by 2010, as against its current capacity of 40 mw. On April 3, this subsidiary signed a 10-year agreement with China-based, LDK Solar, for purchase of high-quality, multi-crystalline silicon wafers (used to produce PV cells) capable of generating 640 MW of solar power. This agreement will ensure reliable supply of raw materials to MBPV. In order to strengthen its roots in the business, MBPV will also be investing in R&D. Lastly, in November 2007, the company signed an agreement with the Rajasthan Government to set up a solar power generation facility in the state with a total

capacity of 5 MW, estimated at a cost of Rs 100 crore. In totality, while the solar-power business is relatively small in size as compared with Moser Baer itself, it has the potential to become bigger than its parent.

Solar Power – MOCVD technology

Another cryptic acronym. Would it help to explain that it stands for Metal Organic Chemical Vapor Deposition? No?

It's not all that bad, really: MOCVD is a super-efficient new solar energy technology owned by Veeco Instruments. Just recently, their system achieved a solar cell conversion efficiency of 40.7 percent. That's a quantum leap – potentially pushing the cost of solar power down to less that 10 cents per kilowatt hour. That would make solar an economical – and entirely renewable – rival for conventional power.

There's more to the equation than end-user cost. Installation is a big consideration when solar power is involved. Vecco estimates the MOCVD system could be priced out at about $3 per watt. But other companies are already trying to undercut that figure.

A Swiss start-up called Flisom is working on solar film: flexible, thin, and easy to tack to almost any surface exposed to the sun. Flisom thinks this concept will fix installation costs below a dollar a watt within five years, and down to 50 cents in a decade.

Solar power is clearly a growth sector. French-based Credit Lyonnais estimates it will represent a $40 billion dollar market by the time 2010 rolls around. So there's plenty of financial incentive for tomorrow's would be sun barons.

Reliance moots solar power unit in Orissa - Power generated to be connected with GRIDCO

The Mukesh Ambani-led Reliance Industries Limited has come forward to set up a five MW solar energy unit in Orissa's Khurda district. The project would involve an investment of around Rs. 100 crore, official sources said here recently.

Representatives of the company recently met chief secretary Ajit Tripathy and other senior State Government functionaries and discussed their plans to established a solar photovoltaic power plant in the State, sources said.

The proposal comes in the aftermath of the Central Government's decision to provide subsidy of Rs. 12 per unit of electricity generated through solar projects. The Centre's incentive is aimed at promoting unconventional and renewable sources of power and also clean electricity.

Energy secretary Suresh Mohapatra told TOI that power generated from the proposed project would be connected with the Sate grid through 11 KV and 33 KV lines and RIL shall have to sell the power to State-owned GRIDCO, the sole bulk supplier in Orissa. "The rates will be fixed by the Orissa Electricity Regulatory Commission," he said.

Officials said the Government has already begun scouting for land in Khurda district and is looking for a 30 acre patch for the project.

"Going by the proposal, the project would see construction of multi-storied solar panels," an official said, adding, "Work on the project is expected to commence during 2008-09 and take six months to complete. The company has proposed to use latest technology for the project."

RIL, sources said, is planning to establish similar projects in other states like West Bengal and Haryana, as solar power units seem economically viable following the Union Government's subsidy.

"Generation of solar power costs around Rs. 15 per unit, which was not financially viable as electricity generation through conventional sources like thermal and hydel is comparatively inexpensive. But following the Centre's decision to give Rs. 12 subsidy per unit, solar energy projects appear viable," a source added.

Wind Power:

Wind power is another alternative energy source that could be used without producing by-products that are harmful to nature. Like solar power, harnessing the wind is highly dependent upon weather and location.

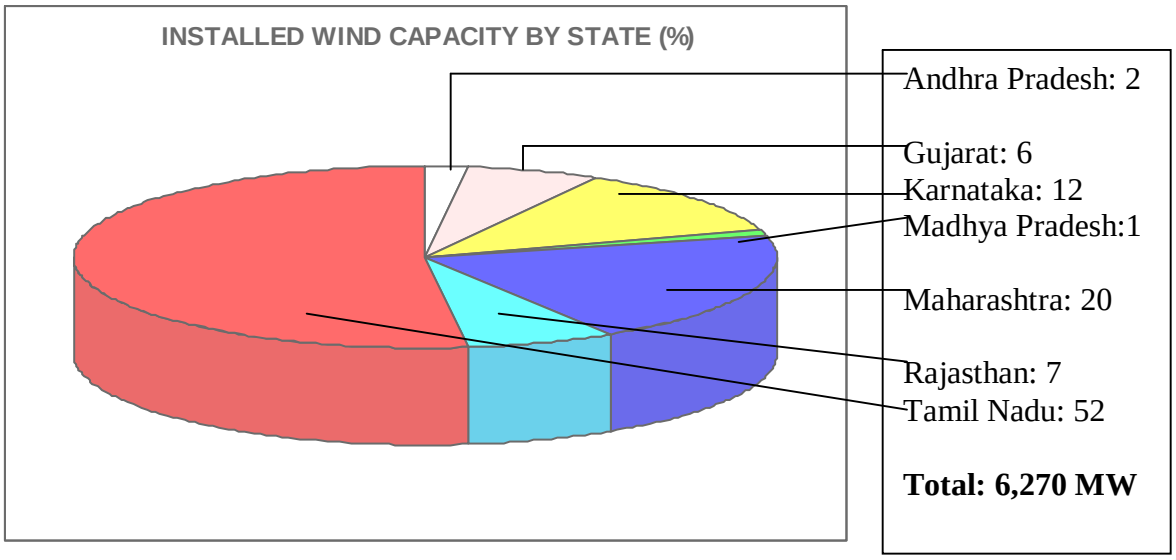
Due to long coast line there is abundance of wind power which should be converted to energy. This is clean and nonpolluting. The technology is well developed. It is used for generation of power pumping of water. There is no consumption of fuel. There is no emission of gas. This is environmental friendly and it could be cost competitive as well. According to International Energy Agency (IEA), the share of wind power in total electricity generation, globally will grow from 0.2 percent in 2002 to 3 percent in 2030. India today is the 5th producer of wind power with installed capacity of 6315 MW by January, 2007. The other four being Germany, Spain, USA, Denmark in that order.

From an installed capacity of 1,167 MW at the end of 2000, the total installed capacity has increased to 6,315 MW as of January 2007. This growth is not restricted to India only. Worldwide there is a resurgence of interest in wind power. The total wind capacity across the world increased from 17,400 MW in 2000 to 74,223 MW in 2006. Germany, the US, Spain, India and China have together added 9,461 MW in 2006 against a total addition of 15,197 MW. India's share in the world total has increased from 6.71 per cent in 2000 to 8.45 per cent at the end of 2006. In terms of capacity addition, at 1,840 MW India has the third highest increase in wind capacity in 2006 after the US's 2,454 MW and Germany's 2,223 MW.

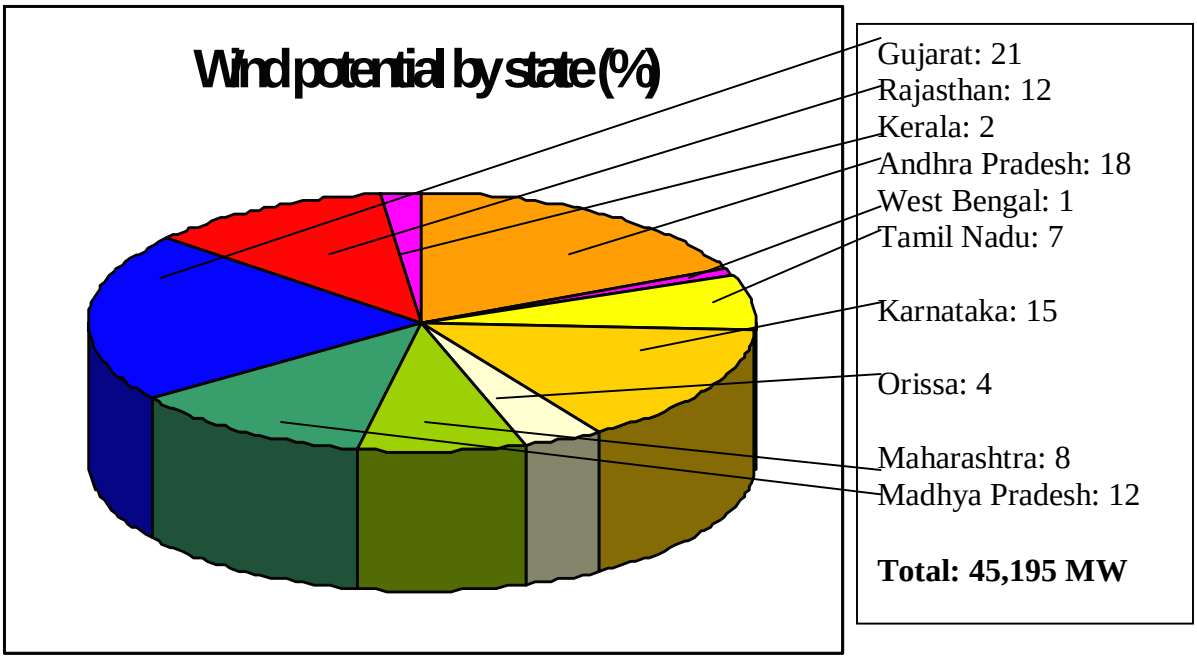
Table - 9

Wind Power capacity in India			
Year	Installed capacity (MW)	% annual growth	% of world total
2006	6,270	41.53	8.45
2005	4,430	47.68	7.50
2004	3,000	42.18	6.30
2003	2,110	23.97	5.35
2002	1,702	20.97	5.47
2001	1,407	20.57	5.89
2000	1,167	8.36	6.71
Figures as of end-December Source: American Wind Energy Association			

A look at the state-wide distribution indicates that Tamil Nadu has developed its wind capacity to its assessed potential. The natural advantage of setting up a wind farm in Tamil Nadu lies in the its “two monsoon effect”, because of which wind is available for over eight months as compared to six months in other states. As a result, PLFs are better here. Suzlon, a leading Indian manufacturer and integrated solutions provider, claims to have achieved a maximum PLF of 36 per cent in Tamil Nadu and a minimum of 28 per cent. In Maharashtra, the PLF is 20-28 per cent. Also, Tamil Nadu was one of the first states to provide incentives to wind power developers. Consequently, it leads wind power development in India with 52 per cent share of the total installed capacity. Other states with significant wind power capacity are Karnataka, Maharashtra, Gujarat and Rajasthan.



It is interesting to note that Tamil Nadu’s assessed wind potential is only 7 per cent of the total potential of 45,195 MW. Gujarat, Andhra Pradesh, Karnataka, Rajasthan, Madhya Pradesh and Maharashtra have higher assessed potential.



Worldwide growth in demand has helped faster development in technology in terms of size, aerodynamics, hybrid technologies, lighter materials and more affordable pricing. Today, the order books of many leading wind turbine and blade manufacturers are full because of an overall spurt in demand. Suzlon, GE Wind Energy, Vestas RRB, Enercon, NEGMicon, LM Glasfibre, Shriram EPC, Pioneer Asia and Elecon are some of the manufacturers operating in India.

Status of Wind Power Pricing in different States

Table –10

State	Wheeling charges	Banking	Buyback rate of SEB	Other incentives	Reactive Energy charges Penalty on kVArh consumption
Andhra Pradesh	At par with conventional	Not allowed	Rs. 3.37/ kWh from April 2004 to March 2009	Industry status	Re 0.10/kVArh upto 10%; Re 0.25/kVArh > 10%
Gujarat	4% of energy	Not allowed	Rs. 3.37/kWh without any escalation for 20 years	Electricity duty exempted. Demand cut 30% of wind farm installed capacity	Re 0.10/ kVArh
Karnataka	5% of energy + Rs. 1.15/kWh as cross subsidy on	Allowed at 2% of energy input	Rs. 3.40 per kWh without any escalation	No electricity duty for 5 years	Re 0.40/kVArh

	third party sale		for 10 years of commercial operation		
Kerala	To be decided by SERC	Allowed June-February	To be decided by SERC		NA
Madhya Pradesh	2% of energy+ transmission charges as per SERC	Not allowed	From year 1-4: 3.97 Rs/kWh, 3.80 Rs/kWh, 3.63 Rs/kWh, 3.40 Rs/kWh; From year 5-20: 3.30 Rs/kWh	No electricity duty for 5 years	Re 0.27/kVArh
Maharashtra	2% of energy as wheeling + 5% as T&D losses	Allowed for 12 months	Rs. 3.50/kWh in 1st year of commissioning; escalation of Re 0.15 per year for 13 years	Power evacuation, arrangement, approach road, electricity duty, loan to cooperative societies	Rs. 0.25/kVArh
Rajasthan	Below 132 kV, 50% of normal charges applicable to 33 kV declared by SERC	Allowed for 6 months	First year 3.25/kWh; 6% annual escalation until 10th year; From 11th-20th yea: Rs. 3.79/kWh	Exemption from electricity duty at 50% for 7 years	Re 0.40/year from April 2006 with escalation of 5% per subsequent year
Tamil Nadu	5% of energy	Allowed at 5% April-March	Re 2.90/kWh	NA	Re 0.25/kVArh if kVArh: kWh upto 10%; Re 0.50/kVArh > 10%
West Bengal	7% of energy + open access charges	Allowed for 6 months	Rs. 4/kWh for five years	NA	Re 0.20/kvArh

Global Growth

Resurgence in interest

Green sources of power like wind or solar have always been an expensive proposition compared with conventional sources like gas and coal. However, the rising costs of conventional fuels have impelled a revaluation. Improving wind technologies have also helped.

Since 2005, increasing natural gas prices pushed up conventional electricity costs to more than those of wind-generated electricity in the US. According to a report of the Earth Policy Institute, Austin Energy (a publicly owned utility in Austin) buys wind power under 10-year, fixed-price contracts and passes this price on to its “Green Choice” subscribers. This energy is extremely attractive to its 388

corporate customers. While they expect to save millions of dollars from the arrangement, many more consumers have signed on as Green Choice subscribers.

While the resurgence is most pronounced in the US, countries like Germany, India, Spain, China, the UK and Italy have also added significant wind power generation capacity in the last few years. The global installed capacity increased by about 68,000 MW during the decade ending 2006 (Fig. 2). Of this, about 27,000 MW was added in 2005 and 2006 alone. The total capacity in 2006 was 74,223 MW.

In terms of country-wise distribution of installed capacity, Germany accounts for 27 per cent of the total, the US and Spain contribute 16 per cent each, India 8 per cent, and Denmark and China 4 per cent each (Fig. 4). The rest of the world, including Italy, Portugal and other African and Asian nations, make up the rest.

Fig: 1: Annual wind capacity addition

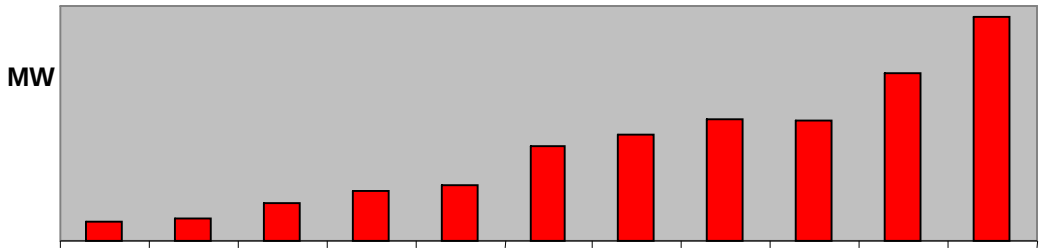


Fig. 2: Growth in global installed wind capacity

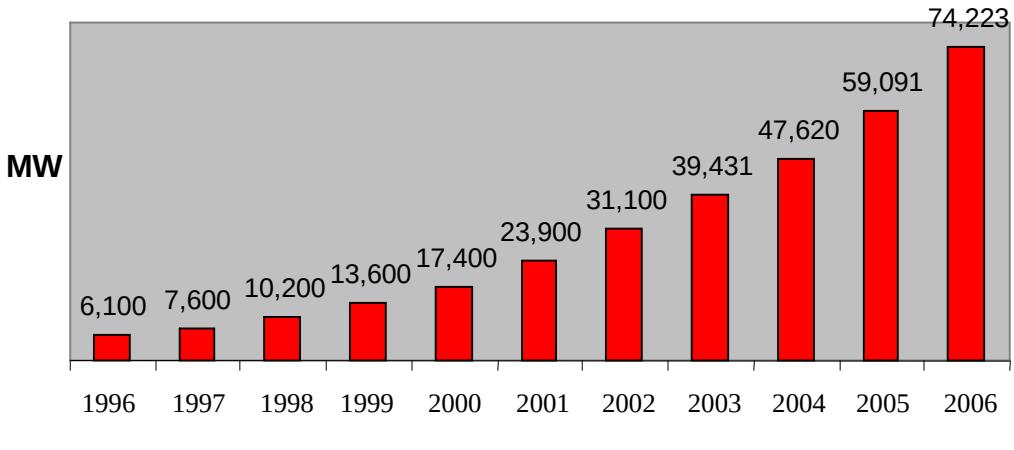


Fig. 3: Capacity added in 2006 (%)

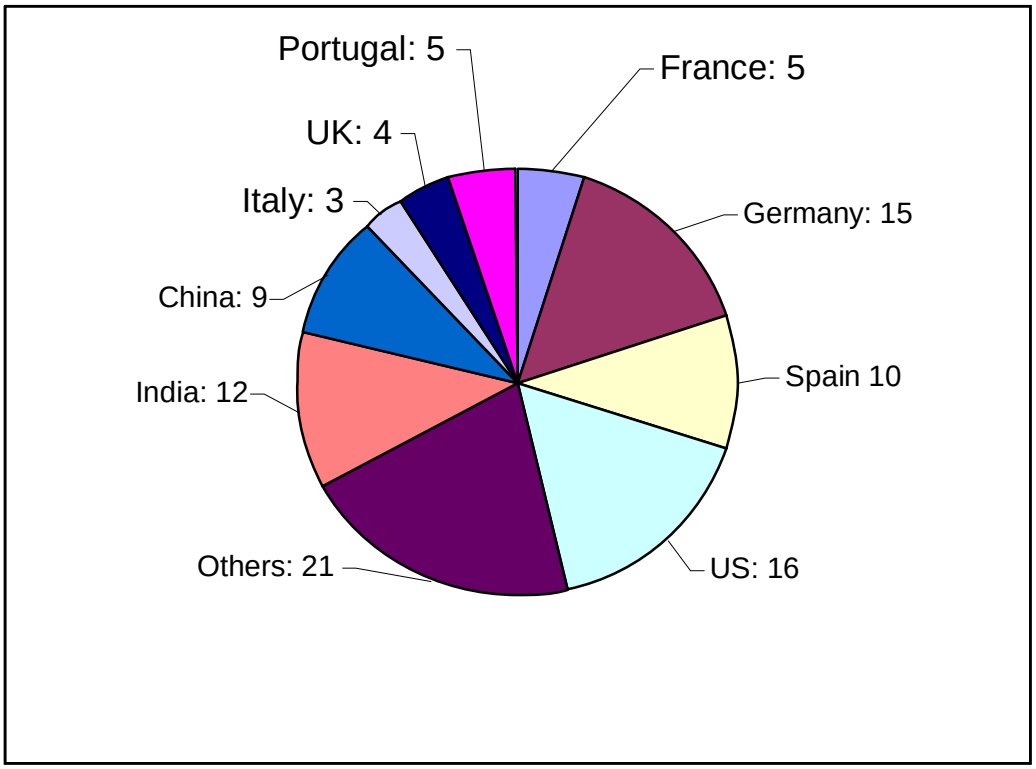
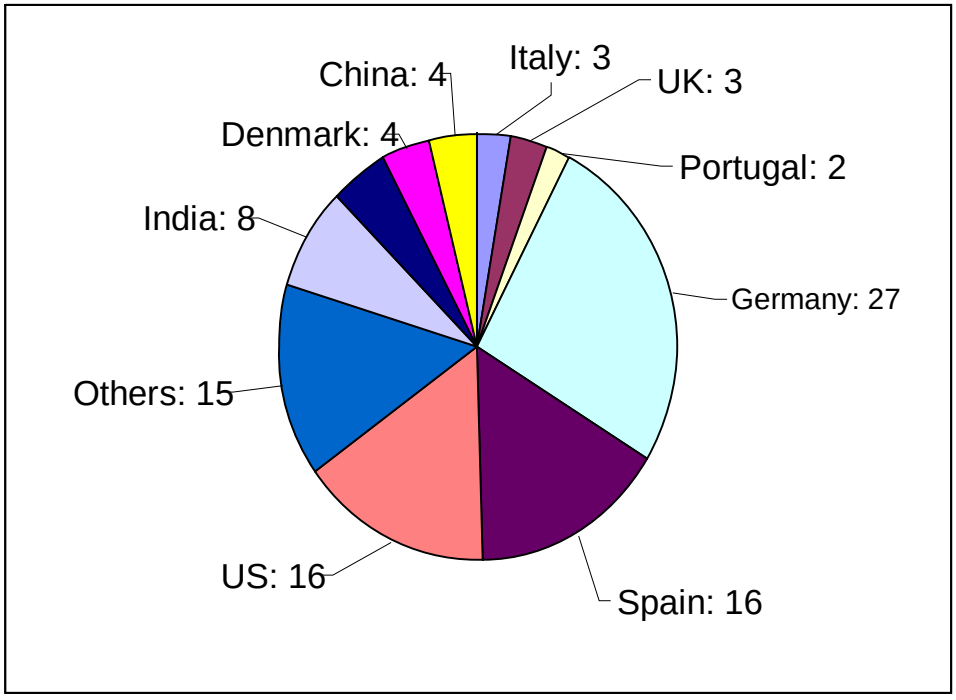


Fig. 4: Global installed wind capacity in December 2006 (%)



The global growth average is about 26 per cent, though in India, wind capacity addition is growing at about 40 per cent (see Fig. 5).

Fig. 5: Percentage annual growth		
year	Global growth	India's growth
2006	25.61	41.53
2005	24.09	47.68
2004	20.77	42.18
2003	26.75	23.97
2002	30.17	20.97
2001	37.36	20.57
2000	27.94	8.36
Source: American Wind Energy Association		

Aside from technological advances and rising conventional fuel prices, there are several other factors that have helped make wind power more popular in recent years. Financial incentives, for one, have given a fillip to the development of wind

power projects. Further, increasing awareness about adopting green power and the promise of perpetual availability of cheaper power have attracted all-round interest from equipment manufacturers as well as diverse development groups, ranging form farmer cooperatives to reputed financial institutions.

Wind power is being seen as a large, rapid and cost-effective solution to global warming. Pro-environment groups are joining hands to accelerate wind power development based on its clean energy nature. Princeton University researchers have identified seven key ways of reducing 1 billion tones of carbon emissions per year. Wind power is one of them. Wind is also being seen as one of the most cost-effective energy sources as it needs no fuel and is a zero-emission technology with the least impact on wildlife.

In India, the growing power shortage, unreliable grid supply and attractive incentives like tax holidays, accelerated depreciation and preferential buyback pricing have been the major reasons for the fast-paced growth of wind power.

Meanwhile, China's installed wind capacity grew form 567 MW in 2003 to 2,604 in 2006, owing to policy reforms, dedicated research and development initiatives, new financing mechanisms, and clear goals in the country's five year plans. In addition, policies supporting wind power generation and a rule to set wind power prices at a level that would repay the capital cost with interest plus a reasonable profit, have helped the cause of wind energy.

Extension of federal production tax credits has been the key incentive supporting the resurgence in wind power in the US. It had the highest capacity addition of 2,454 MW in 2006 and is expected to increase the installed capacity by another 3,000 MW in 2007. In the African and Middle Eastern markets, growth in wind installations picked up considerably and was around 63 per cent. In 2006, the total installed capacity of the regions was 441 MW, with Egypt, Morocco and Iran being the leading developers. In Australia, the installed wind capacity was 817 MW, with 2006. The Australian market is expected to grow faster in the coming years with the introduction of state-based renewable energy targets.

Currently, the manufacturing market seems to be heading towards a supply chain constraint. Due to the growing demand for wind power, most established wind turbine and equipment manufacturers are finding their order books full. GE Wind Energy recently expanded capacity in Germany. Siemens increased capacity in Denmark by acquiring a former LM glass fibre factory; Mitsubishi launched a massive expansion plan; and India's Suzlon drew up a Rs. 30 billion expansion plan to be completed by 2008. Projections from manufacturers indicate that the installed global wind capacity could be about 150,000 MW by end-2010. Europe is targeting 70,000 MW by end-2010, the US about 30,000 MW, India 10,000 MW, China 8,000 MW, Canada 4,500 MW and Japan 3,000 MW.

Wind Power Economics

Cost components

The typical cost dynamics of generating and pricing power using wind turbines relate to capital, running and interest costs. Capital costs are those involved in developing a wind farm, including cost of equipment, grid connectivity if the state has not provided it, preliminary studies, and infrastructure development in the surrounding areas. They typically represent 70-90 per cent of the total project cost. The main components of capital costs are turbines, civil works, electrical infrastructure and grid connection.

Running costs include installation, insurance, legal, development and interest costs during construction. Since fuel is free, the running costs normally include operation, maintenance, rents on leased land, etc. Many private developers in the country buy the land which is typically located in remote areas and costs less. This liberates them from the possibility of future disputes.

The third type of cost relates to long-term borrowing on account of land, equipment and infrastructure development.

Comparative running costs

A look at captive power generation costs across India indicates that wind energy is competitive with conventional and other renewable fuel-based generation

sources. The generation costs of conventional oil-based plants vary between Rs. 4.50 per kWh and Rs.8 per kWh, going up to Rs. 20 per kWh in some cases. They are increasingly being used as standby or limited-use energy options. Coal-based plants have average running costs of about Rs. 3 per kWh, although this cost is comparable to wind when cogeneration or waste heat recovery is combined with coal-based generation. In the long run, as fuel costs tend to increase in coal-based generation, wind power becomes more economical as the interest gets paid off.

The key factors affecting the cost of electricity generated from wind are wind speed, choice of turbine type, size of wind farm, expected return on capital and duration of capital repayment. The higher the load factor, the cheaper the costs. However, the load factor depends significantly on the windiness at the site. A doubling of wind speed enhances power generation eightfold. Wind speeds are typically higher in offshore farms than onshore. However, construction costs are much higher for offshore wind farms. The arrangement of turbines in a wind farm and the rated power availability of each turbine installed are also important. Financially, short repayment tenors and high expected rate of return increase the price of generated power. However, these two factors are determined by the buyback prices fixed by the respective states.

Worldwide, wind power generation costs have decreased steadily. From 40 cents in 1973, the costs declined to 3-5 cents in 2004. While costs may vary with the country, the declining trend is common to all. The key reasons for this decline are improvements in technology, falling cost of financing and increase in wind farm sizes. Turbines are getting cheaper as technology improves and component manufacturing is becoming more economical. Productivity of new designs is also better, leading to more electricity being produced form more cost-effective turbines. Three is also a trend towards installation of larger machines. This reduces capital costs as fewer turbines generate the same output. Moreover, the cost of financing is falling as lenders gain confidence in the technology. Stringent environmental norms have also contributed to this cause. With larger wind farms, operational coasts get spread over more turbines, making it more efficient per unit generated.

Table - 11

Comparative running costs Wind power					
Company	Industry/ Group	Location	State	Capacity (MW)	Cost (Rs/kWh)
Chola Textiles	Textiles	Tirunelveli	Tamil Nadu	21.25	2.75
Priyadarshini Textile	Textiles	East Godavari	Andhra Pradesh	1.80	1.97
Weizmann	Finance	Poolawadi, Kayathyar Ramagiri	Tamil Nadu, Andhra Pradesh	36.00	1.59
Sri Shanmugavel Mills	Textiles	Coimbatore	Tamil Nadu	120.00	1.90
BF Utilities	Auto ancillary	Satara	Maharashtra	22.53	2.50

Geothermal Energy & STEC Technology:

Geothermal energy is an alternative energy source, although it is not resourceful enough to replace more than a minor amount of the future's energy needs. *Geothermal* energy is obtained from the internal heat of the planet and can be used to generate steam to run a steam turbine. This in turn generates electricity, which is a very useful form of energy.

The radius of the Earth is about 4000 miles, with an internal core temperature of about 4000 degrees Celsius at the center. The mantle surrounds the outer core and is only about 45 miles below the surface, depending on location. The temperature at the mantle-surface crust boundary is about 375 degrees, Celsius. (This is too deep to get to...as of today).

So, how does this help us? It turns out that if we drill down only three miles we can reach temperatures of 100 degrees, Celsius, which is enough to boil water to run a steam-powered electric power plant. Drilling three miles through the earth is possible, but not easy, so luckily there are easier routes to access this power source, known as *geothermal hotspots.*

Geothermal hotspots are volcanic features, which are found all around the world. Basically a hotspot is an area of reduced thickness in the mantle, which transmits excess internal heat from the interior of the earth to the outer crust. These hotspots

are well known for their unique effects on the surface, such as the volcanic islands of Hawaii, the mineral deposits and geysers in Yellowstone National Park, or the hot springs in Iceland. These geothermal hotspots can easily be used to generate electricity.

How does Geothermal-Energy Systems Work?

Some systems pump hot water into permeable sedimentary hotspots found underground and then use the steam to generate electricity. Then the used steam is condensed and sent back down to the permeable sedimentary stream. Another system utilizes volcanic magma which is still partly molten at around 650 degrees, Celsius, to boil water which would generate electricity. Also there is a system, which uses hot dry rock, which is just hardened magma, but still is extremely hot. To recover this heat from these rocks, a system is used which circulates water through the rock and transfers the heat up to a steam generator. The first system listed here is not as useful as other methods because of the acidic nature of the fluids found under the ground. These acidities require a lot of maintenance and upkeep on the equipment, and this cost reduces the economic effectiveness of the system. Therefore, geothermal energy systems are more inefficient than other alternative energy sources because of the costs required in upkeep and the shortage of potential sites.

STEC Technology

Spring Thermal Energy Conversion (STEC) differs in that it uses underground energy rather that seawater energy as its heat source, but the principle is just the same as that for OTEC. Therefore, it is an environment-friendly method of power generation that does not use fossil fuels and does not emit CO_2. With the exception of geothermal energy, which has been widely utilized, underground thermal energy like spring water has been labeled unfit for power generation purposes due to its poor energy density and has not been utilized. The STEC, with the highly efficient “Uehra Cycle”, has changed the whole situation and made it feasible to generate power from spring water. STEC is applicable not only with spring water but with any differential temperature 50-60^{o}C between warm water

and cold water and hence should help recover energy costs significantly at those places that discharge huge volumes of waste warm water, such as conventional thermal power plants, various kinds of manufacturing facilities, etc.

Tidal Power, OTEC and M-DTEC

Even the power of the tides can be harnessed to produce electricity. Similar to the more conventional hydroelectric dams, the tidal process utilizes the natural motion of the tides to fill reservoirs, which are then slowly discharged through electricity-producing turbines. The former USSR produced 300 MW in its Lumkara plant using this method.

Practical wave power

Two-thirds of the earth's surface is covered with water, and it's long been known that the waves which cross our oceans expanse carry with them a nearly limitless source of potential energy.

But the devil is in the details. The same energy we'd like to capture to light our homes and power our factories is remarkably efficient at humbling human attempts to tame it. The ocean is a punishing environment. Build it hard, or build it strong: the sea will still take whatever opposes it.

Which speaks to the brilliance of Scotland-based Ocean Power Delivery Limited and their Pelamis machines. OPD understood that survivability is the key to commercial development of wave power, and the traditional approach – big, rigid structures constructed in opposition to the sea's natural motion – was impractical.

So they built Pelamis: an articulated, tubular generator of about 120 meters in length which slithers in the wave like a giant red snake. Wave energy is converted into power by hydraulic joints between Pelamis' sections.

Held in place at sea by anchor moorings, the Pelamis machine sacrifices efficiency for durability. It still produces industrial-grade juice – the prototypes three sections generate a total 750 kilowatts. In farms of forty such machines, each Palamis group will be rated at 30 Megawatts. That's enough to supply

20,000 homes. Two dozen farms could supply the entire energy requirement of a large, modern city.

OTEC Technology

Oceans cover about 70% of the Earth's surface. Apart from sustaining innumerable species of marine flora and fauna, the oceans of Earth do moderate the weather and temperature of the planet. They change the Earth's temperature by absorbing incoming solar radiation (stored as heat energy).

Thus oceans make the world's largest solar energy collector and energy storage system. On an average day, 60 million square kilometers (23 million square miles) of tropical seas absorb an amount of solar radiation equal in heat content to about 250 billion barrels of oil.

What is OTEC?

OTEC, or ocean thermal energy conversion is a unique technology that generates power by utilizing the differential temperatures between warm water (approx. 25-30^{o}C) and cold water (approx. 5-10^{o}C), occurring naturally in oceans.

As long as the temperature between the warm surface water and the cold deep water differs by about 20 ^{o}C (68 ^{o}F), an OTEC system can produce a significant amount of power. The oceans are thus a vast renewable resource, with the potential to produce billions of watts of electric power.

The cold, deep seawater used in the OTEC process is also rich in nutrients, and can be used to culture both marine organisms and plant life near the shore or on land.

In addition to the surface sea water, the technology can also perform effectively with other sources of warm water like warm waste water from various manufacturing facilities, thermal power plants, nuclear power plants, etc. Waste heat of larger diesel engines on-board is also a good warm energy source.

The new construction of thermal power plants is becoming difficult due to the CO_2 emission problem, and nuclear power plants, which had once been encouraged as a substitute for thermal power plants, are losing the confidence of

the world community due to the safety conditions and the deleterious impacts of radioactive waste disposal on the environment. Under these circumstances, world attention has turned to power generation using natural energy. Among the nature-oriented power generation systems, both wind power and solar power are very much subject to weather conditions and are unable to supply constant and stable power, They cannot become a mainstream of natural power generation.

OTEC and other systems of the OTEC family on the other hand, can afford to supply continuous power, as their energy sources have nothing to do with weather conditions. A study made by the Indian government on a 100 MW OTEC plant shows a very competitive cost (¥7/kWh) for power generation, almost the same as that attained by a nuclear power plant of similar capacity.

OTEC is a highly prospective technology to become a core source of energy supply in the future. Furthermore, cold deep seawater pumped up from 800-1,000 meters depth for an OTEC plant is quite nutrient rich and will provide opportunities for multipurpose secondary usage, such as the production of fresh water, mineral water, salt and lithium extracted from the water. By sprinkling these substances on the sea surface, it will be possible to cultivate fishing grounds and thereby increase food supply and prevent global warming. This added-value potential is inexhaustible.

A variety of new industrial avenues open up with Deep Ocean Water (DOW) pumped for OTEC power generation. The following items indicate a few of the potential areas that DOW can create:

- Production of Fresh water
- Production of Mineral water
- Production of Ice-Hygienic ice for preservation of freshness of fish, poultry, vegetables, etc.,
- Production of marine aquaculture
- Extraction of lithium
- Production of Hydrogen
- For Air-conditioning (cooling) systems
- For production of DOW – related byproducts, such as pharmaceuticals, cosmetics, etc.,

Market for OTEC Technology

A worldwide market potential for OTEC system is emerging due to its technical competence and environment friendly power generation. In particular, island governments in the tropical zone and fast developing countries, which have been facing serious problems with CO_2 pollution on one hand and with shortage of fresh water on the other, may be interested in OTEC power plants integrated with the desalination process. Ocean-going vessels driven by large diesel engines may have similar need for cleaner power and self-producing fresh water.

It is quite obvious that countries like Japan, surrounded by the sea, will find OTEC power plants an effective means. The inclination towards earth-friendly natural energy is rapidly getting stronger due to the increasing seriousness of CO_2 emission from thermal power plants and of radioactive accidents at nuclear power plants.

Seawater Desalination Integrated with OTEC Power Plant

There still remains a temperature difference of 10^oC or so between warm surface seawater and cold deep seawater after they have been used for OTEC power generation system. Fresh water from the seawater can be produced by applying the Spray Flash Evaporation Method.

Seawater Desalination System by Spray Flash Evaporation Method

The desalination of seawater can be explained as taking place in the following thee stages.

First, the warm surface seawater is pumped into a depressurized chamber. Second, the warm surface seawater evaporates instantly when being fed into such a chamber. Third, the vapor obtained in the chamber will be cooled and condensed by the cold deep seawater to turn into fresh water.

The deployment of plate heat exchanger in the Spray Flash Evaporation Method makes it possible to do seawater desalination with only 5^o C differential temperature, which had long been thought too small for desalination purposes.

Obtaining Huge Volumes of Fresh Water

A 10MW OTEC power plant will easily provide 12,000m^3 per day (12 MLD) of fresh water form seawater pumped up for power generation. Fresh water is needles to say, indispensable for drinking and for other human life. It can also be utilized as raw water for the production of hydrogen gas, which is expected to be widely used as a fuel for fuel cells, hydrogen-powered automobiles, etc., in the future.

Using Various Waste Heat

As mentioned above, the Spray Flash Evaporation Method works already with only 5^oC differential temperature between warm and cold seawater. Therefore, any source of energy such as warm waste water, other then OTEC, most of which might have been dumped as useless waste, can be utilized for desalination purposes.

Discharge Thermal Energy Conversion

Huge volumes of warm water or heat (mostly less than 100^oC) are being generated off cooling process lines at various manufacturing facilities such as steel mills, power plants, oil refineries, chemical factories, etc., and are been disposal of as useless wastes. The heat energy from this warm-waste water can be converted into electric energy using the Uehara Cycle thermal energy conversion system that uses a mixture of ammonia and water as working fluid. This generation system applies the technology developed in OTEC.

Suitable system for utilizing low-temperature differentials

The Uehara Cycle provides an extremely high-efficiency heat energy system compared with conventional systems. In particular, a clear difference can be seen when using low-temperature differentials.

Replacement of existing cooling facilities

Until now much energy has been consumed to cool down waste heat, but the use of this system provides a function that replaces part of existing cooling facilities.

Contribution to the solution of global environment problems

Amid growing awareness of the environment in the world as a whole, production facilities that emit large volumes of heat are being required to respond even more than before. Because it effectively utilizes unused waste heat, this system also leads to a reduction in the emission of greenhouse gases.

Function as comprehensive infrastructure facility

Since desalination using waste heat is possible at the same time as generation, the system also functions as a comprehensive infrastructure facility.

The system characteristics of the Uehara Cycle itself and also the plate-type heat exchangers with special design deployed in the system shall make the whole plant economically feasible.

Marine-Discharged Energy Conversion (M-DTEC)

M-DTEC is precisely the same as OTEC theory and technology, utilizing waste heat energy. The fossil-fuel consumption on ship will be kept at a minimum in proportion to the effective use of waste heat energy. This is an earth-friendly “energy-saving technology” that restrains the use of fossil fuels.

The efficiency of the diesel engines has been remarkably improved. There are engines with more than 50% single heat efficiency. Nevertheless, the other half of its energy is wasted in the form of exhaust gas or is dissipated into the cooling medium of seawater. Recovering waste heat from a stream generator and turbine is not a new challenge, but the fact that the greatly improved efficiency of diesel engines was difficulties in recovering enough away to make the investment worthwhile.

Now, M-DTEC by the Uehara has made it possible to recover not only waste heat energy of exhaust gas but also that from air-coolers and cylinder jackets of diesel engines and even from lubricating oil, for which recovering heat for power was previously difficult. The Uehara Cycle contributes to the shipbuilding industries

by converting all types of ships, large and small, into “environment-friendly ships” with a saving of energy.

Conclusions of Tidal Power and the State of Art Technologies

The initial capital costs may look prohibitive for implementing the environment friendly OTEC technologies, but this alternative energy resource will soon become a boon for industries, nuclear power plants and island communities for meeting their power and water requirements without contributing to the green gas emissions.

Nature has every resource for meeting the needs and even greed’s of the people, but the search for sustainable means to derive such resources still remains complicated OTEC technology is a sustainable solution for power generation and water production.

If less than one-tenth of one percent of the stored solar energy stored in oceans could be converted into electric power, it would supply more than 20 times the total amount of electricity consumed in the United States on any given day.

Hydroelectricity (up to 25 MW)

Hydro power represents use of water sources towards inflation free energy due to absence of fuel cost – and with mature technology characterized by highest prime moving efficiency and spectacular operational flexibility. India has a history of about 110 years of hydro power. The first small hydro project of 130 KW commissioned in the hills of Darjeeling in 1897 marks the development of hydro power in India. The Sivasamudram project of 4500 KW was the next to come up in Mysore District of Karnataka in 1902, for supply of power to the Kolar gold mines. Following this, there were number of small hydro projects set up in various hilly areas of the country. Till Independence (1947), the country had an installed capacity of 1362 MW, which included 508 MW hydro power projects, mainly small and medium size projects. In the late 80’s, it was realized that the development of Small Hydro Power (SHP) potential had remained largely untapped, as the focus was on large-scale power generation. In order to provide

focused attention to small size projects, the subject of small hydro was brought under the purview of renewable energy.

The decade of the 90s gave a firm footing for the development of small hydro in India. A comprehensive programme for exploitation of its potential was built. Demonstration projects were supported throughout the country with new technical and engineering concepts to harness small, medium and high head for SHP projects in the hills as well as canals. R&D projects and a dedicated Center namely the Alternate Hydro Energy Centre (AHEC) at the University of Roorkee (now IIT, Roorkee), to provide technical support to the small hydro sector were supported. Database of potential SHP sites on small rivers and canals was concurrently developed, and a pre-investment study was carried out under the auspices of the Energy Sector Management Assistance Program (ESMAP) – jointly supported by UNDP and the World investment program to develop irrigation/canal based hydro schemes. Alongside, a manufacturing base for SHP equipment was strengthened.

Small Hydro Potential

The total hydroelectric power potential in the country is assessed at about 150,000 MW, equivalent to 84,000 MW at 60% load factor. The potential of small hydro power projects is estimated at about 15,000 MW. Of this, 4,861 potential sites with an aggregate capacity of 12,841 MW have been identified. A comprehensive resources assessment for all the renewable energy sources – including small hydro and mapping of potential sites/locations on a GIS platform is receiving utmost attention. The aim is to map the renewable energy potential in the country and bring it on a GIS platform with information necessary to take investment decisions to set up projects. Models have been developed that take into account the regional flow duration curves, geological and seismological data, vegetation cover etc. for identification of potential sites. The GIS technology is to extract information on natural drops available in the river system. The water availability at these sites is then determined using a distributed rainfall-runoff model i.e. SWAT (Soil and Water Assessment Tool) model. The model uses terrain features,

land use and soil data along with the rainfall and other meteorological parameters such as temperature, relative humidity and solar radiation data to generate the flow time series. The model has been successfully tested on Bias basin in Himachal Pradesh and is proposed to be extended to other basins also.

Table- 12

State wise identified sites and installed projects with capacity in MW

Sl. No	Name of State	Identified number of sites	Total Capacity in MW	Projects installed	
				Nos.	Capacity (MW)
1.	Andhra Pradesh	377	250.50	57	178.850
2.	Arunachal Pradesh	452	1243.47	68	45.240
3.	Assam	40	119.54	3	2.110
4.	Bihar	74	149.35	7	50.400
5.	Chhatisgarh	132	482.82	5	18.050
6.	Goa	4	4.60	1	0.050
7.	Gujarat	287	186.37	2	7.000
8.	Haryana	23	36.55	5	62.700
9.	Himachal Pradesh	457	2019.03	61	141.615
10.	Jammu & Kashmir	208	1294.43	32	111.830
11.	Jharkhand	89	170.05	6	4.050
12.	Karnataka	468	1940.31	70	441.250
13.	Kerala	207	455.53	16	98.120
14.	Madhya Pradesh	85	336.33	9	51.160
15.	Maharashtra	221	484.50	29	209.330
16.	Manipur	99	91.75	8	5.450
17.	Meghalaya	90	197.32	3	30.710
18.	Mizoram	53	135.93	16	17.470
19.	Nagaland	84	149.31	9	20.670
20.	Orissa	206	217.99	6	7.300
21.	Punjab	204	270.18	29	123.900
22.	Rajasthan	55	27.82	10	23.850
23.	Sikkim	70	214.33	14	39.110
24.	Tamil Nadu	155	373.46	14	89.700
25.	Tripura	10	30.85	3	16.010

26.	Uttar Pradesh	211	267.06	9	25.100
27.	Uttaranchal	354	1478.24	88	80.670
28.	West Bengal	141	213.50	23	98.400
29.	A&N Island	5	1.15	1	5.250
	Total	**4861**	**12,841.81**	**604**	**2005.345**

Hydro Power Programme - Grid-Interactive SHP Projects

Beginning of the 21st century saw near commercialization in the small hydro sector. There are 604 small hydro projects in India with total installed capacity of 2005 MW. The Ministry of New and Renewable Energy (MNRE) decided that out of the total grid interactive power generation capacity that is being installed, 2% should come from small hydro. This translates to about 1400 MW capacity addition during 2007-2012. The present focus of the SHP programme is to lower the cost of equipment, increase its reliability and set up projects in areas that give the maximum advantage in terms of capacity utilization. SHP projects are being set up both in public and private sector.

The India small hydropower development programme received a new dimension and tempo after the liberalization of the economy and invitation economy and invitation private sector for investment in power. The private sector was attracted by these projects due to their small adoptable capacity matching with their captive requirements or even as affordable investment opportunities. In line with Government of India policy, some states announced their policy for inviting private sector to set up SHP projects and announced buy back rate for purchase of power from renewable energy projects. The Indian Renewable Energy Development Agency (IREDA) started financing private sector SHP projects. Consequent to the ESMAP study, in 1993-94, the World Bank offered a line of credit worth US$ 70 million to IREDA to be utilized to support SHP projects on irrigation dams and canals for a target capacity of 100 MW. The credit line moved successfully and IREDA could sanction 33 SHP projects with an aggregate capacity 113 MW by the year 2000. Following this World Bank offered a second line of credit worth US$ 110 million to IREDA.

Today the SHP programme in India is essentially private investment driven. 133 private sector SHP projects of about 605 MW capacity have been setup. Private sector entrepreneurs are finding attractive business opportunities in small hydro and State Governments also feels that the private participation may be necessary for tapping the full potential of rivers and canals for power generation. The Government of India announced the Electricity Act, 2003, National Electricity Policy in 2005 and Tariff Policy in 2006 to create a conducive atmosphere for investments in the power sector.

The Ministry of New and Renewable Energy (MNRE) is giving financial subsidy, both in public and private sector to set up SHP projects. In order to improve quality and reliability of projects, it has been made mandatory to get the project tested for its performance by an independent agency and achieving 80% of the envisaged energy generation before the subsidy is released. In order to ensure project quality/performance, the ministry has been insisting to adhere to IEC / International standards for equipment and civil works. The subsidy available from the Ministry is linked to use of equipment manufactured to IEC or other prescribed international standards.

Small Hydro and Environment

Natural streams are responsible for sustenance of life of various forms. Any interference with its natural flow significantly threatens the land and life in its vicinity and imperils the balance in the ecosystem irrespective of the size of the stream. The SHP development has some impact though may be little and needs to be looked into. It is expedient to analyze the environmental impacts of any project and to provide suitable measures to mitigate the adverse effects to the extent possible. Environment impacts are not considered detracting factor against the SHP development as these can be avoided and mitigated easily with suitable provision in the project design and operation. It is estimated that 1 million units produced by a SHP plant avoids on average the emissions of about 480 tons of CO2. According to a study carried out by APPA (Spanish Association of

Renewable Energy producers) entitled Electricity Costs externalities; to produce one kWh of electricity from small hydro, has an environmental impact:

- 250 times lower in relation with the one generated with coal or petroleum.
- 125 times lower in relation with the one produced with uranium.
- 50 times Ministry of New and Renewable Energys lower than the one generated with natural gas.

Benefits of carbon trading for small hydropower projects are available under United National Framework of climate Change Conference Clean Development Mechanism (CDM).

Manufacturing Status

India has a wide base of manufacturers of equipment for small hydro power projects. State-of-the-art equipment is available indigenously. 15 manufacturers fabricate almost the entire range and type of SHP equipments. Manufactures capacity is estimated at about 250 MW per year. In addition, there are about 5 manufactures that are producing micro hydel and watermill equipments.

Technical and Consultative Services

Consultancy services in the field of small hydro projects are available from a number of Government / private consultancy organizations. The Ministry is strengthening technical institutions to provide such services. AHEC, IIT Roorkee is providing full range of technical institutions to provide such services. AHEC, IIT Roorkee is providing full range of technical services in the field of small hydro including survey and investigation, DPR preparation, project design etc. On site testing facility has been created at AHEC to test SHP stations for their performance. A Real Time simulator has been set up at AHEC which is providing hands on experience to operators of SHP stations. It is the first SHP simulator is capable of replicate all conditions of a hydro power station. AHEC is offering regular training programmes for operators and engineers of SHP stations.

With the constant efforts of the Government and techno-economic viability with some preferential treatment, small hydro has emerged as a viable business option over these years. Over 130 private sector small hydro power projects are now operational in the country on canals as well as small rivers. It is expected that the

growth of small hydro would be @ 250-300 MW per year in the coming years. Simultaneously, micro hydro projects have also emerged as a reliable source of electricity generation for remote and isolated areas. Efforts are being made to strengthen hydrological data base and identify new potential sites on one side and evacuation facilities on the other for effectively harnessing small hydro potential in the country.

Govt. of Orissa have also taken a number of steps to harness power from renewable sources during XI Plan. Govt of Orissa, Deptt. of Energy have encouraged a number of Small Hydro Electric Projects under renewable energy sources to come up during XI Plan. The details of such Small Hydro Electric Projects developed by IPPs by Orissa are shown in Table-13 below:

Table – 13

LISTS OF SMALL HYDEL ELECTRIC PROJECTS DEVELOPED BY IPPS

Name of the Developer	Name of the Small Hydro Electric Project (SHEP)	Location of SHEP	Installed Capacity in MW with no. of units.	Design Energy (in MU)	Project Cost (in Rs. Cr.)	Date of MoU with Govt.
M/s Sharvani Energy (P) Ltd.	Dumajorhi SHEP	On Kolab river at village Dumajorhi	2 x 7.5	52.10	72.00	14.09.2006
M/s Orissa Power Consortium Ltd.	Jalaput Dam Toe SHEP	Jalaput Dam, Jalaput	3 x 6	82.50	83.50	07.11.1994
M/s Salandi Hydro Power Projects Pvt. Ltd.	Salandi Dam SHEP	Hadgarh (V) Dist. Keonjhar	2 x 4.5	28.40	39.52	07.10.2005
M/s Kakatiya Chemicals Pvt. Ltd.	Bargarh Head Regulator SHEP	Near Bargarh Head Regulator 18 km from Attabira	2 x 4.5	27.22	36.00	27.10.2005 (Revised MoU)
M/s Jeypore Hydro Power Projects Pvt. Ltd.	Jeypore SHEP	Sattiguda Reservoir near Jeypore town	2 x 3.0	19.97	27.63	05.07.2004

M/s Sideshwari Power Generation Pvt. Ltd.	Kharagpur SHEP	On Kolab river at Kharagpur	2 x 5.0	29.08	42.00	06.06.2002
M/s Arun Power Projects Ltd.	Hatipathar SHEP	On Nagavali river in Rayagada Dist.	2 x 3.75 + 1 x 2.50	38.02	45.75	08.03.2004

Renewable Energy – Present status, Future Initiatives and Goals:

The contribution of renewable to total electricity generation had reached around 11,550 MW today representing more than 8% per cent of the total installed capacity in India against total renewable energy potential of over 1,83,000 MW.

MNRE is involved in the development, demonstration and utilization of various renewable energy based technologies, such as, solar thermal, solar photovoltaic, wind power generation and water pumping, biomass combustion/co-generation, mini and micro hydel power, solar power, utilization of biomass gasifiers, biogas, improved chulha, energy from municipal and industrial wastes and tidal power generation. MNRE also deals with other emerging areas and New Technologies, such as, chemical sources of energy, fuel cells, alternative fuel for surface transportation and hydrogen energy etc.

Energy from organic material like plant and animals is a potential source of meeting our requirement that includes form bio degradable waste which can be used as fuel or for industrial production. Crop residues, animal waste, horticultural waste needs to be utilized no only for cleaning the environment but for production of energy. Energy plantation can save not only damage to our atmosphere but save on costly foreign exchange.

The objective of alternative energy is well reflected in the arrangement under Kyoto protocol. This is a commitment to upset the effects of emission reduction by investment in projects world wide. Industrialized country can buy carbon credit all around the globe so investments are made in developing countries to reduce emission in preference to expensive investment in their own country. Certified emission reduction programme in renewable power and energy efficiency is to be captured by the Indian entrepreneurs.

While discussing about the supply side improvement let us not forget that demand side management can lead to efficient utilization of energy resources and help reduction of energy demand. To conclude environmental consequences should be fully undertaken because we need lean air, clean water and a green worth for survival apart from reliability security and quality of energy supply.

3. Enabling Regulatory Provisions

Regulatory Provisions in Electricity Act, 2003 mandates SERCs to take action to promote Renewable Energy (RE) as mentioned under Sections – 61(h) and 86(1)(e) – these provisions are mandatory.

Section-86(1)(e) enjoins upon the Commission to "promote co-generation and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify for purpose of electricity from such sources, **a percentage of the total consumption of electricity in the area of a distribution licensee."**

Para 5.12 of National Electricity Policy (NEP) issued by Ministry of Power dtd. 12.02.2005 stipulates the following conditions for harnessing the power from co-generation and Non-conventional sources of energy.

> Non-conventional sources of energy being the most environment friendly there is an urgent need to promote generation of electricity based on such sources of energy. For this purpose, efforts need to be made to reduce the capital cost of projects based on non-conventional and renewable sources of energy. Cost of energy can also be reduced by promoting competition within such projects. At the same time, adequate promotional measures would also have to be taken for development of technologies and a sustained growth of these sources.
>
> The Electricity Act 2003 provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by providing suitable measures for connectivity with grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. Such

percentage for purchase of power from non-conventional sources should be made applicable for the tariffs to be determined by the SERCs at the earliest. Progressively the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the Commission may determine an appropriate differential in prices to promote these technologies.

Industries in which both process heat and electricity are needed are well suited for cogeneration of electricity. A significant potential for cogeneration exists in the country, particularly in the sugar industry. SERCs may promote arrangements between the co-generator and the concerned distribution licensee for purchase of surplus power from such plants. Cogeneration system also needs to be encouraged in the overall interest of energy efficiency and also grid stability.

Para 6.4 of National Tariff Policy (NTP) issued by Ministry of Power dtd. 06.01.2006 states as under on Non-conventional sources of energy generation including Co-generation:

Pursuant to provisions of section 86(1)(e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentage for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by April 1, 2006.

It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission.

Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act within suppliers offering energy from same type of non-conventional

sources. In the long-term, these technologies would need to compete with other sources in terms of full costs.

The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non–conventional sources, to be followed in cases where such procurement is not through competitive bidding.

Para 5.3(i) of National Tariff Policy stipulates that Tariff fixation for all electricity projects (generation, transmission and distribution) that result in lower Green House Gas (GHG) emissions than the relevant base line should take into account the benefits obtained from the Clean Development Mechanism (CDM) into consideration, in a manner so as to provide adequate incentive to the project developers.

4. Actions Taken by State Electricity Regulatory Commission on Renewable Sources of Energy

West Bengal Electricity Regulatory Commission (WBERC)

WBERC vide Notification dtd. 25.03.2008 issued the West Bengal Electricity Regulatory Commission (Cogeneration and Generation of Electricity from Renewable Sources Energy) Regulation, 2008 effective from 25.03.2008 for the State of West Bengal. The brief highlights of the Regulation are as under:

Quantum of Purchase of Electricity from Cogeneration and Renewable Sources of Energy.

Minimum quantum of electricity to be purchased by the licensees from cogeneration and renewable sources expressed as percentage of their total consumption of electricity in a year in the respective area of supply of the licensees during the years 2008-09 to 2011-12 shall be such as shown in the table below.

Year	Licensees				
	WBSEDCL	**CESC Ltd.**	**DPL**	**DPSC Ltd.**	**DVC**
2008-09	4.8	4.0	2.5	2.0	2.0
2009-10	6.8	6.0	4.0	4.0	4.0
2010-11	8.3	8.0	7.0	7.0	7.0
2011-12	10.0	10.0	10.0	10.0	10.0

For subsequent years the Commission may separately specify the purchase obligations for the licensees as the Commission deems fit.

Purchase obligations for the licensees as specified above are mandatory minimum percentage of purchase to be maintained by the licensees. The licensees shall have the option to purchase higher percentage with the prior approval of the Commission.

The buyer licensee shall indicate the proposed quantum of purchase of energy from cogeneration and renewable sources for each ensuing year of the control period in the application for determination of tariff duly indicating the sources of purchase.

The buyer licensee shall source the proposed quantum of electricity from cogeneration and renewable sources within the State. The drawal point at which the licensee shall purchase energy from cogeneration and renewable energy sources shall be the point of measurement for computing fulfillment of purchase obligation.

For the purpose of counter checking and monitoring of the fulfillment of purchase obligation of each licensee, the energy from cogeneration and renewable sources, purchased by the licensee, shall be considered for the average of last financial year as submitted in the application for determination of tariff for the ensuing years of the control period concerned and assessed on pro rata basis from annual energy purchase obligation specified in these regulations.

Energy from cogeneration and renewable sources generated within the State and used for captive purposes within the State shall be taken into account for computing the fulfillment of purchase obligation of the licensee in whose licensed area such captive use of energy from cogeneration or renewable sources is made provided the licensee submits the necessary details of such use to the Commission each year. In case of captive use through open access, the quantum of energy wheeled through the system of any licensee(s) against such open access shall also be taken into account as the fulfillment of purchase obligation for that licensee(s).

While contracting power purchase from cogeneration or renewable sources, the priority for purchase shall be on the basis of the comparative price of energy from cogeneration and other renewable sources only after the minimum obligation for purchase of energy from cogeneration and renewable sources as specified in regulation 3.1 above is achieved for each year.

Determination of Tariff of Electricity from Cogeneration and Renewable Source.

Tariff for purchase of electricity from cogeneration and renewable sources shall be agreed mutually by the licensees and the suppliers at a level not above the price cap specified by the Commission in these regulations.

To facilitate examination of reasonableness of price at which a licensee shall procure energy from cogeneration and renewable sources, the prospective purchaser may require the seller to submit all cost data and financial charges to the purchaser. MOU / PPA as agreed between the seller and the purchaser shall be submitted to the Commission. The Commission at this stage does not debar a licensee from agreeing to a negotiated price within the capped price. However, competitive price within the capped level will be a preferred alternative. The Commission may accept the same for the present if the PPA is made as per these regulations. PPA, if any, entered into between the seller / developer and purchaser before the Act came into force, shall remain valid so far it is not inconsistent with the provisions of these regulations. However, the licensee shall not decline to purchase energy from such sources within the specified capped price untill the minimum purchase obligation is achieved each year provided that connectivity and all other conditions are consistent with these regulations.

Price Capping for Energy from Cogeneration and various Renewable Sources.

(i) Bio-mass –

The price at which the renewable energy from biomass source can be sold to a licensee is capped at Rs.4.00 per kWh and shall remain fixed for three years from the date of coming into force of these regulations with escalation @ 2.5% each year from 2011-12 onwards. The Commission may re-fix the capped price and validity period along with the rate of escalation *suo moto* in consideration of information from market sources or on the basis of any petition filed in this regard. Fuel for power generation from bio-mass source shall be generally rice husk or bio-mass made available by additional energy plantation undertaken by the owner of bio-mass plant. A maximum fuel mix of 15% conventional fossil fuel shall be allowed on yearly basis.

(ii) Wind –

For wind energy, the price cap shall be at Rs.4.00 per kWh for five years from the date of coming into force of these regulations.

(iii) Small Hydro –

For energy from small hydel projects, the price cap is fixed at Rs.3.60 per kWh for five years from the date of commissioning.

(iv) Cogeneration –

For energy from cogeneration, the price cap shall be Rs.2.55 per kWh and the same shall remain in force for five years from the date of coming into force of these regulations.

Solar PV –

(a) Eligible grid connected Solar PV power plant of capacity ranging from 1.0 MW (peak) to 5.0 MW (peak), if set up in the licensed area of supply of a licensee, shall avail the generation based incentive sanctioned under letter No. 32/61/2007-08/PVSE dated 24.1.2008 of the Ministry of New and Renewable Energy, Govt. of India, and the solar energy generated by such grid connected solar PV projects shall be sold to the connected licensees at a tariff not exceeding the highest capped price allowed by the Commission for that year for the purchase of energy by a licensee from among the various categories of renewable sources (other than any solar PV source) as specified in these regulations subject to other terms and conditions contained in the guidelines for generation based incentive of MNRE mentioned above till such date the aforesaid incentive of MNRE continues. On withdrawal of the aforesaid incentive by MNRE for reasons not attributable to the grid connected Solar PV plant authorities, the capped price for sale of such energy to the licensee shall be reviewed by the Commission on application to the Commission for such solar PV projects only which are commissioned upto 2011-12. The capped price of energy for grid connected solar PV plants (including those plants which are availing accelerated depreciation benefit under section 32 of the Income-tax Act, 1961) which are not eligible for aforesaid incentive declared by MNRE, shall be Rs.11.00 / kWh for sale to the distribution licensees and such tariff will be applicable for the grid connected solar PV projects commissioned upto 2009-10 and shall remain valid for ten years from the date of coming into force of these regulations. The capped price of energy for grid connected solar PV plants (including those plants which are availing accelerated depreciation benefit under section 32 of Income-tax Act,

1961) which are not eligible for aforesaid incentive declared by MNRE and commissioned after 2009-10 but on or before 31st March, 2012 shall be Rs.10/ kWh which shall remain valid for ten years from the date of coming into force of these regulations. If at any stage in future such a Solar PV Plant which was ineligible to avail the aforesaid generation based incentive becomes eligible for incentive declared by MNRE or by State or Central Government, the Commission may review the rate of Rs.11.00/ Kwh or Rs.10.00/ kWh, as the case may be, for sale to the licensees and fix a new rate duly taking into consideration the allowable incentive to such Solar PV plants. Any incentive received by the licensee from MNRE on this account shall be passed on to their purchasers of electricity. The Commission will take a fresh view on the price cap for grid connected Solar PV projects commissioned from 2012-13 onwards. The total purchase of energy of a licensee from grid connected Solar PV source in a financial year shall be limited in such a manner that the impact of purchase of such energy on the average cost of supply of the licensee as determined by the Commission in the respective tariff order of the year is less than 1 Paise / kWh in a year. Each proposal for addition of grid connected Solar PV power plant to the licensee's system will be examined and monitored by the licensee itself and the Commission is to be informed by the licensee about the aforesaid impact of cumulative capacity of solar PV projects in its licensed area on the average cost of supply of the licensee on the basis of actual data of a full financial year before finalizing any PPA or MOU with the developer of such solar PV power plant in the aforesaid area of supply of the licensee.

(b) Roof-top Solar PV sources of capacity ranging from 2 KW (peak) to 100 KW (peak) if installed for injecting into the distribution system of a licensee only by such institutional consumer(s) like Government hospitals and health centres, Government and Government aided schools and academic institutions, Government offices and organizations, any housing complex already promoted for this purpose by Government or any Government agency for the development of renewable sources, local bodies like municipalities, panchayats and cooperative societies of consumers located in the same premises, such injection from roof-top

solar PV sources of the above mentioned consumer(s) shall not be more than 90% of the consumption from the licensee's supply by the above mentioned consumer(s) in a financial year. Such injection from roof-top solar PV sources of the above mentioned consumer(s) shall be settled on net energy basis at the end of each financial year. Any excess energy injected by the above mentioned consumer(s) from the roof-top solar PV sources being more than the 90% of the consumption of energy by that consumer(s) from the licensee's supply in each billing period shall be carried over to the next billing period within that financial year. Slab tariff, as per tariff order, shall be applicable for the net energy supplied by the licensee in a billing period if the supplied energy by the licensee is more than the injected energy by the roof-top solar PV sources of the consumer(s) after taking into account the quantum of energy, if any, carried forward from earlier billing period(s) of that financial year. If in a billing period the supplied energy by the licensee is less than or equal to energy injected by the roof-top solar PV sources of the consumer(s) after adding the cumulative carried over injected energy from previous billing period(s) of that financial year the billed amount for energy will be nil for that billing period(s). At the end of the financial year, if the total energy supplied by the licensee to the consumer(s) for that financial year is found to be less than the energy injected by the roof-top solar PV sources of that consumer(s) for that financial year, the licensee shall not pay any charge to the consumer(s) for that net energy, injected by the consumer(s), in excess of 90% of consumption of that consumer(s) from the licensee's supply in that financial year and the same shall be treated as unwanted/inadvertant injunction. At the begining of each financial year, cumulative carried over injected energy will be reset to zero. Payment in a billing period by the consumer(s) (owning roof-top solar PV sources) to the licensee shall be guided by the provisions of the regulations made by the Commission under section 50 of the Act. For each billing period in a financial year the licensee shall show the quantum of injected energy from roof-top Solor PV sources in the billing period, supplied energy from it source in the billing period, net billed energy for payment by the consumer(s) for that billing period and net carried over energy to the next billing period separetely. Any delay

in payment shall attract surcharge at the agreed rate. The MOU/PPA to be signed between the licensee and developer of roof-top Solar PV sources shall include necessary terms & conditions of meter reading, billing, payment, payment of security arrangements, rate of delayed payment surcharge etc.

MSW & Bio-gas Plants

(i) **MSW**

The price at which the renewable energy from Municipal Solid Waste can be sold to a licensee is capped at Rs.4.50/ kWh and shall remain fixed for a period of five years from the date of coming into force of these regulations. Fuel for power generation from Municipal Solid Waste shall be generally from the garbage supplied by a municipality free of cost. A maximum fuel mix of 15% conventional fossil fuel shall be allowed on yearly basis.

(ii) **Bio-gas**

Electricity generated from Bio-gas Plant can be sold to the licensee at a capped price of Rs. 5 / kWh and shall remain fixed for a period of five years from the date of coming into force of these regulations. 5.4 All price caps as specified in these regulations shall include all applicable taxes and cost of connectivity through suitably connected line upto the nearest grid point.

The Commission may, at any time, review the period of capped price, mentioned in these regulations, if necessary.

Connectivity:

The cogeneration and renewable energy sources excepting roof-top Solar PV and bio-gas sources shall be connected to the State Grid at a voltage level of 33 KV or 11 KV / 6 KV subject to technical suitability determined by the licensee. If any dispute arises about the technical suitability of connection of such sources with the grid, the matter shall be referred to the Commission whose decision in this regard shall be treated as final. The delivery point shall be the nearest grid sub-station having 33 KV / 11 KV / 6 KV voltage level. Synchronization point shall, however, remain at the power station end with all protection and inter-lock as agreed between the licensees, STU and developers. Such connectivity shall also be provided for use of

licensee's system under Open Access. More than one such projects located near each other are to be clustered together as far as possible in order to avail connectivity with the grid sub-station.

Roof-top Solar PV sources of capacity as mentioned in regulation 5.2 (b) shall be allowed connectivity at LV or MV or 6 KV or 11 KV of the distribution system of the licensee as considered technically suitable by the licensee. Supply of electricity to the consumer(s) from the licensee's sources and that to the licensee's distribution system from the roof-top Solar PV sources shall be measured either by two separate meters, the readings of which shall be used in each billing period for settlement on net basis as specified in regulation 5.2(b) or alternatively by an export-import type meter suitable for directly measuring the net exchange. The meter for measuring the energy injected from Solar PV sources shall be provided by the licensee against applicable meter rent along with the connection of the meter upto the nearest technically suitable point in the distribution system of the licensee. The connectivity from the roof-top Solar PV sources upto the meter shall be at the cost and responsibility of the consumer(s) and shall be in accordance with the guidance of the licensee so that the licensee's distribution system is not affected by any fault in the system owned by the consumer(s).

Bio-gas Plants, if connected to the distribution system, shall be connected at 415 V, 3 phase or at 6 KV or 11 KV level of the licensee according to the technical suitability examined by the licensee.

Communication system between grid sub-station and generating station shall be developed by the developer/ developers at its / their cost. Protection schemes shall be examined by the licensee to suit the requirements. Developers of cogeneration and renewable energy sources shall abide by all applicable codes, rules, regulations *etc*. in regard to operational and commercial practices.

Wherever cogeneration and renewable energy sources have already been connected to the State Grid at a voltage level lower than the level specified and wherever such State Grid connection causes any bottleneck in capacity addition or causes avoidable discontinuance of generation or low voltage during peak hours or frequent outage of line or insufficient redundancy, such grid connection shall be converted to suitable voltage level preferably with double circuit line and cost for such conversion shall be borne by the developer.

Open Access for Cogeneration and Renewable Sources of Energy.

Any person generating electricity from cogeneration or renewable sources shall have open access, subject to availability of adequate transmission facility to any transmission licensee's system within the State on payment of various charges as specified.

Charges for Open Access.

All open access charges shall be payable as per Open Access Regulations and Tariff Regulations except meter rent, meter reading and other related charges.

Meter rent and meter reading and other related charges shall be paid by the open access customer at the rate of 0.75 paise / unit of monthly energy reading per month subject to a minimum of Rs. 500/- and maximum of Rs. 2,000/- per month and shall be paid to the licensee who is rendering such service.

Transmission Charges:

Transmission charges payable for open access availed by cogeneration and renewable energy sources shall be two third of the rate of such charges applicable for open access customers for long term and short term open access as determined in relevant tariff order.

Wheeling Charges:

Wheeling charges applicable for use of distribution system or associated facilities of a licensee by open access customers for conveyance of electricity from cogeneration and renewable energy sources shall be either one-third of the wheeling charges calculated as per tariff order under Tariff Regulations or 7.5% of the energy fed to the grid irrespective of the distance of wheeling, whichever is higher.

Reactive Energy Charges:

Reactive energy charges will be payable as per Open Access Regulations for all co-generation and renewable sources of power generation except for wind power generation. For wind power the rate will be 20 Paise / KVARh in place of the specified charges for reactive energy in Open Access Regulations.

Other charges for Open Access:

All other charges for open access shall be in terms of Open Access Regulations.

Un-scheduled / Mismatch Charges in Drawal / Injection:

Un-scheduled/mismatch charges in drawal/injection energy shall be mutually decided and agreed either on ABT basis or on TOD basis. A 24 hour day ahead schedule shall be submitted by the open access customer/generator to the Nodal Agency on mutually agreed time block. Un-scheduled/mismatch charges for deviation from the schedule shall be paid weekly as per rate as specified in the Tariff Regulations. The modalities regarding billing and payment mechanism shall be in accordance with the Tariff Regulations. Wind power generation, grid connected solar PV sources and roof-top solar PV sources shall be excluded for unscheduled interchange payment.

Procedure to be followed for Cogeneration and Renewable Energy Sources:

After preliminary discussions with the buyer licensee, the developer shall submit full details of the projects along with cost data and financial charges and tariff for direct sale to the licensee.

The buyer licensee shall examine the tariff proposal in the light of price reasonableness, impact on consumer tariff and the price cap specified in these regulations.

MOU / PPA shall be signed between developer and purchaser. In case of open access, the transmission and/or wheeling agency shall also be a party to the MOU / PPA. In the MOU / PPA with details of connectivity, completion of project and commencement of supply, periods of supply (month wise), time of supply (peak / off peak), technical & commercial obligation, security and modes of payment of each party, etc. in line with these regulations shall be suitably incorporated. The MOU / PPA, as agreed and signed, shall be submitted to the Commission.

While considering the tariffs for NCE sources, the Commission too recognises the following advantages in promoting non-conventional / renewable sources of energy:

i) Conserving the fast depleting fossil fuels.

ii) Reducing environmental pollution.

iii) Social benefits (direct / indirect)

- Providing employment to (mostly) rural population.
- Developing skills among rural population.

iv) Distributed generation as envisaged in the Electricity Act 2003.

v) No rehabilitation is involved in most of the cases.

vi) Short gestation periods.

vii) No environmental concerns.

viii) Reduction in green house gases and protection of the Ozone layer.

ix) Solution for disposal of garbage / Industrial Waste.

The Commission is keen to fix the tariff for NCE sources broadly in line with the following principles:

a) Transparency and interaction with the public, utility and developers.

b) Balancing the interest of all stakeholders

c) Consistency in principles and their application

d) Minimization of regulatory uncertainty

APTRANSCO has submitted that two part tariff cannot be applied for NCE projects for the following reasons:

i) They are not dispatchable as per existing practices in State.

ii) Power is not firm.

iii) Variable component of tariff is variant and not transparent thereby making price discovery mechanism difficult.

iv) While 97% of the total energy is purchased from only 14 suppliers, the balance 3% is purchased from 89 NCE developers.

v) Implementation of two part tariff in respect of NCE developers would therefore involve large administrative machinery for monitoring and settlement. Hence, according to APTRANSCO, two part tariff is not practicable.

Some of the objectors too suggested that tariffs be determined on single part basis.

Tariff Determination

Some of the objectors have criticised the current practice of maintaining the same tariff for all categories of NCE sources. The Commission is also of the same view as the project cost and the fuel are different for each category and allowing the

same tariff across the categories is neither appropriate nor in the interests of the consumers. The Commission has decided to fix the tariff on cost-plus approach so that each element of fixed and variable cost is properly addressed and not to follow any other adhoc basis for fixing the prices at which the different categories of NCE developers sell electricity to APTRANSCO.

Accordingly, the following factors are taken into consideration in determination of the tariff:

i) Capacity of the plant
ii) Project cost per MW
iii) Plant load factor
iv) Heat rate of the plant
v) Calorific value of the fuel
vi) Cost of fuel
vii) Hydrology risks (hydro plants)
viii) Auxiliary Consumption
ix) Operation & Maintenance (O & M) Expenditure, O & M escalation
x) Debt-equity Ratio
xi) Return on equity (ROE)
xii) Interest on term loan
xiii) Interest on working capital
xiv) Depreciation
xv) Royalty on water charges (hydro)

Because of lack of convergence of the views of APTRANSCO and the developers on certain basic issues like cost of fuel and consumption, the Commission deputed the officers of the Commission to some of the NCE projects to study the working of the power plants, type of fuel used and their consumption, to get an indication of the working of such NCE projects.

The data obtained by the staff is co-related with the material available on record and the Commission made efforts to balance the interests of all the stakeholders, while keeping the primary objective of promoting NCE based power projects.

Methodology:

The key issue involved in determination of tariff in case of projects is whether to consider single part tariff or two part tariff.

The Commission recognizes the fact that two part tariff will be difficult to implement in view of the large number of the plants of low capacity. But at the same time, the Commission considers that beyond the threshold level of generation, the developers should get only variable cost (if any) and incentives and not the fixed charges. The Commission would also like to determine the tariff for all the projects of one category based on the year of commissioning of each project.

Tariff determination for Bagasse based Co-generation Plants

Taking into account the technical and financial parameters considered by the Commission in the preceding paragraphs, the fixed cost tariff for Bagasse Based Co-generation Plants is estimated as follows:

Year of operation (n^{th} year)	**Fixed Cost Rs / Unit**
1st	1.72
2nd	1.67
3rd	1.63
4th	1.59
5th	1.55
6th	1.51
7th	1.47
8th	1.43
9th	1.35
10th	0.90

The variable cost tariff for Bagasse based projects is estimated as follows:

Financial Year	**Variable Cost Rs / Unit**
2004-2005	1.02
2005-2006	1.07
2006-2007	1.12
2007-2008	1.18
2008-2009	1.24

The above tariff includes annual escalation on variable cost and O & M expenditure.

The existing and new projects shall be entitled to a tariff with the component of fixed charge based on the year of operation (n^{th} year) and variable charge corresponding to the financial year of the operation.

As observed earlier, fixation of uniform tariff across all Bagasse based co-generation plants with varying capacities, technologies and operating conditions would lead to uneven tariffs and undue enrichment of some developers. The Commission therefore proposes a two tier tariff for the Bagasse based co-generation plants distinguishing those operating up to 55% PLF and others operating above 55% PLF. Where, Plant Load Factor during a settlement period exceeds 55% (the level at which the fixed cost is expected to be recovered), only variable cost indicated above and incentive of 21.5 paise / unit as explained in Para (47) below shall be paid for every unit delivered in excess of the above PLF.

Incentive

One of the objectors has pointed out that only incentive should be paid beyond the threshold level of PLF. The Commission has noticed that some of the Bagasse based co-generation projects are generating beyond the threshold level of 55% also. The Commission is inclined to encourage this non-conventional generation. But at the same time, the consumers should not be burdened with the same tariff beyond threshold PLF as the developers would have recovered the entire fixed cost at the threshold level of PLF itself. In order to encourage the developers and without unduly burdening the consumers, the Commission deems it fit to provide an incentive of 21.5 paise per unit as fixed by Central Electricity Regulatory Commission (CERC) in its tariff notification dated 20th December, 2000 for conventional generation projects. This incentive will be for actual generation beyond the threshold PLF of 55% at generator terminals i.e. including captive and auxiliary consumption.

Tariff determination for Biomass based Power Projects

Taking into consideration the technical and financial parameters as discussed above, the fixed cost tariff for the Biomass Power Projects works out as follows:

Year of operation (n^{th} year)	**Fixed Cost Rs / Unit**
1st	1.61
2^{nd}	1.57
3^{rd}	1.53
4^{th}	1.49
5^{th}	1.45
6^{th}	1.41
7^{th}	1.37
8^{th}	1.33
9^{th}	1.26
10^{th}	0.87

The variable cost tariff for Biomass based projects is estimated as follows:

Financial Year	**Variable Cost Rs / Unit**
2004-2005	1.27
2005-2006	1.33
2006-2007	1.40
2007-2008	1.47
2008-2009	1.54

The above tariff is inclusive of annual escalation on variable cost and O & M expenditure.

The existing and new projects shall be entitled to a tariff with the component of fixed charge based on the year of operation (n^{th} year) and variable charge corresponding to financial year of operation.

One of the objectors has suggested that the Commission should consider only the actual levels of PLF achieved by different types of NCE projects for fixing the PLF for fixed cost. As observed earlier, fixation of uniform tariff across all Biomass based plants with varying capacities, technologies and operating conditions would lead to uneven tariffs and undue enrichment of some

developers. The Commission therefore proposes a two tier tariff for the Biomass based plants distinguishing those operating up to 80% PLF and others operating above 80% PLF. Where Plant Load Factor during a settlement period exceeds 80% at generator terminals i.e. including captive and auxiliary consumption (at which level the fixed cost is expected to be recovered), only variable cost indicated above and incentive of 21.5 paise / unit as explained in Para (63) below shall be paid for every unit delivered in excess of the above PLF.

Incentive

The Commission has noticed that many of the Biomass projects are generating beyond the threshold level of 80% also. The Commission is inclined to encourage this efficiency. But at the same time, the consumers should not be burdened with the same tariff beyond threshold PLF. In order to encourage the developers and without unduly burdening the consumers, the Commission allows incentive similar to that of conventional generation projects. The incentive will be at the rate of 21.5 paise / unit of actual generation beyond the threshold PLF of 80% as the developers would recover the entire fixed cost at the threshold level of PLF itself.

Tariff fixation for mini – hydel projects:

Taking into account the technical and financial parameters considered by the Commission, the tariff for mini hydel power plants is estimated as follows.

Year of operation (n^{th} year)	**Tariff Rs / Unit**
1st	2.60
2nd	2.52
3rd	2.44
4th	2.36
5th	2.27
6th	2.19
7th	2.11
8th	2.03
9th	1.95
10th	1.88

The existing and new projects shall be entitled to a tariff based on the year of operation (n^{th} year).

The above tariff is exclusive of the Royalty. As observed earlier, fixation of uniform tariff across all mini hydel power plants with varying operating conditions would lead to unequal tariffs. The Commission therefore proposes a two tier tariff for the mini hydel power plants distinguishing those operating up to 35% PLF and other operating above 35% PLF. The Tariff indicated above will be applicable for the Power Plants up to PLF of 35% and where PLF during a settlement period exceeds 35%, only an amount of 21.5 Ps. as has been allowed to other categories of NCE developers (in place of the tariff indicated above) shall be paid for every unit delivered in excess of 35% PLF at generator terminals i.e. including captive and auxiliary consumption.

A Municipal waste and Industrial waste based projects

The Developers of Waste to Energy stated that their projects are demonstrative and first of its kind in India where earlier performance data is not available. In view of high risk and the projects being social and environmental friendly, special incentives / price should be given for promoting such projects.

These power projects can be categorized into

a) Industrial waste to energy

b) Municipal waste to energy

The Commission notes:

- The projects are in the nascent stage.
- The essential raw material (fuel) is industrial waste / municipal waste
- Fuel is delivered at no cost or nominal cost
- Handling of fuel, processing and transportation of processed fuel from municipal dumping yards to power houses constitutes the price of raw material.
- No operating experience and hence capacity factor cannot be predicted.

While the need to dispose off these wastes to produce useful energy without causing environmental and civic problems cannot be over-emphasized, the responsibility to dispose off these waste products vests with the concerned agencies.

While the Commission has no reservations whatsoever that the projects of this type need to be encouraged, the agencies responsible for disposal of these waste products should share the cost of implementation of these projects with the developers.

a) Industrial waste to energy :

Among the NCE projects, industrial waste to energy projects are identifiable more with the Biomass projects. Hence, the Commission treats Industrial waste based power projects on par with Biomass projects and authorizes purchase of the energy by APTRANSCO at the rates permitted for sale of power from Biomass power projects.

b) Municipal waste to energy

This category requires a special treatment considering the nature of the project activities. These are in the nature of public utility service. The capital cost of the projects is in the range of Rs. 6 Crs / MW. The Commission is therefore of the opinion that the project of electricity generation from Municipal Waste should have a different tariff and therefore is inclined to continue the tariff for these projects on the guidelines of MNES in refined format without going into the cost details and rationalize the tariff by adopting following methodology.

The Commission likes to retain the base unit price of Rs. 2.25 as on 1.4.1994 and the escalation index of 5% p.a. But, the escalation would be simple and not compounded every year. In other words, the base price as on 01-04-2004 will be Rs. 3.37 / unit. For the reasons explained earlier, the Commission considers this as a reasonable tariff for municipal waste to energy projects.

Wind Electricity Generating Plants

There are about 24 developers in the State who own nearly 270 wind energy generators of varying capacities. Hence each generator is potentially a different

project. The tariff determination for each project therefore would be a very difficult task for the Commission.

While analyzing the performance of these projects over the past three years, it is observed that the capacity factors achieved have been widely varying, from 10% to 20%, depending on the site, technology adopted and efficiency of management of operations.

However, the Developers acknowledged that there is improvement in the technology and the project costs have also come down as 50% of the components for Wind Farm are manufactured in India.

Further, from the October, 2002 MNES publication on Wind Power Development in India, the following is noted:

Development of Wind Energy Technology has made a significant progress. Present-day Wind Turbines are highly sophisticated machines incorporating advanced technologies and are designed to deliver energy across a range of wind speeds. The cost of generation has reduced dramatically as manufacturing and other costs have come down. The introduction of higher capacity machines with large rotor diameter and higher hub height will enable more cost effective and effective harnessing of Wind Power. It is expected that cost could fall as a result of economies of scale as market expands.

Plant Load Factor:

In case of Wind Energy generating plants, the PLF depends mostly on wind velocity at the project site, changes in environment etc, apart from technology.

APTRANSCO assumed a PLF of 25% while NEDCAP indicated a PLF of 16% for existing plants and 20% for the new plants. M/s. IL & FS Wind Farm and other developers stated that the average PLF is around 12%. Indian Wind Turbine Manufacturers Association estimated a PLF of 20% whereas Indian Wind Power Association, Karnataka Council, estimated a PLF of 23% with better rotor profile and hub height. M/s. IL & FS Wind Farm also recommended a PLF of 18% for new plants on account of increasing hub height from 35mt to 50mts.

APTRANSCO stated that normative PLF at 25% is assumed as most of the DPRs have estimated PLF at this range. They also recommended economic justification for the utilisation of assets.

The data submitted by the Developers, APTRANSCO and NEDCAP in support of PLF achieved for the existing plants is as under.

Site	2000-2001	2001-2002	2002-2003
Ramgiri	10.71%	11.30%	10.02%
Tallimadugula	12.92%	14.08%	13.56%
Kadavakullu	11.46%	18.66%	14.38%
Kondameadpally	---	20.97%	19.44%

In the above statement, the capacity of all the Wind plants installed, some of which are defunct and are not operating has also been considered for arriving at average PLF. Low capacity utilisation in comparison to similar projects can be due to operational inefficiencies of the particular plant and such aberrations should not be considered for tariff working.

APTRANSCO submitted data for PLFs as follows.

Site	2000-2001	2001-2002	2002-2003
Ramgiri	**16.6%**	**18%**	**18%**
Kadavakallu	**---**	**21%**	**18%**
Kondameadpally	**---**	**----**	**19%**

The generation report submitted by NEDCAP for 2001-02 indicates average PLF of around 16.5% and later indicated that 20% PLF can be considered for new projects.

From the data submitted it was noticed that even in Ramgiri (where the plants are reported to be operating at lowest PLF) the PLF of some of the plants stands at 17%-19%, which may be due to efficient management of the power plant by some of the developers.

As per MNES publication, generally, the wind farms can have capacity utilization in the range of 20%-25%. MNES has already identified the sites having Annual Mean Wind Power density grater than 200 kgs / sqmt at a height of 50 mt, which are considered suitable for Wind power projects. It is acknowledged that some of the existing projects were under-performing, initially due to inappropriate

selection of sites, inadequate data, lack of compatibility of machine with Indian environmental conditions, stability, outage problems, grid faults etc. The initial problems are mainly overcome as a result of feedback from earlier projects.

With a detailed and thorough project planning and implementation with improved O & M services, the availability and performance of machines can be improved considerably even in existing projects. New projects with modern machines of lighter and larger blades, higher tower heights, direct drive, variable speed gears and operation using advanced power electronics can have considerable impact in achieving higher PLF. Recently erected Enercorn Power Projects with 1 x 230 kW units at Tirumala, is reported to have achieved a higher PLF of around 36%. Considering the uncertainties as discussed above, a strictly "Cost plus" approach if adopted would lead to distortions and would result in higher tariff for the initial years and the resultant extra burden on the consumers.

Indian Wind Power Association proposed following three alternatives for 20 year term for power purchase, quoting that these would mitigate the higher tariff for the initial years:

- Rs. 3.41 / unit with 2% escalation every year.
- Rs. 3.29 / unit with 4.5% escalation every alternate year.
- Levellised cost of Rs. 3.74 / unit

Indian Renewable Energy Association and other developers wanted continuance of the MNES policy. The Commission therefore is inclined to continue the guidelines of MNES in a refined format without going into the cost details and rationalize the tariff by adopting the following methodology.

Energy purchase rate: The Commission likes to retain the base unit price of Rs. 2.25 as on 1.4.1994 and the escalation index of 5% p.a. But, the escalation would be simple and not compounded every year. In other words, the base price as on 01-04-2004 will be Rs. 3.37/kwh. As these projects have no variable expenses and negligible increase in maintenance cost, the tariff will be frozen for a period of five years, to be reviewed however, thereafter.

Conclusion:

The tariffs arrived at along with escalation under each category will be applicable as detailed in the respective paragraphs under each category. The aforementioned tariffs are, however, also subject to the following:

i) In regard to tariff for Bagasse based co-generation projects, where the Plant Load Factor during a settlement period exceeds 55% (the level at which the fixed cost is expected to be recovered), only incentive of 21.5 paise /unit and variable cost as indicated in para (47) above shall be paid for every unit delivered in excess of the 55% PLF.

ii) As regards to tariff for Biomass based power projects, where the Plant Load Factor during a settlement period exceeds 80% (the level at which the fixed cost is expected to be recovered), only incentive of 21.5 paise / unit and variable cost as indicated in para (63) above shall be paid for every unit delivered in excess of 80% PLF.

iii) The tariff for mini-hydel power projects is exclusive of Royalty.

iv) In the case of tariff for mini-hydel power projects, where the PLF during settlement period exceeds 35%, only an incentive of 21.5 paise/kwh shall be paid for every unit delivered in excess of 35%.

v) The tariffs authorized above will be applicable w.e.f 01-04-2004 to all NCE power plants of respective categories for sale to APTRANSCO.

vi) The above tariff structure is valid for a control period of five years with effect from 01-04-2004. Thereafter, the Commission will review the prices and incentives after consultation with the Developers and licensees.

vii) A further review of the individual projects will be undertaken on completion of 10 years from the date of commissioning of the project, by which time the loan is expected to have been substantially repaid, and the purchase price will be based on O & M expenditure, return on equity, variable cost and residual depreciation, if any.

viii) For those developers having captive consumption who supply excess energy to APTRANSCO after meeting their internal consumption, the current practice of meter reading at the interconnection point and grossing up for auxiliary consumption in order to arrive at PLF will be misleading as it will not take into consideration the captive consumption. The incentive payments begin after threshold PLF. In order to ascertain the PLF levels, APTRANSCO should make arrangements for authenticated meter reading at the generator terminals so that the two-tier tariff is properly implemented.

ix) Developers will be entitled to dispatch 100% of the available capacity without reference to Merit Order Dispatch subject, however, to any system constraints.

Punjab State Electricity Regulatory Commission (PSERC)

PSERC vide Order dtd. 13.12.2007 discussed on the New & Renewable Sources of Energy (NRSE) Policy, 2006 of Government of Punjab and finalized the NRSE Policy for the State of Punjab as under:

Govt. of Punjab (GOP), Department of Science, Technology, Environment and Non-Conventional Energy has notified its NRSE Policy 2006 in its Notification No. 10/106/06-STE (1)/5390 dated 24th November, 2006. Salient features of this policy are:

(i)	Share of generation from NRSE based plants to be 10% of conventional power by the year 2020.	
(ii)	Tariff	
	• Biomass,Urban/Municipal/Ind. liquid /solid waste to energy and wind power projects.	Rs.3.49/unit (with base year 2006-07) with five annual escalations @ 5% up to 2011-12.
	• Mini/Micro Hydel, Bagasse/Biomass based Co-generation.	Rs.3.49/unit (with base year 2006-07) with five annual escalations @ 3% up to 2011-12.
	• Solar energy	Rs.7.00/unit (with base year 2006-07) with five annual

		escalations @ 5% up to 2011-12.
	At the end of the above specified escalation periods, the tariff payable shall be the last escalated tariff or the PSEB HT tariff applicable in that year whichever is higher. PSEB/Licensees can purchase power from NRSE projects set up outside the State in the Northern Region at the same tariff applicable to NRSE projects within State.	
(iii)	In case of projects where MOUs/implementation agreements have already been signed by PEDA, under the NRSE Policy – 2001, but PPAs are yet to be signed by PSEB, tariff as per the NRSE Policy, 2006 shall be applicable.	
(iv)	Co-generation plants qualifying as per the criteria in the policy are eligible for consideration of benefits.	
(v)	Wheeling charges shall be 2% of the energy fed to the grid irrespective of the distance from the generating station.	
(vi)	NRSE generators would be entitled to third party sale.	
(vii)	NRSE developers are to pay a percentage of the energy generated to PEDA. PEDA will, in addition, charge 0.1% of the project cost as facilitation charges for all NRSE projects.	
(viii)	Private developers shall file petition in the PSERC for tariff approval within 15 days of signing of implementation agreement. For wheeling of energy such developers shall file a petition with the Commission for approval of wheeling charges.	

The Notification of NRSE Policy by the State Govt. was followed on 16.7.2007 by a Directive to the Commission under Section 108 of the Electricity Act, 2003 (Act) which is reproduced as under:

"In pursuance of the provisions of sub-section (1) of Section 108 of the Electricity Act, 2003 (Central Act 36 of 2003) and all other powers enabling him in this behalf, the Governor of Punjab is pleased to give the following directions to the Punjab State Electricity Regulatory Commission, namely:-

i. that the provisions of the New and Renewable Sources of Energy Policy, 2006, as notified by the Government of Punjab, Department of Science, Technology, Environment and Non Conventional Energy, Notification No. 10/106/2006-STE(1) 5390, dated the 24th November, 2006 should be complied with in letter and spirit.

ii. that the said Commission shall not decide the tariff of New and Renewal Sources of Energy Projects on case to case basis, but shall include the tariff for that particular year in their annual tariff order; and

iii. that while issuing tariff Order for the concerned year, the said Commission shall comply with the provisions of the New and Renewable Sources of Energy Policy, 2006."

On receipt of the Directive, the Commission deliberated upon the issue of implementing the Policy as enunciated by the State Govt. It noted some legal infirmities and inconsistencies in the policy which were brought to the notice of the Govt. in its communication dated 20th August, 2007 (Annexure-I) wherein it was also suggested that the Directive needs to be held in abeyance. The State Govt. has, in its letter dated 17.10.2007 (Annexure-II), reiterated the Directive observing that it be implemented in letter and spirit.

The Commission has again given its earnest consideration to the question of implementing the NRSE Policy of the State Govt. in the light of its Directive. In its communication to the State Govt., as in Annexure-I, the Commission had interalia pointed out that issues such as determination of generation tariff of the NRSE developers or indeed of any other generator are according to the Electricity Act, strictly within the purview of the Commission. In addition, wheeling charges and the percentage of NRSE power that a licensee must necessarily procure has also to be determined by the Commission in terms of Section 86 of the Act. In the situation, where the Govt. even on reconsideration has reiterated its Directives, it becomes necessary for the Commission to first determine the scope of Directives issued under Section 108 of the Act and see whether these can override the provisions of the Act itself. Section 108 of the Act clearly stipulates that the Govt. is empowered to issue directive in matters of policy and that Government's decisions as to what constitutes matters of policy would also be final. However, neither Section 108 nor indeed any other section of the Act specifically empowers the Govt. to override other provisions of the Act while issuing a directive under Section 108 of the Act. As mentioned earlier, Sections 62, 64 and 86 of the Act

specifically empower the Commission to determine generation tariff, regulate electricity purchase, fix cost of wheeling power and the percentage of the NRSE power that a Distribution Licensee must source over time. In para 2 of the Government's letter dated 17.10.2007, it has in fact been admitted that these powers no doubt vest with the Commission but Govt. has considered it necessary to make a specific prescription in this respect on the ground that there has been delay in determining these issues by the Commission and that consequent policy confusion is detrimental to the development of the NRSE power in the State.

The Commission appreciates Government's concern as to the need for encouraging development of NRSE power in the State as well as providing a stable policy environment to achieve that objective. In fact, the Commission is also statutorily bound to encourage NRSE projects as per provisions of Section 86 (I) (e) of the Act. However, such concerns of the Government can not be taken to mean that it can at any time exercise powers that are not vested with it under the Act by issuing directives under Section 108 of the Act. The fact that the Commission may not have taken a final view on NRSE tariffs and associated issues can not be an occasion for the Government to step in and fill the void. It is necessary in this context to also observe that neither the Act nor the National Tariff or Electricity Policy lays down any specific time table for the fixation of NRSE tariffs by the Commission. Moreover, the Commission had initiated the exercise to determine such tariffs when GOP reiterated its directive. In the light of position highlighted above, the Commission must inescapably conclude that Government Directives can not, in any manner, override other specific provisions of the Act. Accordingly, the Commission intends to align those aspects of the NRSE Policy as enunciated by the Government which come into conflict with the provisions of the Act or otherwise require clarification. These matters are dealt with in the succeeding paras.

Government Policy provides for a uniform tariff for NRSE power of Rs.3.49 per unit starting with the base year 2006-07 with annual escalation thereon. In the case of solar power, however, the rate determined is Rs.7.00 per unit. The Commission had initiated the exercise of determining tariff in respect of NRSE

power from different sources and a working paper thereon had been published for inviting objections of the public. The tariff rates indicated therein had varied for different types of NRSE power given the fact that both technologies and fuels are different in each case. It is evident that the rates given in the initial working paper of the Commission vary considerably from those fixed by other Commissions as well as from rates suggested by effected parties in response to the Public Notice. In the normal course, the Commission would be obliged to go into this matter in further detail, obtain expert technical opinion, if necessary, and give its findings on the rates that should be applicable for different categories of NRSE power. The Commission has chosen not to adopt this route as it would be somewhat time consuming and lead to a policy vacuum till such time the Commission finalizes this exercise. The Commission has taken note of rates fixed in adjoining states such as Haryana, Uttar Pradesh and some other states such as Andhra Pradesh, Maharashtra and Karnataka. NRSE rates in the case of Karnataka, Maharashtra and Andhra Pradesh were fixed a while ago and are decidedly lower than those fixed in Uttar Pradesh and Haryana. It is obvious that for the purposes of comparison, it is more relevant to take into account the rates that have been determined in Punjab's neighbourhood. Looking at the rates as fixed in Haryana and Uttar Pradesh, it is seen that the lowest rates are for hydel power and these are marginally more than the rates proposed by the GOP. Rates for other NRSE categories such as co-generation, bagasse and agro based power also vary but are invariably higher than the rates determined for hydro based power. In these circumstances, the rate of Rs.3.49 with the year 2006-07 as base appears to be reasonable when compared with rates in the neighbouring states. Accordingly, the Commission approves rates as indicated in the GOP NRSE Policy subject to the following observations:

a. These rates will be considered the minimum rates that a NRSE developer can claim. It is entirely possible that NRSE projects adopting different technologies and/or fuels might need enhanced rates for their encouragement. Therefore, individual developers would be free to approach the Commission for determination of such rates. The

Commission will, at that stage, decide whether rates are to be approved individually in each case or generically for a category of cases.

b. The tariff rate for purchase of power by the Board/Licensee during the year 2007-08 shall be

• Biomass,Urban/Municipal/Ind. liquid /solid waste to energy and wind power projects	366 P/Unit
• Mini/Micro Hydel, Bagasse/Biomass based Co-generation	359 P/Unit
• Solar energy	735 P/Unit

c. The Commission notes that an important element of Government's policy is to encourage NRSE sector by offering attractive rates initially for a period of 5 years and in case there is no further revision in subsequent policies, rates payable to such projects would be those applicable to PSEB's HT consumers. The effect of this stipulation is that attractive tariff rates intended to encourage investment in this sector will be made available to developers in perpetuity. It is entirely understandable that such rates must be available over the period of pay back of any particular project and even beyond that to allow entrepreneurs earn reasonable profits on their investment. However, enhancement of these rates in perpetuity is not justified and is against the long term interests of the consumers. Accordingly, the Commission holds that rates as prescribed in the Policy will be applicable for a period of 5 years (upto 2011-12) after which the last escalated tariff shall continue and the Commission will determine the manner in which further enhancement in tariff, if any, by way of encouragement to the sector is to be effected.

d. Para III of the Policy stipulates that a Distribution Licensee in the State can purchase power from NRSE projects set up outside the state in the northern region in case power generated by such projects is less than 10% of conventional power. The Commission has separately observed that the present percentage of NRSE power in the State as compared to the total

power supply is less than 1% and it would take considerable effort and time before the percentage of NRSE power can reach anywhere close to 10%. Thus, this provision implies that NRSE projects located outside the state but in the northern region will for considerable time be entitled to supply power to the State at the above approved NRSE rates. The scheme of the Act requires each state to encourage NRSE power projects within their own jurisdiction and thus this stipulation goes beyond that obligation in incentivising NRSE power projects outside the state. Perhaps, the only justification for such a provision can be that it will enable access to hydel based NRSE power in the neighbouring states but that advantage would also not be available if NRSE rates after 5 years are to be perpetually linked to the escalated tariff or PSEB's HT tariff applicable in a particular year whichever is higher. The Commission has in para (c) above already observed about the need to take a second look at tariff based incentive beyond the initial period of 5 years and this becomes specially important when encouragement of NRSE based projects outside the state is being advocated at the cost of the Punjab consumers.

Government Policy provides that all NRSE projects to be undertaken within the state will be facilitated by PEDA and brought before the empowered committee for approval. However, such a procedure cannot obviously be applicable to NRSE projects based outside the state which are supplying power to Punjab. Thus, Govt. would need to look at the creation of credible administrative mechanism that certifies that such projects are indeed NRSE based and are not conventional power generators. An added issue is the manner in which cost of wheeling and transmission losses is to be accounted for in respect of projects located outside the state. The Policy does not make any specific reference to this matter but the Commission would like to clarify that transmission losses and wheeling costs upto the State boundary are to be borne by the developer and the NRSE tariff, as approved, is the net amount payable for power supplied at the touch point of the State grid. Para 4(ii) of Appendix-

II of the Policy further describes Northern Region as the Northern Regional Power System and goes on to clarify that the system comprises of the power systems and generating stations of Union Territory, Chandigarh, States of Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttar Pradesh, Uttranchal, Delhi and National Thermal Power Corporation, National Hydroelectric Power Corporation, Nuclear Power Corporation, Power Grid Corporation of India, Satluj Jal Vidyut Nigam, Tehri Hydro Development Corporation and Bhakra Beas Management Board. While the inclusion of states in the Northern Region is understandable, there is complete lack of clarity as to how other entities can qualify as NRSE producers. For the moment, therefore, the Commission accepts only NRSE projects located in the states in the Northern Region as those entitled to supply power to Punjab at the rates approved. The Government might, at the same time, like to clarify the manner in which the other entities are entitled to be classified as NRSE producers.

e. Para 4(ii) of Appendix-II of the Policy provides that NRSE tariff would also be available in the case of such projects where MOUs/Implementation Agreements had been signed under the State Government's NRSE Policy 2001 but Power Purchase Agreements are yet to be signed by PSEB. The Commission notes that in addition to the above mentioned categories of cases, there are a fairly large number of other projects where Power Purchase Agreements have already been signed in pursuance of MOUs/Implementation Agreements of the developers with PEDA but no concrete steps have thereafter been taken to implement the project for one reason or another. In any case, it is evident that the latter category of cases have taken atleast one more additional step for implementing the project but they are being penalized as compared to those developers who failed to proceed beyond signing the initial MOUs/Implementation Agreements. The Commission is of the view that the distinction drawn between the above two categories of projects is invidious and detrimental to the

interests of developing the NRSE sector. The Commission observes that in either case, substantial steps towards project execution are yet to be initiated and the developer of either category will have to incur enhanced costs before their projects can come into operation. With a view to encouraging the actual setting up of these projects, it might therefore be necessary to offer incentives of enhanced rates to both categories. The Commission, accordingly, allows rates as approved in this order to both categories subject to the condition that these would not be applicable in the case of such projects that have achieved COD before the announcement of the GOP NRSE Policy, 2006.

f. In order to protect the interests of the PSEB and consumers in general, PEDA and State Government may take suitable steps to ensure that the developers/plant owners continue to supply power at prescribed rates during the entire period of contract.

Para II of the Policy stipulates that the objective is to develop NRSE based power to a degree that it would be 10% of the conventional power requirements of the State by 2020. On the other hand, Section 86(1)(e) of the Act requires the Commission to specify the percentage of power from NRSE sources that will be purchased by each Distribution Licensee for sale in its area of operation. Thus, there is an immediate requirement to prescribe this percentage and increase it in a phased manner. From data made available by PEDA, the Commission observes that the NRSE power as a percentage of the total power distributed in the State is less than 1% in the year 2006-07. Taking into consideration, the NRSE projects in the pipeline and likely to be established over the next 5 years, the Commission orders that the PSEB as the Distribution Licensee in Punjab will purchase minimum NRSE power as indicated below:

Year	Minimum percentage of purchase from renewable sources
2007-08	1%
2008-09	1%
2009-10	2%

2010-11	3%
2011-12	4%

Para 4 (ii) of Appendix-II, annexed to the Policy, provides that a producer of NRSE power will have the option to sell electricity generated to a third party within the state on such terms and conditions as may be mutually agreed upon. The Commission observes that one of its functions under Section 86(1)(e) of the Act is to promote NRSE generators by providing suitable measures enabling sale of such electricity. The overall scheme of the Act as enshrined in Sections 9, 10 and 42 of the Act envisages that electricity can be sold to a consumer either by a Licensee or by following the Open Access route. In the light of these provisions, the Commission concludes that while it is possible to provide for third party sale by NRSE generators on terms that may be mutually agreed upon, such sale can, however, be permitted only by adopting the open access route and paying such charges as prescribed in the Open Access Regulations notified by the Commission. Same principles will apply for transmission and wheeling of NRSE power for captive use. Accordingly, the Commission decides as under:

a. The Policy of the State Govt. stipulates that PSEB/Licensees will undertake to transmit NRSE power through their grid at uniform wheeling charges of 2% of the energy fed into grid irrespective of the distance from the generating station. As already observed above, the determination of wheeling charges is a function assigned to State Commissions under Section 86 of the Act. The Commission has already framed Open Access Regulations. These Regulations, as a measure of encouragement to NRSE Developers, already provide that transmission and wheeling charges in case of NRSE power shall be levied @ 2% of the energy injected into the state grid irrespective of distance. Accordingly, wheeling of power generated from NRSE Projects will be permitted on the basis of such wheeling charges including transmission charges as prescribed in the Open Access Regulations.

b. NRSE Policy 2006 is silent about T&D losses. The NRSE generators shall compensate the Licensee as per Open Access Regulations for T&D losses in this regard.

c. Other charges such as surcharge, operation charges, additional surcharge, UI charges and reactive energy charges will also be payable by the NRSE generators, as per Open Access Regulations

The Commission further observes that Open Access charges leviable in the State of Punjab are moderate and that payment of such charges, in addition to tariff that may be mutually agreed upon between a NRSE generator and a third party consumer, would continue to provide sufficient incentive for NRSE generation and third party sale.

The Policy provides that private developers will file a petition before the Commission for approval of tariff which would then be given effect by licensees for signing the PPAs within 45 days. On the other hand, the directive of July 2007 issued by the State Govt. enjoins that the Commission shall not decide the tariff of NRSE projects on a case to case basis. Clearly the provisions of the Policy and the directive contradict each other. The Commission has in this order already approved the rates that will be applicable to developers of NRSE power, wheeling costs thereof and the manner in which sale can be effected to third parties. In the light thereof, individual developers need not, in future, file separate petitions before the Commission and so long as PPA's conform to the findings of the Commission in this order they would be free to approach the licensees for signing of PPAs on that basis.

Orissa Electricity Regulatory Commission (OERC)

In case of Orissa, under the "Single Buyer Model" of power procurement by GRIDCO for DISTCOs in Orissa, the Commission in their Order dated 23.04.2005, in Case No. 151 of 2004 –

(a) Have specified the quantum of energy to be sourced from the renewable energy projects as 200 MU for 2006-07.

(b) Further, the Commission, in their Order have directed that the unit cost of renewable energy should not exceed the highest generation cost of the thermal stations in the Eastern Region.

The Commission further in its Order dated 20.08.2005 in Case No. 14 of 2005 directed as under:-

(a) That procurement of power from non-conventional and renewable energy such as, small hydro, wind, biomass, co-generation of electricity from waste heat products etc. would be allowed by the supply licensees for use of consumers within the State upto 3% of the total purchase during the FY 2007-08 to go up at the rate of 0.5% per annum for each subsequent year to reach a level of 5% by the year 2011-12.

(b) OERC vide Order dtd. 20.08.2005 categorically mentions that small, mini, micro plants may not be in a position to arrange for connectivity with the OPTCL as the cost of such arrangements may be quite exorbitant rendering the project unviable. Therefore, the generating companies of non-conventional and renewable sources would be permitted by DISTCOs / OPTCL to deliver the power at 11 KV or 33 KV as the case may be. Depending upon the techno-commercial viability of the project, the interconnection point for delivery of power may be at 132 KV.

As per OERC Order dtd.20.08.2005, GRIDCO under single-buyer-model has to procure 3.5% of the total Power purchase during the year 2008-09 from Renewable Energy Sources. GRIDCO has proposed in its ARR for FY 2008-09, a total power procurement of 19,110 MU during 2008-09. As per OERC Order dtd.20.08.2005 as against 669 MU (3.5%), GRIDCO has estimated to procure from Renewable sources of about 375 MU during FY 2008-09 which has been approved by OERC in ARR of GRIDCO for such procurement from renewable sources during FY 2008-09. This is presented in table-14 below:

Table-14

Approved drawal from Renewable Sources during FY 2008-09 by OERC

Renewable Sources	Energy Proposed for	Energy Approved for

	drawal by GRIDCO in FY 2008-09 (MU)	drawal by GRIDCO in FY 2008-09 (MU)
NINL	100	100
ARATI STEEL	80	80
TATA SPONGE	120	120
SAMAL SMALL HYDRO	30	30
MINAKSHI SMALL HYDRO	45	45
TOTAL	**375**	**375**

5. Secretary GoI MNRE DO letter dtd. 20.02.2008 to Chairperson OERC on Solar Power

Secretary, MNRE, GoI vide DO letter dtd. 20.02.2008 intimated on the policy followed on Renewable Energy Sources in general and on Solar Power in particular by Government

The Ministry of New and Renewable Energy (MNRE) has been supporting grid quality power generation in the country from various renewable energy sources. The efforts of the Ministry, with supporting policy by State Governments and tariff by some of the State Electricity Regulatory Commission (SERC) for power from wind, small hydro and biomass, have resulted in setting up of more than 11,500 MW capacity renewable energy power projects, which is nearly 8% of the total power generation capacity of the country. The renewable power plants set up during the 10^{th} Plan constituted about 25% of the total capacity addition through the conventional power sources in the country during the same period.

The Ministry has launched a demonstration programme to encourage grid quality power generation from Megawatt size solar power plants. Under the programme, registered companies, as project developers, would be eligible to set up solar power projects on Build, Own and Operate (BOO) basis. The Ministry will provide generation based incentive of up to Rs. 12 per kWh for solar photovoltaic and Rs. 10 per kWh for solar thermal power fed to the grid by the solar power project developers. In view of the high cost of solar power generation, the Ministry would provide this incentive to project developers, which will be in addition to the tariff announced by the SERC. However, a project developer would be eligible to receive a maximum of Rs. 15 per kWh from the utility and the Ministry as tariff and incentive.

The Ministry would provide incentive for installation of up to 50 MW capacity solar power projects in the country. Solar power projects with an aggregate capacity of a maximum of 10 MW in a State would be considered for support. Any project developer would be allowed to set up a maximum aggregate capacity of 5 MW, either through a single project or multiple projects of a minimum capacity of 1 MW each, under the demonstration programme. However, preference would be given to the projects from the States where the State Electricity Regulatory Commissions have announced or in the process of announcing tariff for solar power. Wherever it is not there, the utility should provide the highest tariff offered for medium term power purchase or the maximum tariff fixed for power from any other renewable energy source, till the SERC announces a tariff for solar power, failing which, projects in that State would not be considered under the demonstration programme.

This incentive from the Union Government is to encourage grid connected solar power over and above the tariff that is announced by the SERCs. Hence, it would be appropriate to fix tariffs for such solar power – both pohotovoltaic and thermal. It is our hope that technology would improve and costs would decrease making solar power competitive in the medium term.

The State Electricity Regulatory Commission in Punjab recently has taken lead by announcing a tariff of Rs. 7 per kWh for solar power, with 5% annual escalation. The West Bengal Electricity Regulatory Commission has also circulated draft order with a tariff of Rs. 12.5 per kWh for solar power. The other States have not yet announced any tariff for purchase of solar power. Considering the vast potential of solar power, if up to 1% of the generation from conventional sources is allowed from solar power at preferential tariff, it would not significantly impact the over all power cost. I request you to consider and issue tariff order for solar power in the country, which in turn would help in utilizing this vast resource for generation of power to meet the growing demand of power for sustainable development without polluting the environment.

MNRE has sent the copy of the Guidelines for Grid Interactive Solar PV Power Generation Projects which is also posted on the website of the Ministry (http://mnre.gov.in). MNRE will support Grid Interactive Solar Power Generation

Projects as demonstration projects in the country with a view to develop and demonstrate technical performance of grid interactive solar power generation, achieve reduction in the cost of the grid connected solar systems and the cost of solar power generation in the country. The Ministry will consider support for a maximum capacity up to 50 MW during the 11th plan period. as per the guidelines and norms given below. The Indian Renewable Energy Development Agency (IREDA) will assist the Ministry in fund handling, monitoring and other associated activities in this regard. The following are the broad guidelines for submission of proposals by the interested project developers, details of incentives and other related guidelines.

Eligible Organizations

All existing registered companies, central and state power generation companies and public/private sector PV power project developers who have set up or propose to set up a registered company in India will be eligible for consideration of generation based incentive. Individuals, NGOs, financial institutions, societies and other unorganized investors are not eligible to participate directly.

Eligible Projects & Eligibility Criterion

Grid interactive solar PV Power Generation plants of a minimum installed capacity of one MWp per plant at a single location will be eligible for generation based incentive. However, one mega-watt capacity may be set-up through modular units to make one megawatt at a single location.

A maximum cumulative capacity of 10 MWp of Grid interactive solar PV power generation projects can be set up in a State.

Any project developer, who fulfills the procedural requirements and the guidelines specified by the Ministry, will be eligible for consideration of generation based incentive. Any project developer can set up grid interactive PV power generation projects up to a maximum of 5 MWp capacity in the country, either through a single project or multiple projects of a minimum capacity of one MWp each.

The grid interactive solar PV power generation projects will be undertaken on Build Own and Operate basis.

Setting up of captive grid interactive solar PV power plant or captive utilization of solar PV power is not covered under the generation-based incentive scheme of the Ministry.

In case any project developer is desirous of availing the accelerated depreciation benefit for the project under section 32 of the Income Tax Act 1961, they would not be eligible for generation-based incentive.

Procedures to be followed by Project developers for availing Generation base Incentive

The grid interactive solar PV power projects will be considered for generation based incentive on first come first served basis, in accordance with the guidelines of the Ministry and compliance of the procedural requirements for filing the applications/requests for incentive. Mere information to the Ministry and/or IREDA about the intention of the company/project developer to set up a grid interactive PV power plant will not be sufficient basis for this purpose.

Before submission of application, the interested solar power project developers are required to ensure compliance of all legal and procedural requirements and obtain all necessary clearances from the concerned State Government/State Utility/State Nodal Agency/local bodies and other organizations, as specified by the concerned State Government and/or Central Government.

The state agencies and utilities will provide all assistance and support to the project developers for evacuation of power from the project site, as done in case of other renewable energy based projects, unless specific guidelines for solar power projects are approved by the respective regulatory commissions, which are different from the existing guidelines for other renewable energy projects.

The interested project developers are required to submit complete applications in duplicate to the Ministry with two copies to IREDA. The project developer will also submit copies of the DPR for the project.

For each project submitted to IREDA and the Ministry for generation based incentive in the prescribed formats, among other details information on technical and performance features, technical specifications, requirement and availability of land, title of the land, capital cost, estimated life of the PV power plant, quantum of electricity expected to be generated and fed to the grid, proposed sale price of electricity from PV power plant, duration of power purchase

agreement and power purchase rate (s), arrangements for power evacuation and the time frame for installation/ commissioning of the grid PV power plant etc. are required to be furnished.

On receipt of application, which is complete in all respect, the eligibility for generation-based incentive will be examined in accordance with the guidelines of the Ministry.

Applications which are incomplete or do not provide firm and clear information will not be considered on first come first served basis. The concerned project developer will be informed accordingly and the complete application will be treated as a fresh application.

On examination by the Ministry, if a proposal is found to be eligible, the prospective developer will be informed whether the proposal falls within the approved limit of installed capacity allowed for the concerned state. The applicant will also be informed of the timeframe for installation and commissioning of the plant, which will normally be as stated by the project developer, but not later than 31st December 2009. This communication will not automatically entitle the project developer to claim the generation-based incentive for any project, unless commissioned within the specified timeframe.

The project developers will be required to install and commission the grid connected PV power projects, within the time frame communicated at the time of acknowledging the eligibility of the project. The first progress report must be submitted to the Ministry with a copy to IREDA not later than six months from this date. In case there is no progress on procurement and installation of the plant is noticed in the first six months after the eligibility has been communicated, the Ministry may consider cancellation of the project. In case of progress in the first six months and subsequent delays in completion of project work beyond the specified completion date communicated to the project developer, Ministry will impose penalty by reducing the incentive by 1% for each month of delay, subject to a maximum of 5%. In all cases even the delayed project should be completed by 31st December, 2009, failing which the Ministry will review the decision to provide incentive for that project.

Considering the possibility that the full capacity of maximum one MWp be commissioned in phases by modular commissioning, incentive would be calculated on the commissioning of a minimum of 250 kWp and above and sale to the grid, but the disbursement of the incentive would begin only when a minimum capacity of one MWp is commissioned and power sold to the grid.

All eligible projects will be inspected by a team consisting of officials from the Ministry, concerned state nodal agency, utility and IREDA before the project starts feeding power into the grid and only after the satisfaction of the team regarding compliance to the requirements, the project will be approved for generation based incentive. The generation-based incentive will be approved only after demonstration of satisfactory commissioning of the plant at the project site and its interfacing with the grid of the utility.

While the generation based incentive scheme is applicable to the entire country, preference/priority would be given to those projects, which are proposed in the States that have approved and/or notified tariff for solar power.

A dedicated electronic meter or any other meter (s) as specified and approved by the utility will be installed at the point of power evacuation and/or any other point as specified by the utility. This will be used to monitor the quantum of net electricity being fed to the grid from that project.

The PV power project developers are not allowed to use any other source of power generation along with the solar PV power project. No other power generating source will be connected to the same meter which is used to monitor quantum of PV power fed to the grid from the grid connected PV power plant. At any time after the PV power plant is connected to the grid, if it is found that any other source of power generation is in use or have been used to feed power to the grid through the same meter at that project site, that project will not be eligible to receive generation based incentive. Inhouse consumption of PV power generated from the grid interactive PV power project shall not be eligible for incentive. In other words only sale of power to the grid is eligible.

The grid interactive solar PV power plants, which receive generation based incentive will not be transferable to a new management or sold to any other company without prior written approval from Ministry. In the event of transfer without prior approval from the Ministry, generation based incentive will not be continued for that PV power generation project. However, the Ministry may review the project afresh and decide about new quantum of incentive for that project, if any, for the remaining period.

PV power project developers shall not avail accelerated depreciation benefit under Section 32 of the Income Tax Act 1961. The PV power project developers who submit their applications to

the Ministry with a copy to IREDA and required to submit a declaration to this effect. On approval of the project, IREDA will enter into an agreement with the project developer, among other matters, in this regard. If any violation of this condition is found, IREDA will immediately stop release of generation-based incentive to that project and refer the matter to the Ministry.

Third party sale, banking and wheeling of power is not permitted while availing generation-based incentive.

The project developers will maintain a record of power generation, incident solar radiation on the PV array surface and other technical features of the power plant for the entire period during which they will receive incentives. A copy of the data should also be available in electronic form. This record will also be made available readily for verification / audit purposes, if required.

Generation based Incentives

Wherever the state electricity regulatory commissions have fixed a separate tariff for solar power or they fix the tariff for solar power during the period for which the Ministry is providing incentive, the utilities will offer a minimum of that tariff to the solar PV grid interactive power projects in their respective states. In absence of such tariff orders, the utilities will offer the highest tariff for purchase of power to the PV power project developers, that is being offered by the utilities for purchasing power in their respective states on medium term or the highest tariff being provided for purchase of power from any other energy source for which orders/guidelines are already issued for that State. The PPA would draw reference to the orders of the State Electricity Regulatory Commission's order in this regard and enclose copies of the same. The Ministry will not consider proposals, which do not follow these guidelines on power purchase agreements.

The Ministry may provide, through IREDA, a generation-based incentive of a maximum of Rs. 12 per kWh to the eligible projects which are commissioned by 31st December, 2009, after taking in account the power purchase rate (per kWh) provided by the State Electricity Regulatory Commission or utility for that project.

The maximum amount of generation based incentive applicable for a project will be determined after deducting the power purchase rate for which PPA has been signed by the utility with a project developer, from a notional amount of Rs. 15 per kWh. In all cases the maximum

amount of generation-based incentive shall not exceed Rs. 12 per kWh. In case the project developer has submitted to the state electricity regulatory commission or the utility or to the Ministry an application, where a lower power purchase price or sale price of power from the proposed grid connected PV power plant has been sought, in that case the generation based incentive will be determined with that amount as the base and a lower rate of incentive will be approved by the Ministry The project developers will be required to submit documentary proof and give an undertaking about correctness of this information.

Any project that is commissioned after 31st December, 2009 would be eligible for a maximum incentive with a 5% reduction and ceiling of Rs. 11.40 per kWh.

The generation-based incentive will continue to decrease, as and when the utility sign a PPA for power purchase at a higher rate. The proposed annual escalations agreed with the utility, as in force, should be reflected in the PPA.

The generation based incentive approved for a grid interactive PV power generation project may be available for a maximum period of ten years from the date of approval and regular power generation from that project, provided the utility continues to purchase power from that grid interactive PV power plant.

The Ministry may, at any given time, even before 31st March, 2010, announce a new generation based incentive and guidelines, which will be applicable to all such proposals / projects that have not been approved by that time.

The incentive will be released by IREDA to the eligible PV power project developer on quarterly basis, on receipt of certified information about the net electricity fed to the grid from the PV power project during the period of claim. The concerned utility will provide such information to the project developer on periodic basis. The PV power project developers will be required to produce a certificate from the concerned utility about the solar PV power purchase rate granted by the utility for eligible projects, each time they seek funds from IREDA towards generation-based incentive.

Technical Performance Optimization

With a view to encourage technology development and reduction in the cost of the PV power plant projects, the PV power project developers are expected to utilize the state of the art

technology to set up the plants. They are expected to use large capacity and higher power output PV modules available for the specific technology used in setting up the power plant.

Qualification of PV modules, to be used in grid interactive power plants, in accordance the standards issued by BIS or IEC 61215 certification or other international certification on qualification of PV modules will be necessary. The interested project developer will give an undertaking in the application to use such modules and provide to Ministry and IREDA copies of such certificates either at the time of application or latest at the time of the first progress report. Non-compliance of this requirement will result in withdrawal of approval for generation based incentive.

The electronics, cables, controls, structures etc. must qualify to latest BIS or international standards which are acceptable to utilities and which fulfill all safety norms for grid power projects. The PV power project developers will provide a copy of the test certificate(s)/ report(s) latest with the first progress report.

The PV power project developers are required to optimize generation of electricity in terms of kWh generated per MWp of PV capacity installed vis-à-vis available solar radiation at the site (may be obtained through use of efficient electronics, lower cable losses, maximization of power transfer from PV modules to electronics and the grid, maximization of power generation by enhancing incident radiation by optional methods like seasonally changing tilt angles etc).

The gird interactive solar PV plant may be connected to preferably 33 KV grid line to minimize power transfer losses. However, the choice of grid voltage may be determined in consultation with the concerned state utility.

PV power project developers will be required to maintain and provide to IREDA technical information on daily solar radiation availability, hours of sunshine, duration of plant operation and the quantum of power fed to the grid. The project developer will install suitable instruments, meters and data loggers for this purpose. This information will be provided at the time of seeking reimbursement from IREDA. This will help in estimation of generation in kWh per MWp PV array capacity installed at the site.

Monitoring

The PV power project developers will install suitable instruments and make adequate arrangements to monitor the performance and ensure satisfactory operation of the grid connected PV power plants.

IREDA will make suitable arrangements to monitor the progress and performance of the grid interactive solar PV power generation projects.

The concerned state nodal agency may also visit the project site and provide their feed back and recommendation to IREDA.

All PV power plant projects will be open to inspection by the officials from Ministry, IREDA, concerned state nodal agency and any independent organization appointed by the Ministry/IREDA for performance monitoring.

The Ministry may also undertake field evaluation studies for any of the grid interactive solar PV plants through professional and independent organizations.

Progress Report

The project developers of all approved projects will be required to submit annual progress report about the project and the annual report of the company, which has set up and own the grid interactive PV power plant.

Solar Thermal Power Generation

The broad guidelines specified above will also be applicable for grid connected solar thermal power generation projects.

The generation based incentive for solar thermal power generation project will, however, be limited to a maximum of Rs. 10 per kWh. The same method to determine the eligible incentive will be adopted in this case.

The technical performance optimization parameters will change as necessary.

The maximum capacity of 50 MW would apply to solar thermal projects as well.

Further continuance of the scheme, restructuring of the incentive scheme would depend up on the success of the scheme during the stipulated period.

6. Commission's Approach

The Commission having taken note of the provisions of the Act and the guidelines relating to harnessing power from non-conventional / renewable energy sources issued under National Electricity Policy and National Tariff Policy, decided to issue a consultative paper on harnessing of such power. Accordingly, this consultative paper is being circulated for inviting the suggestions/views of all the stakeholders.

The Commission noted that as per the new definition of an electrified village specified in MOP Letter dated 05.02.2004, Government of Orissa have identified balance villages to be electrified as on 31.03.2007 as 20113 nos. out of which 255 nos. of villages are to be electrified through non-conventional/renewable energy sources which have also been approved by MNRE for implementation by OREDA – a Government of Orissa Enterprise through decentralized distributed generation route. OREDA is to furnish its action plan for electrification of such 255 nos. of villages with renewable sources of energy by the year 2009/10.

The Commission has also noted that MOP has compiled installed capacity of Orissa as on 29.02.2008 as 3843.98 MW which includes 7.3 MW developed by OREDA from renewable energy sources. OREDA is to furnish the details of such installations developed with renewable energy sources.

The Commission is also of the view that OREDA being the State Nodal Agency for development of non-conventional / renewable energy in the State of Orissa shall furnish the copies of Detailed Project Reports (DPR) of the existing projects and the future projects in the pipelines with the relevant justification of pricing of harnessing of such renewable energy sources for the appraisal of the Commission.

The Commission has also noted that Alternate Hydro Energy Centre (AHEC) of IIT, Roorkee under the auspices of the Energy Sector Management Assistance Programme (ESMAP) supported by UNDP has identified 4861 potential sites in the country with an aggregate capacity of 12841 MW for Small Hydro Electric Projects (SHEPs). AHEC has identified 206 nos. of such sites for the development of small hydro electric projects in the State of Orissa with an aggregate capacity of 217.99 MW out of which 6 sites have already been developed with an installed capacity of 7.30 MW.

The Commission has noted that Engineer-in-Chief (Electricity) on behalf of Government of Orissa is authorized to accord Technical Sanction to such SHEPs. GRIDCO being the State Designated Agency (SDA) is used to enter Power Purchase Agreements (PPA) with such Developers who develop those SHEPs. Hence, EIC (Electricity) Government of Orissa and GRIDCO should furnish the DPRs of the existing projects having installed capacity of 7.30 MW, the projects under development as well as the up coming SHEPs with the details of levelized tariff, design energy etc.

7. The Commission, therefore, invites suggestions and comments on the following:

As envisaged under section 86 of the Electricity Act, 2003 the State Commission shall "(e) promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to nay person, and also specify, for purchase of electricity form such sources, a percentage of the total consumption of electricity in the area of a distribution licensee;"

(i) Addition of energy from renewable energy sources will provide a relief to the state and nation's economy by saving of burning of coal and oil, help preservations of limited high carbon resources, reduce import of oil and may prevent environmental depredation. In view of that what kind of assistance should be provided by the state for the growth of R.E. in Orissa ?

(ii) What would be the appropriate percentage and time line for fixing a minimum and / or maximum percentage of the total consumption of electricity in the area of a distribution licensee from a basket of non-conventional / renewable energy sources including that from cogeneration in accordance with the Act and NEP?

(iii) Will it be appropriate to fix up individual percentage in the basket of non-conventional / renewable energy sources including that from cogeneration for sourcing of wind power, solar power, small hydro, Biomass, cogeneration of electricity from waste heat product etc. within the total maximum percentage of the total consumption of electricity in the area of a distribution licensee from a basket of non-conventional / renewable energy sources including that from cogeneration and its time line?

(iv) As the Commission vide Order dtd. 20.08.2005 has categorically mentioned that small, mini, micro plants may not be in a position to arrange for connectivity with the OPTCL as the cost of such arrangements may be quite exorbitant rendering the project unviable, the Commission has ordered that generating companies of non-conventional and renewable sources would be permitted by DISTCOs / OPTCL to deliver the power at 11 KV or 33 KV as the case may be and depending upon the techno-commercial viability of the project, the interconnection point for delivery of power may be at 132 KV. Against this background, what should be the appropriate connectivity for harnessing renewable energy sources if any thing different to the Commission's order dtd. 20.08.2005 is thought of for encouraging distributed generation addition in remote/rural areas of the state.

(v) What would be the appropriate approach either for fixing a price cap for energy from cogeneration and various renewable sources like that from biomass, wind, small hydro, cogeneration, solar PV.

(vi) Any other point that is considered appropriate.