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MITCON

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PROCEEDING DOCUMENT

WORKSHOP ON INVESTMENT DEVELOPMENT & COMMERCIALISATION FOR BAGASSE BASED COGENERATION

Held on June 22, 1999, The Oberoi Hotel Mumbai.

Prepared for

Winrock International
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Prepared by

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June, 1999

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1. BACKGROUND & OBJECTIVES

1.1 Background

The United States Agency for International Development (USAID) are implementing the Greenhouse Gas Pollution Prevention Project (GEP) to assist India's power sector development and reduce greenhouse gas emissions.

The Alternative Bagasse Cogeneration (ABC) component of this programme envisages the utilisation of biomass fuels for efficient cogeneration in Indian sugar mills. The primary objective of the ABC component is to reduce the carbon-di-oxide emissions per unit of electricity generated from bagasse and to encourage the use of alternative biomass fuels instead of fossil fuels during the off-season in high efficiency cogeneration plants.

To accomplish this, the ABC component has provision for extending Financial Assistance grants to support the demonstration of state-of-the-art cogeneration technologies, Technical Assistance grants to perform feasibility studies and Matching Grants to carry out R & D. Nine projects have so far benefited from the Financial Assistance grants out of which four have been completed.

Professional development activities such as workshops and training programs for capacity building are also supported by the Technical Assistance component. The USAID, US Department of Energy and the Federal Energy Technology Center (FETC), through FETC's support contractor, Burns & Roe Services Corporation, have engaged the services of Winrock International (WI) to implement a series of workshops and training programs that will seek to bridge the existing knowledge gaps and build indigenous manpower capabilities for implementation of 'world-class' bagasse based cogeneration projects.

1.2 The Organizers

Winrock International through its Renewable Energy Project Support Office (REPSO) and Maharashtra Industrial & Technical Consultancy Organisation (MITCON) jointly organize a regional Workshop on Investment Development & Commercialization for Bagasse Based Cogeneration on June 22, 1999 in The Hotel Oberoi, Mumbai.

Winrock International is a private non-profit organisation headquartered in the US with offices in over 40 countries including India, has developed REPSO's in seven

countries to implement renewable energy projects. Since 1989, Winrock has been working to accelerate the introduction and expansion of cogeneration in each country where cane is a major crop and source of income.

MITCON, a premier consultancy organisation, working in the energy efficiency, sustainable development and renewable energy sectors, with major focus on biomass power and bagasse based cogeneration has done major promotional work with important stakeholders including IREDA, MNES, USAID, UNDP, SDC, MoP, State Agencies and a number of independent project developers.

1.3 Workshop Objectives

The objective of the workshop is to address the key issues that are impeding the sustainable growth in the surplus power addition through this environmentally benign, renewable source of energy.

The one day programme aims at providing a forum for decision makers from both sugar mill and independent project developers and participants from technology providers, financiers and policy makers to address the issues concerning project development, share international experiences, identify alternative financing options that are workable under the Indian context, review policy related issues and incentives needed for introduction of advance technology options. The interactions are expected to stimulate viable options for investment development in this sector.

The panel of speakers at the Workshop were International and Indian experts, policy makers and speakers from leading financial institutions.

1.4 Invitees

Apart from the Chairmen/MD's of sugar mills, IPP's following high level officials from each various organisations were invited. (Refer Annexure –1 for programme Brochure) :

- Secretaries (Energy Dept.)
- Commissioners of Sugar
- Chairmen (State Electricity Boards)
- Directors of the State Nodal Agencies
- Chiefs of the main financial institutions like IREDA/IDBI/ICICI/ILFS/HUDCO etc.

- Chiefs of the sugar mills from various states :

Table 1.1, Invitees

Sr. No.	Sector	Number of Invitations
1	Sugar Mills	
	• Maharashtra	59
	• Karnataka	15
	• Andhra Pradesh	11
	• Tamilnadu	24
	• Bihar	6
	• Madha Pradesh	2
	• Gujarat	13
	• Uttar Pradesh	75
	• Punjab	14
	• Hariyana	7
2	Equipment Suppliers	40
3	Consultants	19
4	Project Developers	16
5	State Electricity Boards	10
6	Financial Institutions	10
7	State Nodal Agencies	9
8	Secretary Energy	5
	Total	335

2. PROGRAMME SCHEDULE

(Refer Annexure – 1 for details)

2.1 In order to make the entire programme interactive and most effective; the venue of The Oberoi Hotel, Mumbai was selected. Being a financial capital and center place, Mubmai was the best choice to able all the invitees for concentrated interaction on the subject.

2.2 The programme started on July 22, 1999 at 9.30 a.m. with registration and ended almost at 6.00 p.m. in the evening.

The major events of the day were:

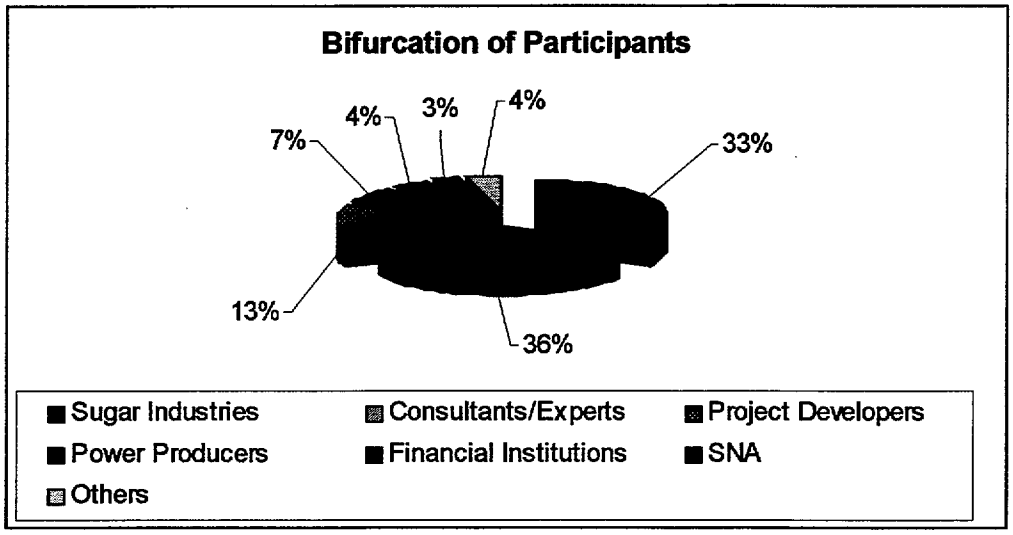
- Registration & welcome
- Inaugural Function (Presided over by Mr. Haresh Bhargava)
- ***Session I*** :Overview of Development of Bagasse Based Co- generation. (Chaired by Mr. Haresh Bhargava). Three papers were presented in this session.
- Question and Answer Session
- ***Session II*** : Investment Development and Commercialisation (Chaired by Mr. Ajitsinh Ghatge, MD, YSSKL, Theur) Two papers were presented in this session.
- Question and Answer Session
- ***Session III*** : Options for Investment Development (Chaired by Mr. D. K. Shukla, AGM, MECON Ltd.) Two papers were presented in this session.
- Question and Answer Session
- ***Session IV*** : Policy & Financing (Chaired by Mr. S. Y. Dixit, GM, Toyo Eng.) Four papers were presented in this session.
- Question and Answer Session
- Panel Discussions & Concluding remarks (Chaired by Mr. Haresh Bhargava)

3. PARTICIPANT'S PROFILE

(Refer Annexure - 2 for details)

3.1 A total of 70 no. of participants attended this workshop. Annexure 2 gives the list of participants, respective company name who actually attended the programme.

3.2 The Participant Profile is indicated in the following figure, explore a maximum interest from the sugar mills in these cogeneration projects. Consultants/experts are also keen in getting these projects implemented.



4. PROGRAMME PROCEEDINGS

4.1 Inaugural Function

Persons on dais -

- Mr. S. C. Natu — MITCON
- Dr. P. V. Ramana — Winrock International
- Ms. Kavita Sinha — USAID
- Mr. Harish Bhargava — Chief Guest
- Mr. H. Nandanpower — MITCON

Mr. Natu did welcome and introduction. He elaborated on the purpose of the workshop at Hotel Oberoi and the expected outcome, in line with the new policy and initiative taken up by Winrock, USAID, MNES, and MITCON.

Dr. Ramana took a critical review of the development of sugar cogen / biomass power projects in the country and role of Winrock till today. He also highlighted the progress made so far, impediments or policy measures and efforts taken by Winrock in this regard. He stated that a favorable atmosphere now exists for implementing these projects and advised that sugar mills should now take distinct steps in the immediate future for implementing these projects, which have now become the need of the hour.

Ms. Sinha introduced to USAID as an implementing agency of GEP to assist India's power sector development and reduce greenhouse gas emissions. She also highlighted on the ABC component of this programme. She further shared experience of nine projects that have so far benefited from the Financial Assistance grants.

Mr. Harish Bhargava illustrated critical issues for implementing the bagasse based cogen projects, which start from sustained cane development effort, energy efficiency improvement, adequate planning and designing of optimum projects suiting individual requirements and future plans, techno-economic evaluation, masterly planning for development and implementation manpower planning and training, etc. He further shared experience of sugar cogen projects elsewhere in the world.

Mr. Nandanpower proposed vote of thanks.

4.2 Session I : Overview of Development of Bagasse Based Co- generation.

Persons on dais -

- Mr. Harish Bhargava — Session Chairman
- Mr. S. V. Shiralkar — MITCON
- Mr. Shankarnarayan — Avant Garde
- Mr. S. C. Natu — MITCON

This session followed after the tea break and mentioned key presentations took place. Annexure – 3 gives copies of presentations / papers from all the faculty.

- Mr. Shiralkar highlighted in detailed on Global and Indian Power Scenario and their relevance in the present context. He also pointed out the year round biomass power generation is feasible in sugar mills.
- Mr. Shankarnarayan presented a technical paper. He illustrated the modern trends in technology to maximize the power generation from cogeneration plants. There are no technological constraints in adopting high-pressure cycles.
- Mr. Natu shared his international experience in cogeneration and CDM projects. He also pointed out the high business opportunities in CDM projects.

4.3 Session II : Investment Development and Commercialisation

Persons on dais -

- Mr. Ajitsinh Ghatge — Session Chairman
- Dr. Ashok Harane — IL&FS
- Mr. Ned Jewett — CMI Consultants, USA

- Dr. Harane explained in detailed on the Bagasse based cogeneration through Joint ventures. He pointed out the distinct steps required to be taken for effective JV from host sugar mill and JV Company. He also highlighted on the IL&FS proposals.
- Mr. Jewett illustrated in detailed on the International opportunities for financing sugar mill co generation in India. The World Bank Group, Asian Developments Bank, Export Credit Agencies and Government Investment agencies all provide funding to the projects – grass roots and expansions.

4.4 Session III : Options for Investment Development

Persons on dais -

- Mr. D. K. Shukla — Session Chairman
- Dr. D. J. Tidke — NUCON Energy Corporation., USA
- Mr. B. C. Mahesh — Thermax

This session followed after the lunch and mentioned key presentations took place.

- Dr. Tidke shared his International experience for financing/developing sugar mill cogeneration in India.
- Mr. Mahesh shared his experience and highlighted on the EPC advantage in economical and timely execution of a cogeneration plant.

4.5 Session IV : Policy and Financing

Persons on dais -

- Mr. S. Y. Dixit — Session Chairman
- Mr. Harish Bhargava
- Mr. L. Prabhkar — MITCON
- Mr. M. Asokan — IDBI
- Mr. P. S. Salunkhe — MEDA

- Mr. Bhargava highlighted in detailed on Power Purchase Agreement and Energy Sale Policy. He illustrated on the key provisions of PPI and pricing of exported power.
- Mr. Prabhkar presented a paper on pricing for alternate biomass. He proposed that it is always better to consider the biomass as alternate fuel instead of the conventional fuel.
- Mr. Asokan had taken a review of the lending options for bagasse based cogeneration projects.
- Mr. Salukhe presented the recent cogeneration policy of State Government for Bagasse based cogeneration projects.

4.6 Panel Discussions

Persons on dais -

- Mr. Harish Bhargava
- Dr. P. V. Ramana — Winrock International
- Mr. P. S. Salunkhe — MEDA
- Mr. Ajitsinh Ghatge — YSSKL
- Mr. D. K. Shukla — MECON Ltd.
- Mr. S. Y. Dixit — TOYO Engg. India Ltd.
- Mr. Ned Jewett — CMI Consultants, USA
- Mr. S. C. Natu — MITCON

This session followed after the tea break.

During the panel discussions a group is formed which consists of all the session chairmen's, MEDA representative, CMI representative and MITCON representative

The panel discussions mainly centered on the major technical/legal/commercial/ financial/ policy/ other hurdles for the state and each sugar mill/independent power producer for implementing these projects and discussions were made as to how they can be solved.

Dr. K. K. Singh shared his experience in the cogeneation projects.
Mr. Harish Bhargava summed up the proceedings.

6. CONCLUSIONS & RECOMMENDATIONS

6.1 The Workshop at Mumbai was immensely useful to take an overview of the key issues of investment development and commercialisation of bagasse based co-generation power projects.

The programme provided a forum for decision makers from the sugar mills, independent power producers, technology providers, financiers and policy makers to address such issues, share international experiences, identify alternative financing options with potential for success in the Indian context, review policy related issues and incentives needed.

6.2 With few projects now successfully operating on 66 kg/cm2 pressure and exporting power to SEB grids, it is necessary to take up additional projects for demonstration, with extra high pressure technology, bagasse gasification technology or in between technology option. This is essential to increase confidence level of the sugar mill owners (when next stage is demonstrated, the earlier stage automatically gets established).

6.3 In view of the status and future of Indian sugar mills, in general and of the co-operatives and joint state companies in particular, it is extremely essential to demonstrate potential models like IPP and individual sugar mill and JV model. The early success of cogen projects at sugar mills will be possible with such demo projects. This is in view of severe shortage of capital and poor creditworthiness of the sugar mills. Additional incentives are also required for such projects in the initial stages. JV or IPP models are high potential options of investment development and commercialisation of these projects in India.

6.4 The power purchase policies still need to get rationalised all over the country and policy interventions are essential for bridging the gaps, particularly regarding guarantee from SEB's for timely payment for electricity sold, wheeling and banking, grid interface equipment, etc. A model Energy Purchase Agreement needs to be finalised, disseminated and gent into force by all SEB's.

6.5 Carbon Credit business, as a part of the CDM and Climate Change Initiative being discussed the world over, will be an excellent near future option for investment development, in bagasse cogen power projects in India. With the barriers taking their own time for removal for this sector, all these projects have carbon credit potential and can be sold in the up-coming International market for generating investments. It is essential to undertake bench marking for this sector as a part of immediate steps for preparation for the CDM application.

6.6 It is recommended that USAID / Winrock / MNES and other such institutions should review the above requirement and initiative early steps in terms of additional development support, promotion, adequate changes in their existing schemes and new schemes to make above happen at a faster rate.

6.7 MITCON as an organisation with vast experience in this field, would like to offer its services for all above required initiatives and work as a nodal consultancy / facilitation agency for this sector.

ANNEXURE - 1

PROGRAMME SCHEDULE

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MITCON

WORKSHOP ON INVESTMENT DEVELOPMENT & COMMERCIALISATION FOR BAGASSE BASED CO-GENERATION

(UNDER USAID GEP PROJECT)

WORKSHOP SCHEDULE

DATE : June 22, 1999 **VENUE : Hotel Oberoi, Mumbai**

Time	Item / Event	By
9.30 - 10.00 am	Registration	
10.00 - 11.00 am	Inaugural Function	
10.00 - 10.05 am	Welcome & Introduction	Mr. S.C. Natu, VP, MITCON
10.05 - 10.15 am	About the Workshop	Dr. P. V. Ramana, Winrock International, New Delhi
10.15 - 10.30 am	Key Note Address	Ms. Kavita Sinha, USAID, New Delhi
10.30 - 10.55 am	Address by the Chief Guest	Dr. Pramod Deo, Secretary, Energy & Environment, GOM
10.55 - 11.00 am	Vote of Thanks	Mr. H. Nandanpawar, Sr. Consultant, MITCON
11.00 - 11.15 am	Tea Break	
11.15 - 12.00 Noon	**Session I : Overview of Development of Bagasse Based Co-generation**	**Session Chairman : Mr. Harish Bhargava**
11.15 - 11.30 am	Global & Indian Scenario	Mr. S. V. Shiralkar, Associate Consultant, MITCON, Mumbai
11.30 - 11.45 am	Modern Trends in Technology & Relevant Issues	Mr. Shankarnarayan Director, Avant Garde, Chhenai
11.45 - 12.00 Noon	Commercialisation Status & Issues	Mr. S.C. Natu, VP, MITCON
12.00 - 1.15 pm	**Session II – Investment Development & Commercialisation**	**Session Chairman : To be confirmed**
12.00 - 12.45 noon	International Opportunities for Financing Sugar Mill Cogeneration in India	Mr. Ned Jewett M/s. CMI Consultants, USA
12.45 – 1.05 pm	Presentation on JV Model	Dr. Ashok Harane, CEO, ILFS
1.05 - 1.15 pm	Question / Answers	
1.15 - 2.00 pm	Lunch	

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WORKSHOP SCHEDULE (Contd.)

DATE : June 22, 1999 **VENUE : Hotel Oberoi, Mumbai**

Time	Item / Event	By
2.00 - 3.15 pm	**Session III** **Options for Investment Development**	**Session Chairman :** **To be confimed**
2.00 - 2.20 pm	International Experience for Financing / Developing Sugar Mill Cogeneration in India	Dr. D. J. Tidke, Country Manager, NUCON Energy Corporation, USA
2.20 – 2.40 pm	Presentation on IPP Model	Mr. Satish Ajgaonkar Nitash Inc., India
2.40 – 3.00 pm	Presentation on EPC Model	Mr. Mahinder Nath, General Manager (Mktg.) Thermax Ltd., Pune
3.00 - 3.15 pm	Question / Answers	
3.15 – 3.30 pm	Tea Break	
3.30 - 5.00 pm	**Session IV : Policy & Financing**	**Session Chairman :** **Dr. N. S. Jain, Director, MEDA, Pune**
3.30 – 3.45 pm	Policy of the Government of Maharashtra	Mr. P. S. Salunkhe, GM (Projects), MEDA, Pune
3.45 - 4.15 pm	PPA & Policy for Energy Sale	Shri Harish Bhargava
4.15 - 4.30 pm	Pricing for alternate biomass	Mr. L. Prabhakar, Associate Consultant, MITCON
4.30 – 4.50 pm	Review of Lending Options for Bagasse Based Cogen Projects	Mr. M. Asokan, Dy. General Manager (VCD), IDBI, Mumbai
4.50 – 5.00 pm	Question – Answers	
5.00 - 5.30 pm	**Panel Discussions**	**Chairman for the panel discussions & Session Chairmen**

ANNEXURE - 2

LIST OF PARTICIPANTS

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ANNEXURE - 3

PRESENTATIONS/PAPERS

DEVELOPMENT OF BAGASSE BASED CO-GENERATION

TOPIC : GLOBAL & INDIAN SCENARIO

WORKSHOP ON INVESTMENT DEVELOPMENT AND COMMERCIALISATION FOR BAGASSE BASED CO-GENERATION

TUESDAY, JUNE 22, 1999

MUMBAI.

SPEAKER : SHRIRANG SHIRALKAR
B.E.PGDIM
Associate Consultant, Mitcon Ltd.
President, Yajna Fuel Services.

GLOBAL SCENARIO

1.	YEAR 1990	Mtoe
	❖ Total Global Primary energy consumption	8811
	❖ South Asia's Share 5%	440
	❖ Renewable Global primary energy consumption	1560
	❖ South Asia's Share 15%	234
	❖ Share of renewables, globally	18%
	❖ Share of biomass in renewables	68%

2.	PERIOD 1990 – 2020	
	❖ Expected global rise p.a. in primary energy consumption	1.4%
	❖ Rise in South Asia.	2.5%
	❖ By 2100. World C02 emission will be 23 G tons more than 4 times 1990 level	

3.	SOUTH ASIA
	❖ Per Capita Consumption only 6.7% of Industrialized Nation, Excluding Non-Commercial Energy
	❖ Smallest Natural Resource in the World (1% of Oil, 2% of Gas, 6% of Coal)

4.	DEVELOPED NATIONS
	❖ In USA Installed Biomass Generating Capacity rose From 200 MW in 1980 to 7700 MW in 1992.
	❖ In Scandivania, Biomass Accounted for about 16% of Primary energy Production.
	❖ In Sweden, Biomass based Energy Generation by 2010 is expected to be 10[illegible] Million Kwh from 70 Million Kwh in 1991

	❖ Industrialised Nations have passed Resolutions to back the CDM Incentive Scheme to Allow Cos. To invest Billions of Dollars in Renewable Energy in the Developing World.

5.	GLOBAL SUGAR
	❖ Average world sugar production (1990-95) : 113.8 million ton p.a.
	❖ Share of Cane – Sugar 66%
	❖ Estimated global power export potential from sugar mills : 51073 : million units (Assumptions : all surplus bagasse to power. 30% bagasse on cane as fuel 68 KW exportable power / ton of cane on all electrified sugar mills. 10% sugar recovery)
	❖ At 3840 hours per sugar year : 13300 MW.

COUNTRY	EXPORT MW FROM SUGAR MILLS (MW)	COMMENTS
Brazil	16.6	Low Power tariffs.
Central America	49	On the growth
Fiji	12.5	On the growth
Mauritius	54	Exploring growth potential
Philippines	8	Govt. policies require review.
Pakistan	10	Large potential (200 MW)
Reunion Island	144	Coal in off – season
Thailand	25	Govt. policies require review.
US	135	Hawaii Sugar industry in decline. New plants in Florida, under commissioning.

INDIAN SCENARIO

1	❖ Largest Sugarcane Producer
	❖ Annual Cane Production (1992-97) : 256 million ton p.a.
	❖ 60% of Cane used for White Sugar.
	❖ AV. Recovery 9.9%
	❖ 1996-97 – 412 Sugar Mills in Operation.

DISTRIBUTION	
A. Public Sector / Joint Sector	15%
Co-op Sector	55%
Private Sector	30%

B. State Wise :
85% of White Sugar from : UP, TM, M.S., Karnataka & Gujarat.
32% from M.S. &
25% from UP .

		CANE CRUSHED %
	A.P.	6.3
	Gujrat	4.4
	Karnataka	8
	Maharashtra	31
	TN.	15
	UP	30
	Bihar, Haryana, Kerala, Goa, MP, Punjab & Rajasthan	Balance

	C. CAPACITY WISE :		
	Tcd		NO. OF MILLS (%)
	1250	≤	44
	2500	>	16.5
	2500		24
	5000	<	8.5
	5000	≤	7

D. Export Potential : 2500 to 3500 MW.
(MNES/USAID/IFREE)

E. PRESENT STATUS : (BIOMASS)		
28 Projects	-	141 MW.
30 Projects	-	180 MW in Pipeline.

Information of Export Potential from Indian Sugar Mills, if Maximisation of Surplus energy objective is adopted :

		Million Tons
a)	Cane Crushed	256
b)	Bagasse available as fuel @ 30% on cane	76.8
c)	Steam generated at 66 bar, 490^{0}C at 2.3 kgs/kg	176
d)	Steam passed through uncontrolled extraction at 8 bar for M.P. steam process needs @ 4.5% on cane	11.5
e)	Steam flow through controlled extraction at 3 bar for L.P. steam process needs @ 46% on cane	118
f)	Steam available for flow through condensing section of the DEC TG set	46.5
g)	Power generation potential at steam rates of 8 kgs / Kw, 6.3 kgs / Kw and 4 kgs / Kw at expansion to 8 bar, 3 bar and 0.14 bar from 66 bar	31792 million units
h)	Power needs of the sugar mill & cogen plant @ 35 Kw/ tonne	8960 million units
i)	Balance available for export (av. 3800 hours per sugar season)	22832 million units (6000 MW)

Constraints in achieving the entire power potential from Sugar Mills :

a) Mills needs to be 2500 tcd or above, to provide economies of scale.

b) Sugar manufacturing process needs to be made energy efficient, to maximise bagasse savings. Could call for major changes in plant & equipment.

c) Absence of power purchase policy in few states like Gujarat.

d) Sugar Mills in the govt. / joint co-operative sectors, may not be able to raise the equity for modernisation & cogeneration.

e) SEB's need to provide payment guarantees to provide comfort level to debt financiers.

CONCLUSIONS :

a) Indian Sugar mills do have a realizable potential of 2500 - 3500 MW exportable power.

b) At the present development pace and if similar tempo is retained by all stake holders, this target can be achieved by 2020.

c) It is essential to encourage project developers to enter this sector, with host sugar mills from Govt. / Joint / Co-op. Sector, to bring in the finance & technology.

d) Bagasse based steam generation, with control on suspended particulate matter in flue, is environmentally harmless, as it only returns back the CO_2 absorbed during photosynthesis of cane.

e) All year around biomass power generation is feasible in sugar mills by saved bagasse, procured bagasse, cane-trash, other locally available biomass like rice husk, cotton stalks, groundnut shells, millet husk etc. However support fossil fuel is required to retain power cycle parameters.

f) At a gross savings of 0.8 kg of CO_2 Kwh generated from bagasse, displacing coal based TPP (70% of India's Central Capacity), annual CO_2 emission avoidance by exporting power from sugar mills will be 0.5 million tons 100 MW exportable power p.a. at 70% plf. This provides significant opportunities for global investors.

g) Biomass based power generation could contribute upto 8% of India's Power needs by 2020. Bagasse / biomass has the highest potential in technically proven harnessable renewable energies.

ASSOCIATION WITH BIOMASS BASED POWER PROJECTS :

A. **MAHARASHTRA**

Pravaranagar, Three M Paper Mfrg., Sahakar Maharashi, Akluj Power Co., Indo-Aust-Maritime.

B. **GUJARAT :**

Sayan, Chaltan, Bardoli, Vadodara, Prime Power.

C. **KARNATAKA :**

Shamanur Sugars Ltd.

D. **U.P. :**

Kesar Sugars Ltd.

E. **HARYANA :**

Shahabad, Meham, Jind.

F. **PUNJAB :**

Rana Sugar.

G. **M.P. :**

Rajaram Maize Products.

INSTITUTIONS & NATIONAL STUDIES

MITCON-IREDA, MITCON-WINROCK, MITCON-MNES MEDA.

MODERN TRENDS IN TECHNOLOGY AND RELEVANT ISSUES IN CO-GENERATION PLANTS OF SUGAR INDUSTRY

(S.Balasubramanian, Executive Vice President & P.S.Sankaranarayanan, Vice President)[*]

Synopsis :

Cogeneration in sugar industry to produce excess power to be exported to the State Electricity Board grid has gained momentum and is the order of the day. The successful operation of four full fledged cogeneration plants in Tamil Nadu and a few more in other states have given the required confidence for the sugar industry to implement cogeneration plants. In fact, the profitability of a sugar plant is centered around the revenue from export of power. The encouragement being given by the central and state government for promoting the use of bio-mass / non-conventional, Eco-friendly energy further encourages the implementation of cogeneration plants in sugar industries. Today the catch word in the industry is to "to maximize the export of power".

Introduction :

The bagasse based cogeneration plants generally consists of a high pressure boiler and a double extraction cum condensing turbine. The terminology "high pressure" has a floating value today as the power cycle parameters adopted are undergoing fast changes. Since, the first fullfledged plant was installed with a capacity of 18.68 MW and was commissioned and stabilized in November 1995 there are a flurry of activities for preparation of Detailed Project Reports and implementation of Cogeneration programs. The Progressive minded changes in a State Electricity Board power purchase policies such as allowing certain percentage of pass through of power using conventional fuels is resulting in the increase of the Cogeneration Plant capacities. The increasing sizes offer options on selection of higher parameters for the power cycle which are in turn related to the capacities of the steam generators and turbo generators. The modern trends in technologies and the related issues are discussed in this paper.

Technical Aspects:

Cogeneration based on Rankine Cycle is not new to the sugar industry, but however Cogeneration based on High pressure boilers and extraction condensing or straight condensing machines are definitely new to the industry. In earlier days, the pressure of the power cycle was 14 kg/cm^2.(g) and 21 kg/cm^2 (g). This has been gradually increasing to 32 kg/cm^2 (g), 45 kg/cm^2.(g) and has now stabilized at 66 kg/cm^2 (g) and 480 Deg C. With the sizes of the cogeneration plant going above 30 MW the use of 80 kg/cm^2.(g) and 105 kg /cm^2 (g) pressure cycle are

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being explored. The following highlights a few of the technical issues for designing of the Cogeneration projects.

Basic design of the Cogeneration plant:

This stage of Project is where the configuration of the Cogeneration plant gets finalized. What is important is that the configuration conceptualized is appropriate for the specific project. Basically the Cogeneration plant configuration is site specific, even though some amount of standardization could be made for the grass root plants. The Scheme should consider the available bagasse, the variations in the bagasse availability, the allowable percentage of the pass through using conventional fuels like oil / coal, the process steam requirements and the pressure levels. Considering the variations in the bagasse availability and the possible variations in the process steam consumption and the number of days of operation, may be it is better to down size the plant and ensure maximum plant load factors. The plant cycle should be optimized to give the best efficiency.

Even though there is no limit to the achievable steam pressures and temperatures with bagasse firing, and elsewhere in the world 84 bar and 105 bar at 510 / 515 Deg C have been used, it is essential a cost benefit study is made before deciding on the steam cycle parameters. In such a study proper consideration should be given to the cost aspects of the higher grade metallurgy of both the turbine and the boiler, specifically the superheater and the piping. Such a study show that for boiler sizes less than 100 TPH, the most optimum cycle parameters are 64 ata and 480 Deg C. With the industry almost voting for a minimum of two boilers as against a single boiler, with the process steam consumption coming below 50% on cane, and with the size of the sugar mills in this county, it is unlikely that the boiler capacities will generally exceed 100 TPH. It is now well established that there are no specific problems in adopting a single boiler configuration in the sugar industries. With boiler capacities above 100 TPH and below 150 TPH the optimum cycle parameter could be 84 ata and 510 Deg C. With the pass through facilities for the use of conventional fuel being available the boiler sizes could go well above 150 TPH and for this configuration adoption of 105 bar, 515 Deg C could be a more viable proposition.

Power Cycles

The Cogeneration scheme for any sugar plant is plant specific and there is no single scheme applicable for all the plants. A scheme applicable for a grass root plant will not fit into an existing operating plant wanting to go for Cogeneration. Even among operating plants, a plant going in for modernization or capacity up gradation can have an economical and power maximizing configuration, than the one where no capacity addition or modernization is planned. The modernization

mentioned above includes, changing Mill drives from inefficient single stage steam turbines to Hydraulic/Electric drives, process improvements to reduce steam consumption by judicious vapor bleeding and usage of continuous pass etc., These steps make more steam available for power generation and improves vastly the viability of the Cogeneration Project.

For a typical 5000 TCD plant with steam consumption 42% on cane the possible maximum steam generation will be around 148 TPH. By adopting difference cycle parameters the indicative figures of the maximum power generation possible are

-	64 ata 480 Deg C	-	27,400 kW
-	84 ata 510 Deg C	-	29,200 kW
-	105 ata 515 Deg C	-	31,680 kW

The above data indicates that adopting 105 ata pressure cycle about 15.6% more power can be generated for the same sugar mill if it had adopted 64 ata power cycle. Thus, the selection of the power cycle and the cost competitiveness depends on the steam generation quantity of the boiler.

By adopting multi stage feed water heating, high pressure deaerator and adopting new technologies for reducing moisture percentage in bagasse will contribute to the overall cycle efficiency increase. The major issues in adopting higher pressure cycles are the selection / availability of proven high capacity boilers and fuel handling / firing system. The availability of servicing facility and spares for imported high capacity turbo generators could also be a specific problem.

Steam generating system:

The capability to design, manufacture and install steam generating systems of any capacity with any outlet steam parameters is available within the country. Bagasse being a fuel not amenable for perfect metering has given some problems with regard to the superheater steam temperatures. Higher temperatures during start-up and at load fluctuations have been experienced, but could be contained because of the desuperheating provided.

Some fine tuning is required in the areas of excess air control and unburnt carbon loss control. The operation of the cinder recovery systems provided is not satisfactory and the system provided need improvements.

Feed water quality control is an area needing attention and this is separately dealt under the water quality management.

In conventional bagasse fired boilers, the bagasse is fed into the boiler directly from the mill. The quantity of bagasse fed into the boiler is controlled manually by opening or closing a gate in the return bagasse carrier. This system cannot have an automatic combustion control. In order to implement an effective combustion control, storage bunkers above the feeders, or a continuous circulation of a large quantum of bagasse, say, about 50% of more bagasse, through a merry-go-round system is required.

An effective bunker system for the storage of bagasse, which will store bagasse for the requirement of about 10 to 15 minutes for the boiler MCR, has been successfully tried and implemented. This system operates satisfactory for bagasse with 50-52 % moisture.

Travelling grate with pneumatic distributors are best suited for wide variations in the type of bio-mass fuel and additional use of conventional fuels such as coal / lignite / furnace oil. The availability of a reliable and well proven travelling grate of large size to suit 150 to 200 TPH indigenously is yet to be established. The experience available with the various boiler manufacturers worldwide seem to have limitation on the boiler capacity matching with high pressure. Many references are available with boiler capacities in the range of 200 TPH but limited to low steam pressures. The operating experience / feed backs of the large size of grates have to be obtained before selecting boilers of high capacity.

Turbogenerator System:

The experience has shown that the turbine for the Sugar plant Cogeneration application should be rugged and preferably with slow speed. Problems in maintaining the steam purity in the boilers affect the turbine with deposits on the blades. The major contaminant is silica that gets carried over as vapor as the operating pressure of the boiler increases. There had been some problems of vibration and failure of bearings. These were due to initial problems in the lube oil system, and these could be resolved by having proper pre-commissioning checks. There had been some problem of exhaust hood spray falling on the blades and causing vibration. This was mainly due to a misdirected spray nozzle in the exhaust hood.

However there is a specific problem with regard to the servicing and spares availability. There are a number of suppliers who can supply the machines, but other than One or Two, there is none that has set up an adequately staffed service network and stocks adequate spares. This could pose major problems, specifically after the warranty periods. Most of the suppliers, import the turbine steam path

components, generators, AVRs and a few auxiliary equipment, and in such cases spares and servicing could pose serious problems.

Water Quality Management:

This is one area that needs more attention. Extraction steam at low pressures is supplied to the sugar plant for processing. About 90% of the steam supplied to the sugar processing is returned as condensate to the steam generator feed water system, at a temperature of around 95 Deg.C. Generally there could be no contamination of this condensate. Sincere and disciplined efforts should be made to keep this condensate free from contamination.

We are not recommending the usage of the vapor condensate for the feed water application as the quality of this condensate varies. Generally the pH is low, the TDS and silica are high and there could be traces of ammonia and organic compounds. We could use this with a lot of monitoring, but the repercussions could be serious if the monitoring system malfunctions or fails.

This aspect of water management needs some more study and a lot more of discipline.

Bagasse Handling :

During the cane crushing season, the cogeneration plant receives the bagasse directly from the mill, and the surplus bagasse is taken to the bagasse storage yard. The bagasse thus saved could be used for the off-season operation of the Cogeneration plant, or could be used to run the Cogeneration plant on the cleaning days or when the mill is not running due to some other reasons. Under such occasions back feeding of the bagasse from the yard to the boiler is required. As the unit size becomes larger the quantum of bagasse to be backfed is so high. The feeding becomes non uniform, resulting in the overloading of the conveyors if the feeding is done improperly with bulldozers or pushers. To overcome the backfeeding difficulties stacker reclaimers have been designed, but only with limited success. Such systems are successfully in use in Mauritius and Reunion Island. We understand that large storage bins with automatic stacking and reclaiming facilities are in use in Australia, but we also understand that the cost of such systems are prohibitively high. Some operationally effective and also cost effective system of stacking and reclaiming is to be devised. If a good system is developed the best operating procedure will be to delink the Cogeneration plant operation from the mill operation, by taking all the bagasse to the storage yard and feed the boiler only through the reclaiming system.

For use of other fuels such as cane trash, cotton stalk etc., the collection of the fuels from the farms, baling, de-baling / chipping facilities have to be perfected. There are many imported equipment available for collection baling and shredding of the bio-mass fuels. The dependability and performance of these machinery in the Indian Environment are yet to be verified.

Bagasse Drying System

The bagasse from the mill contains 50% moisture. This moisture is evaporated in the furnace and is let out from the boiler at a temperature of about 160 Deg C without any useful contribution. This moisture restricts the efficiency of the boiler to around 70%. If this moisture is removed from the bagasse before it is fed into the boiler, the boiler size can be designed to be much smaller in dimensions for the same output or the capacity of the boiler can be increased in an already existing boiler. For every 10% reduction in moisture the boiler efficiency will go up by about 0.6%. This means that with the same quantity of bagasse available the capacity of the cogeneration plant can be increased.

Various methods of drying have been tried. One among them is to tap off the flue gas from the boiler at a higher temperature and use it in a rotary bagasse drier. This method decreases the efficiency of the boiler due to tapping off of the gas at a higher temperature and has added disadvantages of pollution problem due to spreading of the dry pith in the bagasse. In this case, the bagasse is best dried in the boiler furnace itself.

If alternate heat source of surplus low pressure steam is available then it could be utilized in a rotary steam drier. This is a general practice for drying of de-pithed bagasse to about 5% moisture level in particle board plants. In these driers there is a rotating bundle of tubes through which the steam is passed and the bagasse moves on the outside of the tubes from one side of the bundle to the other. It is possible to reduce the moisture percentage in bagasse from 50% to 20%. The steam for the drying can be bled from the power turbine which will in turn improve the efficiency of the power cycle. The scheme for the system should be properly designed and optimized.

In the operating experience available with steam driers have been more with de-pithed bagasse. The size / capacity of the driers also do not match with the required capacities for a Cogeneration Plant. Hence, more feed backs and operating experience on the working of the steam driers with un-depithed bagasse is to be studied before implementation.

Electrical Systems:

As far as the technology for the design of the electrical systems for the Cogeneration plant, right from generation to EHV system and grid paralleling is concerned, enough experience is available. All the electrical equipment required for the Cogeneration plant, as well as its grid paralleling are available indigenously. The only problem faced by the Cogeneration plants is the stability of the grid.

There are unfounded fears in the minds of the plant operators with regard to the ability of the cogeneration plant to cope up with the tripping of the grid. If the protections are properly chosen and the equipment are properly specified, there is no reason why a cogeneration plant should trip with the grid and not go into island operation. To the extent possible efforts should be made to parallel the cogeneration plant at 110 kV level.

Controls & Instrumentation :

Being the most important subject from the point of view of operation and maintenance of the cogeneration plant, this subject deserves a lot of attention. Distributed Control System (DCS) is the order of the day. The technology for the planning and designing the complete controls & Instrumentation system for the cogeneration plants is available, but what is required is to create an awareness among sugar plant people about the importance of instrumentation in the operation and maintenance of the cogeneration plant.

CONCLUSION :

The maximization of power generation from bagasse based Cogeneration plant is the thrust factor in implementation of Cogeneration Plants in sugar industries. The basic design of the plant consists of the selection of power cycle parameters, the number of units and capacities of the boiler and turbo generator. The techno economical viability depends on the correct selection of the technology and adopting higher cycle parameters. The issues relating to the selection of the size, the number of units and the design of various other systems such as bagasse handling system, the water system etc., needs careful attention and a more in depth study of the feed backs and operating experience worldwide. There is no technological constraint in adopting high pressure cycles for the sugar plant Cogeneration systems.

BAGASSE BASED COGENERATION

THROUGH JOINT VENTURES

by

Dr. Ashok Harane
Chief Executive (Power)

MUMBAI
June 22, 1999

IL&FS
Infrastructure Leasing & Financial Services Ltd

IL&FS - Shareholders

IL&FS

Shareholders	Percentage (%)
Unit Trust of India	25.80
State Bank of India	9.55
Government of Singapore	5.00
ORIX Corporation, Japan	20.39
IFC, Washington	8.56
Central Bank of India	8.53
Credit Commercial De France	5.00
Housing Development Finance Corpn	11.04
Employee Welfare Trust / Others	6.13
Total	100.00

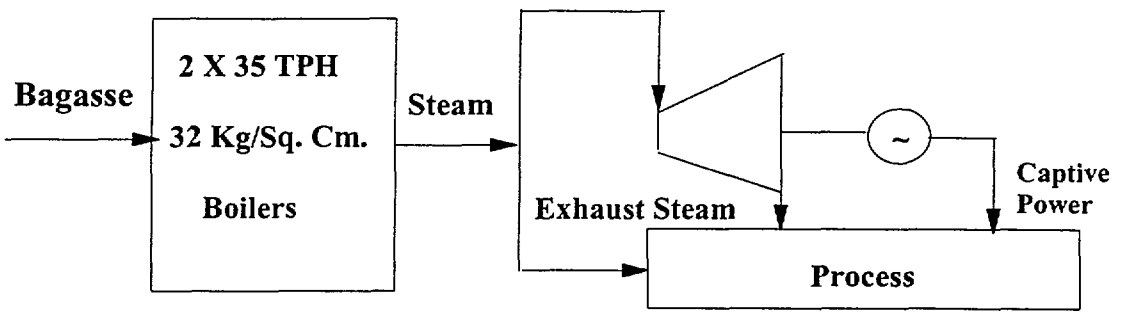
IL&FS

Cogeneration

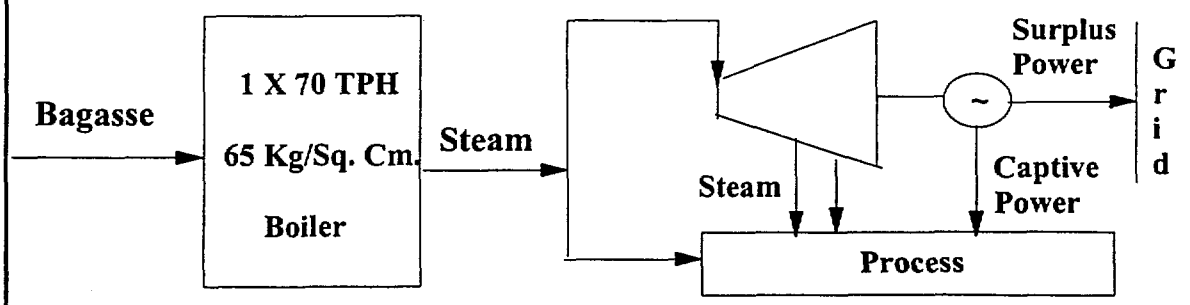
Cogeneration

IL&FS

★ Existing System in Sugar Mills :- (Steam and Power requirement)



★ Concurrent generation of Surplus Power and Steam for Process : -



Cogeneration..... 2

IL&FS

- Cogeneration - Simultaneous generation of process steam and electrical power from a single system
- Existing Sugar Mills with low pressure boilers and turbines - Self sufficient to meet their requirement of steam and power during the crushing season (Incidental cogeneration)
- New concept of cogeneration envisages high pressure boilers and turbines to generate steam and power more efficiently and sell surplus power to the grid
- Modes of Cogeneration

Type	Electrical Power per tonne of sugarcane crushed	Status
Conventional System	110 kWh	Widely adopted
Gassifier	200 kWh	Yet to be commercially proven on a wide scale
Intercooled Steam Injection Gas Turbine	600 kWh	Yet to be established

Statewise sectoral break-up sugar mills in India

IL&FS

State	Private Sector	Public Sector	Co-operative Sector	Total
Uttar Pradesh	44	35	31	110
Maharashtra	3	-	109	112
Andhra Pradesh	10	8	18	36
Tamil Nadu	14	3	15	32
Karnataka	11	3	17	31
Bihar	14	15	-	29
Gujarat	-	-	19	19
Punjab	4	-	15	19
Haryana	1	-	10	11
Orissa	7	-	1	8
Madhya Pradesh	2	3	3	8
Other States	5	5	6	16
Total	**117**	**72**	**241**	**430**

Benefits of Cogeneration

IL&FS

- To SEB
  - Availability of reliable power at tail end of the system
  - Possibility of elimination of low voltage pockets with the availability of reactive power from Cogen
  - Reduction in T&D losses
  - Lower gestation periods
  - Crushing season matches with the peak period of the grid system
- To State
  - Availability of eco-friendly power from Bagasse
  - Power from renewable source of energy
  - Contribution of cane growing farmers in electricity generation
- To Sugar Factory
  - Assured market for the by-product
  - Additional returns to the cane growing farmers
  - Improved process efficiency
  - Incentive to conserve energy and sell surplus power
  - Technology upgradation at the level of the co-operative due to induction of advance technology

Why has cogen failed to take off in Co-operative/ Public Sector?

IL&FS

- Limited experience of financial institutions in lending to the co-operative sector
- Lack of track record of sugar mills in high capacity power generation
- Lack of a suitable implementation framework resulting in absence of private power developers' interest
- Perceptions about high pressure boilers, turbines and critical qualities of feed water
- Difficulty to raise funds by individual sugar factory

A typical 2500 TPD plant has to raise approximately Rs. 14 Crore of equity and Rs. 32 Crore of debt for a 12 MW cogen plant

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MITCON

FOCUS ON INDIA MARKET POTENTIAL, COGENERATION OPPORTUNITIES & THE CDM

Paper Presented By

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At

The Local Power Forum
International Cogeneration Alliance Event
United Nation's Framework Convention for Climate Change
(Bonn, Monday - June 7, 1999)

An ISO 9001 Company

INDUSTRIAL & TECHNICAL CONSULTANTS

MITCON

FOCUS ON INDIA – MARKET POTENTIAL, COGENERATION OPPORTUNITIES AND THE CDM

CONTENTS

- Indian Energy Scenario
- Potential For Renewable Energy & Energy Efficiency
- Stakeholders & Development Incentives
- Status
- Market Potential for CDM Projects in India
- Market Opportunities
- MITCON's Unique Background
- Proposed linkages for Carbon Credit Syndication / CDM Business

INDIAN ENERGY SCENARIO, A CHRONIC CASE

- Low per capita income (0.8 tonne of coal equivalent)
- Lower energy productivity (US $ 400, GNP/tonne of coal equivalent)
- Rising Population & Economic growth
- Continued dependence on depleting commercial sources (89,000 MW, 70% coal)
- Growth in energy consumption
- Demand in excess of supply (Additional 57000 MW capacity required by 2003/4)
- Low pace of Energy Efficiency Improvement
- Insignificant contribution from renewable sources of energy
- Severe shortage of funds
- Delayed initiation of the power sector reforms
- 15 – 30% T & D loss
- Peak demand shortages of 8 – 30%

INDIAN ENERGY SCENARIO, A CHRONIC CASE

- Energy availability shortages up to 15%
- Un-realistic pricing of energy
- The obvious focus calls for
  - Drastic steps for energy efficiency improvement
  - Speedy tapping of the renewable sources of energy like bio-mass (including bagasse co-generation), wind and small hydro
  - Power from co-generation in other sectors, municipal and industrial solid / liquid waste
  - Environment efficiency improvement for sustainable development

POTENTIAL FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY IMPROVEMENT

Sr. No.	Sector / sub-sector	Total Potential (MW)	Realisable Potential (MW)
1.	**Energy Efficiency Improvement** (Industrial, Agricultural, Commercial, Other Sectors)	**15000 – 20000**	**6000 – 9000**
2.	**Renewable Energy**		
2.1	Wind	20,000	12,000
2.2	Mini/Micro hydro (up to 15 MW)	7,000	4,000
2.3	Bio-mass Power (excluding bagasse Co-gen Projects)	16,500	4,500
2.4	Solar	Unlimited	Unlimited
	SUB TOTAL (2)	**43,500**	**20,500**
3.	**CO-GENERATION**		
3.1	Bagasse based co-generation	3,500	2,500
3.2	Cogen in other sectors (textile / paper / chemical)	10,000	7,000
	SUB TOTAL (3)	**13,500**	**9,500**
4.	**OTHER SECTORS**		
4.1	Municipal Solid / Liquid Waste to Energy	5,000	2,000
4.2	Industrial solid / Liquid Waste to Energy	10,000	5,000
	SUB TOTAL (4)	**15,000**	**7,000**
4.	GRAND TOTAL (1 + 2 + 3 + 4)	85,000 – 90,000	40,000 – 45,000 (50%)

STAKEHOLDERS & DEVELOPMENT INCENTIVES

Energy Efficiency Improvement

Stakeholders

- Ministry of Power (MoP), Government of India
- Energy Management Center
- Petroleum Conservation Research Association
- State Nodal Agencies
- Industry Associations
- Consultants & Experts
- Financial Institutions
- Equipment Suppliers
- Educational Institutions

Development Incentives

- Accelerated Depreciation
- Low cost funds
- Promotional support
- Subsidised energy audits
- ESCO Business Promotion
- Training & Development Support
- International Fund Support

STAKEHOLDERS & DEVELOPMENT INCENTIVES *(Contd.)*

Renewable Energy

Stakeholders

- Ministry of Non-conventional Energy Sources (MNES)
- State Nodal Agencies
- Financial Institutions, National (IREDA/REC/HUDCO/PFC/ICICI/IDBI/IFCI/NCDC) & International (World Bank /ADB)
- International Institutions like UNDP/ USAID / WINROCK International/ SDC/GEF
- Industry Associations
- Consultants & experts
- Federations
- State Electricity Boards (SEBs)
- State Energy Departments
- State Co-operative Departments
- Project Developers
- Equipment Suppliers
- Service Providers
- Private & Co-operative Sector Investors
- NGO's

Development Incentives

- Low Custom Duties
- Accelerated Depreciation & Income Tax Holidays
- Exemption to Excise Duty & Sales Tax
- Demonstration Projects
- Interest Subsidy Scheme
- Grant-in-aid for DPR / Assessment Studies
- Attractive lending norms
  - 13 – 16% interest rate
  - moratorium 0 – 3 years
  - repayment 8 – 10 years
  - reduction in interest rate for timely repayment
- Almost uniform power purchase policy
  - Power buyback rate of Rs. 2.25 / KWH or 5.2 cents/KWH, 1994-95 base year
  - 5% escalation every year
  - 2 – 7% wheeling charges
  - banking up to 12 months allowed
  - third party sale allowed
  - fuel pass through up to 40% of total generation
  - currency fluctuation risk cover over 5% variation
  - state capital subsidy / grant
  - state equity participation
  - evacuation arrangements by SEBs and infrastructure support

STATUS

Energy Efficiency Improvement

- Despite promotional efforts since 1979, results well below the expectations
- Cross subsidisation and un-realistically low energy pricing
- Lack of attractive financing instruments and mechanisms
- Slow pace of globalisation of economy
- ESCO concept, backed up by appropriate financing mechanism, has excellent potential.

Renewable Energy

- Concentrated efforts started since 1986 in wind and small hydro and in Bio-mass since 1993, at the Ministerial levels.
- Status of implementation as of March, 1999 is as given below :

Sr.No.	Source	Realisable Potential (MW)	Commissioned as of March 99 (MW)	Under Consideration (MW)	Total
1.	**Wind Power**	**12,000**	**972**	**250**	**1,222**
2.	**Small Hydro**	**7,000**	**200**	**150**	**350**
3.	**Biomass**				
3.1	Bagasse Cogen at sugar mills	2,500	134	195	329
3.2	Bio-mass based Power generation	4,500	37	34	71
	Sub Total (3)	**7,000**	**171**	**229**	**400**
4.	**Total (1 + 2 + 3)**	**33,000**	**1,343**	**629**	**1,972**

Other Sectors (Industrial Co-generation / Solid and Liquid Waste)

Lot of promotional efforts are on-going, yet the capacity additions are very low.

POTENTIAL FOR CDM PROJECTS IN INDIA *

Sr. No.	Sector	Realisable Potential Range (MW)	Sector Maturity Rating	Investment (US $M/MW)	Carbon Credit Potential ('000 T/Yr/MW)	Expected Capacity Addition (MW) & Carbon Credit Potential (Million T/Yr)		
						Upto 2000	2001 – 2005	2006 – 2010
1.	**Energy Efficiency Improvement**	**5,000**	**B**	0.50	8.54	**500 (4.27)**	**1500 (12.81)**	**2000 (17.08)**
2.	**Renewable Energy**							
2.1	Wind	12,000	A	0.95	8.54	250 (2.14)	1500 (12.81)	3000 (25.62)
2.2	Mini/Micro Hydro (up to 15 MW)	4,000	B	0.95	8.54	100 (0.85)	500 (4.27)	1500 (12.81)
2.3	Bio-mass Power excl. bagasse)	4,500	C	0.75	6.41	100 (0.64)	500 (3.20)	1000 (6.40)
	Sub Total (2)	**20,500**	**B**			**450 (3.63)**	**2000 (20.28)**	**5500 (44.83)**
3.	**Co-generation**							
3.1	Bagasse based co-generation	2,500	A	0.75	6.41	250 (1.60)	750 (4.81)	1000 (6.41)
3.2	Industrial co-generation	7,000	B	0.70	7.68	50 (0.38)	500 (3.84)	2500 (19.20)
	Sub Total (3)	**9,500**	**A**			**300 (1.98)**	**1250 (8.65)**	**3500 (25.61)**
4.	**Other Sectors**							
4.1	Municipal & industrial Solid / Liquid Waste	**2,000**	**B**	0.70	5.40	**25 (0.14)**	**100 (0.56)**	**1000 (5.60)**
	GRAND TOTAL	37,000				1275 (10.02)	4850 (42.30)	12000 (93.12)

POTENTIAL FOR CDM PROJECTS IN INDIA * *(contd.)*

Sr. No.	Item	Period			
		Up to 2000 AD	2001 – 2005 AD	2006 – 2010 AD	2000 – 2010 AD Cumulative
1.	Capacity Additions (MW)	1275	4850	12000	18125
2.	Carbon Credit Potential (Million MT/yr)	10.02	42.30	93.62	145.94
3.	Total Investment Required (US$ M)	897.50	4007.50	9225	14130
4.	Carbon Credit Business (@ $ 15 / MT), US $ M	150.30	634.50	1404.30	2189.10

MARKET OPPORTUNITIES

- Equipment & Project Supply
- Project Development
- Financing & Leasing
- Carbon Credit syndication
- Macro, policy and Development Initiatives
- Consultancy / Advisory Services
- Other services (O & M, etc.)

MITCON's UNIQUE BACKGROUND

- Promoted by India's main financial institutions, Public Commercial Banks and Maharashtra State Government Corporations.

- 18 years of experience in industrial, technical and management consultancy services of diverse range in

  - pre-investment
  - project management
  - Project finance
  - macro and policy studies
  - training & human resource development

  Focus service sectors

  - Energy Efficiency
  - Environment
  - Renewable Energy
  - bio-mass & co-generation power
  - industrial infrastructure
  - sustainable building materials
  - rural industrialisation,
  - information business
  - agri - business
  - entrepreneural training and promotion

- ISO 9001 company, professionally managed company , well equipped offices in Pune, Mumbai and New Delhi (Under establishment)

- Working relations with all major stakeholders for possible CDM projects in India, in all focus sectors.
- Linkages with similar State Level Technical Consultancy Organisation in 18 states of India.
- Experience of major Macro studies and assignments like
  - Situation Report on Energy, All India Bagasse Cogen Study
  - Application of Energy Efficiency Data Protocol for Indian Sugar Mills Project Brief for UNDP – MNES – GEF
  - Removal of Barriers to Biomass Power Generation Project
  - Lead Programme Partner of MNES for Development of Bagasse Co-gen and Bio-mass Power Projects
  - Business Development Associate of IREDA
  - Implementation of Demo Project for Environment / Energy Efficient Vertical Shaft Brick – Kiln project for SDC, having huge multiplication potential
  - Project Developer Interface Services
  - Range of pre & post investment services for bio-mass / bagasse power projects
  - Energy Audits
  - EIA Studies
  - Loan / Grant-in-aid Syndication Services

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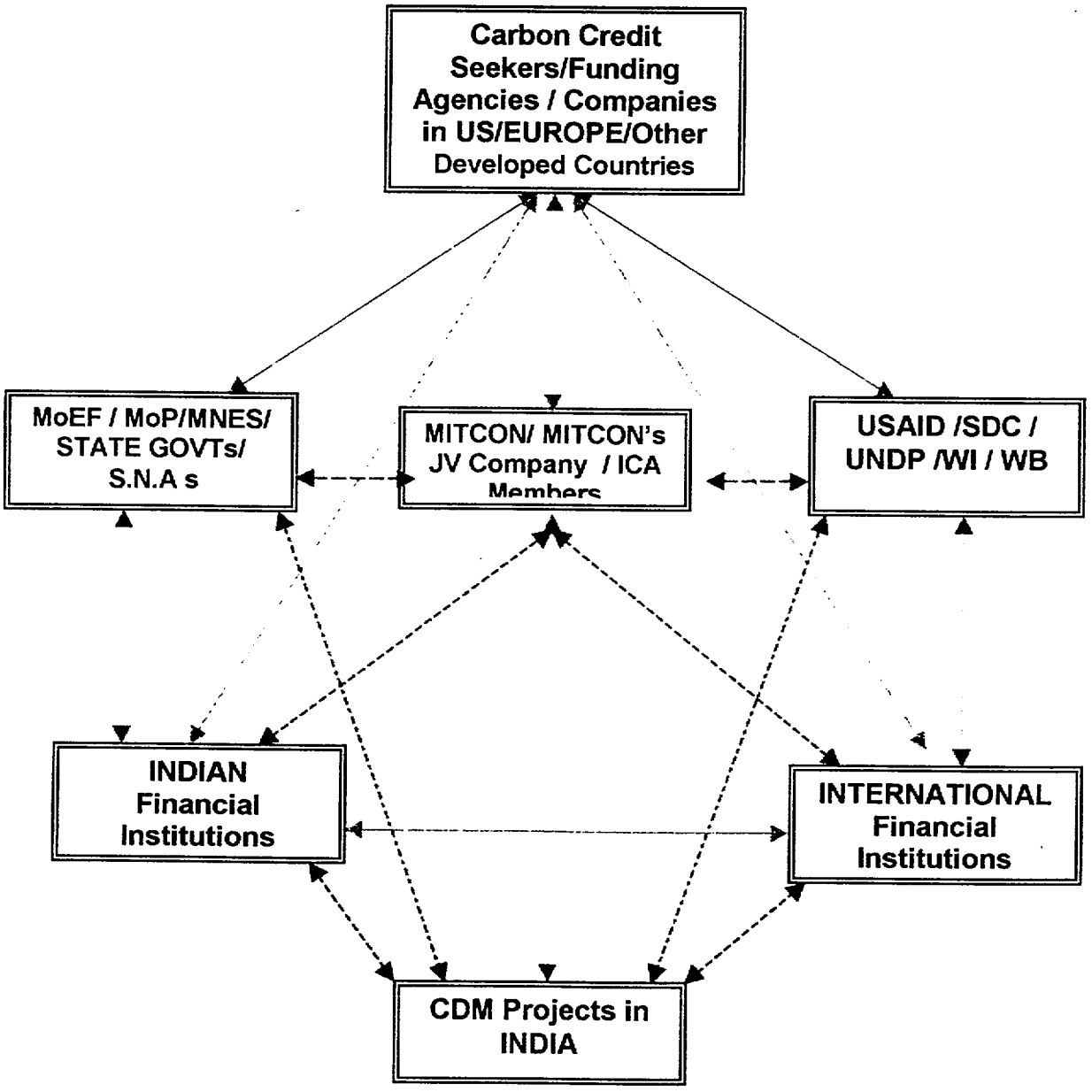
PROPOSED LINKAGES FOR CARBON CREDIT SYNDICATION FOR CDM PROJECTS IN INDIA



IL&FS

IL&FS Proposal

IL&FS proposal

IL&FS

- The potential sugar factories can be grouped together to develop cogen projects at each sugar factory, with aggregate capacity of atleast 100MW
- A group of sugar factories to select a Power Developer (JVP) through a transparent process of competitive bidding based on the following parameters :
  - Fund raising capability of the partner
  - Past track record of the partner
  - The returns to the host sugar factory
- After identification of JVP, the JVC can be formulated with the equity participation of State Govt. Agency, host sugar factory/sugar federation and domestic financial institution like IL&FS
- Advantages of standardisation of main power plant equipments
- Bulk discounts to bring down the capital cost
- The JVC will then set up cogen plant at individual sugar factory on BOOT basis

Responsibilities

IL&FS

Host Sugar Mill (HSM)

- Provide land for cogeneration plant and bagasse storage
- Supply of entire bagasse produced
- Return process steam condensate
- Disposal of all waste from the cogen plant

Joint Venture Company (JVC)

- Supply of process steam
- Supply of auxiliary power
- Monetary incentive to the HSM
- Supply surplus power to SEB / Third Party

Joint Venture Company

IL&FS

Pre-requisites to ensure participation of a private power developer, strategic equity investors and project lenders

- support and commitment of the State Govt. by way of equity participation
- resolution of the sugar factories to adopt JV route and equity commitment to ensure :
  - supply of bagasse, cane trash
  - access to agrowaste
  - committed offtake of steam and power
- support of the SEB through
  - favourable policy climate including 3rd party sale to Industrial Consumers
  - guaranteed power offtake and payment
  - bearing the cost of power evacuation
- project size - minimum 100 MW
- Bankable Detailed Project Report
- Equity returns of at least 28% per annum

The JVC structure would position it as a bankable project implementation format

Status

IL&FS

Ministry of Non-conventional Energy Sources -

- Joint Venture format accepted to develop Cogeneration Projects in sugar mills
- Appealed to all sugar producing States to adopt JV route
- Learnt : announcement of JV scheme for capital subsidy (Rs. 20 lacs per exportable MW during crushing season) and interest subsidy (Rs. 15 lacs per exportable MW)

Tamil Nadu -

- IL&FS as implementation advisor
- Identified - 10 sugar mills in co-operative sector
- IL&FS formulated composite Bid Specification
  - Qualifying criteria
  - Details of identified sugar mills
  - Power purchase policy
  - Final selection criteria on the basis of returns to host sugar mill (Rs. per ton of cane crushed)

Status..... 2

IL&FS

- Equity pattern proposed (Debt Equity 70 : 30)

- Joint Venture Partner (Private Sector)	:	74 %
- State nodal Agenecy (TEDA) (MNES capital subsidy)	:	11 %
- State Government / Govt. Agencies	:	5.5 % (being finalised)
- Sugar factories	:	5.5 % (being finalised)
- Domestic Financial Institutions	:	the balance

Karnataka -

Business meet of sugar mills, co-operation department, energy department etc. called on June 23, 1999 in Bangalore

IL&FS

Next Steps

Next Steps

IL&FS

- To constitute a Steering Committee at the State Govt. level with the participation at Senior Level from Energy, Co-operation Departments, SEB, State Nodal Agency, IL&FS
- State Government needs to convince co-operative sugar factories to adopt JV route
- Identification of group of sugar factories
- Commitment by the State Govt. for
  - equity participation - pre-requisite for obtention of MNES subsidy
  - support - land, water etc.
- Resolution of identified sugar mill to
  - implement cogen projects through JV route
  - invest upto 5% of equity
  - provide land at predetermined charges
  - transfer the extra water allocation to cogen unit

Next Steps ... 2

IL&FS

- SEB needs to announce the following :
  - Favourable power purchase policy
  - To bear 100% cost of power evacuation
  - To standardise Power Purchase Agreement
- Impress upon MNES to evolve a package to support the JVC for the quickest implementation
- Selection of JVP through a bidding process

BIO-DATA

As a Chief Executive - Power Business Group of Infrastructure Leasing & Financial Services Limited (IL&FS), Dr. Ashok Harane was actively involved in development of a first private sector company in Transmission sector for evacuation of power from Mangalore area in Karnataka. Under his leadership, the Power Business Group of IL&FS has advised PSUs/ SEBs like Gujarat Mineral Development Corporation (GMDC) for development of a lignite based power project, MSEB for techno-commercial study of electricity distribution in Navi Mumbai, Electricite de France (EDF) for Orissa distribution. He is instrumental in developing an innovative JV format which has been also accepted by Ministry of Non-conventional Energy Sources (MNES) for development of Bagasse Based Cogeneration projects in co-operative & public sector sugar mills. He has also worked as a member of the committee of experts appointed by Ministry of Power to make recommendations for entry of private sector in transmission

Prior to joining IL&FS, he was heading the Corporate Planning group of Maharashtra State Electricity Board (MSEB) for 4 years during which MSEB has executed the Power Purchase Agreements for three major projects in private sector and developed cogeneration projects in Co-operative sugar factories in Maharashtra. He has 28 years of long experience with MSEB where he has worked in different positions in thermal power plants of MSEB. During his service in Indian power sector for the last 31 years, he has worked on many committees approved by State/ Central Governments

INTERNATIONAL OPPORTUNITIES FOR FINANCING SUGAR MILL CO GENERATION IN INDIA

Edwin G. Jewett, Jr
CMI Consultants Inc
Louisiana

1) GENERAL STATUS OF SUGAR MILL FINANCING IN THE UNITED STATES AND ELSEWHERE AND ITS RELATION TO INDIAN CONDITIONS

Comparing conditions in two very different systems, such as India and the United States, is difficult. The best illustration of these differences is the size of the respective industries. India has 400 sugar mills producing 13 million tons of sugar. The United States aggregated production of sugar from sugar beet and sugar cane is only approximately 8 million tons from about 50 mills.

So you can appreciate the size and uniqueness of **YOUR** sugar industry – which you are most familiar with - I will provide some background on the United States Sugar industry.

Like all sugar producing counties the government plays a significant role in the United States sugar industry. The U. S. Farm Bill, covering agricultural production, has sections dealing with sugar. Included are

- price support system – **NOT** a subsidy payment from government coffers
- provisions for importation of sugar from traditional trading partners at a price above world market
- an assessment - **TAX** – paid by producers and processors to the United States government

Sugar is produced from both sugar beet and sugar cane.

SUGAR BEET

Sugar beet is produced in 14 of our states. In 1998 approximately 4 million tons of sugar were produced from 1.5 million acres of planting. Sugar beets are produced in the colder climates in areas similar to Europe, Russia and former Soviet republics. I mention this so you are aware the United States has a sugar beet capability in the sugar sector.

SUGAR CANE

Sugar cane is produced in Hawaii, Florida, Louisiana and Texas. A very limited, and diminishing, amount of sugar cane is produced in Puerto Rico.

HAWAII

Sugar cane production is over long growing periods with excellent sugar cane and sugar yields per acre. Harvesting practices does not permit a ratoon crop. Grinding season is lengthy utilizing sugar mills with small daily capacity.

Hawaii's sugar industry is characterized by -

- long history of sugar cane production
- favorable agronomic and climatic conditions
- excellent sugar technology and research
- large public company ownership with strong financial resources

Land values for real estate development combined with increasing labor cost have reduced the number of mills over the past several years.

Current levels of production are estimated at 340,000 tons of sugar from 34,000 acres. Down from 1990 when 820,000 tons of sugar were produced from 80,000 acres of sugar cane.

This downward trend in sugar cane production will continue..

For a number of years the Hawaiian sugar industry has been successful in implementing co generation of power from sugar mills with electricity being sold to public utilities

FLORIDA

Florida is the largest and most efficient producer of sugar cane and sugar in the United States. A small number of sugar mills with large daily grinding capacity produce approximately 2 million tons of sugar from 450,000 acres

Florida experiences higher sugar cane yields per acre plus higher recovery rates from the large daily grinding capacity mills, with a milling season of 150/180 days.

Harvest and transport is mechanized. Delivery of cane to the mill by rail car is employed in some operations.

Environmental issues affect the Florida sugar industry. This year a large integrated sugar operation, owned by a public company, closed because of environmental concerns. The United States government acquired the agricultural lands – which will be flooded and be reintegrated with the Florida Everglades swamp - -and the 10,000 ton per mill is being dismantled and sold.

The Florida sugar industry is operated by public companies, private companies and co operatives.

There are established co generation operations in the Florida sugar industry.

LOUISIANA

Sugar is a traditional crop, being introduced in the 1700's.

Today Louisiana produces approximately 1,2501 million tons of sugar from 420,000 acres. This is a growth from 440,000 tons of sugar from 250,000 acres in 1889.

Harvest and transport are mechanized, with chopper harvesters and rail transport being introduced..

A short harvest season – 75/100 days – require large capacity processing mills.

Increases in sugar cane production are a result of technology – a new higher yielding variety. – which has increased sugar yields per acre by 1/3. and conversion of lands from rice, grains and livestock, to sugar cane production, because of adverse impact of government policy - the Farm Bill - on these producer.

Louisiana sugar mills are privately owned or owned by cooperatives.

TEXAS

Sugar cane was reintroduced in the early 1970's. This is the most recent grass roots sugar project in the United States.

A cooperative mill was established in 1973 and produces approximately 90,000 tons of sugar from 45,000 acres of irrigated land.

As a relative newer sugar operation, the mill provides an efficient chopper harvest and truck transport support system to the member growers.

Drought conditions and the lack of irrigation water have adversely impacted sugar cane and sugar production.

FINANCING OF U. S. SUGAR INDUSTRY

The sugar industry – sugar cane production and sugar production -in the Untied States has financing support from a federally established Farm Credit System and from the normal banking and commercial finance providers.

Government established lenders and programs support sugar cane farmers. Commercial banks provide crop loans to growers.

Sugar mills have access to government lending and guarantee programs. The Bank of Co Operatives provides –

- production loans for members of sugar mill cooperatives
- mills for capital expansions
- working capital.

Non cooperative mills – which are usually more efficient and profitable – obtain credit from commercial banks. Many of these private companies have generated substantial retained earnings and are self financing,.

SECURITY

All lending is done on a **SECURED** basis. I believe this is also the case in your sugar industry.

Loans to farmers and growers and equipment owners and operators require a personal guaranty. I believe this is also the case in your sugar industry.

Loans to mills usually **DO NOT** require personal guarantees of owners and directors. This is a negotiation item. I do not believe this is the case in your sugar industry.

INTEREST

Interest rates are based on U. S. government securities, the commercial bank prime rate or other traditional money market instruments.

Current interest rates for crop financing and working capital usually in the 7/10% range.

Financing for capital goods is usually in the same range.

In the cases when a borrower utilizes a U. S. government guaranty program, the interest rate becomes more of function of the value of the U. S. government guarantee, than the underlying credit risk of the borrower.

The point on utilizing government guarantees to lower interest expense will be expanded upon subsequently when we discuss the various external funding sources.

I do not need to remind you of the interest rates you enjoy in your system.

TERM

Government agencies and commercial banks provide a substantial component of crop, equipment and expansions loans.

Crop loans are repaid from annual harvest. The growth period and the plant cost are both recognized in the repayment terms,

Harvest and transportation equipment usually carry a repayment term of 5/7 years. A downpayment of 10/20% is usually required.

Expansions and new mills require grace periods and long term repayment. Only in unusual situations will this term be beyond 10 years.

OTHER COUNTRIES

In other countries funding is provided by a variety of sources.

CROP

Crop loans from government or where available from commercial banks.

Grower cooperatives also function in the agricultural credit process, as a borrower and re lender to members or arrange for loans to members from usually government sources.

Terms are less than one year..

Administration, repayment and collection difficulties characterize many of these re lending operations.

HARVEST & TRANSPORT EQUIPMENT

Local distributors and agents frequently provide funding. This is normally under programs established by manufacturers of equipment.

MILL

Multilateral international and regional development financing institutions (IFI) – the World Bank, Asian Development Bank – are examples. These loans are to governments or guaranteed by governments with re lending to parastatals and other operators.

All of the IFI have private sector units who can provide support for private owned operators.

Export Credit Agencies (ECA) provide funding in support of their domestic manufacturing companies.

Manufactures in some cases now providing leases, many under guarantee of their ECA..

SUMMARY

This has been a very brief recap to provide background on conditions existing in the U. S. sugar sector so you can compare to the day to day problems and realities of you face in your sugar industry.

2) SOURCES, TERMS AND CONDITIONS OF INTERNATIONAL FINANCING

From an American movie, the refrain **SHOW ME THE MONEY** has entered the idiom of American slang.

We'll now provide a recap the major funding sources for good projects. To show you -

WHERE TO GET THE MONEY

INTERNATIONAL FINANCIAL INSTITUTIONS

WORLD BANK

Located in Washington, the group is comprised of:

- International Finance Corporation (IFC)
- Multilateral Insurance Guaranty Association (MIGA)
- Global Environment Facility
- International Development Association (IDA)

INTERNATIONAL FINANCE CORPORATION

A specialized agency of the World Bank to invest and lend to private sector enterprises. This is in contrast to the World Bank who lends to governments and government agencies.

IFC will support both grass root start ups and expansion projects from established companies.. The addition of a co generation capability to an existing sugar mill, they can be approached on the basis of an expansion.

> Expansions allow IFC to be flexible and provide additional support, since the borrower is an established entity with a track record. These know qualities of the borrower IFC level of support can be greater and terms more flexible than a grass root start up project which carries many assumptions and unknowns...

Investments by the IFC in the equity account of the private company is permissible. Conditions IFC will require the private borrower to adhere to are:

- IFC investment may are usually in the form of "quasi equity" and not straight common equity
- IFC equity or "quasi equity" may have a coupon or preference interest payment condition
- IFC investments usually are redeemed or carry a "first out" provision.
- IFC will have covenants and other restrictions, usually within normal and good business practices
- IFC membership and representation on Board of Directors

Loan terms usually include -:

- secured by real estate, fixed and other assets
- on a senior basis
- IFC will provide funding - equity or loan – for a stated percentage of a project.
- IFC will not fund the entire transactions, usually less than 50%
- IFC level of 50% is their combined - equity and loan - exposure.
- grace periods are permitted prior to commencement of re payment
- repayment up to 12/15 years
- interest rate can be fixed or floating
- commitment and other fees
- legal agreements
- project completion guaranties
- adherence to agreed financial ratios
- performance covenants
- operational reporting

IFC usually has a Tranche A and Tranche B loan.

- tranche A is IFC money invested or lent directly to the project.
- tranche B loan is funded by a bank or others and carries an interest rate negotiated with the funders

As is the case with similar institutions, IFC is looking for a role of additionally. IFC wants other lenders and participant in the project and considers their role as complementary to the project. On the other hand, IFC wants to control the transaction and be in a preferred creditor position.

MULTILATERAL INSURANCE GUARANTY ASSOCIATION

A more recent development created to insure a company's investments, against political risk, - in projects and companies in World Bank member countries.

MIGA provides long term insurance coverage against –

- expropriation by host country government
- confiscation by host country government
- war, riot and civil commotion
- convertibility

MIGA does not provide any direct funding.

MIGA is a risk mitigation vehicle.

MIGA insurance – as a risk mitigation vehicle – has value to lenders and funders. of a project or an expansion.

Assignment of proceeds of a MIGA insurance policy can be considered as part of a financing package.

Fee's and premiums assessed by MIGA are market competitive.

GLOBAL ENVIRONMENT FACILITY

An even more recent World Bank development, GEF offers technical assistance and fund support for projects that will impact the environment of the world globally...

Co generation in the India context does favorably and positively impact the global environment..

This is another alternative to consider when reviewing funding support.

INTERNATIONAL DEVELOPMENT ASSOCIATION

IDA is the soft loan window of the World Bank.

Loans from IDA are 40 years and carry a service fee of less than 1%.

IDA loans are to governments and can be sub lent.

Terms of the sub loans of an IDA World Bank credit are established by the host government. While the IDA credit carries a very long term, no interest – only a nominal service fee – the re lending of these funds are not on the same basis as disbursed by IDA. Usually the term will be shorter and the interest rate closer to those prevailing in the local market.

The World Bank Group has a long history of supporting projects in India. The utilization of the various windows of funding will be determined by the structure of your project.

ASIAN DEVELOPMENT BANK

Located in Manila, the Asian Development Bank (ADB), is a regional multilateral international financial institution specializing in loans in the region.

Loans are available on a long term basis for government and private sector borrowers.

Like the World Bank, the ADB lends to governments and government agencies.

A private sector unit modeled off of the IFC is also in place.

EXPORT CREDIT AGENCIES (ECA'S)

All major industrial nations have an export credit agency scheme. Some of the more commonly know ECA's are –

- Export Import Bank of the United States
- Japan Import Export Bank
- Export Development Corporation (Canada)
- COFACE (France)
- Export Credit & Guarantees Department (England)
- HERMES (Germany)
- SACI (Italy)
-

The leading ECA's belong to the Berne Union. The Berne Union acts as a clearing house for the member ECA's in establishing a common meeting ground for dialogue and discussions of terms – coverage and repayment – and comparison of premiums and fees.

While not perfect, the Berne Union endeavors to provide a "level" playing field for all ECA's in the financing of their manufactures exports.

Some common characteristics of ECA's are –

- content must be 100% from the country of export
- a minimum down payment of at least 15% on any transaction value
- determination of repayment based on type and use of capital good
- at least semi annual repayments
- repayment must commence within six month of shipment
- short: term up to 360 days repayment
- medium term up to 5/7 years repayment
- long term over 7 years and usually with a maximum 12/15 year repayment
- assessment of an Exposure Fee or premium based on the risk
- political risk are covered
- repayment risk are covered

- provide funds directly to a transaction
- issue guaranties and or insurance to exporters or their bankers who will fund the export sale

These are general characteristics, but each ECA operates to the benefit of their own export sector. Many will provide terms outside those listed above, and subscribed to in the Berne Union, to enable an exporter to make a shipment when in competition with others.

ECA's will make guaranty facilities available to approved and responsible local banks. This mechanism – like a re lending credit from World Bank or ADB – puts the responsible for credit decision on the local banking institution. The local banking institution will be responsible for:

- providing funding or obtaining a external bank to provide funding under the ECA guarantee/insurance
- determine the transaction is eligible within the guidelines established by the ECA
- exercising the credit judgement on the borrower
- administer the documentation required by the transaction and the ECA.
- record all security documentation with proper local authorities
- collect the semi annual repayments
- re pay the funding to external bank, if the borrower defaults

When an ECA provides its own funds to a transaction they will accede to the rates agreed by OECD. These rates are fixed each six months.

If the transaction is funded by a bank in the country of the ECA or an external bank, the ECA guarantee/insurance is used to determine the interest rate. As an example –

U.S. EXIMBANK GUARANTEED/INSURED TRANSACTION CAN CURRENTLY BE FUNDED, BY BANKS ACTIVE IN THIS MARKET, ON THE BASIS OF SIX MONTH LIBOR PLUS 1/8 TO ½ OF 1 %.. CURRENTLY THIS RATE WOULD BE APPROXIMATELY 5.5%..

While the rate is very attractive, the borrower must calculate the cost of his Exposure Fee/premium and the front end cost assessed by the funding banking.. Both of these fees can be incorporated into the funding of the transactions. You the buyer have a cash requirement to meet the 15% required down payment plus any other fee' associated with the transaction.

INVESTMENT AGENCIES

Most industrial nations have a special agency devoted to the development of investments in the developing world.

Among these specialized agencies are:

- Overseas Private Investment Corporation (OPIC), (United States)
- Commonwealth Development Corporation (CDC) (England)
- Kreditanstalt fur Weiderbau (KfW) (Germany)
- PROPARCO (France)
- FMO – (Holland)
- Industrialized Fund for Development of Underdeveloped Countries (IfU) Denmark
- Swedish Industrial Development Agency (SIDA) Sweden

These agencies complement and work with private sector companies in investments and lending in developing countries.

Each has their own standards, methodology and objectives

Most will make an equity investment, except the OPIC of the U. S. who only makes loans. .

Terms and conditions – like the IFC - are usually tailor made for the transaction, but usually do not exceed 12 years.

Conditions similar to IFC are usual -:

- direct loans to the overseas entity are undertaken
- security and senior creditor positions usually required.
- personal guaranties are not usually required
- project completion guaranties – physical and operational – are required
- interest rates can vary based on the funding - a direct loan from the agency or funding under their guarantee at market pricing.
- fee's will be assessed.
- financial ratios required
- covenants
- board representation
- provide management or require management contracts

These investment agencies work with other investment agencies, IFC, ECA's plus commercial lenders and funders to put a full financial structure in place for a project.

When an equity investment is made it is usually in conjunction with a private company from the country of the agency, together with an overseas partner in the country of the investment.

As an investor, the investment agency has a vested interest in the success of the project. They will be very active in the management and decision process of the company.

INTERNATIONAL BANKS

Many international banks operate offices in India. Additionally, they have special teams assigned to energy projects.

These banks will fund transactions with guarantees from the ECAS and the investment agencies.

Additionally, they can provide funding on a direct basis when they are comfortable with the risk.

EQUITY FUNDS

Equity investors are another possible funding source.

Many of these funds are operated as venture capital sources of funds. As venture capital funds they are seeking above average returns for their investment.

A special opportunity are the funds established by the Overseas Private Investment Corporation in Washington. These are equity investment funds with an exclusive focus on India. Two are currently operational -

- Draper India Fund $55
- India Private Equity Fund $140

While neither of these funds are focused on energy exclusively, they can consider equity investments in energy projects in India.

SUMMARY

The World Bank Group, Asian Development Bank, Export Credit Agencies and government investment agencies all provide funding to projects – grass roots and expansions – on terms – repayment and interest - that are usually attractive. to investors.

International banks provide funding, usually with guarantees, of the ECA or government investment agency. They also can provide direct credit.

Equity funds provide a vehicle for additional capital, usually at a significant cost.

Above we have noted some of the conditions they require. Later will we will expand on many of those conditions.

3) HOW TO CONTACT INTERNATIONAL ORGANIZATIONS TO OBTAIN DETAILS

INTERNATIONAL FINANCIAL INSTITUTIONS

World Bank Group & Asian Development Bank have Resident Representatives in India. These officers which are staffed by professionals can provide guidance and detail on how to access the various programs available.

India has an Executive Director on the board of directors of these organizations.. The Executive Directors office has a staff who can provide guidance.

ECAS & INVESTMENT AGENCIES

ECA'S and Investment Agencies can be contacted through their respective Embassy, Consulate or High Commissioner's Office. The inquiry should be directed to the economic, trade or commercial section.

Concerning the specialized funds operating under the auspices of OPIC, contact the US Embassy or consulate.

VENDORS

The equipment manufactures, and those overseas equipment manufactures with facilities in India, can provide details and facilitate applications with all of the organizations discussed. This is usually done as part of the sales package as an inducement to purchase their equipment.

Construction and engineering companies will obtains or provide assistance in working with international agencies to arrange the necessary funding for projects.

INVESTMENT BANKS

An alternative is to engage an investment bank or consultant to identify and facilitate your funding requirements.

These entities charge fees for their services, but they are usually capable to providing funding, or advising that funding will not be available.

SUMMARY

Being able to contact international lending organizations is not the difficult task. Embassies, Executive Directors at IFI, USAID and any of the participants in the program can provide assistance.

4) HOW TO OVERCOME OBSTACLES IN INTERNATIONAL FINANCING

Now we are getting to the heart of the problem.

You know how to manage a business profitably. You know how to deal with government. You know how to operate a sugar mill profitably. You know how to engineer and expand a processing facility. Now we get to the heart of this discussion –

HOW TO GET MONEY FROM AN INTERNATIONAL AGENCY

These comments will apply to all of the international organizations and agencies previously identified and discussed.

First ask yourself the following questions –

- Does the project make senses?
- Does the project serve a need?
- Is there a legitimate need for the product?

If you are comfortable with the answers then move your project along to the application level..

The first and most basis question these agencies ask when they evaluate your application are:

- Does the project sponsor have a successful track record in the type of business he is asking us to finance?
- Is the technology proven?
- Is there a market – at a realistic price - for the product?
- Is the project sponsor at risk?

If you do have good solid answers – and have presented them in a logical and proper manner – your application will make the first review level of the international agency. If you are not confident with the answers to these basic questions, think again about your investment and project.

If you can answer these three basic questions in a reasonable manner, then begin your Feasibility Study or develop your Business Plan. You need a well thought out application, supported by fact and backed up with solid information – technical, marketing and financial.

All of you know what makes a good Business Plan. Its not size or volume,

ITS RELIABLE ACCURATE INFORMATION GROUNDED IN FACT COMBINED WITH PROJECTIONS BASED ON CONSERVATIVE AND REALISTIC ASSUMPTIONS

The following are the elementary essentials for a good Business Plan: -

1) Brief description of the project

2) Sponsorship, management and technical assistance:

history and business of sponsors, including financial information and statements

proposed management arrangements, with names and CV's of managers

description of technical assistance and other external arrangements (management, production, marketing, finance, accounting, legal)

3) Market and Sales

basic market orientation – local, national, regional or export

projected production volumes, unit prices, sales objectives and market share of proposed venture

potential users of products and distribution channels to be used

present sources of supply for products, future competition and possibility that market may be satisfied by substitute products

tariff protection or import restrictions affecting products

critical factors that determine market potential

4) Technical feasibility, raw materials resources and manpower

description of manufacturing process

comments on special technical complexities and need for know how and special skills

potential supplies of equipment

available infrastructure (transportation, communications, water, power

breakdown of projected operating cost by major component and category of expenditure

source, cost and quality of raw materials supply and relations with support industries

import restrictions on proposed raw materials

proposed plant location in relation to suppliers, markets, infrastructure and manpower

proposed plant size in comparison to other know plant

5) Investment requirements, project financing, and returns

estimate total project cost, broken down into land, constructions, installed installed equipment, working capital

foreign exchange component and impact

proposed financial structure of project, indicating expected sources and terms of equity and debt financing

external financing requirements, equity and loan or both and amount

projected financial statements, information on profitability, and return on investment

critical factors determining profitability

6) Government support and regulations

project in context of government economic development and investment program

specific government incentives and support available

expected contributions to economic development

outline of government regulations on exchange controls and conditions of capital entry and repatriation

7) Time scale for project preparation and implementation

This is the basic outline recommended by the IFC.

Installing a co generation capability at an existing successful operating sugar mills, many of the questions outlined in the above Business Plan will be easily answered..

FINANCING PLAN

The most critical component of your Business Plan is your Financing Plan.

This will include –

- Capital contribution of project sponsor
- Debt financing, including details of who and where will provide
- Capital cost
- Operating cost
- Pricing
- Revenue Projections
- Cash Flow projections
- Current ratio
- Debt/Worth ratio
- Debt Service ratio
- Internal rate of return

The Financing Plan will confirm the ability of the project to repay the borrowings incurred.

All of these components are important. You must be **REALISTIC AND CONSERVATIVE** when you prepare the Financial Plan.

An observation is the role of internal rate of return. The IRR. is a calculation with provides a measure to the investor.

CASH FLOW AND DEBT SERVICE REPAY LOANS

APPROVAL OF YOUR APPLICATION

OK, we now get to the hard part of the process. You have reviewed your situation. You have made a well reasoned business decision to proceed. You have prepared a good Business Plan and are prepared to submit your application to an international lender. Maybe you have invested 3 to six months of time and effort of you and your staff. Most of the cost to date is most probably fixed overhead, so you are not expended a substantial amount of cash.

HOW LONG DOES IT TAKE A WELL THOUGHT OUT, DOCUMENTED AND DEVELOPED APPLICATION TO GET PROCESSED AND DISBURSED?

What ever the lender, the vendor, your competitor, the government minister tells you in terms of time from application to disbursement of cash money to your project, consider it an educated guess. The processing time is unknown.

IT IS A LONG LENGTHY PROCESS.

Assuming your Business Plan is perfect. There still will be questions. There will be additional reviews, They may require independent out side consultants. All of these international lenders and agencies are bureaucracies and they do things by consensus on their own time table. They do not want to be "second guessed" at a later time if a problem arises.

COMMITMENT LETTER

Once you receive an approval for your funding request, a commitment letter and agreement is negotiated. This is only another step in the process. The funders commitment letter only enumerates in specific detail all the terms and conditions that they require.

The commitment letter will detail –

- amount
- term
- grace period
- repayment or amortization program
- basis for calculation of interest
- fees
- security
- undertakings or guarantees of project sponsors
- equity requirement
- financial ratios
- affirmative and negative covenants
- government approvals required
- other approvals or agreements required
- expiration date of commitment letter
- other funders
- escape clause

Before you sign and accept the commitment letter,

. **BE SURE THE COMMITMENT LETTER IS SATISFACTORY AND ACCEPTABLE TO YOU**

These terms and conditions are not created without input and agreement with you and your company. There is a negotiation of the details so when the international lender issues his commitment letter you should not have surprises.

Changing the commitment letter will be very difficult and will consume additional time. The commitment letter

Also once the commitment letter is executed you will be assessed a commitment fee. So money will be expended.

LEGAL AGREEMENTS

Again, we have another step in this lengthy process. The lawyers or solicitors now begin preparation of the legal documents.

Once these are in draft form, another round of negotiation ensued, until agreement is reached with the funder.. This loan agreement will enumerated –

- the many documents you must prepare, produce, execute and register
- the legal opinions required
- the required government approvals you must obtain
- agreements with others which are required conditions of the commitment letter
- details on security documents, the preparation and perfection of these documents with the appropriate registration authority
- details of relationships with other funders
- requirements for the first and subsequent disbursement of funds

PROMPT REVIEW OF DRAFT LEGAL DOCUMENTS IS NECESSARY TO INSURE YOU CAN COMPLY WITH AND PRODUCE THE DOCUMENTS AND APPROVALS IN A TIMELY MANNER

To produce final legal documents for signature is another time consuming step in the process.

DOCUMENTATION PREPARATION

Once you have come to agreement on the legal agreements the preparation of the required documents, government approvals and other legal necessities commences.

We would assume that during the entire process, you are aware of the requirements of the lenders in their legal documents and would have initiated action to be in position to have these documents ready or near ready for completion.

DISBURSEMENT

After you have provide all the documents in proper form, and received approval from the lender and the lenders legal department will your loan be declared effective and you can request disbursement..

Usually, there will be a delay in disbursement. Any of the following can be reasons for delay in disbursement –

- a document is missing
- a document is not in a form acceptable to the funders legal department
- a new document is introduced by the funders legal department

Until the funders legal department reviews and signs off on all documents are in proper and acceptable form you cannot receive funds. Therefore, notwithstanding your long work and best efforts, the disbursement is delayed.

Corrective action on your part is the only solution.

Let us now again ask the question –

HOW LONG DOES IT TAKE TO GET APPROVAL AND DISBURSEMENT?

IMPLEMENTATION & MONITORING

After a loan is declared operational or effective and disbursements are under way, you will be required to submit various reports on a frequency basis.

The loan agreement will have a detail of what reports and when are required. These reports will be geared to the phase of the project. Construction reports during implementation phase. Operational and financial reports after start up, commissioning and acceptance of the project.

This is a costly and time consuming, document process.

REPAYMENT

After all of the steps to achieve operation of your co generation facility, you now have to generate sufficient funds to repay the loans.

Maybe the most difficult phase.

SUMMARY

Applying and receiving a loan is a long, time consuming, expensive process. It may take a few months or it may take a lot longer year. From my experience I can only advise you that -

PATIENCE AND PERSEVERANCE
ARE REQUIRED TO ACHIEVE THE OBJECTIVE

Once the loan is disbursed, the co generation facility commissioned and operational, you then have the obligation to repay. The lender, while not a director or equity holder, is in reality your partner. While you are managing on a day to day basis, you are providing reports to the lender, they are monitoring your performance – operational and financially – and they will influence and control your operation – directly or indirectly. Again, I can only advise –

PATIENCE AND PERSEVERANCE
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5) POWER PURCHASE AGREEMENT

A key element of the project and the security package is the power purchase agreement . (PPA)

The PPA will be a comprehensive binding legal undertaking between you and the purchaser of the power. Terms should be very specific and spelled out in detail.

HEADS OF AGREEMENT

Essential heads of agreement to be included in the PPA are –

- parties
- representations, warranties and covenants
- term and termination
- pre operation period
- control and operation of the facility
- sale and purchase of energy and capacity
- interconnection
- metering
- testing and capacity rating
- compensation, payment and billing
- options to purchase
- insurance
- liability, non compliance and guarantees
- taxes and claims
- force majeure
- disputes and arbitration
- law
- notices
- entirety
- definitions
- miscellaneous

DEFINITIONS

Within the PPA the definitions are significant. These spell out the actions required, and who is responsible for performance of these actions. Among the more important issues are –

- **Terms of agreement** – The term of agreement is stated in years. The effective date is the date of commissioning of the plant. The agreement must be in effect as along as there is outstanding debt. An option to extend the term of the agreement may be included. Disposition of project assets at termination of agreement is specified.

- **Plant fuel** – Plant fuel should be described in detail, including constituent make up, heat content, limits on contaminants, supply pressure and other qualitative measures. Fuel can be a pass through cost from supplier to purchaser or, depending on the risk of participants are willing to accept, and tied to a price index. As fuel is a major operational cost for most technologies, treatment and recovery of fuel cost is critical to power pricing.

- **Facility operation** - Operation and dispatch of the co generation plant allows for a base load or fully dispatchable plant, in accordance with the principles of economic dispatch.. It provides for the owner to suspend purchase of power without penalty during emergencies. It obligates the owner to operate the plant in accordance with recognized practices and the owners requirements.

- **Performance testing** – The article on testing and capacity rating details procedures for testing the plant facilities based on international codes and standards and design specifications. The plant is required to pass certain performance and reliability test before the plant goes into commercial operation and capacity payments commence. A one time adjustment at the specified price is made if power test do not meet guarantee, which is usually reflected in the negotiated capacity change Performance test are made on both heat rate – to assure efficient use of fuel, as specified – and on capacity. In addition to the performance test prior to operation, the PPA may call for periodic test of dependable capacity. A failure to satisfy those performance test could result in a reduction of capacity payments.

- **Energy Purchase** - The article on sale and purchase of energy and capacity requires the plant to make available and sell to the purchaser, and the purchaser will purchase for an agreed on compensation a specific maximum dependable capacity and an associated energy out put of the plant after commercial operation commences.

- **Tariff Structure** – The article on compensation, payment and billing describes the tariff compensation to the plant owner for plant capacity and energy payments based on actual operation.

- **Compensation, Payment and Billing** – Details on price per unit produced and delivered or -not produced and not delivered – are agreed. Method of payment – **INCLUDING CURRENCY OF PAYMENT** - plus time period for payment by the purchaser are agreed. Billing periods and cycles for the plant operator are agreed.

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6) FINANCING OF ADVANCE BIOMASS TECHNOLOGIES

These observations are based on my perspective from abroad.

All of the following do not provide finite concrete answers on how to finance your co generation project. They are tabled so you can structure the project in a manner that is best suited for your company and future.

REMEMBER YOUR BASIC BUSINESS IS PRODUCING SUGAR

All of the potential projected co generation facilities are constructed adjacent to an existing sugar mill. The co generation facility is an addition to an existing physical structure containing its own infrastructure and utilities.

LEGAL STRUCTURE

Do we create a separate company or entity for the co generation project? Do we do within our existing organization. The answer will vary, but each has its own set of impacts.

If you establish a separate company, do you transfer or sell land or do your lease land to the new entity?

Either action has an impact on the financing. The lenders want a first secured position on the assets their money finances. With land owned by the separate entity the mortgage or charge will be on the land and improvements. On lease land there will be additional issues to resolve, since the lenders can only obtain a mortgage or charge on the improvements and assets and not a mortgage or charge on the land.

A separate company will require a contribution of capital. It will not have a track record or historic balance sheet and income statement. Both of which are important to lenders.

As a separate company there will not be any direct liability. There may be cross guarantees.

FINANCIAL IMPACT

If you construct the co generation facility within the existing company, the project becomes a significant factor on your balance sheet. You will be adding debt against current and existing equity capital.

Your financial ratios are adversely impacted.

Do you want your balance sheet and financial structure to support the new co generation plant.? What effect will this have on your existing financial arrangements? Will your bankers object?

Do you want your existing successful company to be directly liable for the repayment of the debt incurred by the new co generation facility?

Will the co generation facility be a financial burden to your existing sugar mill operations?

If you create a new entity, the amount of equity contribution by you and others may be larger than anticipated.

A new entity does not have a track record nor historic financial statements for lenders to review.

ALLOCATION OF COST

Do you share existing infrastructure of the existing sugar mill.. How are the cost of inputs – ie water, labor, outside power, management etc allocated to a new entity owned by you, operating on your premises – either as a land owner or leasee?

Will the new co generation facility be burden on the capability of your sugar mill operation?

EQUITY INVESTORS

If you have new outside equity investors – domestic or foreign - do you they invest in your sugar operation? Do they invest in a new entity with you?

RISK & LIABILITY

Does your existing sugar mill company assume all of the risk – construction, operational and performance – and liability – repayment - for the new co generation facility?

Do you insulate the risk and liability by the creation of a separate entity?

If the co generation project does not perform – for any reasons – are you prepare to have your sugar producing company be required to honor these liabilities?

CAN YOU AFFORD TO HAVE YOUR SUGAR OPERATIONS AT RISK?

FOREIGN EXCHANGE RISK

The international lenders will only extend credit in dollars or other major currency

ARE YOU PREPARED TO ASSUME THE FOREIGN EXCHANGE RISK OF ANY EXTERNAL BORROWING?

A co generation plant will sell its production to a domestic user. A utility or government body will contract and pay for the energy in local currency.

While foreign exchange markets may support the conversion of rupee to dollars or other currency in which an international loan is denominated, there is not guarantee on the value of the rupee against the foreign currency available over the extended periods of time..

SUMMARY

Once you determine the structure that suits your unique situation then you can proceed to prepare your feasibility study or business plan. See the prior section detailing the components of a Business Plan.

The funders – equity and/or debt – can be identified and solicited. See the previous section identifying the institutions where funding can be sought.

Commence the process of applying for funds and commence the cycle. See the previous section detailing the process of dealing with the funding institutions.

The value of the rupee over a long period of time is a risk that must be recognized. The lenders will require some form of support or undertaking to obviate this risk.

7) IMPACT OF INDIAN GOVERNMENT POLICY ON FINANCING

As a foreigner I am not expert, competent or expected to comment on the policy of your government, nor the reasons why any policy exist.

With the long press reports on the Dahbol energy project, by the US company Enron, with Bechtel and General Electric as co investor, many lenders and financial observers are aware that in India governmental actions have been taken that have modified terms of legal agreements between and among commercial parties and government entities.

The cost of government actions, correct or not, adversely impact on a project financially. The level of such adverse impact can be from an indeterminable loss, to some loss – both time and money – depending on how quickly the problem can be resolved.

Investors and lenders can obtain political risk insurance against arbitrary actions by a government. However, this protection only provides a vehicle and course of action for redress and recourse against outside non government parties. It does not immediately solve a problem. Additionally, the cost of effecting action and collection must be measured..

While governments may be receptive to new projects, beneficial projects, the implementation of government policy cannot be inconsistent with agreements in effect between commercial parties and government..

INCENTIVES

While tax holidays – these are only holidays and you still have to pay the tax at the end of the day - special approval process and procedures to issue new investment permits with the attendant incentives and exoneration's, fiscal incentives, accelerated depreciation and other devices made available by government, all are positive signs and indications of government support:

THE REALITY IS IN THE IMPLEMENTATION.

The best example I can offer is the tax exemption on imported equipment. Yes, this is in the law, it is in your government investment approval document. This means you do not have to include this as a budget capital cost in your feasibility study or Business Plan. Go down to the port area and try to convince the customs duty collection officers that you do not have to pay any duty to move your container – of approved tax free equipment – and he will tell you his Minister has not signed the form and he will only authorize the release when you pay the duty.

FOREIGN EXCHANGE

The resolution of the foreign exchange issue identified as a significant constraint to a co generation project could be assisted by positive government action..

SUMMARY

Government policy while enticing on the surface may not provide the desired effect in the implementation.

Government investment incentives are inducements for you to investment money the government does not have nor does not wish to invest in your area. .

When you make your investment decision, acknowledge the government policy and incentives, but –

MAKE YOUR INVESTMENT ON SOLID BUSINESS AND FINANCIAL INFORMATION AND DATA NOT ON A CURRENT GOVERNMENT POLICY OR INCENTIVE THAT CAN CHANGE TOMORROW, NEXT MONTH OR NEXT YEAR

8) A COMPARISON OF FINANCING FROM INDIAN ORGANIZATIONS TO INTERNATIONAL FINANCING

International lenders terms may be equal or better than those available in the Indian market.

Interest rates of 21% in Indian are very high compared to international lenders.

The foreign exchange risk is a key determinate on where to seek funding for a project. The sugar mill operator willingness, and the international lender willingness, on risk of the value of the rupee to external currencies is a critical issue.

The utilization of re lending credits from the Asian Development Bank and others – administered by government – while offering a source of funding the conditions may or may not be attractive to borrowers.

SUMMARY

Interest and borrowing cost from international lenders may be more attractive, the foreign exchange issue must be resolved.

WELCOME TO THIS PRESENTATION

"THE EPC ADVANTAGE"

BY

MAHINDER NATH

THERMAX LIMITED

THE EPC WAY

FOR

ECONOMICAL & TIMELY EXECUTION OF A COGEN PLANT

Conventional Power Project Execution

- Appointing an Engineering Consultant
- Buying out multiple packages
- Awarding Construction Contract
- Project Management
- Liaison with various agencies
- Checking on performance

The EPC Way

- Single point responsibility for:
  - System Configuration
  - Basic Design
  - Procurement
  - Erection & Commissioning
  - Performance Trial
  - Training & Handing over

The EPC Process

- Study Steam & Power Balance
- System Optimization
- Cycle Selection
- Fuel Options
- Power & Steam Evacuation
- Detailed Engineering
- EPC Execution

Conventional Execution-Limitations

A

Overall Project	Conventional Route
• Overall performance guarantee	• None • Individual package supplies • Does not constitute overall performance guarantee
• Overall schedule	•None
• Overall price guarantee	•None

The EPC Advantage

A

Overall Project	EPC Route
•Overall Performance Guarantee	•Higher penalties •Larger risks for EPC Contractor- hence obliged to perform •Overall performance assured
•Overall Schedule Guarantee	•Overall commissioning schedule maintained
•Overall Price guarantee	•Firm price contract

Conventional Execution-Limitations

B

Engineering	Conventional Route
•Responsibility & Coordination	•Interactions with multiple agencies :

- All documents need to be checked
- Time consuming
- Needs dedicated manpower
- Knowledge bank limited to in house resource
- Grey areas in scope of work
- Miss-outs & surprises in scope

The EPC Advantage

B

Engineering

•Responsibility & Coordination

Conventional Route

•Single point responsibility

•Fewer documents to be checked

•Faster communication

•Lower resources required

•Knowledge bank wider due to EPC business

•Total scope responsibility

•No miss-outs & surprises allowed

Conventional Execution-Limitations

C

Procurement	Conventional Route
•Buying Power	Low negotiation power •Single project execution •No vendor partnership •Limited vendor data
•Sourcing	Higher purchase cost •High cost of global sourcing •Less flexibility in vendor sourcing •Longer deliveries

The EPC Advantage

C

Procurement	EPC Route
•Buying Power	Better negotiation power •Multiple project execution •Vast vendor data bank •Vendor partnership •Rate contract possible
•Sourcing	Lower purchase cost •Global sourcing at lower cost •High flexibility in vendor selection during crisis

Conventional Execution-Limitations

D

Construction	Conventional Route
•Faculties required	Resources required for : •Project Management •Scheduling •Quality •Inspection •Erection & Commissioning

The EPC Advantage

D

Construction	EPC Route
•Faculties required	•These faculties already exist with EPC contractor

Conventional Execution-Limitations

E

Project Management	Conventional Route
•Skills required	•May require to acquire project management skills
•Monitoring	Requires to generate : •Daily reports •Weekly reports •Monthly reports •Critical issue reports

The EPC Advantage

E

Project Management	EPC Route
•Skills required	•Skills already with EPC contractor
•Monitoring	Progress review through : •Daily reports •Weekly reports •Monthly reports •Critical issue reports

Conventional Execution-Limitations

F

Quality	Conventional Route
•Skills	Resources need to be in place for : •Quality checks •Quality plans
•Resources	•Quality Inspectors

Conventional Execution-Limitations

G

Results	Conventional Route
•Project cost	?
•Project Schedule	?
•Project Quality	?

The EPC Advantage

G

Results	EPC Route
•Project cost	•Fixed
•Project Schedule	•Guaranteed
•Project Quality	•Guaranteed

The EPC Advantage
A Case Study

Tangible Benefits

Re	Item	Project Cost		Performance Obligation		Remarks
		Non EPC	EPC	Non EPC	EPC	
		Value in Rs Lacs		Value in Rs Lacs		
1	Boiler & Accessories	66	66	6.6		
2	Steam Turbine Generator	78	78	7.8		
3	Electricals	45	45	2.25		
4	Civil Work	21	21	0		
5	Miscellaneous Items	15	15	0		
6	Engg. & Project Management Cost etc.	20	45	0		
7	Erection & Commissioning	30	30	3		
8	**Total Project Cost**	**275**	**300**	**19.65**	**30**	LD on Total Value for EPC
	Difference in LD's			10.35		

The EPC Advantage
A Case Study

Intangible Benefits

→Project Management Personnel Cost

→Inspection & Expediting Cost

→Contingency , Escalations & Miss-outs

→Cost Overruns due to delayed commissioning

The EPC Way

Benefits to :

- The developer
- The lender
- The EPC contractor

THANK YOU

BIO DATA OF MR. MAHINDER NATH

Mr. Mahinder Nath is a graduate engineer of 1979 batch from Delhi College of Engineering in mechanical engineering stream with specialisation in Thermal Power Plant Engineering.

He started his career with Wanson India Ltd (former name of Thermax Ltd) as a graduate engineer trainee and subsequently handled Marketing of liquid and solid fuel fired boilers, liquid phase heaters and other process heating equipment in Bombay, Gujarat and Goa markets.

From 1983 to 1986, he was in charge of product development function at Thermax Ltd, Pune. In 1986 he moved to International Operations of Thermax Ltd and was in charge of export of company products in far East and South East Asia markets.

In 1987 he moved to Garden Silk Mills Ltd Surat, and was in charge of their engineering diversification manufacturing textile machinery. In 1994 he took the charge of developing a 300 MW gas turbine based combined cycle plant near Surat alongwith setting up a 5 MW wind farm in coastal Gujarat.

In 1996 he rejoined Thermax Ltd and since then has been heading the EPC marketing function. He is based at Pune.

POWER PURCHASE AGREEMENT

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UTILISATION OF EXPORTABLE POWER

Any or all on the following means can be used to dispose of exportable power from biomass-based cogeneration projects:

Supply to:	Mode:
Ancillary units within or adjacent to the cogeneration plant	Direct radial supply
Other units of the Promoter	Direct/Wheeling/Banking
Other End-users	Direct/Wheeling/Banking
Utility Company (State Electricity Board or Private)	Sale/Purchase
Rural areas around the cogeneration plant	Through the Utility

For this, a formal agreement between the cogeneration plant and the Utility is required.

The name, "Power Purchase Agreement" (PPA), for such an agreement, is a misnomer, since most cogeneration plants will not be in a position to assure firm availability of generating capacity and will only be able to deliver "Energy" that is surplus to their own requirements. It would, therefore, be more appropriate to use the name - "Energy Purchase Agreement".

Such an agreement should be carefully designed to be fair and equitable to both the parties – the cogenerator and the Utility.

Any capital investment in cogeneration of exportable power requires contractual arrangement, which will ensure, in the long-term, returns to the investor adequate to:

- discharge obligation to the lenders
- provide for depreciation
- earn profit at least equal to, if not more than could be earned from other investment opportunities
- generate internal resources for future investment

Protection of adequate long-term return to the promoter from cogeneration projects is an imperative, which can not be overlooked if cogeneration is to take-off on the fast track.

At the same time the Utility as buyer of co-generated power must also get a fair deal.

KEY PROVISIONS OF ENERGY PURCHASE AGREEMENT

Important provisions, which must be covered in the Agreement, are listed in the table below.

ITEM	SUGGESTED PROVISION
PRICING	Basic rate of Rs. 2.25/kWh for 1994-95. Escalation in same proportion as change in HT tariff. All related taxes & duties extra.
PAYMENT BY THE UTILITY	• Payment through irrevocable, revolving and self-replenishing Letter of Credit. • Interest on delayed payment. • Automatic payment by the Utility's bank if payment becomes "delinquent", under a tripartite agreement between the cogenerator, the Utility and the Utility's Bankers.
MINIMUM SUPPLY	Level of minimum supply to be stipulated.
WHEELING, BANKING RADIAL SUPPLY	Reasonable provisions governing wheeling, banking and radial supply to be included.
REACTIVE POWER	Sharing between Cogenerator and Utility
PEAK / OFF-PEAK SUPPLY	Optional provision if TOD Tariff is in force
DUAL FUELSYSTEMS	Pricing to equally apply to Dual Fuel cogeneration
CO-GENERATION EQUIPMENT	Cogeneration equipment provided by the Cogenerator to be specified and agreed with the Utility.
INTERCONNECTION AND PROTECTION EQUIPMENT	Cogenerator to provide cogeneration side facilities. Utility to provide tie line to and the equipment at its sub-station. Equipment to be provided as agreed between the cogenerator and the Utility, in line with good engineering practice and with approval from the competent government authority
SYNCHRONISATION	Procedure for synchronising to be specified.
METERING	Billing meters to be those provided by the Utility. Check meters to be those provided by the cogenerator. Provisions for testing, calibration and certification of meters and, also, adjustment for inaccuracy detected.
COMMISSIONING DATE	The commissioning date to be specified. Maximum extension of one season/year. Penalty for delayed commissioning.
CONTINUITY OF SUPPLY	Temporary curtailment or interruption as mutually agreed. Provision for "Deemed Generation".
DURATION	20 years.
DEFAULT AND TERMINA TION	Events of default and consequent termination to be clearly specified.
DISPUTE AND ARBITRATION	Resolving of disputes amicably by mutual discussions. Arbitration in line with the international practice and Indian Arbitration Act 1996, governed by Indian laws.

Brief explanation of the provisions and need for inclusion in the Agreement follow:

PRICING OF EXPORTED POWER

Protection of adequate long-term return to the investors from cogeneration projects is an imperative, which can not be overlooked if cogeneration is to take-off on the fast track. At the same time, the Utility, as buyer of the co-generated power must pay not more than a fair price.

The Base rate of Rs. 2.25/kWh may be adopted. It is the same rate as suggested in the Guidelines of the Ministry of Non-conventional Energy Sources (MNES) issued in 1994-95. The year of issue of the Guidelines, 1994-95, should be taken as the Base Year.

In accordance with normal commercial practice the taxes and levies, directly related to generation and sale of electricity, should be borne by the Utility.

The flat basic price on the lines of the MNES Guidelines is suggested for adoption only after considering a number of pricing methodologies. The rationale of rejecting other methodologies follows:

- **The Two- part Tariff**

  The Two-part tariff that was used for large Private Power Producers can not be applied to co-generated power. The first part, capacity pricing, in Two-part tariff is based on capital cost of the Plant and a minimum Plant Load Factor. In case of cogeneration, the plant is used for providing steam and power for use in manufacturing processes as well as for generating exportable power. The capital cost of the plant, therefore, can be apportioned to internal use and to production of exported power only by allocation, which will always be open to argument. Cogeneration power plants can not operate at a minimum plant load factor since demand for process steam and power fluctuates and varies a great deal from time to time. In the second part too, costing of energy, is problematic. There is no determinable market price for biomass fuels, such as bagasse. Depending on how is it viewed, the cost can be anywhere between "zero" to Rs. 3,000.00 per tonne. Further, it is not possible to uniquely determine operating and maintenance (O & M) costs, as is also the case with costs related to capital investment.

  In case of cogenerated power, it is not logical to calculate the cost of exported power based on the Two-part Tariff methodology, without giving credit for steam and power used by the process plant.

- **Avoided Cost**

  This methodology is not suitable for India. In absence of firm, reliable and published cost data on Utility's avoided costs, which are not normally computed in India, the cogenerators may not accept avoided cost stated by Utility on case-to-case basis. Further, avoided costs will vary widely between different State utility companies and Private power utilities. Even in USA, competitive bidding is now usually followed in preference to pricing on avoided cost.

- **Cost of Generation + Profit**

  For the same reasons as applicable to the Two-part Tariff, price can not be determined on cost -plus basis.

- **Linkage with High-Tension Tariff**

  Pricing based on HT tariff was tried in Tamilnadu, but was soon rejected. The Utility companies do not seem to like pricing based on HT tariff, which is the highest price realised by the Utility and is the only one earning substantial margin.

Justification of the Base Price of Rs. 2.25/kWh

It will be seen from the above that on practical considerations and in the present context, the base price of Rs. 2.25 per kWh for 1994-95 is the most suitable basis for pricing of co-generated power. This is further supported by the fact that exporting of co-generated power at this rate by cogenerators in certain states, such as, Tamilnadu, has been found to be financially viable.

Escalation

- There is no cost index, or a combination of indices, which could be logically used for indexing price of co-generated electricity.
- Escalation at a flat rate, such as, 5% per year may not remain valid for duration of 20 years.
- Type and cost of fuels that can be used for cogeneration vary greatly. An escalation formula based on cost of fuel and O & M is not practically feasible.

After giving careful thought to the above, it is felt that the best option is to link escalation to the change in the price of HT supply to industrial customers. This should cover changes in cost of cogeneration and give stable margin to the Utility.

PAYMENT

Payment for power exported from the cogeneration facility should be made on basis of monthly invoices, within reasonable credit period of 30 to 45 days and covered by a letter of credit.

A tripartite agreement between the cogenerator, the Utility and the bankers of the Utility is strongly recommended. If payment is delayed for more than 15 days beyond the credit period, it should be regarded as "delinquent" and the bankers should automatically pay the amount with stipulated interest, without reference to the Utility.

MINIMUM LEVEL OF SUPPLY

Since the Agreement requires the Utility to "purchase and accept all energy made available" from the cogeneration plant, in fairness to the Utility, a minimum level of supply should also be stipulated.

WHEELING & BANKING

Provisions governing wheeling and banking should be included in the Agreement. Period of Banking should be stipulated. One year is a reasonable term. Wheeling and Banking charges should not be excessive and should be recovered in form of energy and not monetarily.

RADIAL SUPPLY

Direct radial supply to end-users may be provided for under following conditions:

- Radial feeder not to exceed 25 km in length.
- Feeders to be set up by the cogenerator at own cost.
- Sale / Purchase terms to be agreed between the Cogeneration plant and the end-user.
- Names of end-user/s and duration of supply arrangement to be advised to the Utility.
- No responsibility will attach to the Utility in respect of radial supply.

REACTIVE POWER

Some of the utility companies want to lay down supply of certain quantum of reactive power as a mandatory condition. This is often difficult to comply with. Even so, cogenerators must supply fair share of reactive power, within their operating parameters and constraints.

Power factor at which cogenerators can generate power is significantly higher than that in the neighbourhood grid. Cogeneration plant can, therefore, when supplying power to the grid, also supply reactive power, which will be to advantage of the Utility. Fair share of reactive power can be delivered by properly controlling generator excitation.

PEAK / OFF-PEAK SUPPLY

If a Utility has "Time-of-Day" tariff, consideration may be given to provisions for "Peak" and "Off-peak" supply.

An electric utility needs power most during the peak periods and, generally, have adequate availability during the off-peak periods. Power from cogenerators will become more attractive to the Utility if more power is supplied during peak periods. To motivate cogenerators towards doing so a basic price may be set for "Off-peak" with premium for supply during "Peak", without forcing the cogeneration plant to do so. No compulsion should be placed on cogeneration plant to supply more power during "Peak" periods. The only condition placed should be that the "Off-peak" and "On-peak" supply should be in proportion to the duration of the respective time periods.

Efficiently managed cogeneration plants, with condensing T.G. sets can vary the quantum of exportable power during "Peak" and "Off-peak" periods.

Provision for Peak / Off-peak supply should, therefore, be negotiated on case-to-case basis.

DUAL FUEL SYSTEMS

Agro-based units, such as sugar mills and food processing plants use biomass as fuel for cogeneration. The operation of such plants is seasonal because the raw material and, therefore, the biofuel is not available throughout the year. If a secondary fuel is available for use during the off-season, cogeneration of electricity can be continued during the off-season. This makes exportable power uniformly available year round, which is more attractive to the Utility. Further, productivity of capital becomes substantially greater, making investment in cogeneration more attractive. If use of secondary fuel for off-season is found to be feasible from considerations of availability and economic viability, dual fuel cogeneration system should be installed. This does not go against use of biomass for generating power, since it leads to better financial viability of biomass-based cogeneration projects. All available biomass should be fully used as fuel. Quantity of the supplementary fuel used should be minimum. Dual-fuel systems, in fact encourage use of biomass in cogeneration projects.

PASS THROUGH

In such cases, the price for electricity exported during off-season should not be lower than that for the season. If the cost of the secondary fuel is higher than that of the main fuel, It would make cogeneration more attractive if higher cost of secondary fuel, up to a maximum level, is compensated by payment of an off-season fuel surcharge, i.e., 'pass through' element of

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price. This should be on the condition that all internally generated fuel must be fully consumed for

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cogeneration during the operating year, and the other fuel should be used only to supplement the main fuel.

Government of Maharashtra has laid down a policy providing such "pass through" for projects generating power from non-conventional sources.

COGENERATION EQUIPMENT

Cogeneration equipment that the cogenerator proposes installing should be specified and agreed with the Utility.

INTERCONNECTION, SYNCHRONISATION & PROTECTION SYSTEMS

The Cogenerator should provide cogeneration side facilities and the Utility the tie line, and the equipment at its sub-station.

Equipment to be provided and the corresponding specifications should be as agreed between the cogenerator and the Utility. Installation must be in line with good engineering practice should have approval from the competent government authority.

Synchronising procedure should be agreed with the Utility and clearly specified.

METERING

Billing meters to be those provided by the Utility. Check meters to be those provided by the cogenerator. Provisions for testing, calibration and certification of meters and, also, adjustment for inaccuracy detected to be agreed and stated in the Agreement.

COMMISSIONING DATE

The commissioning date to be specified. Maximum extension of one season/year may be normally allowed. Thereafter, provision of penalty for delayed commissioning would be reasonable.

CONTINUITY OF SUPPLY

Circumstances under which supply may be temporarily curtailed or interrupted, with prior mutual agreement or because of a forced outage should be stated. Provisions relating to notifying the other party and earliest resumption should also be included.

In case the Utility is unable to accept delivery of electricity from the cogenerator, unless force majeure conditions exist, the energy will be deemed to have been supplied. The "Deemed Generation" should be the Cogenerator would have been capable of generating but could not because of the Utility's inability to accept it.

BACK-UP POWER

The Utility should supply back-up power to the cogeneration facility on normal commercial terms, but without Demand charge, during:

- Construction period
- Start-up and commissioning of the facility
- Scheduled and forced outages of the facility

DURATION

20 years

DEFAULT & TERMINATION

Events of default and consequent termination to be clearly specified.

DISPUTES & ARBITRATION

Resolving of disputes amicably by mutual discussions. Arbitration should be in line with the international practice and in accordance with the Indian Arbitration and Conciliation Act 1996.

The provisions of the Agreement should be governed and construed in accordance with laws of India.

BOO / BOOT PROJECT DEVELOPMENT AND FOREIGN EXCHANGE RISK

A number of units which have good cogeneration potential do not go in for cogeneration project because of lack of capital funds or inexperience with power generation at higher levels, particularly for. In such cases, development of cogeneration projects could be based on "Build, Own and Operate" or "Build, Own, Operate and Transfer".

BOO /BOOT projects should be given the same treatment as Owner developed projects.

Presently, not many Indian promoters are coming forward for BOO / BOOT promotion of cogeneration projects. On the other hand a number of parties from abroad have shown keen interest. Such parties may bring in debt funds from abroad, but are apprehensive of bearing the risk of unfavourable variation in foreign exchange rate. Some protection may be given to such developers by compensating for such variation in foreign exchange rate as is more that a stipulated level over the period of debt repayment.

CONCLUSION

As stated earlier, the Energy Purchase Agreement between cogenerator and the electric Utility and price to be paid to cogenerator for sale of exportable power are critical issues. These need to be resolved at the highest levels in Central & State Governments.

It is strongly recommended that the issues relating to EPA documentation are studied and discussed in detail by a working group comprising MNES, Ministry of Power, Ministry of Finance, CEA, CPU, and representatives of industries having cogeneration potential. The object should be to evolve an Energy Purchase Agreement, which could be adopted as a national document acceptable, in principle, to all concerned parties.

Thereafter, it should be given legislative force through suitable enactment and made applicable to the Union Territories. The States should be advised to evolve their own standard EPA, based on the Central document, introducing such minimum changes as are absolutely necessary and unavoidable in view of conditions and circumstances unique to the State. Only such States as conform to the above procedure should be given financial and other developmental support by the Central Government.

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Pricing for Alternate Biomass

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Profitability of bagasse based cogeneration and biomass based power plants is depends upon the number of operating days. Sugar Industry is having season of 120 days to 200 days. This needs to operate the power plants either with the saved bagasse or with alternate fuels for the balance of days. The performance of sugar industry for the last five years are given below:

Table 1 Performance of Sugarcane Industry.

Year	1993-94	1994-95	1995-96	1996-97	1997-98
Cropped area '000 ha	3422	3867	4147	4168	3940
Production '000 te	229660	275540	281100	277254	262194
Yield te/ha	67.1	71.3	67.8	66.5	66.5
Cane used for sugar	98338	147643	174726	130379	129135
Operating days	114	159	181	130	123
Sugar Recovery	10.00	9.92	9.42	9.90	9.95
Installed capacity in lakh te	116.000	122.197	127.607	134.593	142.752
Capacity utilization %	84.8	119.8	128.9	95.9	90.0

Ref: Cooperative Sugar, March 1999.

From the above table, we can observe that, the operating days are varying from 114 days to 181 days. Some of the states like Tamilnadu, Karnataka and Maharashtra operates on an average of 180 days, whereas UP, Punjab, Haryana, AP are having the operating days of around 130 days. The yield in Tamilnadu is the highest with above 110 te/ha, followed by Karnataka – 87.1 te/ha, Maharashtra, 81 te/ha. In Up , the yield is around 60te/ha.

In Tamilnadu, few sugar plants are operating with lignite as off-season fuel. In some factories, cane trash is used as off-season fuel. Some of the off season fuels are given below:

Table 2. Alternate fuels with Price and CV

Material	K.Cal/Unit	Price Rs. Unit	Rs/ 10000 K.Cal
Coal	4000	1700/te	4.25
Oil	9000	6000/KL	6.66
Electricity	860	4/kwh	48.00
Imported Coal	6000	1800/te	3.00
Natural Gas	8500	2500/1000 NM^3	3.00
Wood	4000	800/te	2.00
Bagasse	2270	300/te	1.50
Rice Husk	3300	600/te	1.80
Cane trash	4000	300/te	0.75

Ref: Prof. Vasudevan, IREDA Business Meet,

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It is always better to consider the biomass as alternate fuel instead of the conventional fuels.

Biomass meets a major fraction of the energy demand in rural areas of most developing countries. For example, in our country, the share of biomass energy use is about 46% of the total energy consumption. The decreasing availability of firewood has necessitated that efforts be made towards efficient utilization of agricultural and forestry residues.

The large scale utilization of non fodder, non fertilizer agricultural residues as energy sources depends upon variety of factors, such as their availability, characteristics as fuel and, of course, their financial viability as compared to other options. The financial viability of their use, in turn, critically depends upon the "price tag" attached to them and their opportunity cost to the user. While some of the agricultural residues which are replacing commercial fuels or are already being used in industries have some sort of price tags associated with them, for others, it may be necessary to estimate their cost to the users.

Agricultural residues can be divided into two groups: crop residues, and agro industrial residues. Crop residues are plant materials remaining in the farm after removal of the main crop produce. The remaining materials could be of different sizes, shapes, forms and densities, i.e. straw, stalks, sticks, leaves, haulms, fibrous materials, roots, branches, twigs, etc. Agricultural industrial residues are by products of post harvest processes of crops, i.e. cleaning, threshing, delinting, sieving, crushing etc., and could be in the form of husk, dust, straws etc.

The quantity of agricultural residues produced differs from crop to crop to crop and is also affected by seasons, soil type, irrigation conditions etc. The production of agricultural residues is directly related to the corresponding crop production, and the ratio between the main crop produce and its residues varies from crop to crop and, at times with variety of seeds in one crop itself. Thus, for known amounts of crop production, it may be possible to estimate the amounts of agricultural residues produced using the crop to residue ratio. It may be noted that, with the improved agricultural farming techniques, the production of crops has been increasing consistently in the past three decades. Correspondingly, the availability of agricultural residues has also been changing with time.

Table 3. Availability of biomass

Type of Agrowaste	Quantity Million tonnes/ annum
Straws of various pulses and cereals	225.50
Bagasse	31.00
Rice husk	10.00
Ground Nut Shell	11.10
Stalks	02.00
Oil Stalks	4.50
Others	115.90
Total	400.00

Table 4. Types of Biomass

Agro Crop Residues	Biomass
Straw	Rice, wheat, Jowar, Millet, Ragi, Barley, Gram, Urad, Moong, Masoor, Khesari, etc
Stalks	Arhar, Bajara, Castor, Cotton, Jute, Maize, Mustard, Safflower, Sunflower, Tapioca, etc
Others	Cane tops, Cane trash, Tea plant wastes, Condiments, Species, Tobacco & Coffee
Agro Industrial Residues	
Husks	Coffee, Coconut, Rice, Tamarind, Soya, etc
Shell	Coconut, Groundnut, Cotton, etc
Seeds	Castor, Rapeseed, Linseed, Soyabean etc
Other process by products	Saw dust, Press mud, Bagasse, coir pith, etc

Table 5. Typical uses of Biomass

Residue	Uses
Paddy straw	Cattle feed, thatching, packing, paper, burning
Husk,	As fuel in boilers, brick kilns, hotels etc
Wheat straw	Cattle feed
Jowar Stalks	Cattle feed, domestic fuel
Bajra	Domestic fuel
Maize cobs	Domestic fuel, fodder
Maize Stalks	Domestic fuel, fodder
Pulses	Domestic fuel, fodder
Millets	Domestic fuel, fodder
Oil seeds stalks	Domestic fuel, fodder
Oil seeds pulp	Fodder
Cotton Stalks	Domestic fuel
Cotton Gin	Brick kilns. Fuel
Jute stalks	Domestic fuel
Sugar cane bagasse	Fuel, and paper
Tops	Fodder
Trash	Burning
Coconut shell	Activated carbon, fuel
Fibre	Mattresses, carpets etc
Pith	
Tobacco stalks	Processing leaves and burning
Mesta stalks	Domestic fuel
Castor stems	Burning

Residue availability:
Agricultural residues are not available throughout the year, and the amounts available depend upon harvesting time, their storage-related characteristics, the storage facility etc.

Agricultural residues are produced as a byproduct along with the main crops. Thus normally, they are assumed to be available at "no cost" to the user, which may not be a

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valid assumption. As long as the owner himself uses the agricultural residues, their costs may not be explicitly determined.

Cost of crop production, harvesting, collection, transportation and storage of the residue would be the primary contributors towards the cost of crop residues.

Harvesting Cost:
Conventionally, the cost of crop production includes the harvesting cost as well. Thus for most of the agricultural residues which are harvested along with the crop. However, in the case of maize and cotton stalks, the crop is harvested first, followed by separate harvesting of the residues.

Collection cost:
The agricultural residues are required to be collected at a single point in a farm / agro industry for stacking before transportation. The collection cost of agricultural residues depends upon the agricultural wage rate and time required for their collection in a particular area.

Transportation cost:
Two common transportation modes are animal cart and tractor trolleys. The transportation cost depends upon the distance, carrying capacity, daily wages and rent or depreciation and interest of the investment.

Storage Cost:
The storage cost includes the cost of handling and the capital invested in the storage facility. Storage cost could be the rental cost of the space or cost incurred to cover the residues to protect them from rain. Normally, residues are stored on the farm in an open space only when they are produced and are transported as early as possible.

Table 6. Total Cost of agriculture residues

	Cart	Tractor		
Residue	**0-15 km**	**0-15 km**	**15-30 km**	**30-50 km**
Arhar Stalk	247	244	298	306
Maize Stalk	302	298	325	360
Maize Cobs	135	132	159	194
Cotton Stalk	569	566	593	628
Mustard Stalk	487	484	511	546
Jute and Mesta Stalk	302	299	326	361
Rice husk	237	234	261	296
Groundnut shells	507	504	531	566

Ref: Dr. AK Tripathi, Dr. PVR Iyer, And Dr. KK Singh, Energy Conversions, 1998

Importance of Cane Agricultural Waste (CAW):
CAW has great potential as a yearly renewable biomass. Very attractive for over 100 countries growing sugar cane world wide on a surface of about 15 million ha, with agricultural yields of 40 – 60 t/ha for the less technologically developed and 80 to 115 t/ha for the most advanced countries. CAW is made up of green and dry leaves, tops and unrecoverable cane. Historically, this residue is burnt in the field before or after the cane is cut and /or spread over the field during harvest for the sake of high productivity and for lack of appropriate technologies for industrial recovery and use of the biomass. In India,

the sugar cane tops are at present being used for feeding draft and milch animals while dry leaves are burnt / spread over the field after harvesting of cane.

The vegetative structure of cane consists of clean cane and CAW, or simply extraneous matter (EM). Its composition is interrelated with agriculture yield, for as yield decreases the percent CAW increases, generally ranging from 18 to 22%.

In India, sugar cane is grown on a surface of about 4 million ha with an average cane yield of about 70 t/ha only, about half of it is converted into crystal sugar. The amount of dry matter in cane fields in India averages to about 20 t/ha of which, nearly 6 to 7 t/ha may be CAW. This is an inexhaustible energy source considering its renewable character.

The average weight of green top obtained from these varieties per hectare is highest in Co8014 (32.50 t/ha) and lowest in Co740 (19.40 t/ha), thus on an average 25 t/ha of green tops is available per ha. The average dry weight of these green tops is about 6.35 t/ha.

The average dry weight of trash is estimated to be about 4.7 t/ha.

This cane trash is having calorific value of 4000 K.Cal/Kg. This material is dry and also improves the efficiency of the boiler. This trash, if collected and used, the operation of the cogen plant can be easily extended to 270 days. In this field, REPSO had done considerable work.

Effect of Price of Alternate fuel:
Case study has been made with the present cost of various fuels.

Assumptions of Steam to Fuel ratios (@ 64 Kg/Cm^2, 485 ^{0}C)

Bagasse	: 2.3 Kg/Kg
Furnace oil	: 12.0 Kg/Kg
Coal	: 4.5 Kg/Kg
Natural Gas	: 12.0 Kg/Kg
Imported Coal	: 6.5 Kg/Kg

The difference in generating price with bagasse price of Rs. 300, Rs. 500 and Rs. 800 per tonne is tabulated below:

Table 7 Difference in Generating Cost Rs/Unit

Bagasse rate Rs/Te	800	500	300
Coal	0.12	0.64	0.99
Oil	0.61	1.13	1.48
Imported Coal	-0.32	0.20	0.55
Natural Gas	-0.56	-0.04	0.31
Wood	-0.68	-0.16	0.19
Rice Husk	-0.71	-0.18	0.16
Cane trash	-1.09	-0.57	-0.22

From the above table, it can be seen that, with Rs. 500 per tonne of bagasse, Natural Gas, Rice husk and cane trash is the better off-season fuels.

Table 8 Physical and Thermal Characteristics of Biomass

Biomass	Density	EMC (%)	CV (MJ kg-1)		Proximate analysis (% w/w)		
	(kg m-3)		HCV	LCV	FC	VM	ASH
Acacia auriculiformis	700*	29.5	19.6	17.9	16.1	81.8	2.2
Acacia nilotica	820*	24.8	19.2	17.8	16.8	80.8	2.3
Albizia lebbek	630*	-	19.1	17.5	13.6	84.4	1.9
Albizia procera	550*	-	18.9	17.4	15.2	83.4	1.4
Amaltas	-	-	16.0	-	11.5	86.5	1.2
Arhar stalks	180	20.6	18.6	17.6	15.1	82.9	1.9
Azadirachta indica	700*	30.7	18.2	16.7	15.9	80.7	3.3
Bagasse	70	-	20.0	18.3	15.9	79.2	4.9
Bamboo	-	-	17.5	-	21.2	76.5	2.4
Castor stalks	-	-	16.5	-	18.4	77.9	3.8
Casurina equisatifolia	-	-	18.5	-	19.2	77.2	3.6
Coconut husk	-	-	15.6	-	14.3	78.7	6.9
Cotton Sticks	160	27.1	17.4	16.0	15.3	81.4	3.3
Cow dung	-	-	13.2	-	14.5	57.2	28.3
Malia zadarachu	-	-	17.8	-	17.7	79.8	2.4
Dalbergia sissoo	710*	24.6	18.7	16.9	15.7	80.4	3.9
Derris indica	590*	30.3	18.2	16.5	15.5	81.6	2.9
Eucalyptus hybrid	770*	30.4	19.4	17.9	16.6	82.4	0.9
Groundnut shell	100	-	20.0	18.6	11.7	83.9	4.4
Leucaena leucocephala	730*	30.4	19.4	17.8	16.6	84.4	1.0
Maize cobs	100	28.0	17.4	15.3	15.2	83.0	1.8
Maize stalks	50	38.2	16.7	16.1	17.1	79.6	3.4
Mulbury (Morus alba)	-	-	17.3	-	17.4	79.5	3.4
Pine needles	-	-	16.0	-	15.8	80.6	3.6
Pithecellobium dulce	650*	28.1	19.4	17.8	16.4	81.5	2.0
Prosopis juliflora	780*	24.2	18.7	17.1	20.9	75.9	3.1
Rice husk	105	29.4	15.5	14.1	12.5	71.0	16.5
Rice straw	30	36.7	15.0	13.5	11.1	69.7	19.2
Sesbania acculiata	-	31.0	17.5	16.1	14.3	82.7	3.0
Sesbania grandiflora	340*	25.9	17.9	16.3	11.7	82.3	6.0
Sorghum stalks	-	-	17.0	-	11.2	85.0	4.8
Sunflower stalks	-	-	15.5	-	8.8	75.4	8.9
Terminalia arjuna	660*	28.4	17.4	15.9	14.4	78.6	7.0
Wheat straw	60	34.0	17.2	15.7	17.9	73.6	8.5

Table 9 Chemical Analysis of Biomass (%w/w)

Biomass	Cellulose	Pentosan	Lignin	Extractives
Acacia auriculiformis	33.38	8.27	38.97	8.00
Acacia nilotica	30.99	13.91	37.03	7.97
Albizia lebbek	31.20	12.30	38.90	9.05
Albizia procera	36.44	8.90	35.64	7.00
Arhar stalks	41 90	8.30	39.70	2 20
Azadirachta indica	34.78	11.80	40.10	5.90
Bagasse	40.00	22.60	14.80	15.90

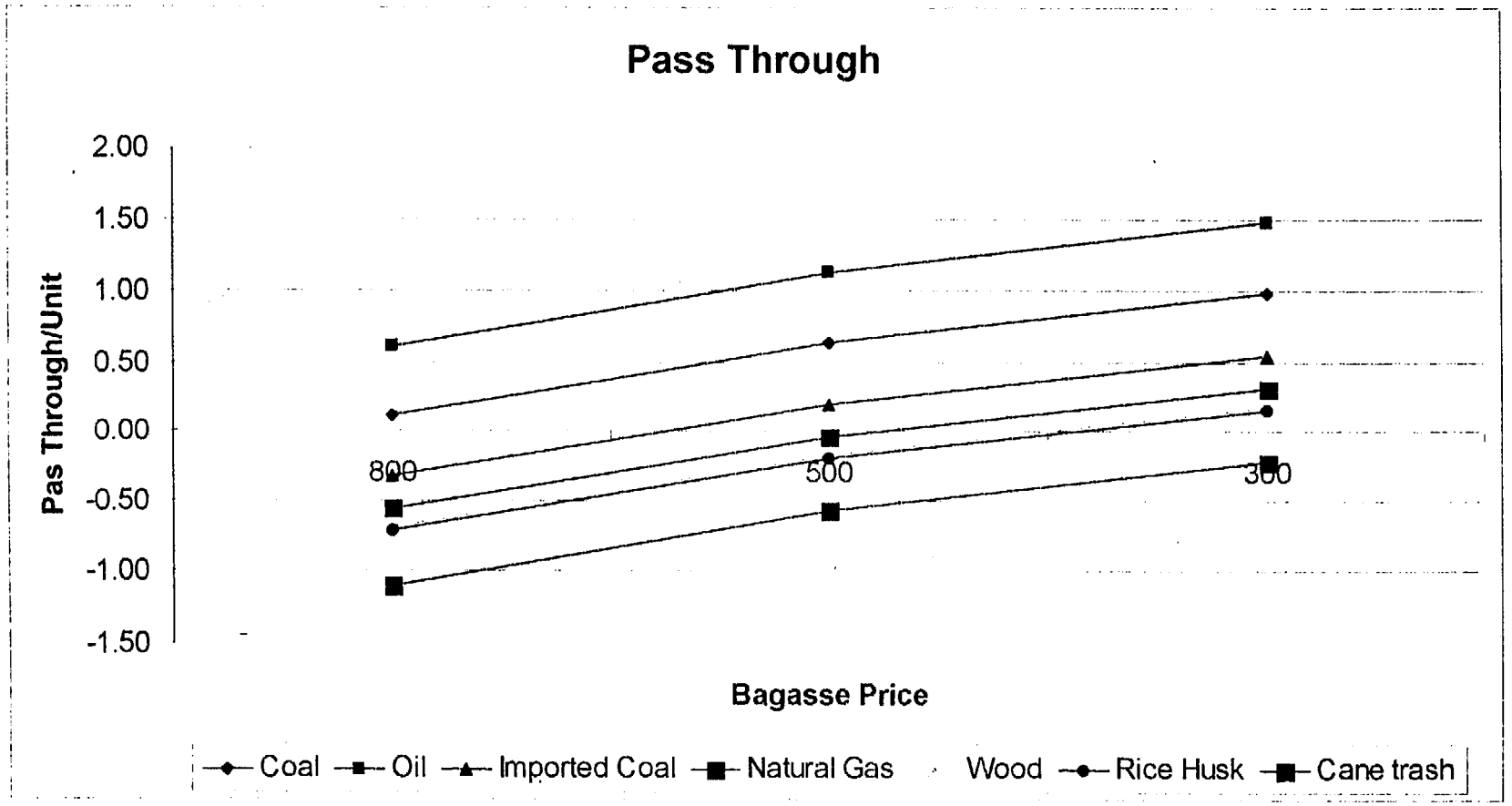
Cotton Sticks	41.90	19.00	27.20	9.30
Dalbergia sissoo	33.20	8.20	39.40	7.50
Derris indica	35.60	14.10	39.40	7.51
Eucalyptus hybrid	34.20	12.90	39.20	7.30
Groundnut shell	36.50	13.90	31.30	12.20
Leucaena leucocephala	44.87	17.74	22.36	9.73
Maize cobs	36.80	27.90	11.20	14.60
Maize stalks	43.40	19.60	22.80	9.30
Pithecellobium dulce	3.34	13.50	39.10	11.40
Prosopis juliflora	32.10	8.90	39.30	8.80
Rice husk	44.10	17.80	17.20	3.40
Rice straw	41.40	20.40	12.10	5.60
Sesbania acculiata	46.30	14.10	32.00	4.10
Sesbania grandiflora	30.40	18.82	36.07	6.01
Terminalia arjuna	37.20	8.90	37.40	7.00
Wheat straw	39.60	24.10	17.00	7.30

Table 10 Stiochiometric Formula and Air Fuel Ratio of Biomass

Biomass	**Stoichiometric ratio**		**Air/fuel**
	X	y	ratio
Acacia auriculiformis	1.625	0.589	6.480
Acacia nilotica	1.539	0.712	5.533
Albizia lebbek	1.673	0.632	6.242
Albizia procera	1.648	0.746	5.496
Arhar stalks	1.518	0.634	5.994
Azadirachta indica	1.477	0.591	6.217
Bagasse	1.060	0.563	5.859
Cotton Sticks	1.153	0.600	5.766
Dalbergia sissoo	1.531	6.370	5.916
Derris indica	1.687	0.587	6.519
Eucalyptus hybrid	1.491	0.645	5.995
Groundnut shell	1.401	0.906	4.218
Leucaena leucocephala	1.143	0.556	6.189
Maize cobs	1.273	0.764	4.948
Maize stalks	1.230	0.961	4.942
Pithecellobium dulce	1.836	0.713	5.853
Prosopis juliflora	1.586	0.584	6.407
Rice husk	1.587	0.808	4.294
Rice straw	1.631	0.795	4.253
Sesbania acculiata	1.072	0.566	5.926
Sesbania grandiflora	1.012	0.764	4.457
Terminalia arjuna	1.544	0.625	5.822
Wheat straw	1.480	0.725	5.048

Table 11 Elemental Analysis of Biomass

Biomass	C	H	N	Na	K	P	Ca	Mg	SiO_2
Acacia auriculiformis	50.9	6.9	0.33	0.15	0.10	-	0.11	0.34	0.33
Acacia nilotica	47.0	6.0	0.22	0.03	0.10	-	0.13	0.40	1.20
Albizia lebbek	49.5	6.9	0.38	0.03	0.23	0.02	0.15	0.32	0.66
Albizia procera	46.2	6.3	0.22	0.03	0.37	0.03	0.10	0.34	0.40
Arhar stalks	53.3	4.7	0.60	0.05	0.57	0.08	0.11	0.41	0.68
Azadirachta indica	50.6	6.2	0.30	0.07	0.24	0.01	0.12	0.27	1.10
Bagasse	48.2	6.1	0.20	0.06	0.51	0.04	0.14	0.36	1.30
Cotton Sticks	51.0	4.9	1.00	0.09	0.61	0.08	0.12	0.43	1.33
Dalbergia sissoo	48.6	6.2	0.33	0.04	0.19	0.03	0.20	0.48	0.56
Derris indica	50.5	7.1	0.30	0.12	0.41	0.03	0.12	0.28	0.35
Eucalyptus hybrid	49.9	6.2	0.30	0.06	0.07	0.02	0.09	0.22	0.40
Groundnut shell	41.1	4.8	1.60	0.05	1.20	0.12	0.10	0.40	2.52
Leucaena leucocephala	53.6	5.1	0.70	0.03	0.57	0.07	0.08	0.34	0.11
Maize cobs	46.2	4.9	0.60	0.03	0.54	0.07	0.08	0.28	0.90
Maize stalks	41.1	4.2	0.60	0.04	0.42	0.05	0.09	0.45	2.00
Pithecellobium dulce	46.4	7.1	0.37	0.05	0.25	0.02	0.09	0.34	0.65
Prosopis juliflora	50.7	6.7	0.38	0.05	0.29	0.04	0.15	0.29	1.10
Rice husk	37.8	5.0	0.30	0.02	0.30	0.03	0.08	0.17	15.60
Rice straw	36.8	5.0	0.59	0.09	2.50	0.06	0.10	0.53	16.77
Sesbania acculiata	52.6	4.7	0.70	0.07	0.55	0.08	0.11	0.36	0.04
Sesbania grandiflora	44.7	3.8	0.38	0.14	0.72	0.08	0.13	0.49	3.24
Terminalia arjuna	47.4	6.1	0.30	0.06	0.20	0.01	0.20	0.25	2.00
Wheat straw	43.8	5.4	0.40	0.06	0.78	0.04	0.10	0.35	7.08

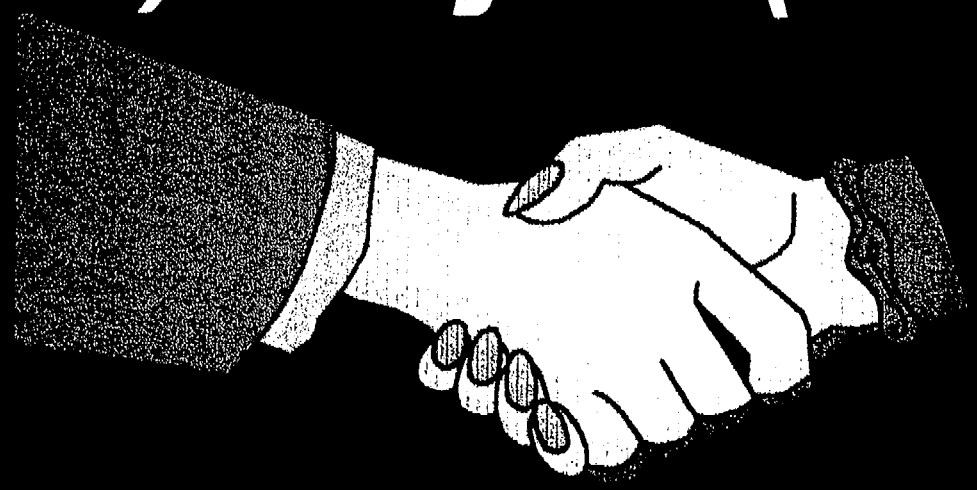

Pass Through
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
Pas Through/Unit
800
500
300
Bagasse Price
Coal
Oil
Imported Coal
Natural Gas
Wood
Rice Husk
Cane trash

132

Greenhouse gas Pollution Prevention (GEP) Project Alternative Bagasse Cogeneration (ABC) Component

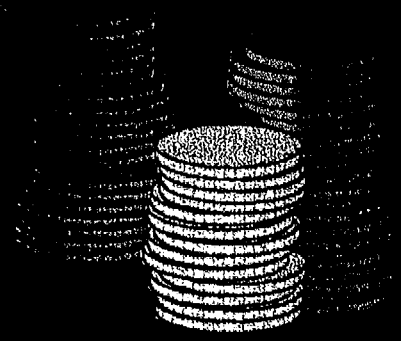
Industrial Development Bank of India
M.ASOKAN
Dy. General Manager

Greenhouse gas Emission Prevention (GEP) Project (USAID)



Greenhouse gas Pollution Prevention (GEP) project

- Alternative Bagasse Cogeneration
- Efficient Coal Conversion Program (ECC)
- Total funds available US$ 10.5 million



Greenhouse gas Pollution Prevention (GEP) project

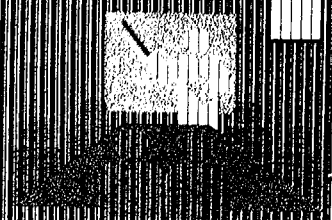
ABC program

- encourages bagasse / bio-mass co-generatio in sugar mills
- US$ 40,000 per MW generated subject t maximum of US$ 1.0 million
- Five sugar mills have been assisted in Phase-I
- Four sugar mills have been assisted in Phase-
- Total assistance sanctioned - US$ 7.34 million

Financial assistance available for ...

- The ABC component is providin Financial Assistance (FA) grants t support demonstration of state-of-the-ar cogeneration technologies,
- TA grants to perform techno-economi feasibility studies, and
- Matching Grants to carry out researc and development (e.g., biomass handlin and storage for off-season operations).

Financial assistance available for ...



- *Information dissemination an professional development in bio-mas cogeneration is also one of the mai objectives of the ABC component.*
- *To accomplish this objective, periodi seminars, workshops, conferences, on-site visits, and other training program are being supported.*

Greenhouse gas Pollution Prevention (GEP) project

Eligibility

- Sugar mills with a crushing capacity of 250 tcd and above
- Power generation for a period of atleast 27 days per year based on bagasse/bio-mass
- Steam generation at 60 ksc and 480 dec C
- Financial soundness of the sugar mills

GEP- project- Essential features of the proposal

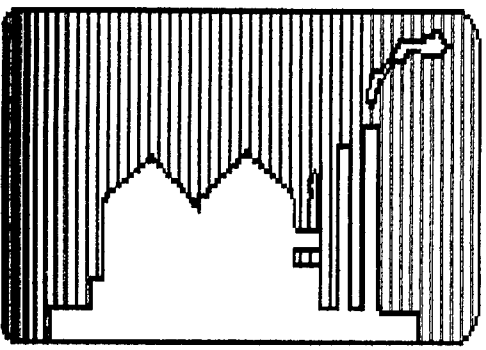
- Viable plan for surplus power generation for minimum 270 days of operation using bagasse/bio-mass
- Surplus electricity generation capacity/export capability
- Supplemental bio-mass utilisation
- Detailed Project Report

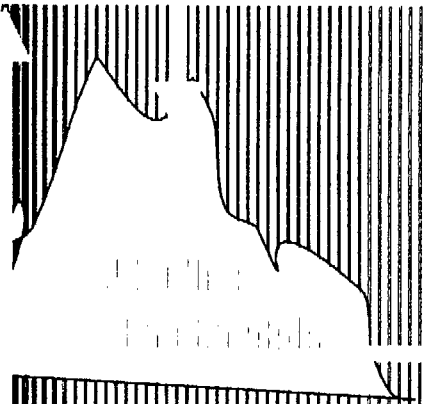
Essential features of the proposal (cont'd)

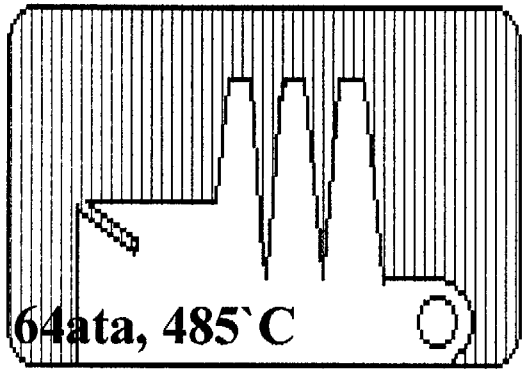
- Firm financing arrangemen
  financing capability
- Willingness to share th
  results/lessons learnt and also t
  provide information on a regula
  and ongoing basis

■ Additional features

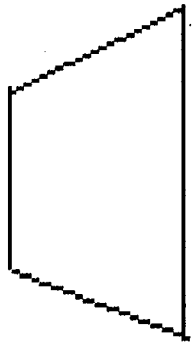
- maximise local development
- Minimise environmental issues

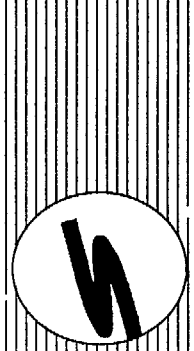


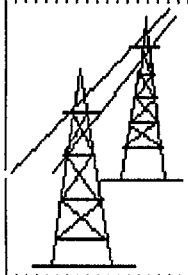


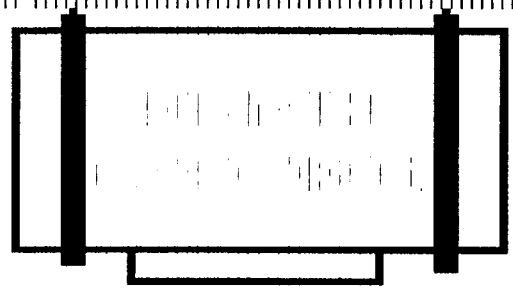


80t/h BOILER



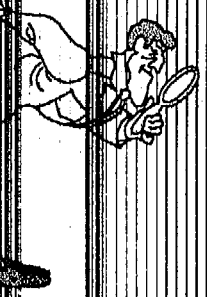






Greenhouse gas Pollution Prevention (GEP) project

- Evaluation procedure
  - Technical aspects
    - carried out by USAID
  - Financial aspects
    - carried out by IDBI



Greenhouse gas Pollution Prevention (GEP) project

Financial evaluation

- Financial soundness and capabilities are evaluated
- About 10 criteria are considered for evaluation
- Ratings are given based on technical and financial evaluation and final ratings are arrived
- Selection is based on final ratings

GEP- project- Financial evaluation

- Financial parameters considered for evaluation
  - profits for past three years
  - Return on average total assets (GP/TA)
  - Ratio of gross profit to net sales
  - Ratio of operating profits to net sales
  - Debt-equity ratio

GEP- project- Financial parameters considered for evaluation (contd.)

- Current ratio
- Past records of dealing with FIs
- Project cost
- Promoters contribution
- Perceived capabilities of managemer

Greenhouse gas Pollution Prevention (GEP) project

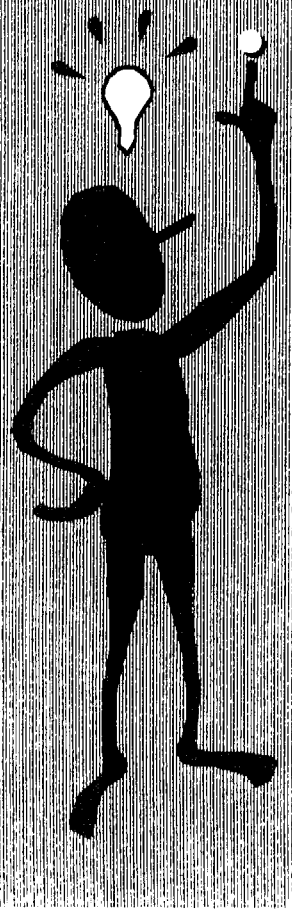
- Sanctions
  - Phase-I
    - 5 projects are selected for assistance
    - Amount sanctioned US$ 4.34 million
    - Total Installed Capacity - 110 MW

Greenhouse gas Pollution Prevention (GEP) project

- Progress achieved (Phase-I)
  - Four of five sugar mills hav completed the project an exporting power to grid
  - 30% of sanctioned grant has bee disbursed (US$ 3.0 million)

Greenhouse gas Pollution Prevention (GEP) project

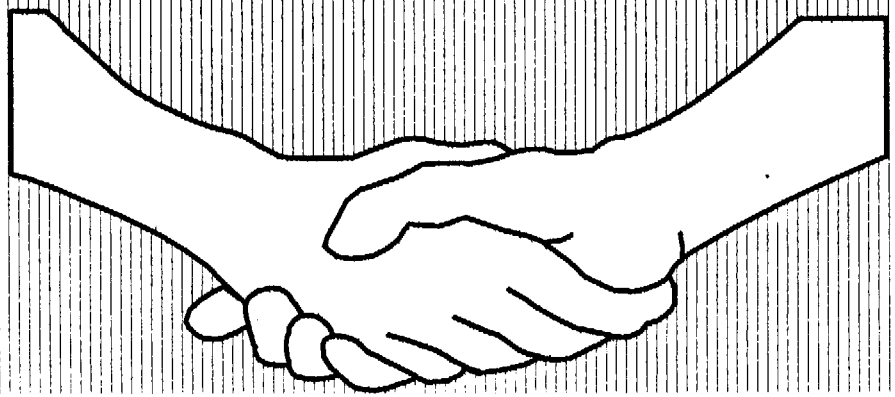
- Sanctions
  - Phase-II
    - Grant available US$ 3.0 million
    - No. of projects assisted - 4
    - The projects are in the various stages of implementation



Sugar Mills assisted

- EID Parry(TN)
- Thiru Arooran(TN)
- Dharani(TN)
- Dhampur(UP)
- Godavari(KA)
- Shamanur(KA)
- Sagar(AP)
- Ugar(KA)
- Rana(PJ)

Let us work together to build up an energy efficient, pollution free industrialised country and foster the growth of Indian econonmy thro' our joint efforts



Thank You

Industrial
Development Bank of India

ANNEXURE - 4

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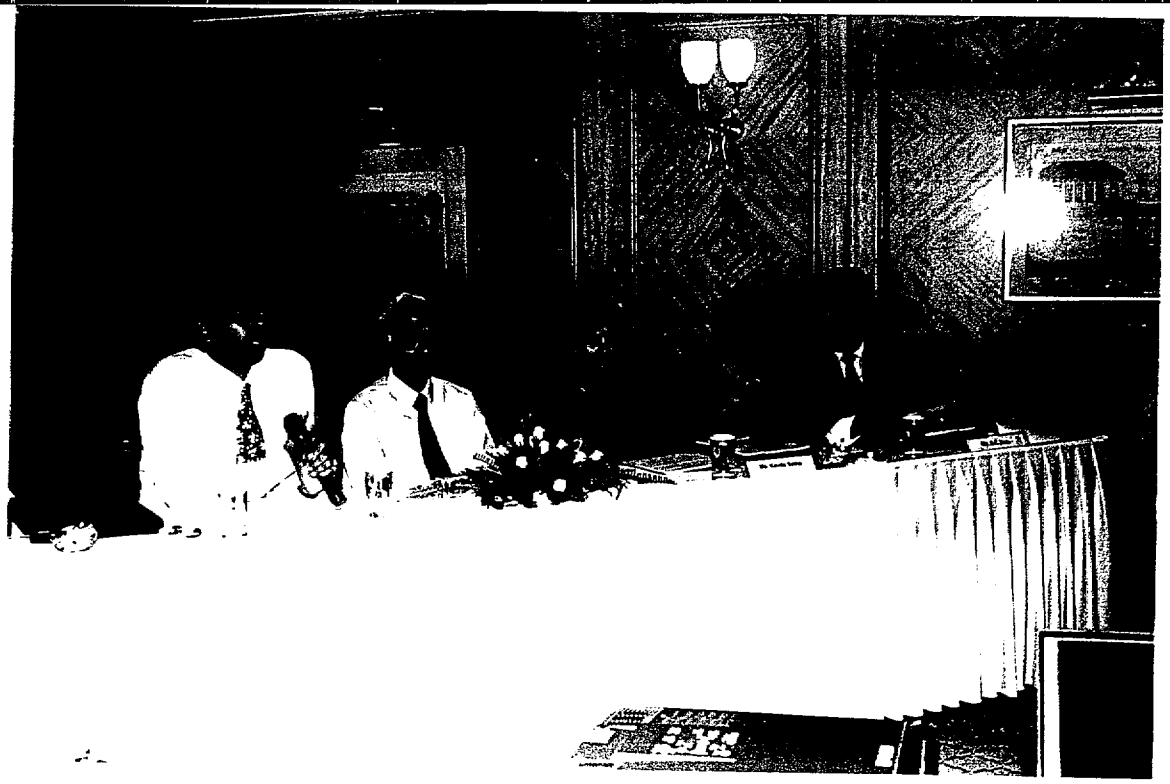

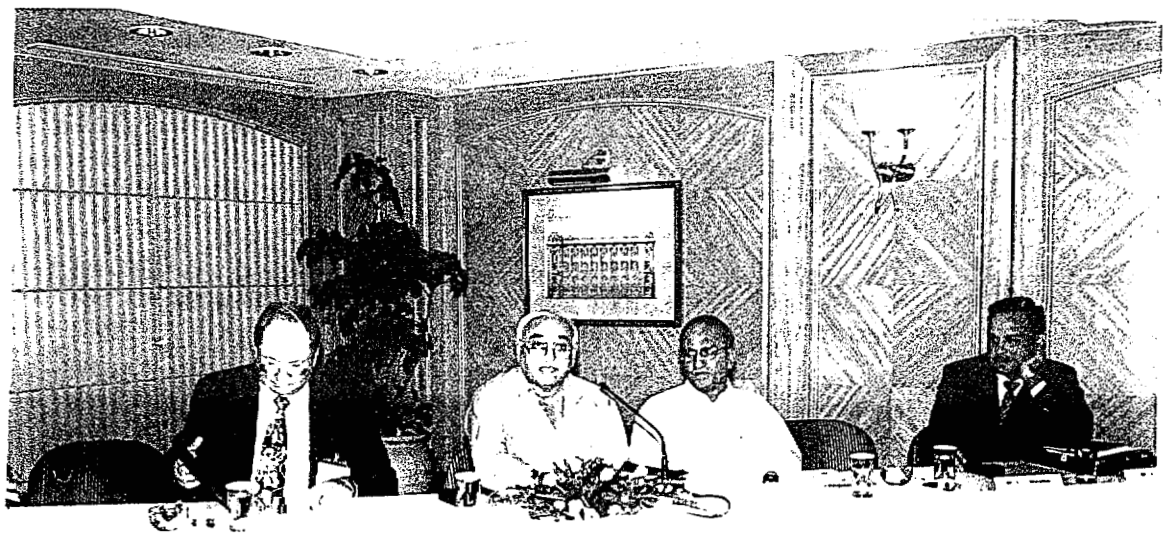

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ANNEXURE - 5

PRESS COVERAGE

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सामना

संपादक: बाळ ठाकरे दि. 23/6/99

उसाच्या चिपाडापासून सहवीज; आज चर्चासत्र

मुंबई, दि. २१ (प्रतिनिधी) - यू. एस. ए. आय. डी. च्या 'बगॅसपासून सहऊर्जानिर्मिती'च्या खास कार्यक्रमाद्वारे विनरॉक इंटरनॅशनल, नवी दिल्ली आणि मिटकॉन लिमिटेड, पुणे या संस्थांच्या विद्यमाने 'उसाच्या चिपाडापासून वीजनिर्मिती प्रकल्पातील वित्तपुरवठा आणि त्यांचे व्यापारीकरण' या विषयावरील एक दिवसाचे चर्चासत्र दि. २२ जून रोजी ओबेरॉय हॉटेलमध्ये आयोजित केलेले आहे.

या चर्चासत्राचा मुख्य उद्देश म्हणजे अशाप्रकारच्या प्रदूषणविरहीत आणि अपारंपरिक ऊर्जास्रोतावर आधारित प्रकल्पांच्या भांडवल गुंतवणुकीबाबतच्या आणि व्यापारीकरणातील अडचणींवर ऊहापोह करून योग्य मार्ग काढणे व त्याद्वारे अशा प्रकल्पांच्या वाढीस पोषक वातावरण निर्माण करणे हा होय, असे 'मिटकॉन'तर्फे सांगण्यात आले.

देशात साडेचारशे साखर कारखान्यांतून जवळजवळ ३५०० मे. वॅट एवढी अतिरिक्त ऊर्जानिर्मिती होऊ शकते. हिंदुस्थान सरकारच्या अपारंपरिक ऊर्जास्रोत मंत्रालय, विविध राज्य सरकारे आणि ऊर्जाविकास अधिकरण संस्थांच्या ८ ते १० वर्षांच्या प्रयत्नांनंतरही फक्त १३४ मे. वॅट एवढीच वीजनिर्मिती आज प्रत्यक्षात कार्यान्वित झालेली आहे. अजून २५० मे. वॅटचे प्रकल्प हिंदुस्थानभर उभारण्याच्या दिशेने वाटचाल करीत असले तरी शक्यतेपेक्षा खूपच कमी प्रमाणात हे प्रकल्प पुढे जाताना दिसताहेत. याबद्दल खंत प्रकट करण्यात आली असून योग्य भांडवलाची गुंतवणूक आणि व्यापारीकरण हे दोन मुख्य प्रश्न या चर्चासत्रातील विविध संस्थांच्या उपस्थितीमुळे व चर्चेमुळे सुटण्याची शक्यता आहे, असेही म्हटले आहे.

या चर्चासत्राचे प्रमुख पाहुणे म्हणून राज्य सरकारचे ऊर्जासचिव प्रमोद देव उपस्थित राहणार असून हिंदुस्थानातील व परदेशातील तंत्रज्ञ, प्रकल्प उभारक, सल्लागार आणि राज्य व केंद्र सरकारच्या संस्थांचे प्रतिनिधी, साखर कारखान्यांचे प्रतिनिधी व इतर मान्यवरदेखील उपस्थित राहणार आहेत.

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२६ जून १९९९

ऊसाच्या चिपाडापासून विद्युतनिर्मिती करण्याबाबत विटकॉनने मुंबईत एक कार्यशाळा घेतली होती. त्यावेळी मार्गदर्शन करताना व्यासपीठावर डावीकडून नेड जेवेट, हरिश भार्गव, अजितसिंग व विटकॉनचे उपाध्यक्ष सुनील नातू इत्यादी मान्यवर दिसत आहेत. हा कार्यक्रम यूएसएआयडी व बिनरॉक इंटरनॅशनल यांनी पुरस्कृत केला होता. ऊसाच्या चिपाडापासून बीजनिर्मिती प्रकल्पांचा जागतिक स्तरावरील व भारतातील आढावा, तंत्रज्ञानातील प्रगती, पुढील प्रकल्पांच्या शक्यता इत्यादी विषयांवर या कार्यशाळेत प्रबंध सादर केले गेले. यूएसएआयडीच्या कविता सिन्हा तसेच हरिश भार्गव हेही या प्रसंगी उपस्थित होते.

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ज्वलंत हिंदुत्वाचा पुरस्कार करणारे एकमेव मराठी दैनिक

सामना

वर्ष: ११ अंक: १५४ मुंबई, शनिवार, दि. २६ जून १९९९ किंमत २ रुपये (पृष्ठे १२)

चिटकॉन, पुणेच्या वतीने ओबेरॉय हॉटेल येथे आयोजित करण्यात आलेल्या एका कार्यशाळेच्या व्यासपीठावर हरीश भार्गव, सीबत हेमंत गंडमवार, श्रीमती कविता सिन्हा आणि चिटकॉनचे उपाध्यक्ष सुनील मातू आदी.

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