

# Industrial COGENERATION India



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## Editorial



**Smt Varsha Joshi**  
Joint Secretary, Ministry of  
New and Renewable Energy  
(MNRE)

Later this year, France will be hosting the 21<sup>st</sup> session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21). This is a crucial conference as it needs to achieve a new international agreement on the climate, applicable to all countries.

Renewable energy will play a significant role in these negotiations. Besides the ever-popular solar and wind technologies, biomass-based power generation is also renewable, and its fuel is widely available and carbon-neutral. It also has the potential to provide significant income generation and clean power to the rural community.

The Ministry of New and Renewable Energy (MNRE) is thus supporting Business Meets on Bagasse-based Cogeneration in Lucknow and Dehradun in October 2015, being organized by Cogeneration Association of India, followed by Operator Training Programs at cogeneration plants in Uttarakhand and Maharashtra later this year. We hope that all stakeholders will attend these programs and work together to maximize the potential in our country.

Another area of interest to the sugar industry is the up and coming ethanol industry, to support the Government policy of ethanol blending with fuel (for transport). To promote and implement distillery/ethanol projects, MITCON Consultancy & Engineering Services organized Business Meets at Pune (July) and Belgaum (Sept).



Two technical articles by manufacturers (Cheema and Praj) on the benefits of their innovative technology, along with actual case studies have been included in this issue.

Energy management and cost efficiency are important components of all plant operations today. An article on energy efficient milling solutions by Ulka and another on energy management in a sugar/cogeneration plant by Triveni has been included this time, with actual savings and other benefits described.

Financing of these projects is crucial. There are several agencies willing to finance credible projects; and updates on financing initiatives by North Eastern Development Finance Corporation (NEDFi) are included this time.

It is hoped that CSR (Corporate Social Responsibility) funds from big corporate houses and public sector units (PSUs) will also be channelized towards the above initiatives in future, and MNRE had supported a conference on "Business Case for Sustainable CSR Interventions" on this issue in July this year.

A very happy, pollution-free and prosperous Dussehra and Diwali to you all!

We continue to look forward to your articles, feedback and suggestions for making this an even more informative and useful newsletter next time!

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# Tapping CSR Funds for Sustainability of Biomass-Based IPPs and Cogeneration Power Plants in India

## Background

Biomass-based power generation is renewable and carbon-neutral, and its fuel is widely available. It has the potential to provide significant employment and income generation in the rural community, particularly farmers and villagers. The cumulative capacity of biomass power generation in the country is about 1,400 MW, of which only about 50% is operating and the rest has either shut down or is operating at low plant load factors. The installed capacity of biomass-based cogeneration power plants in the country is about 3,000 MW.

The major reason for under-performance of installed biomass power plants and cogeneration power plants is unavailability of the required quantity of biomass at reasonable cost. This is due to lack of a proper fuel supply logistics chain and due to the presence of cartel of traders/middlemen forcing the biomass price to go higher artificially.

Fuel security can be achieved by establishing an independent fuel supply chain starting from fields to the boiler inlet involving farmers, local labour, and own staff for supervision and control of complete fuel logistics chains. Thus, there is a need for specialized companies in the field of biomass aggregation, processing and supply to biomass and process plants.

M/s Punjab Renewable Energy Systems (P) Ltd (PRESPL) was established in March 2011 to address this principle issue of biomass fuel supply management and looks into aggregation, processing, transportation, and supply to biomass-based power plants and cogeneration power plants.

## Description of Business Model

In order to develop a biomass supply chain to power plants, identification and training of rural youth is carried out to develop them as "Village Level Entrepreneurs (VLEs)". They are then provided with necessary machinery such as shredders, balers, etc., and are given the responsibility of collecting biomass from individual farmers, and of processing and transporting it to the power plant. VLEs are paid at pre-determined rates for biomass supplied to the plant. They are strategically located across the catchment area so as to get the complete reach in the potential areas targeted. The typical flow diagram of biomass supply chain management, involving farmers and VLEs, is shown below.

This biomass model is unique, innovative and sustainable due to the following:

- PRESPL enters into a long-term fuel supply agreement with clients with a pre-decided price and schedule of supply of fuel supply for the calendar year, and guaranteeing quantity and quality of fuel supply for parameters such as moisture, gross calorific value, etc. PRESPL acts as a single-point solution for all fuel needs of the client. Thus, the power plant doesn't need to be worried about biomass collection.

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Figure 1: Flow Diagram of Biomass Supply Chain Management

- Due to establishment of fuel supply chain management, plants are able to operate the plant at design PLFs in the range of 70-80%, which results in profitable and sustainable plant operations. The cogeneration power plants are able to operate for more number of days in the off-season and sell power to the grid, which improves their top-line and bottom-line considerably.
- PRESPL has become the “Centre of Excellence”, and has been approached by other private entities/ entrepreneurs to provide technical assistance and consultancy services for setting up biomass fuel supply business.
- The PRESPL team carries out research, interacts with other world-wide players and has prepared a “Knowledge Management System” based on the business models/best practices for biomass supply across the world.
- In a short span of about four years, PRESPL has served more than 20 biomass power and cogeneration power plants and has collected, processed and supplied more than 300,000 MT of various biomass, which has sequestered about 1,720,000 MT of CO<sub>2</sub> emissions.

**Socio-Economic Benefits**

- PRESPL is providing an additional source of revenue to the farmers through sale of the feedstock, which otherwise used to be burnt/left in open fields leading to deadly particulate and methane emissions. Farmers are happy to get an additional source of income from selling crop residues. This additional income helps farmers to purchase seeds, fertilizers, etc., for the next crop as well as improve their lifestyle and expenditure on health and education.
- For collection, storage and supply of biomass, many tractors, trolleys and other farming equipment are also involved, which results in additional use and source of income to the local farmers.

- Rural income and employment generation increases for the whole rural chain involving VLEs, farmers and rural youth. In fact, many unemployed rural youth find employment opportunity either as VLEs or unskilled labour involved with biomass harvesting, processing, storage and transportation. This leads to creation of skilled and semi-skilled manpower in rural India with ‘OJT (On-the-Job) Training’.

A case study on the socio-economic benefits from supply of cotton stalks to an operating 13.2 MW biomass-based power plant is depicted in Figure 2 below. The biomass power plant requires 450 MT/day of biomass and delivers an estimated 1,421 “green jobs” within the rural community through the collection of biomass waste, and transportation and collection operations. There is income generation of more than Rs 20 crores to the rural population on account of this activity for one power plant. In India, there is potential to generate more than 17,000 MW of power generation based on various agri-residues and thus, there is huge potential of rural economy upliftment on account of biomass fuel supply.

**Harnessing CSR Funds to Upscale the Biomass Supply Model**

PRESPL is right now operating only in select districts in the states of Maharashtra, Punjab, Gujarat and Karnataka, while biomass power plants are spread all across the country. Thus, there is tremendous upscale potential to

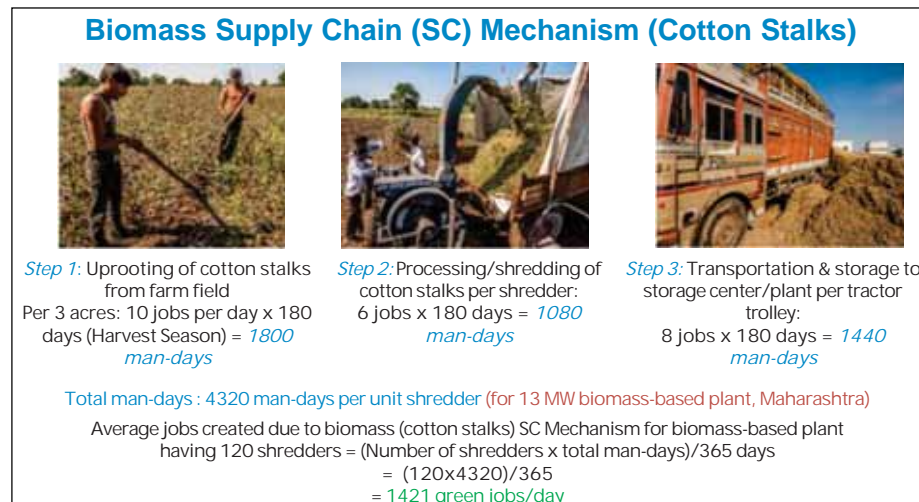


Figure 2: Case Study on Rural Employment Generation on account of Biomass Supply Chain



**The 3rd National Conference on Green Energy CSR - Business Case For Sustainable CSR Interventions** was held at New Delhi on July 15, 2015. It was aligned with the launch of National Mission on Skill Development by the Hon. Prime Minister of India.

Sponsors included the Ministry of New and Renewable Energy (MNRE) and Indian Renewable Energy Development Agency (IREDA); and corporates including Lloyd Insulations (India) Limited, Verdia Technologies, Overdrive Engineering as Key Technology Partners. Junxion Strategy, Ruchi Telecom, Power Plus Consultants and Minda Energy were the corporate associates to the Conference. Department of Public Enterprises (DPE) under the Ministry of Heavy Industries and Public Enterprises and the Ministry of Drinking Water and Sanitation (MDWS) provided their strategic inputs. The Indian Institute of Corporate Affairs (IICA) was the knowledge partner and UNDP-GEF-SGP supported the Conference with their thought leadership.

Through this platform, the Guest of Honor Dr. Bhaskar Chatterjee, Director General and CEO – IICA set the tone for day-long intensive deliberations on how to move forward and realize the game-changing potential of CSR in India. He also identified ways to effectively involve NGOs towards achieving this goal.

Interactive discussions during the day included participation from corporate delegates; PSUs; CSR professionals, NGOs and Government Ministries and highlighted best practices & lessons learned from wide range of CSR programs - which will help to achieve government's mission for Sustainable CSR interventions. The Conference deliberations provided strategies and mechanisms for leveraging CSR funds for various National flagship programs such as Swachh Bharat Abhiyan, Skill India, Make in India and Sustainable Development.

The soft copy of the CSR publication – IMPACT – which focuses on how sustainable CSR is enriching lives and can be aligned with national development goals in a manner that goes beyond the traditional definition of sustainability in terms of energy and environment, is available on the following link -<http://www.sharpdevelopments.org/>.

For other post conference updates, please log on to <http://sharpdevelopments.org/csr3/index.html>

The author (Monish Ahuja) of this article also made a presentation at this conference.

the model both in terms of volume and geographical spread.

The biomass aggregation and supply model can be used by big corporate houses, Public Sector Undertakings (PSUs) and government-owned companies as Corporate Social Responsibility (CSR) activity, where PRESPL will act as an implementing agency. PRESPL can help in establishing the complete biomass logistics chain. It can become a "knowledge hub" and execution partners on behalf of big corporates/PSUs/government corporations who can use this biomass for many value-added products. The agri-residues can be utilized to generate power in biomass power plants/cogeneration power plants, or used in bio-refineries to produce bio-fuels, or can be used to produce biomass pellets which can be exported from India. There are multiple opportunities and end-products from biomass supply. In fact, PRESPL is already engaged with big corporate houses such as Tata Power Company Limited, Reliance Industries Ltd, etc. to enter the biomass power generation business, due to the dual potential in terms of power generation as well as rural economy upliftment.

PRESPL can provide skills-based training to unemployed rural youth in the field of biomass/agri-residues/agro-industrial residues aggregation, processing and supply to various biomass power plants and process industries having captive power plants. VLEs will undergo proper training so that they can undertake this business as independent and profitable enterprises. This will also convert waste agri-residues such as cotton stalk, paddy straw, maize cob, soya husk, etc. into commercially-traded fuel for biomass-based power plants and process industry as alternative fuel to various fossil fuels such as coal, lignite, natural gas, furnace oil, etc. This will mitigate CO<sub>2</sub> emissions from industry as well as prevent local pollution on account of field or open burning of various agri-residues in the field.

Thus, CSR funds from big corporate houses and PSUs can be channelized not only for rural upliftment, but also lead to sustainability of biomass-based power generation and cogeneration power plants in the country and to the higher global goal of climate change mitigation.

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## Business Meet on Accelerated Deployment of Incineration-Type Boilers in Distilleries

The Indian sugar industry today is at a very critical juncture and needs investments for expansion, modernization, as well as implementation of ethanol plants and cogeneration power plants, for their long-term integration. The recent Government policy has pegged 5% ethanol blending with fuel (with possibility to extend to 10% shortly), at an attractive price of Rs 48.50/liter for ethanol. This provides an excellent opportunity to the sugar factories to implement ethanol projects in the immediate future.

There are 429 distilleries in India, 216 connected to sugar factories and 213 standalone, with about 100 distilleries having installed ethanol manufacturing facilities, which can produce over 5 billion liters of rectified spirit (alcohol) per year in addition to 2 billion liters of fuel ethanol. Despite the conducive policy environment today, the ethanol industry still faces several issues regarding timely evacuation of ethanol by the petroleum companies, payments, etc., as well as strict pollution control norms imposed by the Central and State Governments and financing by banks/financial institutions/Sugar Development Fund.

It is well-known that the Central Pollution Control Board (CPCB) has prescribed and implemented zero discharge norms from effluent for the distillery industry with effect from January 01, 2006. CPCB had provided about three years' time to the distillery industry to achieve zero discharge through any process of distillery effluent treatment suitable to each distillery. The current stringent pollution control policies and norms for effluent through distilleries have made many distilleries shut down their



*Dr Pradeep Bavadekar, Managing Director, MITCON, presenting the souvenirs to the sponsors*

operations, thereby making heavy losses with the investments becoming "dead". Deployment of Incineration Type (Slop Fired) boilers has proved to be an effective solution in resolving this issue.

Considering the need of the hour, MITCON organized a one-day business meet on 20 July at Pune with an aim to discuss policy, technical/commercial aspects, environmental issues and financial schemes for implementing the above projects at factories and/or deployment of incineration type boilers at the proposed distillery/ethanol projects.

Industry sponsors and presentations included Praj, Cheema, Thermax, Mojji, KBK-Chem, Uttam, Sitson and SS Engineers. Over 115 participants were present including equipment manufacturers/suppliers, engineering consultancy organizations, associations, and representatives from sugar factories/distilleries, etc.

The presentations made by the speakers during the technical session of this meet (*two papers by Praj and Cheema follow in this newsletter issue*) and the interactions/discussions held during the open house discussions/concluding session, certainly helped stakeholders understand and hopefully to implement these projects in future.

The final conclusions...

In order to help sugar factories implement these projects quickly and for their sustained growth, it is necessary to lobby for continued policy support

*contd on pg 13*



*Dignitaries lighting the lamp at the inaugural function*



## Slop-Fired Boiler Technology: A Case Study

### Introduction

Distilleries generate (i) spent wash (SW) from the distillation column; (ii) spent lees from the analyzer column; and (iii) other wastewaters like fermenter washings, fermenter cooling, floor washings, spillage and cooling. Among these, SW is of major environmental concern owing to its quantity and quality. About 10-15 liters of SW are generated for every liter of alcohol produced. The SW is characterized by a high percentage of dissolved organic (52,000–58,000 mg/L BOD; 92,600–1,00,000 mg/L COD) and inorganic matter (1,660–4,200 mg/L form of nitrogen, 225–3,038 mg/L phosphorus and 9,600–17,475 mg/L potassium, etc.), is dark brown in colour (238,000–252,000 Platinum-Cobalt units), with high temperature (70-100°C), low pH (4-4.5) and strong odor. About 50% of the organic and inorganic matter is present as reducing sugars. Thus, Indian SW contains very high amounts of potassium, calcium, chloride, sulphate and BOD as compared to SW in other countries.

In addition, there are other issues such as:

- Usage of excessive ground water
- Disposal of distillery effluent
- Fuel cost, etc.

### CPCB Guidelines for Treatment & Disposal of SW

As per the effluent standards notified under the

Environment (Protection) Rules, 1986, treated effluent from distillery should have BOD of 30 mg/l for disposal into surface water bodies, or 100 mg/l for disposal on land for irrigation.

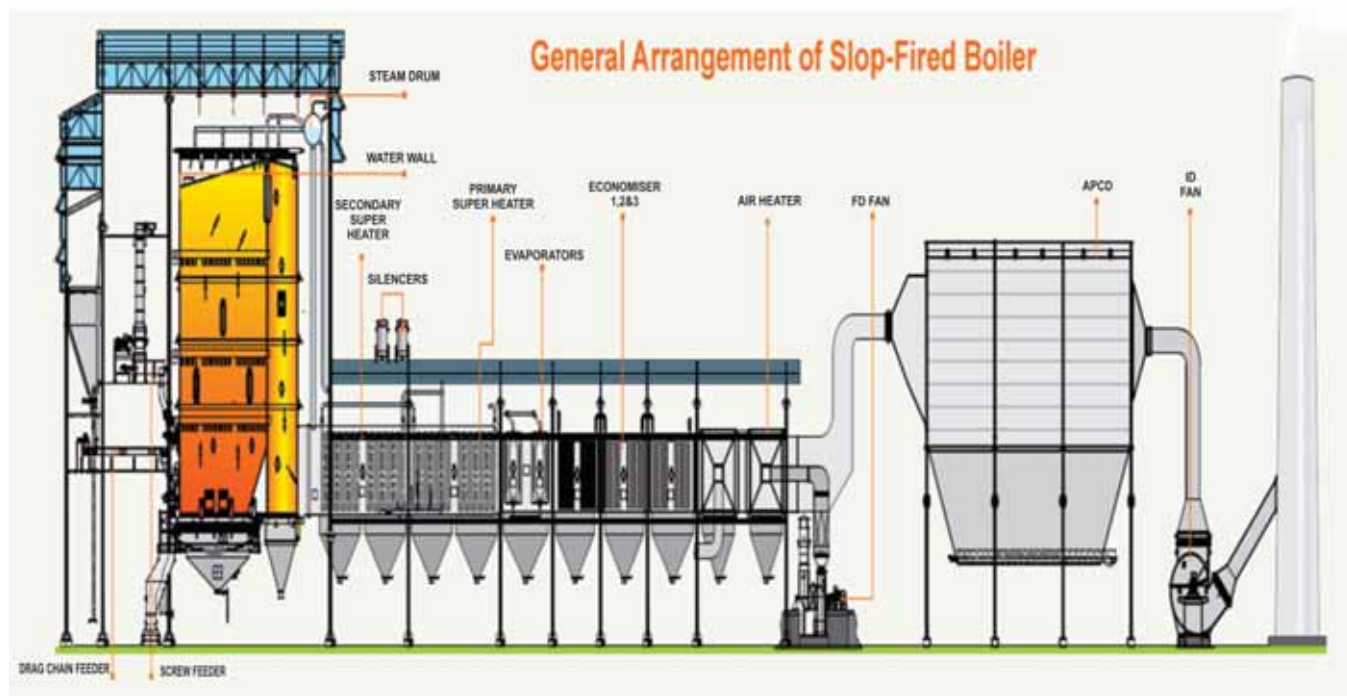
Therefore, most of the molasses-based distilleries have installed anaerobic digesters and adopted the following practices for SW management:

1. Ferti-irrigation
2. One-time application before sowing of crop (Pre-sown irrigation)
3. Bio-composting of pre-treated SW

### CPCB's Earlier Issued Guidelines (2008)

The problems associated with distilleries due to the currently used treatment methods of composting, ferti-irrigation and one-time land application of SW vis-à-vis advanced technologies including evaporation, concentration and incineration of concentrated SW for power generation were discussed and the following recommendations made:

- A. Proposal for establishing stand-alone distilleries comprising ferti-irrigation and one-time land application of SW may not be considered henceforth by State Pollution Control Boards (SPCB)/Ministry of Environment & Forests (MoEF)/Pollution Control Committee (PCC).



Note: COD-chemical oxygen demand; BOD-biological oxygen demand; SS-suspended solids



B. Proposal for establishing distilleries attached with sugar units may be considered if they followed one of the following options:

- Bio-methanation followed by bio-composting; or
- Reboiler/Evaporation/Concentration followed by incineration of concentrated SW in boiler (for power generation).

C. The proposals of existing stand-alone distilleries for increase of production/expansion based on composting, ferti-irrigation and one-time land application of SW may not be considered henceforth by SPCBs/MoEF.

D. The proposals of existing distilleries (both stand-alone and those attached with sugar units) that are not complying with the required environmental standards may be asked to switch over to emerging technologies from existing technologies of composting, ferti-irrigation and one-time land application of SW in a time-bound manner.

### Present Scenario/Facts

During the last few years, CPCB have made surprise visits under the Environmental Surveillance Squad (ESS) program to molasses-based distilleries in the country and in different seasons. The outcome of this surprise monitoring of distilleries indicates abysmal environmental performance of distilleries adopting ferti-irrigation, one-time land application and bio-composting, with more than 60% cases of serious non-compliances. Ground water contamination, river water pollution and soil degradation due to mismanagement of SW with these practices have been reported across the country. In view of this continuous non-compliance, CPCB is insisting that all existing distilleries (both stand-alone and those attached with sugar units) that are not complying with the required environmental standards, should switch over to emerging technologies.



M/s NSL KSL (P) Limited (25 TPH, 65 kg/cm<sup>2</sup>, 485°C boiler)

### Technologies for Concentration of SW

- Anaerobic digestion – Biogas
- Reverse osmosis (RO) – Permeate/Reject
- Multiple effect evaporation (MEE) – Concentrate/ Process condensate

#### Anaerobic Digestion:

- Well-established technology; almost all distilleries have anaerobic digesters.
- Digesters designed for COD loading rate of 5 kg/m<sup>3</sup>/day have given best performance; Continuous Stirred Tank Reactor (CSTR) and UASB (Upflow Anaerobic Sludge Blanket)-based digesters are more suitable for molasses-based distilleries.
- BOD removal efficiency – 85-90%, COD removal efficiency – 55-65%, Specific biogas generation (Nm<sup>3</sup>/kg of COD consumed) – 0.45-0.55, Methane content of biogas – 55-65%, H<sub>2</sub>S content of biogas – 2-4%.

#### RO System:

- SW volume can be reduced by 45-55% for Biomethanated Spent Wash (BSW) and 35-45% for Raw Spent Wash (RSW).
- Permeate can be used after pH correction. Hence, fresh process and non-process water requirement is reduced.
- Permeate recovery: BMSW: Average 45-55%; Raw SW: Average 35-45%.
- Permeate can be recycled after proper treatment as make-up water in cooling towers or for molasses dilution.
- Operational cost (about Rs 0.60 per cum) is slightly lesser than MEE plants.

#### MEE:

- Well-established technology for concentration up to 40% solids, which can result in substantial SW volume reduction.
- Some MEE plants are susceptible to scaling above 2000 ppm SS in the feed.
- Process condensate requires polishing treatment before reuse in process and non-process applications.
- Integrated RSW evaporation can result in reduction of final SW volume to 3.5 to 6.5 lit./lit. without additional steam requirement depending on fermentation technology employed.
- Scaling is severe when product concentration is above 50% solids and it is extremely difficult to remove the scaling.

### Technologies for Drying/Incineration of Concentrated SW

- (i) Spray dryer/Rotary dryer





(ii) Slop-fired boiler

**(i) Spray dryer/Rotary dryer:**

- Calorific value of dried powder is about 2200 kCal/kg; moisture content 4-5%.
- Disposal of dried power is not standardized. At some distilleries, it is used as supplementary fuel along with agro-based fuel in boilers, whereas at some of the distilleries it is sold as fertilizer.
- Distilleries with capacity of about 30 KLD to 45 KLD have reported operating dryer systems successfully, and therefore this is a viable option for small-scale distilleries with capacities <60 KLD.

**(ii) Slop-fired boiler:**

- 55 to 60% solids concentrate or SW powder is fired in a specially designed boiler with or without subsidiary fuel. Steam generated runs a TG set to generate electricity. Exhaust steam is used in distillery and evaporation plant operations.
- Overall system is supposed to be self-sustaining in terms of steam and power balance after initial stabilization period.
- Potash-rich ash as a by-product.
- Slop-fired boilers are in operation in India since 2006 and distilleries/technology suppliers have reported addressing various bottlenecks through improved design/innovative technologies.

**Co-processing of Concentrated SW**

SW can be effectively disposed off in cement kiln systems through the co-processing route to substitute coal up to 5% without adversely affecting the kiln performance and product quality. Co-processing of SW concentrate in cement kilns has successfully been put to trial runs and can be adopted by distilleries in lieu of captive slop-fired boilers, for SW management to achieve zero liquid discharge (ZLD), subject to the availability of adequate kiln capacity and necessary logistics arrangements. Co-processing could be a cost-effective



*M/s Wave Distillery (25 TPH, 45 kg/cm<sup>2</sup>, 440°C Boiler)*

alternate option for attainment of ZLD by distilleries that have already installed evaporation-concentration facilities, depending upon their location suitability. However many cement plants are not keen due to transportation/handling/storage/scaling of the SW, and the distance involved, etc.

The suggested technological options for achieving ZLD may include:

- Bio-methanation followed by RO/MEE followed by incineration (slop-fired).
- Bio-methanation followed by RO/MEE followed by drying (spray/rotary).
- Concentration through MEE followed by co-processing in cement/thermal power plant.
- Bio-methanation and RO followed by MEE followed by bio-composting.

**Solution**

**Slop Incineration-based Cogeneration Technology**

Slop-fired boiler technology offers enhanced energy security to the distillery along with solving its effluent management challenges. The technology concentrates SW (Slop) and then fires it in a specially designed boiler, thus enabling the distilleries to dispose the effluent in an environment-friendly manner as well as generate quality steam for meeting their entire process and power requirements. Slop incineration-based cogeneration technology perfectly fits the distillery's environmental compliance needs. With CBL's (Cheema Boilers Limited) slop incineration solution, stringent regulations, including those that require zero liquid effluent discharge from distilleries, are fully complied with.

**CBL's Technology Leadership**

CBL has been the first Indian company to commercially commission slop incineration-based boilers. Today, many distilleries across the country are successfully functioning with the application of this technology in diverse operating ranges and support fuel options.

In the year 2006, the company successfully developed a commercial scale boiler technology that concentrated the SW and then fired it in a specially designed boiler, thus enabling the distilleries to dispose the effluent discharge in an environment-friendly manner (and fulfill the 'Zero Effluent Discharge' [ZED] norms) as well as generate quality steam for meeting their process steam and power requirements.

**Benefits**

**Savings on fuel cost** – By using SW as boiler fuel,



distilleries significantly save on fuel costs as each ton of concentrated SW replaces approximately 335 kg of coal.

**Effective energy solutions** – Slop incineration-based boiler systems offer a balanced solution for the distillery’s steam and power requirements.

**Design advantages**

- Efficient online cleaning for higher operational availability
- Greater reliability
- Single drum, natural circulation, bottom supported design
- Designed for maximum heat recovery
- Tall furnace for adequate residence time ensuring complete combustion
- Specially designed temperature profile to minimize ash deposit while enabling maximum combustion efficiency
- Precision engineering and robust construction
- All boiler constituents designed and manufactured to deliver high efficiency and long life
- Fuel flexibility
- Support fuel options - Bagasse, rice husk, coal, etc.

**Proven & Tested Technology** – CBL not only pioneered the technology almost a decade ago but has continually improvised it through in-depth research, extensive field trials and user feedback. Its dedicated team of technocrats has worked to enable distilleries reap maximum benefits of this technology, which is why its slop incineration-based boilers enjoy highest availability among their class.

**Case Study**

**M/s NSL KSL (P) Limited (25 TPH, 65 kg/cm<sup>2</sup>, 485°C)**

Before commencing any project, the requirements of the customer need to be understood. The distillery capacity was as below:

Capacity: 60 klpd  
 Evaporator capacity: 25 m<sup>3</sup>/hr  
 Slop generation: 8000 kg/hr

Description	Design	At site*
Steam capacity (TPH)	25	20
Steam pressure kg/cm <sup>2</sup> (g)	65	65
Steam temperature°C	485	484
Slop quantity kg/hr	8100	8500
Concentration of slop %	60	50

\*Random log book parameters

**Fuel Savings Using Slop-fired Boiler**

	Conventional System	Slop-fired Boiler System	Savings
<b>Coal consumption</b>	75 MT/Day	50 MT/Day	25 MT/Day
<b>Cost of coal (@ Rs 6000/Ton)</b>	Rs 450,000/Day	Rs 300,000/Day	Rs 150,000/Day
<b>Power cost (3 MW)</b>	Rs 6.25/kW	Rs 4.16/kW	Rs 2.09/kW (Rs 2090/MW)

Slop to be fired in the incinerator boiler: 8000 kg/hr  
 Randomly available fuel in the company belt is Indian/imported coal.

**Saving on Effluent Treatment Cost**

In conventional systems, effluent is treated by adopting the bio-composting method in which effective micro-organisms are used to make compost out of the SW, which has vital nutrients but high values of COD and BOD in making compost for zero discharge of their distillery effluent. This requires huge land area resulting in additional cost to the company. By using a slop/SW-fired boiler, the cost of effluent treatment is eliminated and saving upto Rs 500,000/month is possible.

**Revenue Generation by Selling Slop Ash**

Burning of slop (SW) results in formation of potassic ash, which can be used in making ash bricks for low landfilling and potassic fertilizer in fields to increase fertility of land. The ash used for such purposes is sold at Rs 800 per trailer and around 20 trailers of ash are sold per day, which generates revenue of around Rs 480,000 per month to the distilleries.

**Ground Water Retention**

Since large amounts of water are recovered through concentration of SW, the use of natural water is limited, thus assisting in retention of ground water.

Distilleries can now function without the fear of hazardous SW percolating into the surroundings and polluting the environment. With almost zero effluent discharge, it is now possible to contribute positively to the cause of environment conservation as well as fully comply with pollution control regulations.

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# Value Maximization through Sustainable Solutions for Distilleries

## Abstract

For sustainability and round-the-year operation of ethanol plants, Indian sugar factory-attached distilleries are adopting advanced technologies in fermentation, distillation and effluent treatment technologies to sustain operations and, at the same time, achieve Zero Spent wash Discharge (ZSD) and be compliant with Central Pollution Control Board (CPCB) norms. All these advanced technologies can be integrated with existing fermentation, distillation and effluent treatment technologies, thereby resulting in net reduction in energy, water consumption and fresh water requirement in the overall process plant. The author has attempted to give a brief overview of the advanced technologies for distilleries either attached to sugar factories or on a standalone basis.

Today, it is mandatory to install distilleries in compliance with statutory requirements, especially 'Zero Spent Wash Discharge'. With these investments on compliance for meeting the statutory requirements, it becomes imperative that distilleries run round the year or at least 300+ days and at the same time have Operating Expenditure (OPEX) as low as possible and preferably have multi-product facilities to cater to the dynamic market situations.

Praj has developed integrated technologies for distilleries at its Research and Development Center called Praj Matrix, where the focus is on introducing innovative and sustainable technologies with the underlying theme of *Reduce, Recycle and Reuse* of effluent streams.



Vinasse Evaporation System

The following are some of the path-breaking technologies developed and implemented by the company at some distilleries across the globe.

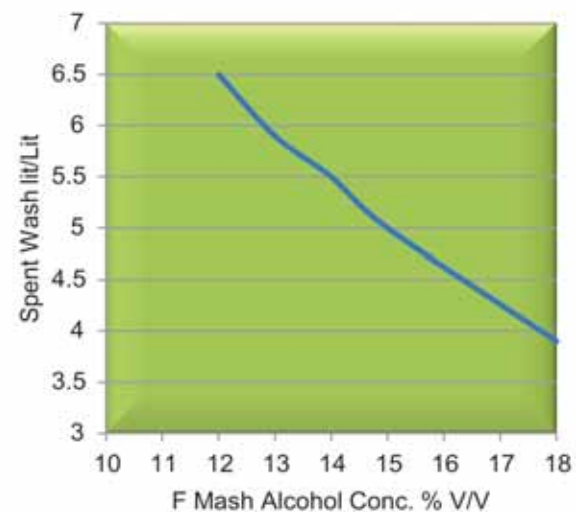
## Fermentation

- 1) **Hiferm** fermentation technology ensures higher ethanol concentration in fermented mash generating less spent wash as against conventional fermentation technology. In Hiferm fermentation, recycle streams like spent wash, spent lees and evaporation condensate are recycled in fermentation, which eventually reduces fresh water consumption, load on the effluent treatment plant (ETP), as well as reduces capital investment and operating cost.
- 2) **Combiferm** technological process innovation helps the sugar-attached distilleries to operate on various sugar streams and also increase the capacity of the existing plant with minimal addition of hardware. Typically this would help the sugar-attached distilleries in value maximization by running on sugar streams during crushing season and on molasses B/ C during the off-season.

## Distillation

Praj's Advanced Ecofine Distillation and EcoSmart Distillation technologies ensure lower steam consumption and reduced effluent generation.

In **Ecofine distillation technology**, the innovative column internal design ensures lower scaling and lower Cleaning-In-Place (CIP) effluent generation.



WASTE & WATER MANAGEMENT



*Biomethanated Spent Wash Evaporation*

In **Ecofine Distillation** the energy required for conversion from wash to Absolute Alcohol (ethanol) is around 1.7 kg/lit of total spirit versus the conventional system of around 2.4 kg/lit of total spirit, wherein there is a reduction of around 0.7 kg/lit of total spirit. Typically, for a 60 kilo lit/day plant this works out to saving of around 42 tons of steam/day. Taking the steam cost of around Rs 1000/ton, this works out to around 42 x 1000 = Rs 42,000/day.

Typically for a plant which runs 300 days a year this works out to a **Savings** of

**42,000 x 300 days of operation = Rs 12,600,000 per year**

The main feature of the **EcoSmart Distillation** technology is the flexibility of producing various grades of ethanol like Industrial Grade/Fuel Grade/Pharma Grade/Beverage Grade, etc., from the same plant and also the energy required, which is less by almost 30-35% when compared to the normal Multi-Pressure distillation.

The energy required for conversion from wash to extra neutral alcohol in EcoSmart is around 2.4 kg/lit of total spirit versus the conventional system of around 3.2 kg/lit of total spirit, wherein there is a reduction of around 0.8 kg/lit of total spirit. Typically, for a 60 kilo lit/day plant this works out to saving of around 48 tons of steam/day. Taking the steam cost of around Rs 1000/ton, this works out to around 48 x 1000 = Rs 48,000/day.

Typically for a plant which runs 300 days a year this works out to a **Savings** of

**48,000 x 300 days of operation = Rs 14,400,000 per year**

### Bio-Methanated Spent Wash Evaporation

#### ECOVAP/ECODRY: Zero Spent Wash Discharge

Bio-methanated spent wash evaporation technology removes sulfur and ammonia effectively from the bio-methanated spent wash, which is concentrated in multi-effect evaporators (MEE). To enhance thermal efficiency in the evaporator, Thermo Vapour Compressors can be used. The concentrated bio-methanated spent wash is fed to the drying system wherein it is converted to a powder and the same can be granulated/pelletized.

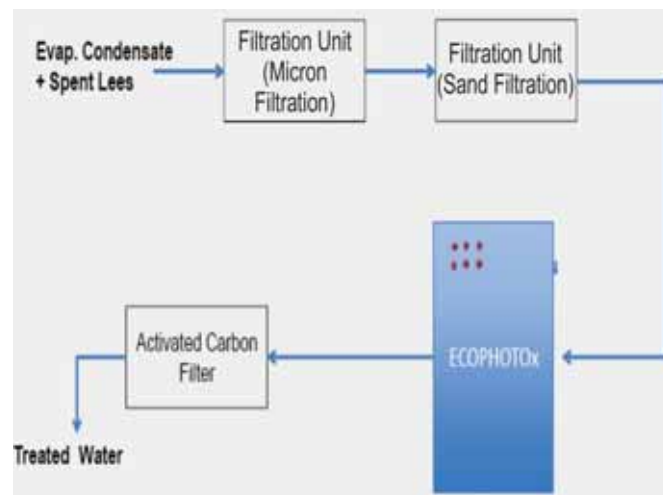
Evaporation can also be integrated with distillation to reduce the energy consumption. The outcome of evaporation is a Potassium-rich residue which can be used along with other constituents and converted into fertilizer.

Typically, from a 60 kilo lit/day plant, the spent wash coming out from the bio-methanation plant will be around 600 cu.m/day, containing around 5-6% w/w solids. The Potassium-rich material after the above process will be around 30-35 tons/day.

### Evaporation Process Condensate & Spent Lees Treatment

#### ECOPHOTOx:

The various streams like spent lees, evaporation process condensate, etc., which comes from distillery operations can be treated and reused back in the process. Praj has developed a cost-effective technology using photo-chemical oxidation technology for effluents like evaporation condensate generated from molasses-





Distillation Plant

based raw spent evaporation and also spent lees from the plant. Photochemical oxidation technology converts recalcitrant COD and BOD in the effluent into carbon dioxide and water.

The above system has reduced the fresh water intake by almost 8-9 lts/ltr of alcohol.

Thus the water after treatment can be recycled back to the process/cooling towers, etc.

#### Advantages of ECOPHOTOx:

- 1) The cost of operations is almost 60-65% as compared to conventional technologies.
- 2) There is no sludge generation and hence the cost of disposal of sludge is completely eliminated.
- 3) The entire water can be used in the process.

*contd from pg 06 (Business Meet on...)*

for early evacuation of ethanol at the depots of the oil companies, as well as secure low interest and long-term debts from institutions like Sugar Development Fund (SDF) and IREDA. It is also necessary to guide the sugar factories to select optimum solutions for their individual projects, and provide "handholding" services from concept to successful commissioning and operation. MITCON proposes to take the leadership role for this purpose, along with the equipment suppliers and technical experts.

MITCON proposes that sugar factories should avail reliable and quality services from end to end for these

- 4) The footprint required for the unit is hardly 1/3 of that required for a conventional system.
- 5) This is a plug and play kind of system and hence does not require stabilization time as in biological processes.
- 6) The technology is capable of handling variations in feed characteristics.

#### ECOFINE CST:

Typically the evaporation process condensate coming from the bio-methanated spent wash evaporation plant contains constituents like H<sub>2</sub>S and Ammonia apart from the BOD and COD.

A unique system has been developed wherein the condensate is treated and the H<sub>2</sub>S and Ammonia are stripped off to an extent wherein it can be used back in the fermentation process or for cooling tower makeup.

**This system is running at a couple of installations and the fresh water consumption has reduced to the extent of almost 4-7 lts/ltr of alcohol.**

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projects, starting from DPRs, loan syndication, environmental services, NoCs/approvals, pre-contract engineering and post-contract engineering and project management services. MITCON has been providing these services to several distilleries and ethanol plants in the past/present and looks forward to working with them in the future as well.

Another similar Business Meet was held at Belgaum on 30 September. For further details/the proceedings of both Meets, please email: Abhay Kulkarni at abhay.k@mitconindia.com or call/ fax at Tel.: +91-20-25533309/66289109 Fax +91-20-25533206

# Steam Turbines

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## Energy Efficient Milling Solutions by Ulka

Electrical power is a necessity for any nation for social, agricultural and industrial development, particularly in developing nations.

In such circumstances, the cane sugar industry could be one of the best resources to help produce power by way of 'cogeneration' and, in the process, make the sugar industry once again a profit-making industry, which will help in not only its survival, but also its development and expansion in India.

For any cogeneration plant, besides efficient power generation, it is important that the factory is also run efficiently/economically, in order to save power. Savings in power can deliver higher coincidental cogeneration and effect additional profits in the process.

### Technology Background

Globally, "three-roller mills" are in vogue. These will be referred to as "conventional mills" hereafter. These conventional mills are based on technologies and designs that date back to more than two centuries ago. Of course, with the availability of modern technology, different kinds of efficient drives are now available to drive the mills. It is a painful contradiction that the mill itself has not seen any significant developments in technology. The only developments which have been made in the past, is in the feeding arrangement of these mills, making the conventional mills more bulky and more power consuming equipment.

Cogeneration, however, has presented new opportunities coupled with new demands for the sugar industry. Some of these are:

- Economy in power consumption so that the saved power can be exported
- Reduction in bagasse moisture contributing to additional saving of bagasse, resulting in improved boiler efficiency and higher cogeneration

All these, obviously, lead to enhanced profitability.

There is, however, a dilemma. Any attempt to enhance efficiency of the mills or reduce bagasse moisture adds to additional power demand from the mills themselves, defeating the whole purpose of economy and increased profitability.

### The Solution

What then is the solution? It lies in re-designing the mill, which will fulfill the desired targets of reduction in power consumption and delivery of reduced bagasse moisture.

The scope of redesign is limited to the removal of the trash plate of the conventional mill and of the closed pressure chute of the pressure feeders, thus enabling the mill to offer substantial and smooth escape of juice (juice drainage).

Several such attempts of redesign have been made, where two-roller mills have been used with or without an under-feed roller and with the mounting of conventional pressure feeders with the closed pressure chute. In some of the designs, the hydraulic loading was also removed. Also, different configurations like horizontal placement of mill rollers with vertical feed of bagasse, etc., have been introduced. It is for the industry to study the actual working of such attempts; but it could be said, without prejudice, that these attempts have not been able to deliver proven satisfaction.

### The Ulka Solution – The CMR Mill



Ulka Industries, after a lot of research, was successful in developing and offering to the Industry, the **Ulka CMR Mill**. This mill is a unique combination of the company's two-roller mill (*patented*) and its three-roller pressure



feeder system (*patented*), and does not have the conventional trash plate and closed pressure chute – both of which consume the major share of mill drive power while hardly contributing to the desired goals of ideal milling.

Moreover, this incorporates many thoughtfully designed and incorporated features like a higher diameter bottom roller with deep Messchaert grooves, Lotus-type top roller even for the last mill, three-roller pressure feeder system without a closed pressure chute, bottom roller of the pressure feeder with a Lotus-type arrangement,

hydraulic loading of the top mill roller with a swing arm and, among others, a design which allows fluent juice drainage through five ports as against three ports, as offered by conventional six-roller mills, and deliverance of four compressions with only five Rollers, as against four compressions as delivered by the conventional six-roller mill. All these factors contribute to extraordinary efficiency and performance of the Ulka CMR mills. This is complemented by the fact that, at the same time, power consumption is reduced by about 1.0 kWh per TCH per mill as compared to the conventional six-roller mill.

Installations as Last Mill									
Cane Crushed in Lakh MT									
Sr.	Factory Name	Year of Installation	Crushing Season						Total
			2014-15	2013-14	2012-13	2011-12	2010-11	2009-10	
1	Godavari TEW Tandem	2007	8.84	7.83	6.35	9.63	7.85	11.96	52.46
2	Sakthi Sugars Erode	2006	4	4.59	11.43	15.45	15.12	10	60.59
3	Chamundeshwari	2006	8	5.47	7.91	7.12	8.91	5.08	42.49
4	Nandi	2007	9.5	8.45	7.7	8.78	9.27	7.3	51
5	Wahid Sugar	2008	4	3.26	3.76	2.66	2.72	2.33	18.73
6	DSM Rajpura	2009	6.5	7.4	7.57	7.73	5.6	5.03	39.83
7	DSM Mansurpur	2010	10.9	8.52	8.91	7.2	7.42	–	42.95
8	Dhampur Bijnor	2010	16.7	13.08	15.13	13.68	12.74	–	71.33
9	Vithalrao Shinde	2010	17.5	10.79	11.87	14.21	13.98	–	68.35
10	Karmayogi	2010	12.2	9.21	9.29	11.9	14.36	–	56.96
11	Vishwasrao Naik	2011	4.82	4.41	4.23	3.87	–	–	17.33
12	Khedut, Kosamba	2012	6.47	6.32	6.3	–	–	–	19.09
13	Gurudutt	2012	7.29	6.76	5.71	-	-	-	19.76
14	Sakthi Sugar Shivaganga	2012	2.3	3.52	4.38	–	–	–	10.2
15	E.I.D. Parry	2012	–	–	6.62	–	–	–	6.62
16	Godavari WIL Tandem	2014	12	–	–	–	–	–	12
17	Dharani Polur	2013	4.1	4.1	–	–	–	–	8.2
18	Venkateshwara Power	2014	8	–	–	–	–	–	8
19	Ganesh Khand	2009	6.89	6.87	6.29	6.03	7	5.92	39
20	Sahyadri	2011	13.4	12.42	12.86	11.79	–	–	50.47
21	Kisanveer S.S.K.	2012	8.6	8.18	7.12	–	–	–	23.9
22	Hiranyakeshi	2014	8.3	–	–	–	–	–	8.3
23	Vishwaraj Sugar	2014	8.35	–	–	–	–	–	8.35
24	Shivshakti Sugar	2014	5.82	–	–	–	–	–	5.82
25	Sanjivani Takali	2014	6.61	–	–	–	–	–	6.61
26	Shahabad Coop	2008	6.91	6.98	5.96	5.32	4.7	–	29.87
<b>GRAND TOTAL</b>		–	208	138.16	149.39	125.37	109.67	47.62	778.21





Last Mills	
Installations	26
Cane Crushed	778.821 lakh MT
Power Saved	778 lakh kWh
Bagasse Saved	933,600 lakh MT
Extra Power Produced	410,784,000 kWh OR 410,784 MWh

These elements and efficiency parameters make it highly attractive for not only a cogeneration unit, but for any factory, having cogeneration or not.

### Advantages & Benefits

The following are the advantages/benefits of installations of the Ulka CMR Mills as proved and experienced at actual field installations at various factories:

Installations as Milling Tandem							
	Factory Name	Year of Installation	Crushing Season				Total
			2014-15	2013-14	2012-13	2011-12	
1	Gangakhed	2008	9.65	5.34	7.31	8.2	30.5
2	Mukteshwar	2009	2.75	1.06	1.8	2.07	7.68
3	Shivshakti	2011	5.82	4.14	3.87	2.9	16.73
4	Shiraguppi	2011	5.56	4.55	3.87	0.09	14.07
TOTAL in lakh MT							68.98

1. Power saving of about 1 kWh/TCH per mill, as compared to conventional six-roller mills.
2. Enhanced efficiency – Primary extraction (PE) of 75-80% at zero/first mill position, as compared to a maximum of 72% by the conventional mill with GRPF.

Zero/First Mills	
Installations	13
Cane Crushed	207 lakh MT
Power Saved	207 lakh kWh
Extra Sugar Produced	124,200 quintals

3. Reduction in bagasse moisture to below 48%, in the last mill installations, which directly lead to:
  - a. Improvement in boiler efficiency with consequent improvement in steam parameters like steam temperature and pressure.
  - b. Increase in quantity of bagasse savings by about

Installations as Zero/First Mills									
Sr.	Factory Name	Year of Installation	Crushing Season						Total
			2014-15	2013-14	2012-13	2011-12	2010-11	2009-10	
1	Sanjivani	2006	6.61	6.59	5.84	6.09	6.32	5.93	37.38
2	Vasantdada	2011	3.5	4.6	4.76	5.3	-	-	18.16
3	Vishwasrao Naik	2011	4.82	4.41	4.23	3.87	-	-	17.33
4	Nira Bhima	2012	6.5	3.5	5.98	-	-	-	15.98
5	Majalgaon	2012	6	4.69	4.61	-	-	-	15.3
6	Vijayanagar	2012	7.4	6.15	5.37	-	-	-	18.92
7	Venkateshwara Power	2012	8.1	7.05	6.81	-	-	-	21.96
8	Y.M. Krishna	2013	11.7	11.27	-	-	-	-	22.97
9	Khedut	2014	6.47	-	-	-	-	-	6.47
10	Nandi	2014	10	-	-	-	-	-	10
11	Hiranyakeshi	2014	8.3	-	-	-	-	-	8.3
12	Vishwaraj	2014	8.35	-	-	-	-	-	8.35
13	Shivshakti Sugar	2014	5.82	-	-	-	-	-	5.82
TOTAL in lakh MT									206.94

- c. 1200 tons per lakh ton of cane crushed.
  - c. Since the percentage of sweet water going to the boilers is reduced, it would reflect in additional bagging of sugar and hence additional profit.
  - d. Increase in imbibition even upwards of 250%, and at higher temperatures, which would result in increased milling efficiency.
4. With the above achievements, enhanced RME by about 1% for the mill tandem.
  5. Re-absorption factor is successfully controlled.
  6. Installation of one size larger mill possible using the existing mill foundation.
  7. Existing mill drives can generally be used with

*contd on pg 23*



# Energy Management in Cogeneration Plants

Triveni Engineering and Industries Limited is one of the largest manufacturers of sugar and the market leader in its engineering business. The company has 7 sugar mills, 6 cogeneration plants and 1 distillery unit spread over 8 locations in Uttar Pradesh, and is progressively engaged with over 250,000 farmers.

In the cogeneration business, Triveni currently operates 103 MW grid-connected power capacity. The company's cogeneration plants utilize high-efficient 87 ata, 510°C steam cycles to maximize power and steam generation per unit bagasse. HP (high pressure) feed water heaters have been used for maximizing cycle efficiency. The company's plants have been engineered keeping in mind high levels of automation and minimum human intervention. Its cogeneration plants are registered under Clean Development Mechanism (CDM) projects with UNFCCC (United Nations Framework Convention for Climate Change) and also as Renewable Energy Certificate (REC) projects of CERC (Central Electricity Regulatory Commission).



Boiler: Capacity 120 TPH, 87 ata, 510°C

ENERGY EFFICIENCY PRACTICES

Cogeneration is defined as the sequential generation of two different forms of useful energy from a single primary energy source, typically mechanical energy and thermal energy. Mechanical energy may be used further to drive the alternator for producing electricity, or rotating equipment such as a compressor, fan or pump for delivering various services, and thermal energy can be used for direct process applications for heating purposes.

The main purpose of adopting energy management in every sector is to reduce the wastage of different energy resources and improve cost-effectiveness without

compromising the productivity and safety of plant and personnel. In the present scenario of financial crunch of sugar cogeneration industry, inefficiency and non-judicial use of energy resources further exacerbate the situation. Efficiency of all resources is crucial both in economic and environmental aspects. A successful energy management program within the organization needs the support of top management, an effective strategy, reliable monitoring systems, and technical ability of personnel.

The first step in the energy management program of any organization is the assessment of energy performance, which helps in identifying opportunities to improve energy performance and to gain financial benefits. It is a periodical process and the key aspects include **data collection, analysis and evaluation of the data, establishing baseline or benchmarking, and conducting performance assessment.**

## Energy Efficiency Opportunities

Some energy efficiency opportunities in cogeneration plants have been described below, technology/equipment-wise:

### In Boilers

**1- Stack Temperature:** Flue gas or boiler stack temperature is the temperature of the combustion gases as they leave the boiler. The temperature represents the major portion of the energy not converted into usable output. The higher the temperature, the less energy transferred to output and the lower the boiler efficiency. Hence, stack temperature should be low as possible. However it should not be so low that water vapor in the exhaust condenses and leads to cold end corrosion, which is a perennial problem in bagasse-based boilers.

### Case Study: Dry flue gas losses at different stack temperatures

#### Case 1: Flue gas temperature ( $T_f$ ) 135°C

Mass of dry flue gas (m)	7 kg/kg fuel
GCV of fuel	2260 kCal/kg
Ambient Temperature ( $T_a$ )	25°C
Specific heat of flue gases ( $C_p$ )	0.23 kCal/kg°C
Dry flue gas losses = $m \times C_p (T_f - T_a) / \text{GCV of fuel}$	



Dry flue gas loss at 135°C =  $7 \times 0.23(135-25)/2260 = 7.8\%$

**Case 2: Flue gas temperature (T<sub>r</sub>) 150°C**

Dry flue gas loss at 150°C =  $7 \times 0.23(150-25)/2260 = 8.9\%$

**2- Feed water temperature:** In cogeneration plants, boiler feed water comes from three different sources, namely returned condensate water from process, condensate of turbine condenser and makeup from the RO water, and these are collected into the boiler feed water tank. This boiler feed water further heats in the deaerator and HP heater for thermal deaeration and improvement of plant cycle efficiency. As per energy concerns, the exhaust steam condensate water from the process still has lots of sensible heat and should be utilized as much as possible to achieve maximum efficiency. Hence, sincere and disciplined efforts should be made to minimize the loss of returned condensate and keep this condensate free from contamination.

Therefore, boiler feed water temperature should be monitored regularly and maintained as per the design.

**Case study: Boiler fuel consumption at different feed water temperatures**

Steam generation per hour	120 TPH
Enthalpy of output steam	830 kCal/kg
Enthalpy of inlet water at 150°C	150 kCal/kg
Enthalpy of inlet water at 170°C	170 kCal/kg
Boiler efficiency	70%
GCV of bagasse	2260 kCal/kg
Fuel consumption at 150°C = $120(830-150)/0.70 \times 2260$	= 51.5 TPH
Fuel consumption at 170°C = $120(830-170)/0.70 \times 2260$	= 50 TPH

Effort should be made to optimum utilization of returned condensate from the process to minimize both the cold RO water makeup and steam consumption of the deaerator.

**Case study: Deaerator steam consumption at different % of returned condensate**

<b>Case 1: Returned condensate</b>	<b>70%</b>
Boiler steam flow (m)	120 TPH
Enthalpy of Initial water temperature (h <sub>1</sub> )	79 kCal/kg
Enthalpy of steam (h <sub>s</sub> )	648 kCal/kg

Enthalpy of final water (h<sub>2</sub>) 110 kCal/kg  
 Steam required for deaerator TPH =  $m \times (h_2 - h_1) / (h_s - h_2) = 120 \times 31 / 538 = 6.9$  TPH

**Case 2: Returned condensate 90%**

Boiler steam flow (m) 120 TPH  
 Enthalpy of Initial water temperature (h<sub>1</sub>) 93 kCal/kg  
 Enthalpy of steam (h<sub>s</sub>) 648 kCal/kg  
 Enthalpy of final water (h<sub>2</sub>) 110 kCal/kg  
 Steam required for deaerator TPH =  $m \times (h_2 - h_1) / (h_s - h_2) = 120 \times 17 / 538 = 3.8$  TPH

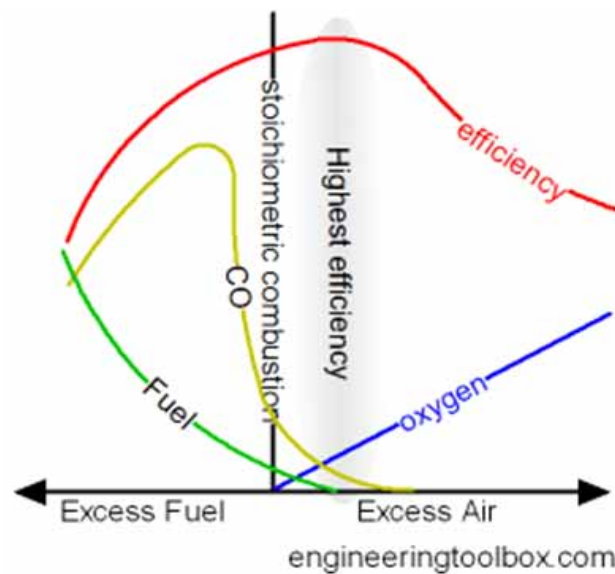
**Saving in terms of fuel =  $(6.9 - 3.8) / 2.4$  (boiler steam to fuel ratio) = 1.3 TPH**

**Saving in terms of Rs in 150 days operation =  $1.3 \times 24 \times 150 \times 1600$  (bagasse price) = Rs 74.88 lacs**

**3- Combustion air temperature:** In order to increase the thermal efficiency of the boiler by 1%, combustion air temperature must be raised by 20°C.

**4- % Oxygen in flue gas:** Oxygen present in the boiler flue gases helps to determine the combustion efficiency and the excess air supply.

**Excess Air (EA) =  $\%O_2 \times 100 / 21 - \%O_2$**



Shortage of air leads to incomplete combustion while high % of excess air increases the flue gas loss. As a thumb rule, for every 1% reduction in excess air there is approximately 0.6% rise in efficiency.

Monitoring of the oxygen at different locations in the flue gas path viz. before and after APH (Air Pre Heater), at the suction of the ID fan helps to check the ingress of



*Turbine: Extraction cum condensing;  
Capacity 22 MW, 87 ata*

unwanted atmospheric air in the system, which significantly increases the auxiliary consumption of the plant.

**Case study: Saving occurred after the air leakage arrested in the boiler flue gas path**

Total flue gas quantity at APH inlet	90 m <sup>3</sup> /sec
Delta P across the ID fan	220 mmwc
% Oxygen before APH	2%
% Oxygen at ID fan inlet	6%
Fan Efficiency	80%
Excess air factor before APH = $1 + (2/21 - 2) = 1.105$	
Excess air factor before ID fan = $1 + (6/21 - 6) = 1.4$	
Flue gas quantity at ID fan = $90 \times 1.4 / 1.1 = 114 \text{ m}^3/\text{sec}$	
Power Input (kW) = $114 \times 220 / 102 \times 0.80 = 307 \text{ kW}$	
Power Input after leakage arresting (kW) = $90 \times 220 / 102 \times 0.80 = 243 \text{ kW}$	

**Saving in Rs for 150 operating days = (307-243) × 24 × 150 × 4.5 (rate of power) = Rs 10.4 lacs**

**5- Boiler loading:** The maximum efficiency of the boiler occurs around two-thirds of the full load. If the load of the boiler further decreases, efficiency also starts to decrease. Boiler efficiency below 25% of the rated load decreases significantly. Hence, as far as possible, operation of the boiler below this level should be avoided.

**In Turbines**

**1- Steam temperature and pressure:**

As an estimate:

**In condensing-type turbines:** Increase in inlet steam pressure by 1 kg/sq cm improves the turbine efficiency

by 0.1% and an increase in inlet steam temperature by 10°C improves the efficiency by 0.12%.

**In back pressure-type turbines:** An inlet steam pressure by 1 kg/sq cm improves the turbine efficiency by about 0.15% and an increase in the inlet steam temperature by 10 degree C improves the turbine efficiency by 0.12%.

**2- Exhaust pressure/vacuum:**

Higher exhaust pressure/lower vacuum increases the steam consumption in turbines, keeping all other operating parameters constant. As an estimate, increase in the exhaust vacuum by 10 mmhg reduces the steam consumption in the turbine by about 1.1%. In case of back pressure turbines, reduction in exhaust pressure by 1 kg/sq cm reduces the steam consumption by about 0.8%. There are a number of reasons why the condenser vacuum may vary from the optimum value such as:

- Cooling water inlet temperature
- Cooling water flow rate
- Fouling or chocking in condenser tubes
- Air leaks into the condenser
- Performance of the ejector system
- Higher pressure drop in the exhaust pipeline from turbine exhaust to condenser

There are still many other opportunities for energy conservation in cogeneration plant such as in pumps, fans, compressed air systems, AC plants, cooling towers, etc., but these are not being discussed in this article in detail.

**Best Operating Practices Followed at Triveni**

- Continuous monitoring, recording and analysis of all operating parameters of the plant.
- Online monitoring of O<sub>2</sub> in flue gases to monitor the combustion efficiency and periodic verification of its reading with hand-held O<sub>2</sub> analyzer.
- Maintain the steam quality injected into steam turbine as per specifications.
- Maintain optimum level of vacuum in the condenser to achieve maximum efficiency.
- Run the boiler with automatic control loops to control steam, water and air.



- Continuous operation of HP heater to achieve the maximum cycle efficiency.
- Variable speed control used in fans and pumps.
- Auto control of boiler feed pump discharge pressure w.r.t boiler drum pressure.
- During off-season, regularly conduct learning programs to increase the awareness of staff.
- Online monitoring and recording of differential expansion, casing expansion, rotor expansion vibration, etc. of turbine.
- Online monitoring of vibration and temperature of all important running equipment.
- Carry out plant maintenance as per the OEM guidelines.
- Minimize maximum demand by controlling load through an automatic demand controller.

### Barriers to Good Energy Management Practices

There are many barriers to adopting good energy management practices in cogeneration industry as discussed below.

**Energy pricing:** Low energy pricing makes energy conservation not justifiable due to the higher payback period, and this leads to under-investment in energy efficiency.

**Lack of skilled personnel:** There might be a need to engage full-time energy professionals who will be dedicated to solving energy issues. This will lead to better performance in terms of energy management. A huge amount of operational data is generated on an ongoing basis, which needs to be stored properly for future reference, analysis and feedback. A proper knowledge management framework needs to be developed in the cogeneration plant for its smooth and efficient functioning. In order to build upon the shared expertise across various units, a pool/committee of technical experts from different areas (boiler, turbine, control & instrumentation, electrical) can provide in-house consultancy to technical problems at any location.

**Awareness:** Reaching the goal frequently depends upon the awareness and commitment. Many people in the organization are unaware of how their daily activities and action affect energy use. Increasing overall awareness is the effective tool to gain more support for energy management initiatives.

**Resistance to change:** There is a frequent misconception that energy efficiency improvements will disrupt production. To overcome this there is need for proper technical planning, discussions and awareness.

**Availability of capital:** The lack of capital and constraint of budget can lead to reluctance in terms of acquiring equipment to increase energy efficiency. Capital availability is the most important factor, which directly determines the feasibility of energy efficiency initiatives.

**Lack of energy audit:** If variables are known, then efficiency can be improved and recorded to monitor whether the targets are being met or not. Hence, monitoring, measurement and verification of energy consumption in the cogeneration plant is very important for better energy management. It has been observed that energy audits lead to significant inexpensive performance improvement by capture of low-hanging fruits (energy loss).

### Conclusion

A good energy management system and following industry best engineering practices both in operation and maintenance of the cogeneration industry is very beneficial as discussed above. It will not only improve the competitiveness as well as energy security, but several other benefits can also be derived. Several opportunities for energy conservation exist in the cogeneration industry and there is a need for exploring all of these opportunities to achieve better energy performance.

Bagasse is a clean and renewable fuel, hence adds no net carbon dioxide in the atmosphere. Therefore, bagasse-based cogeneration plants are regarded as environment-friendly, green fuel-based plants. Triveni is committed to managing its operation to ensure a safe, healthy and clean environment to its employees and also create an environment that contributes to communities. The idea of sustainable development is deeply ensconced in Triveni's business climate.

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## COP21: An Update

In 2015, France will be hosting and presiding the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21/CMP11), otherwise known as "Paris 2015" from November 30th to December 11th. COP21 will be a crucial conference, as it needs to achieve a new international agreement on the climate, applicable to all countries, with the aim of keeping global warming below 2°C. France will therefore be playing a leading international role to ensure points of view converge and to facilitate the search for consensus by the United Nations, as well as within the European Union, which has a major role in climate negotiations.

### COP - What's it all about?

The international political response to climate change began at the Rio Earth Summit in 1992, where the 'Rio Convention' included the adoption of the UN Framework Convention on Climate Change (UNFCCC). This convention set out a framework for action aimed at stabilizing

#### India Announces New Climate Change Targets

The government has pledged to reduce its greenhouse gas emissions intensity — the ratio between a country's gross emissions to its gross domestic product at a particular point — by 33-35 per cent by 2030, compared to 2005 levels. For this, India has to ensure about 40 per cent of its electricity comes from non-fossil fuel sources.

India will also increase its forest cover to create an additional carbon sink of 2.5-3 billion tons of carbon dioxide equivalent.

These targets (called the intended nationally determined contribution, or INDC) were presented to the United Nations Framework Convention on Climate Change for the global Paris summit on Thursday. Prakash Javadekar, Union environment and forests minister, released these to the media in Delhi recently.

The government has said till 2030, these emission intensity-reduction targets and adaptation to climate change will require about \$2.5 trillion, as well as an array of technologies.

It committed to mobilise new funds from developed countries and said it would work to build an international architecture for diffusion of cutting-edge technologies, as well as collaborative research and development in this regard.

#### First Two Official Pledges for COP21 in Paris

*Vienna, 10 March 2015*

Switzerland has committed to reduce greenhouse gas emissions by 50% by 2030. It is the first country that announced its intended nationally determined contribution (INDC). Switzerland, which is responsible for 0.1% of global greenhouse gas emissions and, based on the structure of its economy, has a low level of emissions (6.4 tons per capita per year), should be able to avail of emissions reduction measures abroad to reduce the cost of emissions reduction measures during the period 2020-2030.

Just a few days later, Latvia, as President of the European Union, submitted the EU's INDC for the agreement to be made in December. "By 2030, the EU aims to cut greenhouse gas emissions by at least 40%, boost renewable energy by at least 27%, and improve energy efficiency by at least 27%."

atmospheric concentrations of greenhouse gases (GHGs) to avoid "dangerous anthropogenic interference with the climate system." The UNFCCC, which entered into force on 21 March 1994, now has a near-universal membership of 195 parties.

The main objective of the annual Conference of Parties (COP) is to review the Convention's implementation. The first COP took place in Berlin in 1995 and significant meetings since then have included COP3 where the Kyoto Protocol was adopted, COP11 where the Montreal Action Plan was produced, COP15 in Copenhagen where an agreement to continue Kyoto Protocol was unfortunately not realized and COP17 in Durban where the Green Climate Fund was created.

In 2015, COP21, also known as the 2015, Paris Climate Conference, will, for the first time in over 20 years of UN negotiations, aim to achieve a legally binding and universal agreement on climate, with the aim of keeping global warming below 2°C.

France will play a leading international role in hosting this seminal conference, and COP21 will be one of the largest international conferences ever held in the country. The conference is expected to attract close to 50,000 participants including 25,000 official delegates from government, intergovernmental organizations, UN agencies, NGOs and civil society.

#### What was the outcome of COP20 in Lima?

In 2014, COP20 held in Lima attracted over 15,000 official delegates, and negotiators concluded talks with the 'Lima Call For Climate Action', a draft document that lays the foundations for a new global climate deal.



**The Sustainable Innovation Forum (SIF15)** is the largest business focused event held during the annual Conference of Parties (COP), taking place this year on 7-8 December at COP21 in Paris.

Building on year-round work from Climate Action and the UN Environment Programme, the 2-day Forum will convene cross-sector participants from business, Government, finance, UN, NGO and civil society to create an unparalleled opportunity to bolster business innovation and bring scale to the emerging green economy.

Alongside COP20, there were more than 400 conferences in which new research projects and initiatives were presented. The Sustainable Innovation Forum 2014 was the largest commercially-focused event during COP20, attracting high profile speakers, celebrities and over 500 pre-approved delegates representing private sector, government, NGO, UN agencies and civil society. During the two weeks of COP20, over 140 press conferences were held and more than 900 journalists from around the world covered the

international event.

**SIF15 Highlights:**

- 750+ attendees - the largest number of global stakeholders at any commercially-inclusive side event at COP21
- International attendance – meet decision makers from across the globe with delegates spanning 43 countries at SIF14
- Over 80 world class speakers including country Ministers, industry CEOs and international thought leaders
- Interactive discussion panels throughout the event, allowing for in-depth debate via audience Q&A and polls
- Workshops and co-located events to maximize content and networking opportunities throughout the two days

Sources:  
<http://www.cop21paris.org/>  
<http://www.cop21.gouv.fr/en/cop21-cmp11/what-cop21-cmp11>

*contd from pg 17 (Energy Efficient Milling...)*

Mill Tandems	
Installations	4
Cane Crushed	69 lakh MT
Power Saved	69 lakh kWh
Extra Sugar Produced	41,400 quintals
Extra Bagasse Saved	82,800 MT
Extra Power Produced	36,432,000 kWh or 36,432 MWh

modifications to suit new CMR mill installation, as the power requirement of the Ulka mill is lower as compared to the conventional six-roller mill.

8. Modernization/efficiency improvement/capacity expansion, possible to be executed in stages, each stage adding to the profitability and desired goals.

Many cogeneration factories have installed the Ulka CMR mill as the last mill in replacement of the existing conventional mill and have derived outstanding benefits from such installations, adding to the profitability of the factory. Most of these factories have been able to recover the cost of the new mill within 1-2 seasons only.

It is estimated that the installation/replacement in the Zero or First Mill position enables the factory to avail additional profitability of about Rs 18 lakhs per lakh ton of cane crushed. If installed/replaced as the Last Mill in the existing tandem, these benefits rise to a

phenomenal figure of about Rs 50 lakhs per ton of cane crushed.

**Impact on National Cogeneration**

The detailed analysis below, of about 50 installations of the Ulka CMR Mill, show that this mill has been immensely beneficial not only to the industry, but to the nation, in terms of the huge additional amounts of power that have been generated as a direct consequence of the substantial reduction in bagasse moisture.

As of date, almost 100 Ulka CMR mills have been installed all over India, ranging from a size of 30" x 60" to 50" x 100", which is the **largest mill ever installed in India**. While these also consist of five complete mill tandems, most of the installations are as Last Mills, since the profitability of the unit is highly enhanced by the reduction in bagasse moisture.

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## NEDFi: Financing Development in the North-Eastern States of India

North Eastern Development Finance Corporation Ltd. (NEDFi), an ISO 9001-2008 certified company, is a Public Financial Institution with a mandate to identify, finance and nurture commercially-viable industrial, infrastructure projects and accelerate the pace of industrial development in the North-Eastern region of the country comprising Assam, Arunachal, Meghalaya, Mizoram, Nagaland, Manipur, Tripura and Sikkim.

NEDFi was incorporated in 1995 and is promoted by all-India Financial Institutions and Banks viz. IDBI, SIDBI, ICICI, IFCI, SBI, LIC, UTI, GIC and its subsidiaries.

### Financing

The Registered Office of NEDFi is situated at Guwahati with 15 (fifteen) branches and 5 (five) representative offices spread over the North-Eastern States including Sikkim. Since its inception more than a decade and a half ago, NEDFi has made significant contribution to the economic development of North-Eastern states by financing and supporting a large number of business ventures in various sectors like Steel, Cement, Ferro-Alloy, Power, Tourism, Tea Processing, Food Processing, etc. The various financial products of the Corporation are as under:

- Project Finance Scheme
- Equipment Finance Scheme
- Working Capital Term Loan Scheme
- NEDFi Opportunity Scheme for Small Enterprises
- North East Entrepreneurs Development Scheme (NEEDS)
- Women Enterprises Development Scheme (WEDS)
- Jute Enterprises Development Scheme (JEDS)
- Scheme for North East Handloom & Handicrafts (SNEHH)
- Initiative for Development of Entrepreneurs in Agriculture (IDEA)
- Micro Finance Scheme

Besides extending credit to large ticket-size projects, NEDFi also has schemes that cater to credit needs of micro enterprises in the hinterland of North-East India through its Microfinance Scheme and specific schemes targeting the grassroots level and first-generation entrepreneurs at low interest rates.

Besides funding support from **Ministry of Development of North Eastern Region (DoNER)**, Government of India, NEDFi has also tied up with National Backward Classes Finance and Development Corporation, National Scheduled Castes Finance and Development Corporation, National Scheduled Tribes Finance and Development Corporation, etc. for accessing low-cost

fund for the benefit of small-scale units and Micro Finance sectors.

### Support Services

Besides financing business ventures, NEDFi recognizes the need to augment and discover newer opportunities that can be utilized for the region's economic growth for which NEDFi has put in place a number of support services for facilitating investment and growth of businesses in North-East India:

- Techno Economic Development Studies – Techno-economic feasibility studies for conducting sector studies and for identifying and mapping the resources available in the North-East region of India for setting up industrial and infrastructure projects suitable to the region. NEDFi has completed 65 studies so far.
- R&D Centre for Medicinal & Aromatic Plants – For training and commercialization of Medicinal and Aromatic plants
- NEDFi Databank Quarterly – A regional resource database
- NE Databank Website

### Corporate Social Responsibility

The CSR initiatives of NEDFi focus on women empowerment, livelihood enhancement projects, employment-enhancing vocational skill development, and development of traditional crafts sector and of rural/backward areas through promotion of entrepreneurship. NEDFi had joint initiatives on CSR projects with all-India Institutions like IDBI and SIDBI.

### Business Facilitation Centres (BFC)

As part of its CSR initiatives, NEDFi has established Business Facilitation Centres (BFCs) in all the eight states manned by an experienced Mentor to provide handholding support to first-generation local entrepreneurs that include preparation of DPRs, help the



NEDFi had financed one 4 MW Biomass Power Plant (for supply of power to a cement plant) in Badarpur, Silchar, Assam, which is in operation now.





budding entrepreneurs to get credit linkage, and guide in establishing successful business enterprises.

The Corporation has been nurturing entrepreneurship in the region by conducting various Business/Entrepreneurs Meets, Workshops, exposure visit to Industries within and outside the region and Entrepreneurship Development Programmes (EDPs). NEDFi also conducts capacity building programs for Microfinance Institutions/NGOs and organizes awareness camps for the beneficiaries. NEDFi conducts skill development training programs in various disciplines through established institutes/experienced trainers. All these programs are part of the CSR initiatives of the Corporation.

### Consultancy & Advisory Services

NEDFi provides fee-based services like Third Party

Monitoring (TPM) of Centrally Sponsored Schemes.

NEDFi is also the nodal agency for the disbursement of central subsidy under NEIIPP 2007. There are four types of subsidy being disbursed, viz;

- Central Capital Investment Subsidy
- Central Comprehensive Insurance Scheme
- Central Transport Subsidy
- Central Interest Subsidy

#### For further details, please contact:

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## Promotion of Bagasse-based Cogeneration in Uttar Pradesh & Uttarakhand

Uttar Pradesh is the foremost state in production of sugar and sugarcane in the country. The state tops the list of sugarcane-producing states, whereas, it ranks second in sugar production. The sugarcane is produced in 44 districts of the state and of these, 28 districts are the major sugarcane-producing districts. Today, there are 125 operational sugar mills running in the state\*.

Out of 553 operating and 161 upcoming sugar factories in India, as of December 31, 2014, 276 cogeneration power projects have been commissioned with 5,424 MW installed capacity. Of this, the total installed

capacity in Uttar Pradesh is 1,370 MW and 78 MW in Uttarakhand. But there is substantial potential still to be tapped in these two states.

With the above background for disseminating information and sharing experiences to promote these projects on a fast-track mode, Cogen India is pleased to announce 'One-day Business Meets for Promotion of Bagasse Based Cogeneration Power Plants in the States of Uttar Pradesh & Uttarakhand' on October 8, 2015 at Lucknow and on October 10 at Dehradun.

#### For further details, please contact:

cogenindia@gmail.com

\*Data from UP Sugarcane Development Department

### List of Sugar Mills in Uttarakhand with Cogeneration Power Plants

1	Rai Bahadur Narain Singh Sugar Mills Ltd., Laksar-247663, Dist Haridwar, Uttarakhand	Bagasse Cogeneration	35 MW
2	Uttam Sugar Mills Ltd., Libberheri, Roorkee, Haridwar, Uttarakhand	Bagasse Cogeneration	23 MW
3	Laxmi Sugar Mills, Iqbalpur, Haridwar	Bagasse Cogeneration	20 MW

### List of Non-Bagasse Cogeneration Power Plants in Uttarakhand

(Rice Husk-based)

1	Sidharth Papers Ltd. (Unit-2), 7 <sup>th</sup> km., Moradabad Road, Kashipur-244713	Biomass Cogeneration	6.0 MW
2	Siddheshwari Paper Udyog Ltd., 7 <sup>th</sup> km., Moradabad Road, Kashipur-244713	Biomass Cogeneration	6.0 MW
3	Kesoram Industries Ltd., Laksar, Haridwar	Biomass Cogeneration	7.5 MW
4	Bahl Paper Mill, Kasipur, US Nagar	Biomass-based	4 MW
5	Gujarat Ambuja Exports Ltd., Sitarganj, US Nagar	Biomass Cogeneration	5 MW

Source: Uttarakhand Renewable Energy Development Agency



## FORTHCOMING EVENTS

### MNRE-Supported Operator Training Programs (OTP) for Cogeneration Power Plants at Sugar Factories in Maharashtra/Uttarakhand, Dec 2015 - Mar 2016

A critical review of the performance of the commissioned cogeneration projects in India has identified the need for improving the operator skills within these sugar factories. This is only possible through proper on-the-job training at similar plants. The trained operators from sugar factories can then take on the operation and maintenance (O&M) for the entire plant life. It is further identified that the skills for O&M of high-efficiency cogeneration power plants need to be upgraded.

Based on the success of the OTP in 2014-15 in Maharashtra, conducted at 6 select cogeneration plants (host sugar factories) and where a total of 72 operators from 13 cogeneration plants participated, Cogeneration Association of India (Cogen India) is holding the next 2 OTPs in Maharashtra and Uttarakhand as follows:

#### OTP Maharashtra

Dec 01, 2015 to Jan 10, 2016

Venue: Six host sugar mills from Solapur District

#### OTP Uttarakhand

Feb 01, 2016 - Mar 10, 2016

Venue: Three host sugar mills from Uttarakhand

**Interested sugar mills can send boiler/turbine/substation/water treatment plant/DCS operators for training.**

These OTPs will be organized by Cogen India, in association with MITCON Consultancy & Engineering Services Ltd., Pune, with support from Ministry of New and Renewable Energy (MNRE), New Delhi.

These 6-week intensive on-the-job training programs are designed to inculcate required skills to participating operators, so that they can be effective at their respective work places. On-the-job training at specific locations, lectures from experts, weekly VIVAs/tests, strong monitoring, etc. are the salient features of the program design. Certificates will be issued to successful candidates on completion of the training.

**The selection of operators for training is strictly on a first-come-first-served basis, as the numbers are limited.**

For those interested in this unique opportunity (in terms of co-sponsorship or training), please contact Cogen India at 09811743217 – New Delhi or email: [cogenindia@gmail.com](mailto:cogenindia@gmail.com)

## International Bioenergy Exhibition and Asian Bioenergy Conference 2015

21-23 October 2015

Shanghai, China

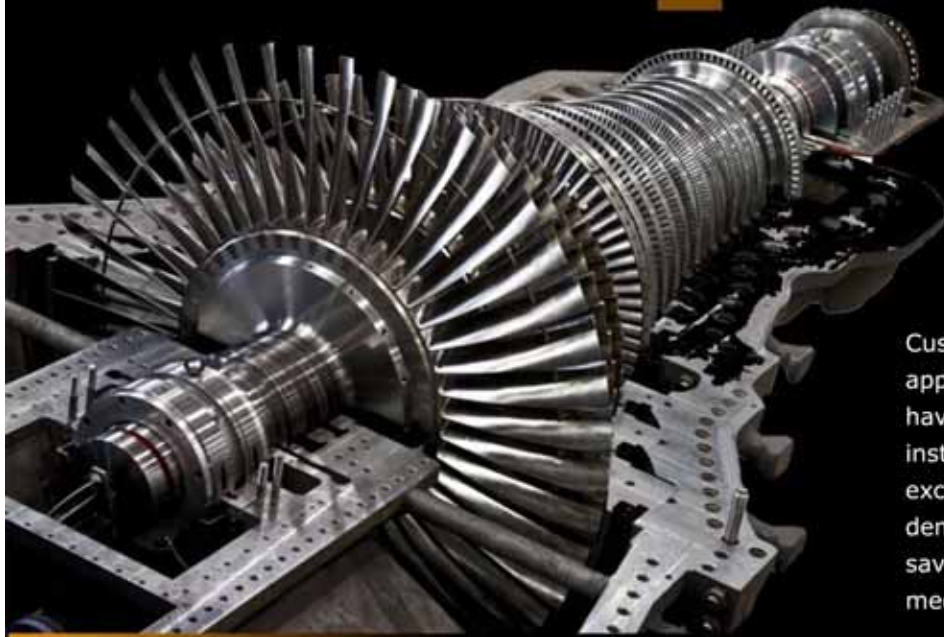
[www.ibsce.com](http://www.ibsce.com)

The International Bioenergy (Shanghai) Exhibition and Asian Bioenergy Conference 2015 is the new leading conference and exhibition in Asia, an invaluable and influential international platform to discuss the role of bioenergy in the Asian context.

The Conference Technical Program will be coordinated by the European Commission - JRC.



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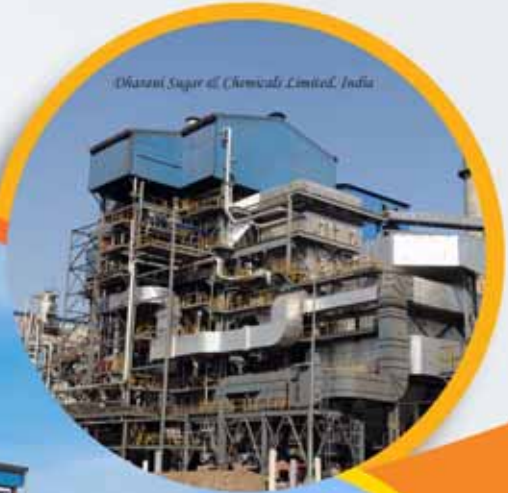
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