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Energy Security Integrated to Sustainability In Seshasayee Paper

Abstract

Increased and efficient use of Black liquor solids (the certified biomass-derived from wood and bagasse) in High pressure Recovery Cogeneration plant has resulted in quantum jump in Green Energy generation for process use and reduced carbon footprint, contributing to increased self-sustainance. With advanced state of the art and innovative scheme implementation, such as minimizing MP steam extraction in favour of LP steam exhaust in the 16 MW steam turbo-generator reducing specific steam consumption for power generation, achieving increased steam temperature at inlet to turbine, avoidance of steam through high pressure PRDS, in-house power generation had gone up significantly in Seshasayee Paper mill-Erode over the years. Successful implementation of Low carbon smart schemes viz., Increased Boiler Combustion efficiency and Station power consumption reduction through High energy efficiency Boiler feed pump integrated with matching low pressure drop feed control valve do contribute to Energy conservation.

The above schemes are reflected in the successful accomplishment of diverse facets viz., Renewable Energy Security Factor (100); specific coal consumption reduction (1.1te/te); reduced SEC (44 GJ/te),lowered GHG emission (2.3 tCO2/te); renewable green power generation increase(20 to 25%)-all based on finished product. All of the above as stated related to Energy Security for SPB unit are detailed in the paper. Besides, Waste to energy conversion initiatives already implemented and being planned should contribute further to enhanced Energy security through less dependence on fossil fuel resources. Spin-off is one of Non energy benefits viz., cleaner environment and water conservation.

Introduction

Power and fuel block is one of the major components in the manufacture of pulp and paper. Whereas Power for process requirement is derived from grid power import as also in-house power generation, steam for process has to be totally generated in house. For conserving natural resources and for mitigating Carbon emission reduction , moving towards low Carbon economy is the order of the day as can be seen from Life cycle diagram for paper (Fig.1).

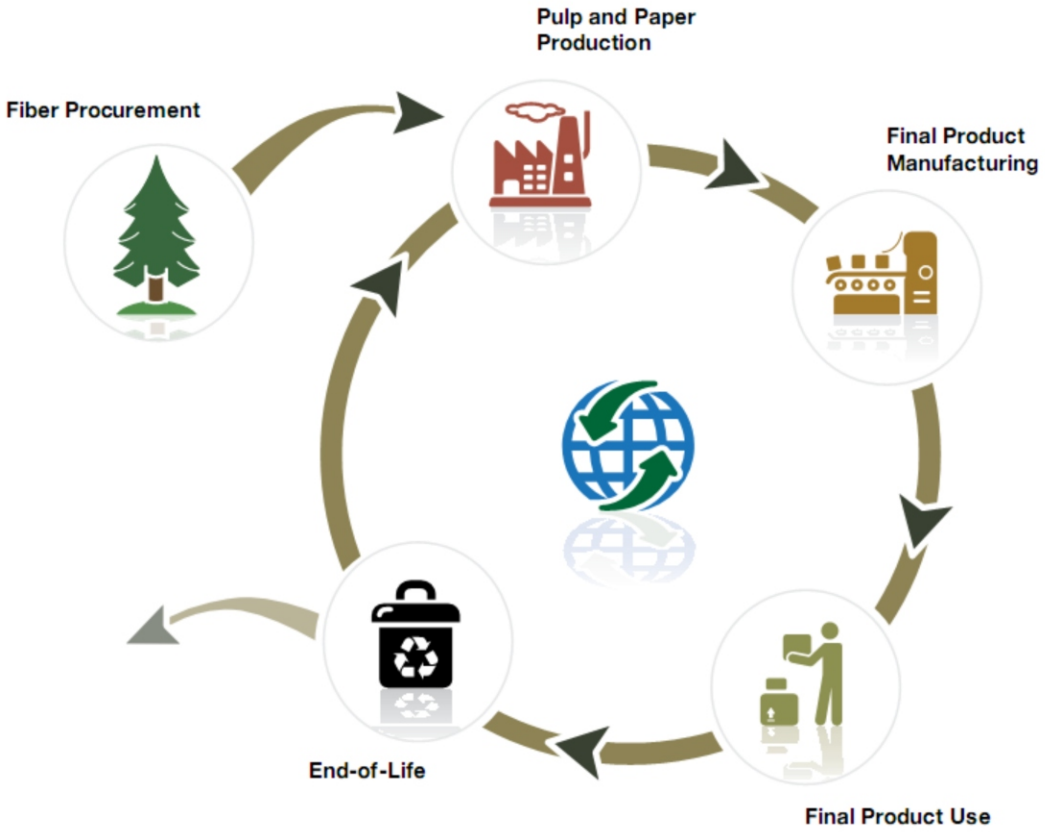


Fig.1. Life cycle for paper from cradle to EoL is illustrated

In Seshasayee Paper Erode unit, utmost importance is being given to Energy Security and Environmental Footprint related to continued Emission reduction, thereby strengthening Sustainability (Fig.2).

Raw materials Security integrated to Energy Security

For Seshasayee Paper and Board Ltd, Erode unit, the raw materials for pulp manufacturing are wood

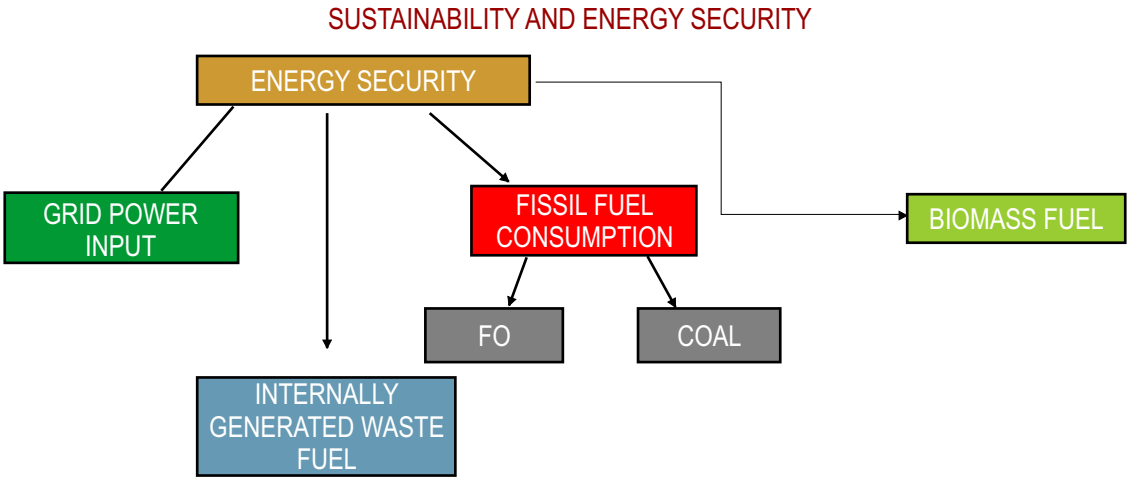


Fig.2 Energy Security and Sustainability

and bagasse; Eucalyptus and Casuarina are obtained from tree farming and certified forests wheras bagasse is derived from milling of sugarcane primarily from the adjoining Ponni Sugar mill and occasionally from other sugar mills near-by (Fig. 3). Since cane is with high fibre content, the depithing of bagasse and subsequent cooking would result in higher fibre yield for quality pulp production. The excess pulp after meeting mill's paper requirements is exported to Tirunelveli unit, thus reducing dependence of imported pulp. Alongside, waste liquor filtrate is being gainfully converted to Green energy through evaporator-cogen unit. Thus wood and bagasse are estimated to be more than double resource efficient as the use of residual wastes strengthen energy chain.

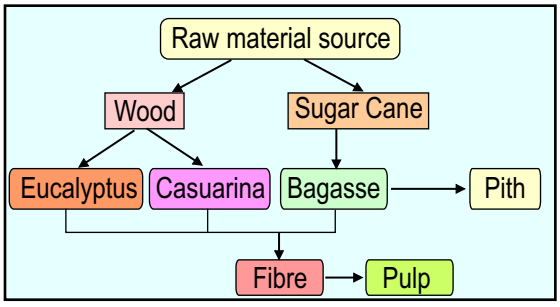


Fig.3 Source of raw materials for paper and pulp industry

CPP Maximization of Fossil fuel Utilization

Innovative Power Reduction scheme Boiler Feed Pump Station

Both in Process as well as in Utilities (with HP Cogen included), Pumps do consume major chunk of electrical power. Topping the list are - Boiler Feed water pumps (of high pressure boilers) followed by cooling water pumps related to Cooling towers, Vacuum pumps, Fan pumps etc. Opportunity exists in reducing the power consumption in all these sectors through implementation of select energy conservation schemes. In High Pressure Cogeneration plants, Boiler Feed Pump consumes maximum of auxiliary power consumption (40 % to 45%). Any scheme which effects reduction in BFP power consumption relates to higher net power availability for the process; thereby calling for that equivalent reduction in external fossil energy in-take. In hp power generation centre in SPB, both the bfp consume significant electrical power because of higher head requirement. In the first phase, replacement of existing large inefficient bfp with energy efficiency unit (Fig.4.) had yielded significant power reduction . Energy Efficient BFP Increase of 20 to 25 % (55-60 % to 70-74%) in efficiency .

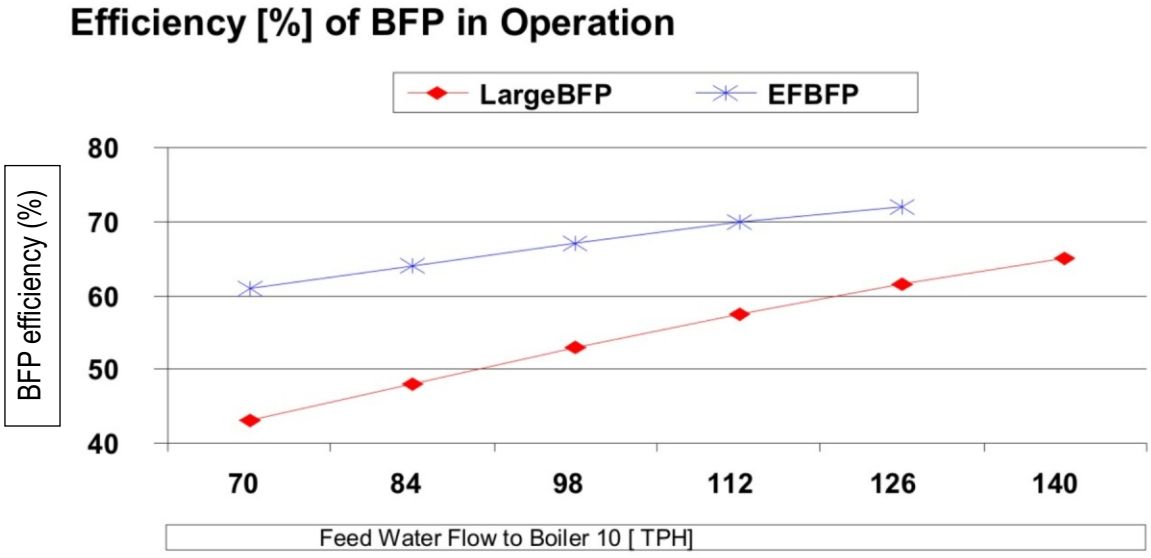


Fig.4. BFP efficiency Comparison of BFPs in Boiler 10

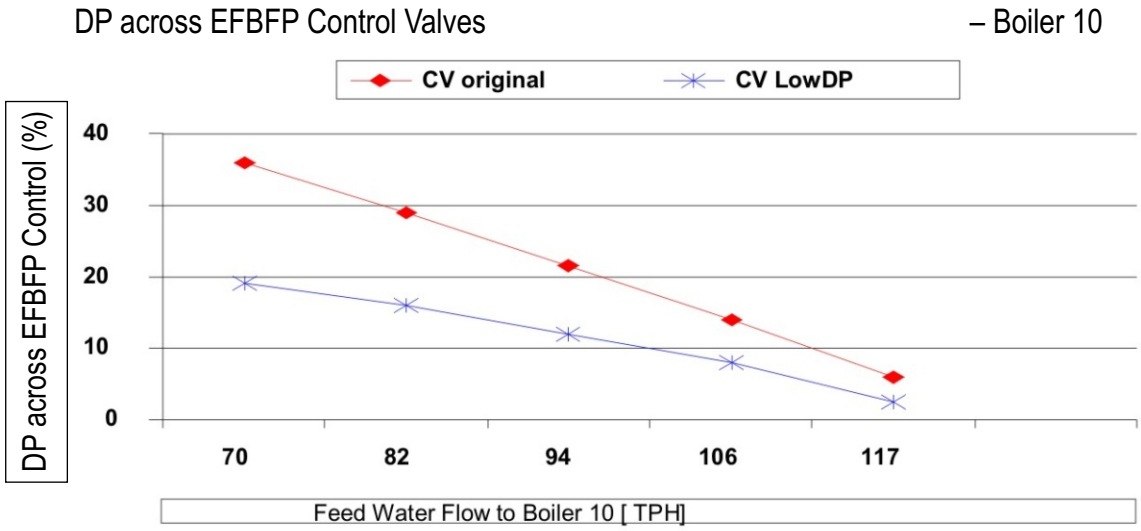


Fig.5. Pressure loss across BFP Control Valves

To crown it all, SPB had now gone in for innovative low DP control valve concept to the existing BFP . the original high DP Control valve is being replaced with newly designed low DP control valve (Fig.5) , thus enabling the smaller energy efficient BFP to run even at higher boiler loads and at lower frequency with the same high efficiency (>70%). Selection of lower ramp pump discharge pressure characteristics and limiting to design flow and not beyond, had resulted in narrowing down pressure upstream and downstream of control valve.

To summarize, in Boiler 10, through implementation of the following schemes , substantial reduction in power consumption, around 10,000 units/day on a sustained basis is being effected.

Select areas wherein significant energy reduction had been achieved on a continuous and sustained scale are elicited in Table-1 :

Beneficial Impact of Frequency Reduction

In SPB, as a part of Power consumption reduction in the mill as a whole, Frequency had been gradually reduced from 50 to 49.5 Hz to start with and finally fixed at 49.2 Hz. This had roughly resulted in mill wise power consumption reduction (from 26 to 25.2 MW) of ~0.8 -1 MW (Fig.6).

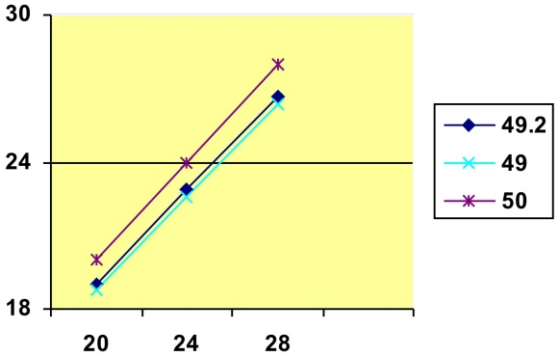


Fig.6. Frequency Impact on Power Consumption

Table -1 Innovative Energy Conservation schemes in CPP & CR Cogen

Sl No.	Section	Device	Motor kW	Energy Conservation Scheme	Saving, Units/day
A	CPP	BFP	950	Energy Efficient Pump	5000
B	Recovery Cogen	BFP	675	Energy Efficient Pump	3000
C	21 MW STG	CW Pumps	2@180	Vacuum/DF improvement	1000
D	CPP	CV-BFP	–	Low DP Control Value	1200

Towards achieving self sufficiency, plans are under way to effect further reduction in frequency to 49 Hz , which would result in power gain of 0.2 -0.3 MW on a continued sustained basis.

Optimization of Operation of Coal fired Cogen Battery

For deriving maximum mileage from the high cycle efficiency of CPP , it had been decided to run the 3 MW STG sparingly and limit steam generation to the extent practicable in the low pressure coal fired boilers. The shortfall in power requirement had been made up by grid power import. The above scheme coupled with the high efficient operation of CPP unit, avoidance of HP steam through PRDS (105 bar) and implementation of innovative energy Management schemes had resulted in significant specific coal consumption reduction in particular (Fig.7).

Advocation of Indirect Steam over Direct Steam in Paper Sector

Indirect Steam

Indirect steam used in the process(Evaporator first body), as well as in utilities (Recovery boiler APH ,PM dryers etc.) is being recovered as hot condensate for reuse as feed water for boilers.

Direct Steam

Direct steam is used in process as also in Deaerator. Steam used in the deaerator would be a part of feed water for high pressure boilers in SPB .Though Direct steam is more efficient in heat transfer and does not need an intermediary heat exchanger as is the case with indirect steam, it is not a preferred option in some cases as can be seen from the following issues

Steam used directly in process is lost as impure condensate and is irrecoverable. This calls for fresh additional DM water production. Moreover, steam used in SPB mill is invariably of high quality being derived from high quality DM water.

Also steam condenses with product fluid thereby diluting the latter. In most cases in pulp and recovery section, this resultant fluid is further heated -using additional fuel/heat input- and vaporized to gaseous state. After imparting the sensible heat, the vapour is discharged to the environment.

To start with, following areas have been identified for switch to Indirect steam heating-of which, few schemes had already been implemented and others are planned to be taken up :

- Black liquor indirect heating (partly implemented)
- Steam for generating hot water in Recausticizing

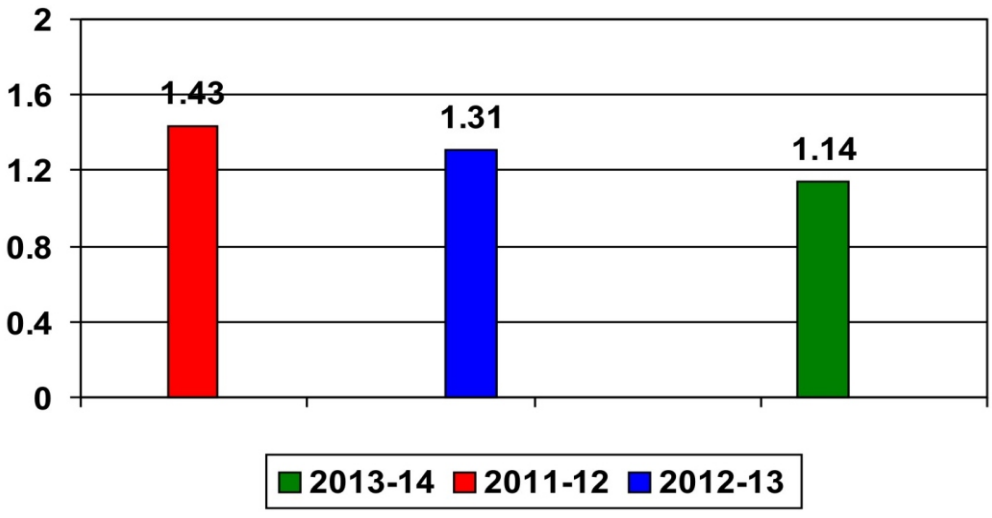


Fig. 7 Specific Coal Consumption Reduction [MT/te]

section (partly implemented)

- Steam heating for hot water generation in RDH section (planned)

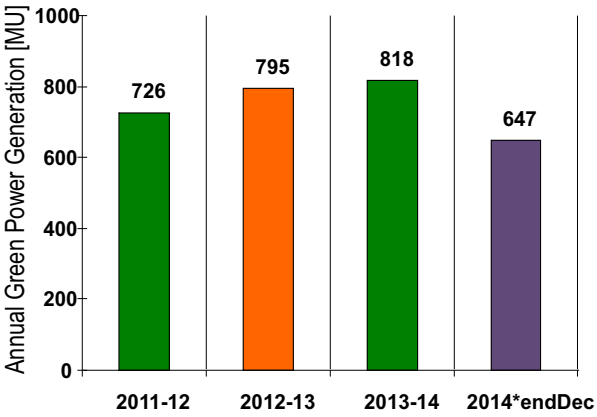
But for steam usage in deaerators, in all other areas, indirect steam heating is being advocated ,

Industrial Wastes Conversion to Green Energy

A. BLS as Biomass fuel

There are many sources that can be used as biomass fuel. One such source of biomass is by-products of pulp/paper processing that yields process residues, black liquor, chipper/ saw dust, bark and bagasse. Black liquor is typically an energy rich biomass waste generated in paper and pulp industry owing to wood /bagasse pulping process.The biomass waste generated during pulping process whether from wood or from bagasse also contributes to liquid renewable biomass fuel. In the process of utilizing black liquor solids after concentrating the weak liquor in multi-effect evaporator to highly concentrated liquor , which in turn is used as fuel for firing in the boiler, the dissolved woody biomass , lignin is burned for energy and the spent pulping chemicals are recovered and recycled.

Black liquor cogeneration [CHP] plants contribute to reduction of GHG emission on a significant scale and is one of the promising substitute energy source minimizing the usage of fossil fuel. Taking advantage of BLS as carbon neutral renewable fuel available in-house, the firing concentration as also the quantity had been stepped up as to achieve enhanced Green energy generation through high pressure chemical recovery cogeneration unit. This apart, implementation of innovative energy management schemes (including MP to LP steam switch in 16 MW STG and advanced main steam pipe insulation) had ensured further increase in Green power generation for process use (Fig.8) .



*: Projected : 875 MU [2014 – 15]

Fig.8. Renewable Power Generation from Chemical Recovery Cogen

Combined with the operational energy gains, already accrued from the successful implementation of energy conservation schemes in high pressure cogeneration battery, and limited use of fossil fuel in low pressure boilers, specific energy consumption had been substantially lowered over the last 3 years, as can be seen from Fig.9.

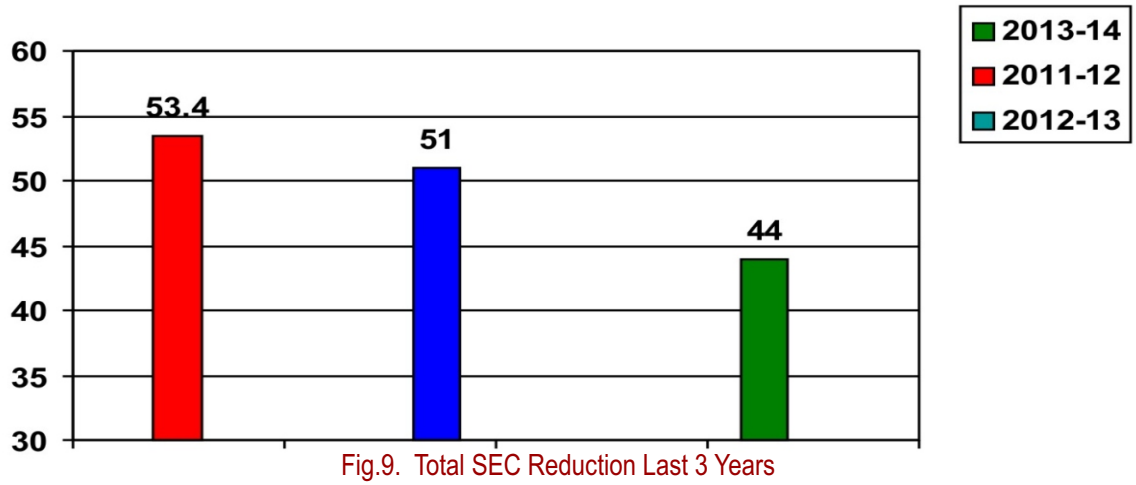


Fig.9. Total SEC Reduction Last 3 Years

Thus it can be seen that with the increased green power generation coupled with lowered SEC, the Renewable Energy Security factor [Self-sufficiency Index /SEC] had been strengthened further over the last 2 to 3 years (Fig.10).

B. Industrial Waste Management

Waste management is one of the main facets of GreenCo movement in SPB. In SPB, all 3 forms of wastes (solid,liquid & gaseous) had been converted for useful energy generation and had been contributing in no small measure to Energy Security as can be seen from the various schemes (Table - 2):

Carbon Emission Control Integrated to Energy

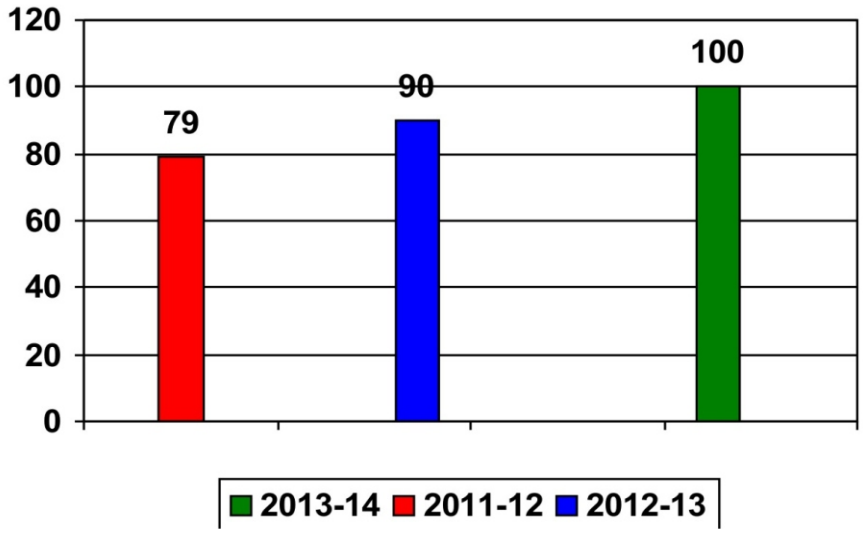


Fig.10 Renewable Energy Security Factor [SSI/SEC][%/GJ/te]

Table - 2 : Waste Energy Management Schemes

Sl No.	Waste Conversion Form	Scheme in – place
1	Solid	Unburnt carbon in flyash reduction through Process optimization in Power Boiler – Higher combustion efficiency
2	Liquid	CPU + HRU - Integrated Water & Energy Management – Power Boilers – Water Conservation & Deaerator Steam reduction
3	Gaseous	Advanced Reinsulation of Main steam pipeline radiation heat loss reduction in Chemical Recovery Boiler – Higher steam temperature to 16 MW STG
4	Gaseous	Advanced Nansulate coating of Paper machine Dryer ends related to Energy conservation – Trace steam saving

Security

Chemical Recovery cogeneration relates to Bio-CO_2 emission as it is related to closed carbon cycle and hence does not contribute to GHG emission. With increased green energy (power and steam) generation on a continued and sustained basis over the years and more so with advanced energy management schemes in place (refer Table -1), specific GHG emission had been on decreasing trend as can be seen from Fig. 11.

Non-Energy Benefits [NEB]

There is a new dimension of late to energy security viz., NEB which are being now considered as adding additional values to energy conservation. Some of the NEBS which are not totally non-exclusive are as under:

- Cleaner Environment - particulate emission through boiler stack is maintained less than that called for by Ministry of Environment. Ex, Stack particulate emission : < 50 mg/Nm3
- Lower N2O [GHG] in flue gas leaving Boiler Stack.
- ECF bleaching Switching over to Enviro-friendly ClO_2 from Cl_2 system.
- Nansulate coating of inaccessible areas for temperature sensitive scanner functioning in Paper Machine (PM5) .
- Water in-take consumption reduction aids in lowering of Water Footprint/specific water consumption as a part of GreenCo movement.

  # Excess water than required goes into total system
  # Chemicals are being additional adding to process effluent treatment as is being discharged as effluent.
  # Unnecessary additional water relates to unwanted energy requirement.
  # Water conservation through Process Condensate Polishing scheme implementation.
  # Lowered water loss through reduced evaporation in Cooling tower connected to 21 MW DEC STG

Conclusions and Way Forward

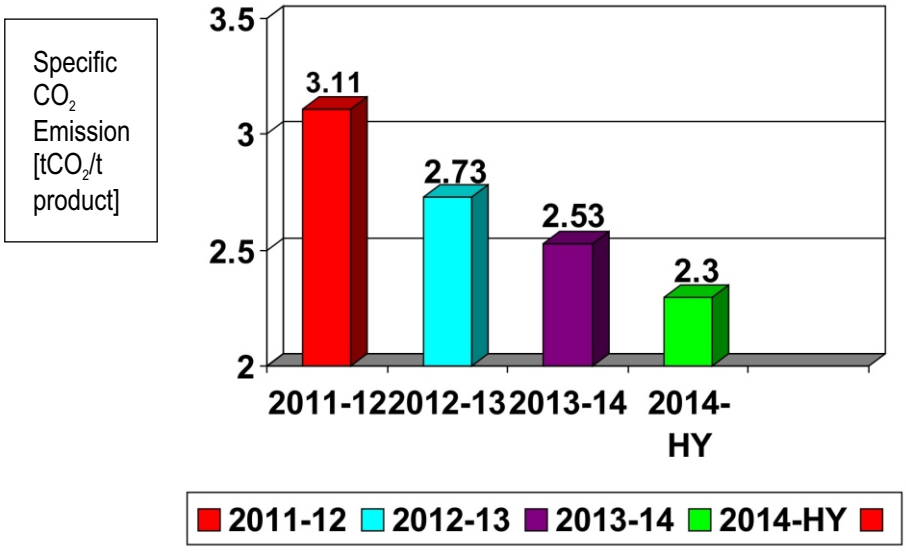


Fig.11. GHG Emission Reduction [G to G]

Reduction in Specific unit consumption be it Power, Fuel, steam , water or emission on a sustained basis in SPB had contributed to strengthening of Energy Security.

Maximizing fibre yield from Bagasse the byproduct from the adjoining Sugar mill had also contributed to Energy Security through increased green energy from waste lignin as fuel in Chemical Recovery Cogen .

Increased In-house Energy Generation based on black liquor (plant biomass waste) as fuel on a sustained and continuous basis had resulted in strengthening Energy Security through reduced dependence on external source (Grid power import, Fossil fuel).

Through steadily increasing quantity and concentration of BLS firing in high pressure recovery cogen unit, in house green energy generation for process use had gone up . This had been further enhanced through innovative energy conservation schemes implementation.

H.P. Cogen battery optimization, minimizing usage of low pressure boilers and associated inefficient 3 MW STG contributed to substantial fossil fuel (external source) in-take.

Reduction in Auxiliary Power consumption through implementation of innovative schemes viz., high energy BF pumps integrated with low DP Control Valves, lower frequency operation etc. enhanced energy security.

All three forms of wastes have been converted to Energy through innovative schemes, thereby adding to Energy Security .Water footprint reduction through CPU, indirect steam heating and other selective schemes implementation.

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