

# Sustainability through dendro powered electricity generation environmental scienc...

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## **Long-run GHG and local pollutants decrease**

The undertaking will ensue in coevals of power of 14, 000 MWh at an one-year 80 % works capacity use factor utilizing sustainably produced fuelwood. This will displace an tantamount volume of electricity that would otherwise be generated by dodo fuel based thermic power workss and fed into the Sri Lanka national grid. Harmonizing to the long- term coevals program of the CEB, electricity demand is turning at an mean one-year rate of 7 - 8 % . Due to societal, economic and environmental impacts associated with the development, farther development of large-scale hydro resources is going progressively hard. The CEB forecasts thermic power coevals capacity to increase its 2005 degree of 1266 MW to a mark degree of 4, 230 MW in 2019. The bing thermic workss include gas turbines fuel oil fired reciprocating engines, and combined rhythm workss. The enlargement works prognosis includes gas turbines, combined rhythm workss, Diesel workss, furnace oil workss, and coal workss.

Economic, societal, environmental and technological benefits

Economic benefits

The entree of electrification is tremendous difference in regional in the state. In the western state where about 90 per centum offamilyhave entree to electricity while North cardinal state have entree to electricity about 65 per centum. In the Sabaragamuwa, Uwa, North Western and East between 40 to 50 per centum of families without entree to electricity. The entire figure of electrification of small town strategies was increased from 2115 to 14690

since 1980 and 1998. By 2015, the Government plans to provide electrification to about 100 per centum of the state 's small towns. Some 600 rural electrification strategies, covering eight states will supply electricity supply to about 112, 500 extra families and other consumers, Some 600km of 33 kilovolts distribution lines will be supplied to beef up CEB 's bing webs in rural countries to cut down overloading and losings on those lines. A scope of alternate energy beginnings ( solar, air current, mini-hydro and biomass ) will besides be developed through community-based organisations and the private sector to spread out rural electricity entree, peculiarly in the more distant, dry zone parts. Where capital costs for rural electrification are prohibitory, crystalline subsidies will be provided, to spread out entree.

Merely theagribusinessentirely would non be equal to increase incomes in the rural countries. There is discouraging facts that these rural households that gain the extreme portion of their income from off-farm income are cagey to work their manner out of poorness faster. Access of electricity is besides of import to any off farm activity. Electric illuming besides makes a important part to the quality and success of rural instruction.

Economic benefits of the undertaking are discussed farther below.

( a ) Adequate electricity supply-

In order for the national economic system to turn, adequate and dependable supply of electricity should be available at low-cost monetary values. Despite puting big amounts of borrowedmoneyon the electricity sector for the past many old ages, our state is unable to run into the turning demand for

electricity. Furthermore, our electricity monetary values are one of the highest in the part.

These defects could be remedied if we could acquire our private sector to put on moderate graduated table decentralized power workss with autochthonal fuel supply. The survey carried out by the Ministry of Science and Technology with EU support reveals that over 4000 MW of biomass based electrical power could be generated by change overing the debauched fringy land available in the state. The proposed 2 MW works would turn out the commercial viability of this construct.

( B ) Organic nitrogen-bearing fertilizer-

Nitrogenous chemical fertiliser such as urea had been extensively used in the agricultural sectors in Sri Lanka. The current one-year use is in the part of 0.4 million metric tons. The entire national demands of urea are imported at a cost of around US \$ 50 million per twelvemonth. In the recent yesteryear, the monetary value of imported carbamide had been lifting steeply. In order to prolong the husbandman community and to guarantee equal supply of our basic nutrient, the authorities had been supplying some grade of subsidy for urea. At nowadays this has reached about a 3rd of the existent cost. Even with this heavy subsidy, paddy husbandmans are unable to do a populating out of rice cultivation. On the other manus, giver bureaus such as the World Bank/ IMF etc. have been exerting force per unit area through WTO on the authorities to minimise all signifiers of subsidies and let the market forces to find the optimal allotment of resources.

As explained in Chapter 3, from a Gliricidia energy plantation, the mean output of wood per hectare per twelvemonth is 30 metric tons ( at 20 % wet ) and the corresponding output of fresh leaf is 26 metric tons.

Systematic surveies carried out by the Coconut Research Institute had revealed that the application of 50 kilograms of fresh Gliricidia leaf for a coconut thenar provides the equivalent of N from 800 gms of urea [ ... .. ] .

Furthermore the application of leaf improves the wellness of dirt by increasing the organic content in dirt.

The aim of this undertaking is to show the commercialization of the construct of sustainable fuelwood production from Gliricidia energy plantations and the operation of an associated biomass power coevals installation. This 2 MW installation would necessitate the equivalent of 800 hour angle of Gliricidia plantations. Harmonizing to the survey conducted by the Ministry of Science and Technology and the Land Use Policy Planning Division of the Ministry of Lands, the entire extent of debauched fringy land in the state is around 1. 6 million hectares. This means that the entire potency of Gliricidia leaf production in the state is  $1.6 \times 26 = 41.6$  million metric tons yearly. This is tantamount to 0. 67 million metric tons of carbamide. The states entire one-year use of carbamide is merely 0. 4 million metric tons. The cautionary value of this is USD 96 million. This clearly shows the economic benefit of Gliricidia energy plantation to the agricultural sector. [ ... ]

( degree Celsius ) Increasing the capacity of national milk production-

About 60 % of our national one-year demands of milk amounting to 500 million liters are imported at a cost of USD 125 million. One ground for our failure to bring forth our demand of milk is the deficiency of nitrogen-bearing fresh fish for our cows. Though we have equal measures of carbonaceous fresh fish in the signifier of rice straw, nitrogen-bearing fresh fish is in short supply. Gliricidia leaf is a first-class nitrogen-bearing fresh fish. A 1-hectare plantation of Gliricidia would give 30 metric tons of wood and 26 metric tons of fresh leaf per twelvemonth. Along with 26 metric tons of rice straw, this measure of leaf is sufficient to feed 6 cattles. The one-year income from the sale of milk from 5 cattles would amount to USD 1, 654 per twelvemonth. This construct of incorporating Gliricidia Energy Plantation with the rapid enlargement of dairy industry in Sri Lanka may not be realized in the short term. Equally far as this undertaking is concerned, it is expected that the present cattle population of 84 cows would be expanded to 500 within the undertaking boundary. Possibly this would move as an accelerator for other countries to follow suit. In the average clip excess leaf produced would be used as organic fertiliser.

The 1.6 million hectares of debauched fringing land in our state could be used to bring forth the state's full demands of milk.

Droppings from the cattles could be used as organic nitrogen-bearing fertiliser replacing urea as described in subdivision ( B ) above. It should be noted that the usage of leaf as fresh fish and the droppings as nitrogen-bearing fertiliser brings more benefits than straight utilizing the leaf as green

organic fertiliser. Nitrogen in cow droppings is easily absorbed by works therefore cut down leaching and evaporative losses.

( vitamin D ) Auxiliary harvests in the entire manner in energy plantations-

As described in Chapter 3, an entire manner with a 4-meter breadth will be provided at 11-meter intervals in the energy plantations. This spread is provided to supply entire for tractors to roll up and transport the fuelwood harvested in the 11-meter broad strips of trees in the energy plantations. These spreads are used as entire manner merely one time in 6 to 8 months. These spreads besides function as limit of blocks to ease systematic harvest home.

A major disadvantage of supplying this spread is it encourages the growing of weeds, peculiarly Guinea A and B ( *Panicum upper limit* ) and Illuk ( *Imperata cylindrica* ) .

One manner of minimising the growing of weeds and optimizing the land infinite in energy plantations is to turn short-run hard currency harvests in these spreads during the two short rainy seasons ( April to June and October to January ) . Crops such as corn, sorghum, benne, black-eyed pea, mung bean, black gm etc. are suited for short-run harvests. Gross from these hard currency harvests would better the economic viability and heighten the sustainability of the plantations.

Leaf of *Gliricidia* subdivisions harvested could be used as organic fertiliser for the hard currency harvest. *Gliricidia* leaf has the undermentioned alimentary

contents: 3 to 4.5 % N, 0.2 to 0.3 % P, 1.5 to 3.5 % K, 1 to 1.4 % Ca and 0.4 to 0.6 % Mg. Furthermore the debut leaf to the dirt increases the organic content and improves the dirt.

( vitamin E ) Conservation of foreign exchange-

Ever since the state adopted an `` unfastened economic '' policy in 1977, the para value of Sri Lankan Rupee has been deprecating in an exponential mode. Figure 15 illustrates this characteristic.

## **Start of Open Economy**

Figure 15: Depreciation of SLR with regard to USD since the 'open economic system ' [ ... ]

The primary ground for this depreciation is that the demand for foreign currency is much higher than the supply of foreign currency. There are two ways of deciding this crisis. One is to increase the supply of foreign currency. That is by increasing exports and spread outing the services, which bring foreign exchange to the state ( such as touristy, foreign employment etc ) . The 2nd manner is to cut down imports. Unfortunately, since 1977, we have been following merely the first method. This has non resolved the crisis. Therefore, we need to follow the 2nd way every bit good. That is we should cut down foreign currency outgo. In other words, if we should try to bring forth locally whatever goods or services which can be produced locally at competitory cost instead than importing such merchandises at a higher cost. Electricity produced by IPPs is a authoritative illustration. For the twelvemonth 2004, the mean monetary value paid for imported fuel based



electricity produced by IPPs was SLR 9. 20 ( USD 0. 0902 ) per kWh, whereas the monetary value paid for local resource based electricity for the same twelvemonth was merely SLR 5. 49 ( USD 0. 0538 ) per kWh. If the same mean monetary value is paid for both, the state could bring forth all the electricity demands from local resources.

The entire foreign exchange demands to run into the expected thermal based electricity from imported dodo fuel, including the foreign capital, fuel, runing and foreign transmittal costs for the twelvemonth 2005 to 2015 ( based on US Cts 8/kWh ) are given in Table 04 below.

It is of import to observe that by the twelvemonth 2015, the expected foreign exchange demands needed exceed the expected foreign exchange net incomes from traditional harvests - tea, gum elastic and coconut ( USD 1000 million ) . With such big demand for foreign exchange, and with the expected diminution in foreign exchange income from the local garment industry when the Multi-fibre Agreement comes into consequence in the twelvemonth 2005, the state of affairs would be wholly unwieldy.

If we develop local biomass resources, these demands could be reduced to manageable degrees.

Sri Lanka is wholly null of any proved militias of fossil fuels. All demands of crude oil fuels are imported from the Middle Eastern states. If we decide to import coal, so we would import it from Australia. Depending on imported fuels to run into most of our energy would put the state in a serious insecure

place. Development of autochthonal resources would put the state in a unafraid place.

### 5. 2. 2 Social benefits

The undertaking has a big constituent for community engagement throughout-grower system. Fuelwood harvested from sustainable energy plantations will be used as fuel for the power works. Fuel wood plantations will be managed both as a big graduated table plantations every bit good as small-scale husbandman out-grower system. The out-grower system will cut down the poorness degree in the part, so that the undertaking has societal benefits. A farmer household can gain sum SLR 25, 000 per twelvemonth from a hectare of land from cultivating *Gliricidia* for fuel wood. If this wood could be cut into 50 to 100 millimeter pieces, so the income would increase to Rs. 45, 000 per hectare, as the current sale monetary value of cut wood ready for gasification or direct eating to boilers is Rs. 1. 50 per kilogram at the farm gate and Rs. 2. 75 per kilogram at the energy transition Centres.

The undertaking is be aftering to present an incorporate attack for fuel wood plantation, which include cowss farming utilizing leaf fresh fish, organic fertiliser utilizing waste, and outflowing fertiliser or biogas, and organic agribusiness merchandises. Farmers can gain around SLR 45, 000 from selling 30 dozenss of fuel wood, SLR 7, 350 from selling 32 dozenss of droppings as organic fertiliser and SLR 168, 750 from selling 6750 liters of milk.

Around 2000 households are expected to take part in the out-grower strategy so that their income will increase the undertaking besides provides regular day-to-day employment for around 50 people throughout the twelvemonth in the fuel wood aggregation and transit activities. In the fuelwood aggregation and transit activities. In add-on to this, during the building phase, a big figure of skilled and unskilled workers will be hired from the local countries. Over 50 % of the employees are likely to be hired from the nearby communities.

Additional roads will be built by the company to entree the human dynamo and the plantations. These roads are available for usage by the local people and in some instances will supply motorable entree to their places where there were merely footpaths earlier.

The undertaking is expected to supply the undermentioned societal benefits.

( a ) Supplying employment for rural hapless -

The Government of Sri Lanka yearly spends SLR 8, 500 1000000s ( USD 83 million ) on poorness relief on the about 25 % of the entire population. Over halve of the entire population in the state are populating in the rural countries. Most of them are engaged in agricultural activity. Despite the huge sum of money spent in many agricultural development undertakings such as the Mahaweli Project, the farming community in the state is populating at subsistence degree.

Most of the husbandmans are engaged in paddy cultivation. This provides merely intermittent employment chance, numbering 5 to 6 months in a twelvemonth. During the balance 6 to 7 months, these workers look for alternate employment. Many of them are tempted to acquire involved in illegal activities.

The proposed method of sporadically reaping mature subdivisions and utilizing the wood as fuel for electricity coevals and the leaf as fresh fish and organic fertiliser would ( a ) provide employment chance during the slack periods and ( B ) increases the one-year income well for the husbandmans in the dry zones.

The constitution of plantations and periodical harvest home provides around 30, 000 man-days of work yearly for each MW of power works, averaging 76 man-days per hectare.

Assuming a household is entrusted with 1 hour angle of plantation and provided with 6 cattles, the one-year income for this household is as follows:

Income from wood ( SLR/ha/y ) : SLR 45, 000 ( USD 441 )

Income from milk ( SLR/ha/y ) : SLR 168, 750 ( USD 1, 654 )

Income from droppings ( SLR/ha/y ) : SLR 7350 ( USD 72 )

Entire SLR. 221, 100 ( USD2, 168 )

A household is expected to give merely 76 man-days of work per twelvemonth on these activities. Rest of the clip could be devoted to traditional rice cultivation.

( B ) Nutrition for children-

It has been found that most of the rural kids are enduring of malnutrition. The production of milk in each family would ensue in deciding this crisis. The undertaking is expected to better the quality of the rural hapless through increased income, which will further ease the obliteration of child malnutrition.

( degree Celsius ) Electrification of villages-

The Government of Sri Lanka has revealed that merely 80 % of the families in the state would be connected to the national electricity grid. The balance 20 % of the population amounting to over 1 million is to be provided with off-grid system. The World Bank funded Renewable Energy for Rural Economic Development ( RERED ) plan is expected to cover approximately 5 % of this 1 million families.

The proposal to set up biomass based power coevals undertakings in rural countries would widen the national electricity grid to countries, which would non hold otherwise been reached. Besides the debut of this engineering would excite the constitution of biomass based off-grid systems to supply electricity to rural communities.

( vitamin D ) Cleaner fuel for rural household-

The debut of 6 cattles per family would promote the use of biogas systems to these families. Biogas therefore produced could be used for cookery or for electricity coevals in stray single families. The usage of biogas for cooking would ensue in the wellness of the household vastly as it would extinguish fume from traditional wood ranges.

### 5. 2. 3 Environmental benefits

There are no issues related to pollution as a consequence of this undertaking. Fuelwood plantations will be established in under-utilised lands. This in fact will be a solution for the land debasement job of the state. Fuelwood plantation will back up to keep ecological balance in the part. Most of the debauched lands are in close propinquity to the rice Paddy Fieldss. The paddy Fieldss constitute the low-lying lands the debauched shifting cultivated lands constitute the high-lying lands. Normally, shortly after the harvest home of rice Paddy, the husbandmans cultivate the high-land country by the `` Slash & A ; Burn/ Shifting Cultivation '' method. By presenting Gliricidia as an energy plantation harvest, these husbandmans could change over these debauched lands into a sustainable and perennial harvest land. There will be no demand for firing or switching activities. Though non advocated in this undertaking, `` Alley Cropping '' system with Gliricidia and chash harvests like maize has been demonstrated in Sri Lanka. In this system, Gliricidia ( or Leucena ) trees are planted in rows with a spacing of 0. 5 metres within the rows and 2 to 3 metres between rows. These lines of trees lie in the East - West way ( along the way of the Sun ) . At the terminal of the monsoon rains in January, the side subdivisions of

Gliricidia trees are cut go forthing the chief root integral. In between the lines of Gliricidia trees, short-run hard currency harvest such as maize is planted. In three months the maize would maturate and would be ready for crop. Gliricidia trees are allowed to turn and the subdivisions harvest at the terminal of the following monsoon season in January following twelvemonth. This manner, the husbandmans could acquire a significant income from three beginnings: ( 1 ) Traditional paddy cultivation in the low-lying lands ; ( 2 ) Short-run hard currency harvests: ( 3 ) Perennial Gliricidia brush wood and leaf.

Environmental benefits of the undertaking are discussed below:

( a ) Suspension of emanations of GHG and other pollutants -

Sri Lanka has ratified the UNFCCC and the Kyoto Protocol. Therefore, we have a moral duty to cut down emanations of GHGs. The 'Business As Usual ' option adopted by contrivers depends to a great extent on coal as the major fuel in run intoing our hereafter electricity demand. Figure 16 illustrates the fuel demands for electricity coevals harmonizing to BAU scenario.

## **Coal**

## **Oil**

Figure 16: Fuel demands for electricity coevals: BAU scenario

Table 05 gives the CO<sub>2</sub> and other pollutant emanations of power coevals under this scenario. This is illustrated in Figure 17.

The estimated baseline emanation of particulates, SOX, NOX and CO2 are given in the tabular array 05. This undertaking will displace the tantamount sum of CO2 and SOX about in its entirety and to great extent of NOX and particulates.

Figure 17: Tendencies of baseline emanation from electricity coevals

As illustrated in Figure 17, the emanations of GHG from the power sector will increase bit by bit while the particulate affair emanation will worsen if the baseline scenario continues. Harmonizing to the public-service corporation ( CEB ), the largest beginning of particulates are IC engines used with furnace oil or residuary oil. With the debut of coal based power workss, the reciprocating workss would be phased out. Coal power workss will be provided with electrostatic precipitators and bag filters etc. to minimise particulate emanation. Hence, CEB expects the particulate emanation degrees to drop over the old ages. The proposed 2MW power works based on sustainable supply of fuelwood from SRC Gliricidia plantations would ensue in zero CO2 emanation, therefore dramatically bettering the emanation degrees. The undertaking besides expects to command other pollutants such as SOX, NOX and particulate affair. The proposed method of electricity coevals is an alternate to the dodo fuel based electricity coevals soon practiced and planned for future enlargement. Fossil fuels such as oil and coal would non merely breathe C dioxide, they besides emit big measures of sulfur dioxide and oxides of N. Sulphur and nitrogen content of woody biomass are undistinguished compared to those present in fossil fuels. All ash produced in the procedure will be returned to the plantation country and



will be applied as organic fertiliser. Thus the bottom ash disposal jobs encountered in coal based power coevals would non be encountered in the proposed method.

The proposed system eliminates most of the environmental jobs encountered in dodo fuel based power coevals methods.

The impact of the proposed 2 MW biomass power works on the national emanation degree would no uncertainty be really undistinguished. But the possible in Sri Lanka for sustainable biomass based electricity coevals is really big. There are over 1. 6 million hour angle of debauched land available for sustainable energy plantations. This would be adequate to bring forth 4000 MW of electricity with an one-year end product of 28, 000 GWh. Our hydropower potency is around 6000 GWh per twelvemonth. Hence biomass plus hydro we have a potency of 34, 000 GWh per twelvemonth. Our present demand for electricity is 8000 GWh/ twelvemonth. Even at 8 % steady growing, we could bring forth all our electricity ( without any fossil fuels ) for many 20 more old ages to come. By that clip there would be many renewable engineerings which are commercially feasible.

Furthermore, Gliricidia plantations from the 1. 6 million hour angle of debauched land would bring forth 42 million metric tons of leaf. This together with the rice straw soon incinerated in the Paddy Fieldss could be used to bring forth biogas. This could be used as conveyance fuel ( like in Sweden in Switzerland ) . This would extinguish the emanations from the conveyance sector.

( B ) Change by reversing land degradation-

About a 3rd of the land countries of the state amounting to approximately 1.6 to 2.0 million hectares are in a debauched province. These extents of land were productive dry zone forests a few hundred old ages ago. The primary ground for debasement had been unsustainable pattern of cut and burn signifier of switching cultivation adopted by coevals of subsistence agriculture in these countries. Most of these countries receive an one-year rainfall of about 1250 millimeter. Most of this rainfall is received during the monsoon months of October to December. Agricultural activity could be practiced merely during this monsoon period. Consecutive cut and burn system of agribusiness with unequal fallow period to recover birthrate has resulted in debasement of these lands.

Locations of these lands are given in Figure 18 below.

Figure 18: Locations of debauched fringy land

As the pattern of cut and burn signifier of agribusiness is still go oning in these countries, the extent of these lands is bit by bit increasing. Furthermore, the grade of debasement is besides on the addition due to firing followed by dirt eroding. The procedure of desertification has already started in some of these countries. Unless remedial methods are taken, these lands will stop up as comeuppances.

One possible manner of reconstructing the initial position of these lands is to present some tree screen with lasting closed canopy. The proposed method

of setting N repairing Gliricidia trees at a spacing of 1 metre by 1 metre and periodical harvest home of selected mature subdivisions go forthing the chief root and the stamp subdivisions integral would be a satisfactory method of up-grading this land.

As ash from the burning of wood would be returned to the dirt, dirt foods will be sustained.

( degree Celsius ) Renewable energy beginning and C sink -

The proposed method of setting N repairing Gliricidia trees at a spacing of 1 metre by 1 metre and periodical harvest home of selected mature subdivisions go forthing the chief root and the stamp subdivisions in tact would ensue in prolonging the C balance in the system. In the land readying stage, merely the weedy biomass would be removed. All productive bing tree harvests would be retained till they reach their economic life.

( vitamin D ) Organic nitrogen-bearing fertiliser to replace chemical urea fertilizer-

As mentioned in subdivision ( B ) , the proposed method besides produces big measures of organic nitrogen-bearing fertilisers, replacing chemical urea fertiliser manufactured from fossil fuels. Apart from extinguishing the tantamount sum of C dioxide emanation, the usage of organic nitrogen-bearing fertiliser increases the organic content of the dirt therefore heightening the environmental impact.

## 5. 2. 4 Technological benefits

The new engineering expected to be introduced by the undertaking include the followers:

( a ) Biomass production engineering -

As mentioned earlier in Chapter 3 `` Modern method of fuelwood production " , bio fuel for the proposed power works will be produced in Short Rotation Coppice plantation utilizing modern methods. This engineering, though introduced to the state late, it has non yet been practised in commercial graduated table operation. The debut of 2000 hectares of SRC plantations utilizing this modern method would transform the full dry zone country into a healthy, sustainable and profitable zone.

The undermentioned characteristics of biomass fuel production are described in Annex A Land Preparation

Planting Materials

Constitution of Plantations

Care of Plantations

Harvesting, roll uping and transporting of wood

( B ) Biomass energy transition technology-

Apart from a few sugar Millss, a freshly introduced presentation unit and a power undertaking under building, there are no commercial graduated table bio fuel based electricity bring forthing installations in Sri Lanka.

Furthermore, the Sugar industries use merely the waste baggase as fuel utilizing crude inactive grating burning systems. The freshly introduced presentation unit consist of a biomass down bill of exchange gasifier with H<sub>2</sub>O scrubber/ gas ice chest and a spark-ignition based IC engine-generator with an end product of 35 kilowatt. This is installed in a distant rural are to supply electricity to 100 families. The other works is a 1 MW power works with boiler-steam turbine system.

The proposed power works will utilize Circulating Fluidised Bed burning system with high force per unit area and high temperature steam coevals. These factors will well better the steam use efficiency, therefore cut downing the operational cost, peculiarly, if the cost of fuel constitutes a important portion in the concluding cost of electricity. Furthermore, the improved burning system would cut down the emanation degree.

Features of electricity coevals are discussed below. The alternator of the system is designed for 3200 kVA with a power factor of 0. 8. This power end product would be 2. 56 MW. But with parasitic burden, the expected net end product is 2 MW.

Fuel treatment-

Fuel wood from the plantations would get in dawdlers. These would be weighed and moisture degree determined by portable wet metres. These will be stacked in the storage country in the power station.

Fuel wood from the storage place would be removed on a 'first-in-first-out' footing. These would be chipped to allow size ( for fluidised burning ) and stored in a hopper. Flue gas from the boiler would be assorted with ambient air and would be used to dry the wood french friess to the coveted wet degree for burning.

#### Combustion system and boiler-

The steam generator shall be of natural circulation, balanced draft, and fluidised bed burning ( FBC ) type, designed for firing wood french friess. The capacity of boiler is about 35 TPH on maximal uninterrupted footing at approximately 60kg/cm<sup>2</sup> ( g. ) operating force per unit area and about 490oC temperature.

The economizer subdivision of the boiler shall be of nona<sup>^</sup> steaming type. Super warmer subdivision shall be designed so as to keep rated steam temperature of about 490oC at mercantile establishment over the control scope of 60 % to 100 % MCR burden. A steam de-superheating station with proviso for spray H<sub>2</sub>O tapped off from feed H<sub>2</sub>O discharge shrieking shall be provided. Air pre-heaters of cannular type shall be provided for steam temperature control.

The AFBC shall dwell of in-bed / above-bed ace warmer subdivisions, bed evaporator, H<sub>2</sub>O walls/refractory walls, economiser and air prea<sup>^</sup> heater. The boiler shall be equipped with a suited fuel fire system.

The complete boiler shall be bottom-supported type and be provided with all back uping steel platform, galleries, staircases for easy attack and care of the units. Adequate conditions protection shall be provided for instruments and runing forces. Necessary liner and insularity along with repairing stuffs to restrict outside surface temperature to a safe degree shall be provided. Monorails and hoists required for managing motors, fans shall be provided.

A trim boiler provender pump shall be provided.

Turbine-

The turbine shall be of Multistage, Nozzle governed, Horizontal spindle, two bearings, Impulse type with hydraulically operated halt and exigency valve and built-in steam strainer, hydraulically operated Throttle/ Regulating valves shall be used as the chief power coevals equipment. Turbine steam recess conditions will be maximal uninterrupted footing at approximately 60kg/cm<sup>2</sup> ( g. ) operating force per unit area and about 490oC temperature. The exhaust force per unit area shall be about 0. 1 saloon ( a ) .

Condenser-

The capacitor shall be of shell and tubing building, horizontal, divided H<sub>2</sub>O box with built-in hot good.

Cooling tower-

The chilling tower shall be of forced-draft type with concrete building and aggregation pool.

### Alternator-

The alternator shall be an AC synchronal generator with 3200kVA, 3.3kV, 50Hz, 3-phase, 4-wire system coupled to the steam turbine through a velocity decrease gearbox complete with following

( a ) Brush less exciter

( B ) Twin bearings

( degree Celsius ) AVR and excitement panel

( vitamin D ) Antia<sup>^</sup> condensation warmers

( vitamin E ) VARs control

### Auxiliaries-

The undermentioned aides shall be provided:

( a ) Auxiliaries for generator protection and control panel

( B ) Generator ledgeman

( degree Celsius ) Battery with care tools

( vitamin D ) Battery courser and DC distribution panel.

( vitamin E ) Standby Generator for 'Black Start ' .

### Fuel feed system-



The fuel provender system shall dwell of a chipper, a drier using energy in boiler fluke gas, a mechanical/ pneumatic conveyance system directed into the burning chamber of the boiler. The fuel shall be stored in the storage country and fed manually in to the splintering machine.

Ash remotion disposal-

Ash shall be collected at the underside of the ash aggregation system. The disposal shall be done manually by opening the ash disposal door and collected in an ash cavity. Manual disposal is required thenceforth. The ash can be used as a fertiliser for the plantations.

Features of fuelwood samples collected in the undertaking country have been analysed. Consequences obtained are as follows:

Other impacts of the undertaking

Positive impacts

This undertaking will be an illustration for an attempt to advance sustainable biomass energy based electricity coevals with community engagement. Experience of this undertaking could be shared at national, regional and planetary degrees.

Negative impacts

One of the negative impacts of the undertaking would be the force per unit area on demand for land in the hereafter. If this undertaking is successful, many similar undertakings will be established throughout the state. This will

negatively act upon other land usage options, such as agribusiness and small town enlargement etc.