THE FEASIBILITY OF 10 MW POWER PLANT INSTALLATION WITH PALM OIL WASTE AS A BIOMASS FUEL IN HORMOZGAN, ISLAMIC REPUBLIC OF IRAN

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ABSTRACT

The power industry in Iran annual production exceeding ١٥٠ million tons of carbon dioxide has carbon emissions about ٢٨ per cent share. In other hands, for production of each power per kilowatt hour of electricity production is released more than ٦٥٠ grams of carbon dioxide. Integrated program designed to reduce the carbon intensity of the electricity industry and the development of renewable Energy sources (RES) leads to have more than ٣٠٠٠ MW capacity from DG behind the year of ٢٠٢٦[1].

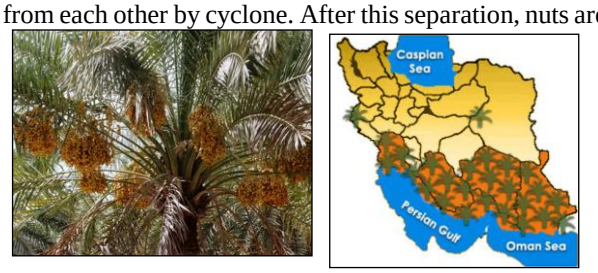
One of kind of RES is using Biomass for Power Generation and CHP. In this manner we have more kind Biomass resources include agricultural residues, animal manure, wood wastes from forestry and industry, residues from food and paper industries, municipal green wastes and sewage sludge. This article has been examining the possibility of generating electricity from waste palm tree in the Hormozgan province in th south of iran with capacity about 10 MW. It's come from about 200000 ton Palm waste in agricultural area.

1. INTRODUCTION

Dates are strategic agricultural products for export from Iran and in according to the annual statically reports, production of dates in Iran are about one million tons. Also the land area under taken for palm tree planting is about 250 thousand hectares.(fig.1,2) Iran exports 30 percent of the world's date that include about 70 percent exporting from this amount to European and American countries. According to Iran's Ministry of Agriculture report, 500 thousand tons of dates production in Iran will be wasted or usefulness.[2]. Only 10 percent of this amount will be used for the industry becomes .therefore There are about 400000 tons of waste annually with the value about 800 000 dollars that on the date palm industry disappears.

According to hormozgan agriculture of jahad organization report(2009), 25 percent from these production comes from this province. however this report says that about 200000 tons comes from palm trees as a waste.[3]

Palm oil empty fruit bunch (EFB) is waste residue generated from palm oil industries. After harvesting fresh fruit bunches from oil palm tree, these bunches are sterilized in a horizontal steam sterilizer to inactivate enzymes present in pericarp and loosen fruits from bunches. The sterilized bunches are fed into a rotary drum thresher in order to remove the sterilized fruit from bunches. These bunches without fruit are called as empty fruit bunch (EFB) which are conveyed to the damping ground, whereas the sterilized fruits are further used as feedstock for palm oil production in palm oil extraction process by means of screw type press. The effluents from screw type press are nuts and fibers which are separated from each other by cyclone. After this separation, nuts are



Figure(1,2): Oil Palm with fresh fruit bunches and the land area under taken planting map in iran

cracked into shells and kernels. The former are solid waste and left unused, the latter are sent to the kernel oil mill. It was reported that 20-22 tons of empty fruit bunch, 14 tons oil-rich fiber and 5 tons of shell are generated from 100 ton of fresh fruit bunch, as illustrated in Figure 3:

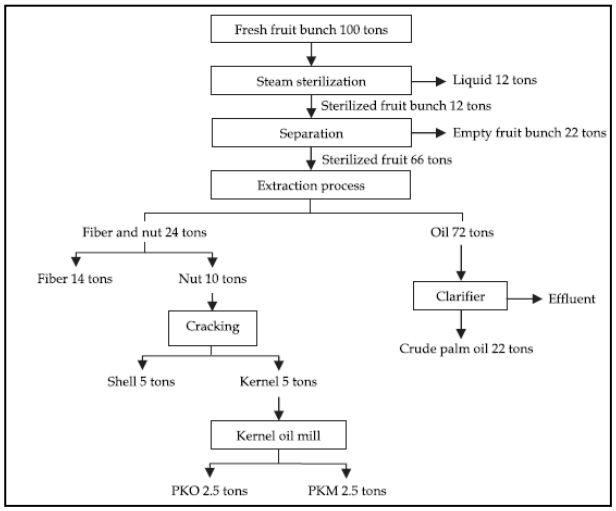


Figure 3: schematic block diagram for palm waste process

Due to its higher moisture and ash content, lower energy content compared to palm oil shell or some types of biomass feedstock as well as its non-uniform shape, there are a large amount of experimental studies and modeling focusing on combustion, co-firing as well gasification of EFB in order to investigate the feasibility of using above mentioned technologies to convert EFB into energy in term of operating conditions, configuration of reactor, emission and efficiency.[4] (figure 4)

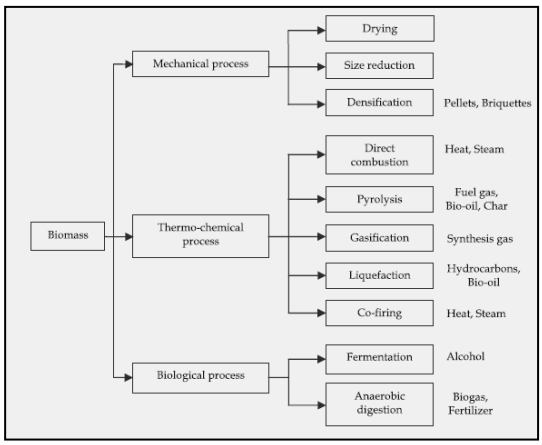


Figure 4: Pathway for energetic utilization of biomass

2. The Use of Palm Oil As Biofuel and Biodiesel

With about 200000 ton Palm waste in agricultural area, Hormozgan province can put about 10 mw power plants with Biomass fuel. The well-established palm oil industry of Hormozgan opens an alternative and Renewable way of providing electricity. The palm oil industry must dispose about 1.1 ton of empty fruit bunches (EFB) for every ton of crude palm oil (CPO) Produced. This biomass waste could be utilized to fuel a power plant generating electricity for sale to either national or local grid. A palm oil mill processing 200,000 ton/year fresh fruit bunches could supply a power plant with about 182000 ton/ year crude palm oil .

As the heating value of dry EFB is 15.5 MJ/kg then, at 25 percent energy conversion efficiency, this amount of EFB is equivalent to a generating capacity of 10 MWe. Utilization of this amount of EFB as power plant fuel would potentially result in Generation of 8 up to 10 MWe . but before that, need to have a mill for convert and product all kinds of palm waste to biodiesel fuel.

After this separation, nuts are cracked into shells and kernels. The former are solid waste and left unused, the latter are sent to the kernel oil mill**.**

An industrial downdraft gasification plant consists mainly of 5 parts, as in the following: fuel preparation system, downdraft gasified, heat exchanger, gas cleaning unit and internal combustion engine-generator, as shown in Figure 5

Historically from December 2008, 14 biodiesel plants have been established with total annual biodiesel installed capacity of 1.7 million tons, with additional four waiting to commence production. The production of biodiesel rose by 32% to 171,700 tons in 2008, compared to 129,715 tons 2007. Exports of biodiesel increased by 91.7% to 0.18 million tons in 2008 against 0.09 million tons recorded in 2007. USA was the largest biodiesel importer from Malaysia, accounting for 71,324 tons or 39.2% of total biodiesel exports, followed by the EU with 70,273 tons or 38.6%.[5]

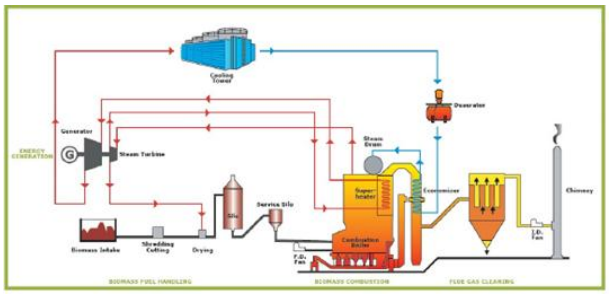


Figure 5: a schematic block diagram for electricity production by palm oil process.

3. The project description

The project described in this report is a power plant combusting 200.000 ton/year empty fruit bunches (EFB) in a specially designed high-pressure boiler and generating 10 MW electricity with a steam turbo-generator. The plant will be located in MINAB, a city with about 75 km

In the East of BANDAR ABBAS , the capital city of Hormozgan province. The biodiesel can be transport from a palm oil mill and transported to the site. This fule is a technically challenging fuel and Equipment has been specifically designed for dealing with this waste. The estimated economic life of the power plant is 20 years.

The objective of this project is to generate electricity for sale to the grid of HEDC (the State Electricity Company of Hormozgan) through utilization of surplus biomass residue from palm oil mills. This renewable energy project will offset the requirement of diesel generation to satisfy the ever-growing demand of electricity in the surrounding area. Thus this project would fit well to the principles and rules of Clean Development Mechanism. Potential estimated net reductions in Greenhouse gases (GHGs) emissions are 55,650 ton CO2-equivalent per year.

The ultimate beneficiary of the project is the local community in the province of Hormozgan (especially in the area of MINAB and the neighborhood regencies like ROODAN), who would obtain a new supply of clean electricity from a power plant operating in their own area. The Hormozgan local economy would benefit from the injection of US$6 million in local goods and services, up to 150 construction jobs and 42 permanent direct jobs. Indirect jobs and economic activities, e.g. for the

transportation of the EFB fuel, will also be created in the surrounding area. In addition, the project will strengthen Hormozgan's palm oil industry structure and aid rural electrification.

The other beneficiaries and stakeholders that will favorably be affected by or interested in the project are local and provincial governments, Hormozgan agriculture of jahad organization, HEDC (State Electricity Company), Iranian Palm Oil Business Association ,Iranian Renewable Energy organization(SANA), Ministry of Energy(TAVANIR) and Hormozgan university. The Iran government is supportive of the project both directly and indirectly.

4. Project Scope

The selected project site will be locate near the palm tree lands and close to a river of MINAB to ensure the security of makeup water supply.

The project scope is to utilize palm oil mill residues as fuel and produce electricity for uploading to the medium voltage (MV) side of the substation through a dedicated interconnection circuit at 20 kV.

5. Emissions Baseline Technology

New power plants are needed to satisfy the ever-growing demand of electricity energy in the surrounding area. Existing power plants run on fossil fuels and has environmental problem, particularly handling liquid waste and pollutant. This renewable energy project will provide 10 MW electricity and offset the requirement for diesel generation. The CO2 emission of the latter technology is 0.65 kg CO2/kWh.

6. Emissions Estimation and Monitoring and Verification Approach

The parameter that needs to be monitored for verification of CERs is power production. For this, the power sold and billed to the HEDC will be used.

CO2 emissions from the baseline technology will be calculated from the produced power, electricity generation efficiency of a diesel power plant of comparable capacity, and other factors To estimate emissions reductions from an energy efficiency or fuel substitution project, the energy savings are estimated first and then translated into emissions reductions using fuel or grid electricity emissions factors. These emissions factor should be the same ones used to set the baseline emissions. The methods used for estimations on this project :

1. on-site emissions : estimation using default emissions factors based on utility
2. on-site electricity savings and demand reductions : engineering algorithm method; and
3. upstream emissions reductions (emissions coefficients).

Assumptions and approaches used in the methods to monitoring and verification of GHG emissions reductions

7. Project Components and Costs

The capacity of this power plant would be 10 MW. The capital cost of the project is estimated to be USD 10.2 million. The components of investment costs are described in Table 1.

The time period that credits arising from the project can be claimed is not necessarily equal to the operational lifetime

N0	**Equipment**	**cost(USD)**
1	Fuel Preparation	380000
2	Drayer	800000
3	Boiler	2000000
4	Baghouse & Cooling Tower	120000
5	Boiler Feed Water/deaerator	300000
6	Steam Turbine/Gnerator	3000000
7	Cooling Water System	320000
8	Workshop Equipment	80000
	Total Price	**7000000**

Table 1: Equipments cost Evaluation

of the project activity. There are two options for the crediting period of project :

An initial period of seven years, which may be renewed at most twice – for a total of twenty-one years; orA maximum of ten years with no option of renewal.

The crediting period for this project is ten years with no option of renewal. This option has been taken for the purpose of calculations.

The Protocol requires that 2% of CERs from project activities be deposited into a designated account to help meet the costs of adaptation. In addition to the provision to fund adaptation, a share of proceeds from project activities will also be garnered to cover administrative costs.

For this project, the adaptation levy and administrative expenses are USD 3,950. Revenues generated via sales of CERs in the registry –which is administered by the Executive Board- will be forwarded to the countries in which projects took place, and where there is a need for addressing the impacts of climate change.

8. Investment Plan

In general, most companies will participate to obtain emissions reduction credits to help meet their domestic emissions reduction targets in an economically efficient manner. However, companies that has no requirement to reduce GHG emissions may also choose to gain ownership of credits through the at a low price to sell on the international market at a future date.

Regardless of the motive, a company participating in the may choose from a variety of financial options :

- Full or Partial Equity – a company finances all or co-finances part of a project in return to full or shared financial returns and emissions reduction credits;
- Financial Contribution – a company provides a financial contribution towards the cost of a project equal to some portion of the incremental cost of the project over and above the baseline technology, or

finances the removal of market barriers, in return for

emissions reduction credits.
Loan – a company provides loan or lease financing at concessional rates in return for emissions reduction credits; or
❖ Certified Emissions Reduction Purchase Agreement – a company agrees to buy certified emissions reduction credits as they are produced by the project.
The project will be funded by a long-term loan from a financial Bnak up to 60 percent of the project capital cost. The project joint venture partners will fund the rest of the investment required by way of equity.(Table 2)

N0	Items	cost(USD)
1	Equipments	7000000
2	Piping	300000
3	Electrical works	50000
4	Utilities	120000
5	Foundation	300000
6	Building	500000
7	Stand by Genarator for Start up	1000000
8	Start up costs	1000000
	Total Price	10270000

Table 2:The scope of investment plan

9. Financial and Credit Analysis
Table 3 is shown the calculation of Internal Rate on Return (IRR) for total project and the investor.(Table 3)

N0	Project Cost	10.2 million USD
1	Means of Financing	Debt 70% Equity 30%
2	Rate of Interest on Tearm Loan	12% per Annum
3	Plant Load Factor	82%
4	Annual Electricity Generation	87 million KWH
5	Operational Cost	1 million USD
6	Rate of Fuel	0.027 /Kg USD
7	Rate OF Power Supply	0.065/KWH USD
8	Annaul O&M Cost	1% project cost

Table 3: Financial Analysis

Based on data in Table 2, this project promises Internal Rate on Return (IRR) value 19.5%. This IRR is higher than rate of interest on term loan (12%). So it concluded that this project is feasible and profitable.

10. Sensitivity Analysis
Estimation of the sensitivity of the financial viability and GHG emissions to changes in these parameters:
- investment cost
- power purchase
- manufacturing cost

In the same manner as described in Table 3, thus some principal things that can be concluded are :
- the change of investment cost that implemented in isn't make big impact to IRR value. If investment cost more bigger, thus more less profit could be get, then on the contrary;
- the change of power purchase very impact to IRR value. Decrease of profit –state as Net Present Value (NPV)- by change of selling rate is very steep then others variables. But decrease of sales until 10%, the project is still make a profit refer to IRR value 14.5% if compare with rate of interest on term loan 12% the change of manufacturing cost is less impact then the change of Investment cost and power purchase. Computing shows that increase of manufacturing cost until 20%, still make a profit by IRR value 16% at rate of interest on term loan 12%.

11. Conclusion

As described in this paper, the feasibility of generating electricity from waste palm tree has been shown as a DG planning. Financial calculations shows that with the putting on the investment with about 10.2 Million USD, we will see returning of this capital after 8 years. Also we can have annual GHG emissions reduction about the 55ooo ton. This is the best choice for electricity supplying in agricultural lands with palm planting as a renewable energy source.

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