

Title: **Byproduct utilization for transportation system in Valencia, Spain**

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Summary:

Valencia Community is located on the Mediterranean Coast in Spain. Its capital city, Valencia City, is the third largest city in the country. As of 2010, it has around 800,000 inhabitants. It has a land area of 134.65 km². The city's main agricultural products are rice and orange. Valencia produces around 57.6% of the orange production of the country. Spain has an estimated orange production of 2.8 million tons in 2011.

Transportation takes the largest portion of the electricity demand of the community at 39.9%. Industry, which includes farming and fishing, comprises 37.8% while residential and commercial use 12.5% and 9.8%, respectively, of its electricity [1].

In 2006, 5% of the total electricity demand of the community comes from renewable resources with 4% of it coming from biomass production. A large portion of the renewable resource comes from hydroelectric power at 75.7% while 19.3% and 0.95% come from wind and solar power, respectively [2]. 27.2% of the total primary energy supply of the community is produced locally while the 72.8% is imported [3]. Other sources of electricity of the community come from nuclear power and coal.

With the largest consumption of electricity coming from transportation and an abundance of orange production in the community, we propose the use of orange residue to produce bio-ethanol to fuel transportation system in Valencia City and to supply for heat utilization of the residences and industries.

In this report, we focus on the utilization of bio-ethanol from orange peel to fuel the transportation system in the city. We aim to decrease the carbon dioxide emission from transportation system and to decrease the cost of fuel for transportation. In an ambitious scale, we plan to attain energy independence on foreign resource, achieve European Union (EU) renewable energy standards, address precautions for global warming, and tackle oil price. The choice of orange residue to further production of bio-ethanol aims to reduce waste from consumption of orange.

Other sources of renewable energy such as solar power through photovoltaic cells and wind power are generally not accepted by the public, companies and the government. Electric companies have reported a deficit in terms of the supply and distribution of the electricity to the consumer due to the tariff imposed on solar power. The companies then put a high price for the individuals who wish to connect to the grid to sell the solar power they generated. The integration tariff has not been attractive for the consumers. Wind power, on the other hand, goes in the way of the preference of the people as it destroys the view of the environment.

The amount of local consumption of oranges in the community is around 0.746 million tons while 0.864 million tons is exported. Orange residue that can be recovered by weight is around 50-65% and when not used goes to waste. This comprises around 0.425 million tons of residue annually. This much amount of residue produces around 398,000,000 liters of ethanol.

In Spain, 33,888 TJ is spent for transportation system. An estimate of 580 TJ is utilized by Valencia City. The amount of energy generated from the residue is around 395.7 TJ. The demand of the transportation system in Valencia estimated to be around 579.2 TJ.

The Energy Return on Investment (EROI) of cellulosic ethanol, same mechanism which is applied for orange peel, has an average value of 5 [4]. 80% of the bio-ethanol production will be used to power the transportation system while 20% will be used to power the bio-ethanol plant for it to be self-sufficient.

Currently, a budget subsidy of 45% is directed to project cost for the production of renewable energy. An additional 10% is given for medium-sized companies and 20% for small companies. This incentive will attract further investors in the city.

Based on obtain data and the current support of the government, this project seems feasible for Valencia city.

References:

- [1] International Study of Renewable Energy Regions
<http://reregions.blogspot.jp/2009/10/region-of-valencia.html> Accessed on September 11, 2014
- [2] Renewable energy in Spain http://en.m.wikipedia.org/wiki/Renewable_energy_in_Spain
Accessed on September 11, 2014
- [3] Energia y Rehabilitacion <http://www.energiayrehabilitacion.com/wp-content/uploads/2012/11/primaria5-1024x315.jpg> Accessed on September 11, 2014
- [4] The Net Energy of Biofuels
<http://www.iperasmuseprobio.unifg.it/dwn/THENETENERGYOFBIOFUELS.pdf> Accessed on September 11, 2014

Energy systems for a city- Sustainable Valencia city (GROUP D)

- ☐ Valencia is a city at the west Europe located at the east part of Spain.
- ☐ Famous with its touristic places, beaches sea and sun.
- ☐ It has moderate winter and hot summer.
- ☐ One of the producers of orange in the world



Energy systems for a city- Sustainable Valencia city

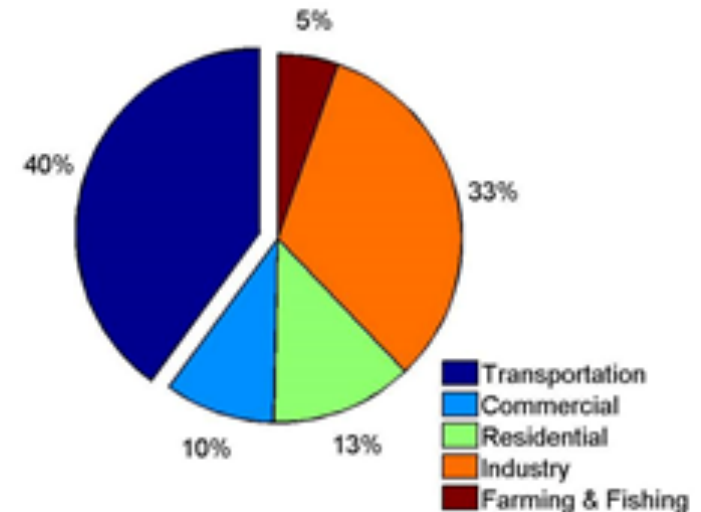
Total production of Spain: 116000 TJ
Domestic production: 33000 TJ

14% is only renewable sources

Nuclear energy production: 14000 TJ
Wind: 4000 TJ
PV: 700 TJ
Geo: 18 TJ
Coal: 1300 TJ
BE: 7200 TJ

Distribution of energy consumption:

Transportation: 40%
Commercial: 5%
Residential: 13%
Industry: 33%
Farming and fishing: 9%

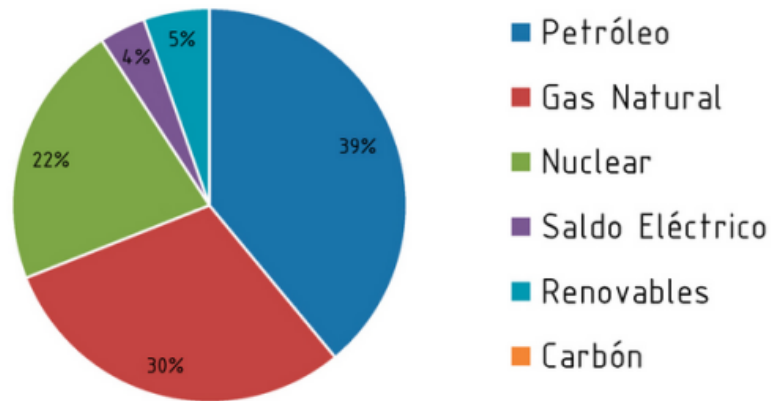


Properties about distribution;

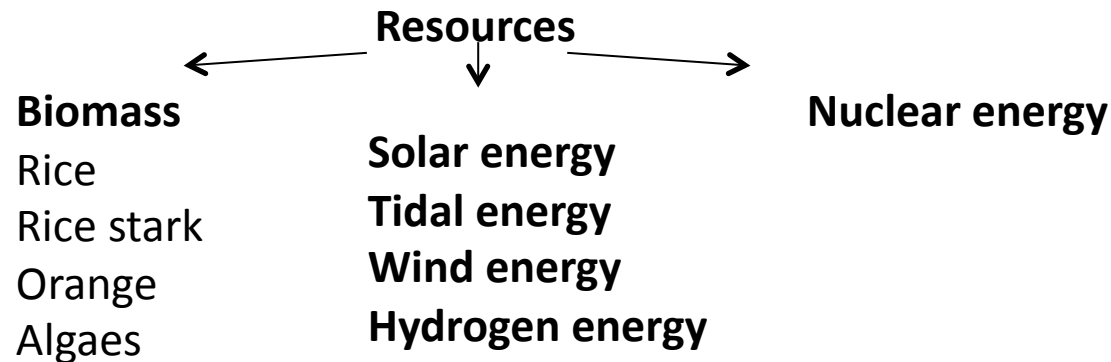
Transportation depends on fossil based
Nuclear can cover need for electricity
Industry revenue compensate by tourism sector

Comunidad Valenciana

Energy supply for Valencia



Resources and technologies to support these;



What are the things that need to be improved?

- ☐ Increase the percentage of renewable sources specially for transportation
- ☐ Decrease the dependency to imported energy sources.
- ☐ Increase the quality of life as decreasing carbon emission.

What we should do for sustainable city?

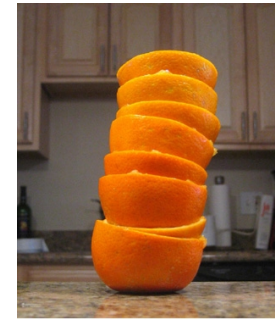
- ☐ Replace energy supply for transportation to bioethanol.

Why we should do for sustainable city?

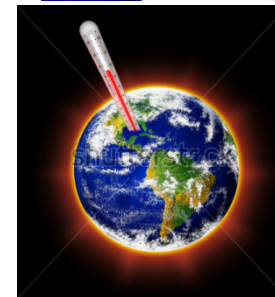
- ☐ Decrease the energy dependence on foreign sources.
- ☐ Achieve EU renewable energy standards.
- ☐ As precautions for global warming.
- ☐ Increasing oil prices

How we can change this?

- ☐ Building bioethanol plants for transportation
- ☐ Utilizing sources such as rice, orange.
- ☐ Build incineration plants for rice stark.
- ☐ Deploying eolic wind plants.
- ☐ Using tidal energy far away from sea.



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Image courtesy of Pannonia



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Biomass Energy

Utilizing orange peels for obtaining ethanol can create sources for transportation.



Total production of orange in Valencia city: 1.61 million tons

Exports: 0.1864 million tons

Consume: 0.746 million tons —————→ 0.425 million tons orange peel can be obtained



According to this 4,675,000 gallons of ethanol can be produced as 200 proof.

A facility for processing ethanol costs 25-30 million dollars with a capacity of 100 million gallons;

Amount of energy can be generated is 396 TJ.

Procedure to Estimate Amount of BE

Energy Content from gasoline (34.2 MJ/L)

Energy Content from ethanol (22.57 MJ/L)

Amount of orange production (1.6million tons)



Rate of residue's weight (57.6%)

Amount of residue (0.425 million tons)



Amount of ethanol from unit of residue (11 gal/l)

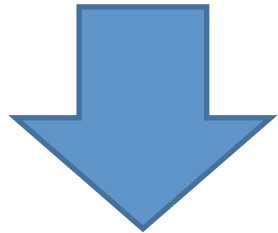
Amount of energy content in bioethanol (BE) is...

395.7 TJ

Procedure to Estimate Amount of Demand

Population in Spain (46.81 million)

Amount of energy use for transportation in Spain (338.88 TJ)

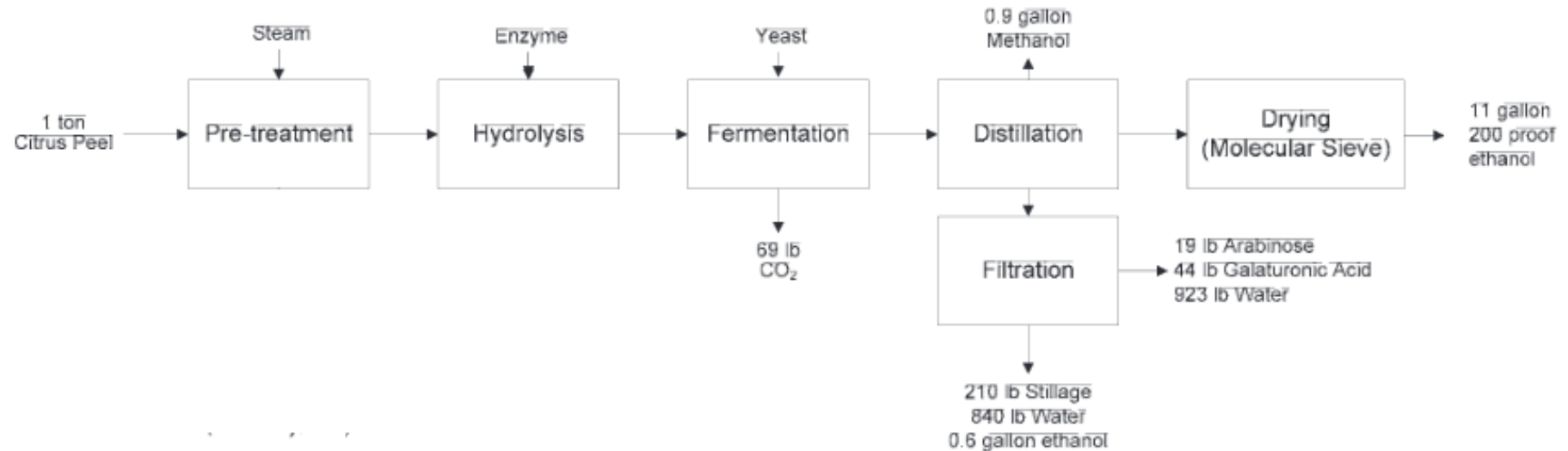


Population in Valencia city (8 million)

Amount of energy use for transportation in Valencia city is...

579.2 TJ

Process for obtaining bioethanol



With this process ethanol costs 1.23 \$ per gallon¹ which is 3 times cheaper than gasoline. Environmentally more friendly solution.

200 Proof ethanol which is pure ethanol more efficient than corn and rice source ethanol Supplies from the aspect of purity.

¹Weyang Zhou, Economic Analysis of Ethanol Production from Citrus Peel Waste, Proc. Fla. State Hort. Soc.120: 2007. Proc. Fla. State Hort. Soc.120:310–315. 2007.

Biomass Energy

Utilizing rice stalk for obtaining ethanol can create sources for transportation and generating electricity.

According to literature it is achieved to obtain ethanol using rice stalk cost 0.45\$ in Vietnam.

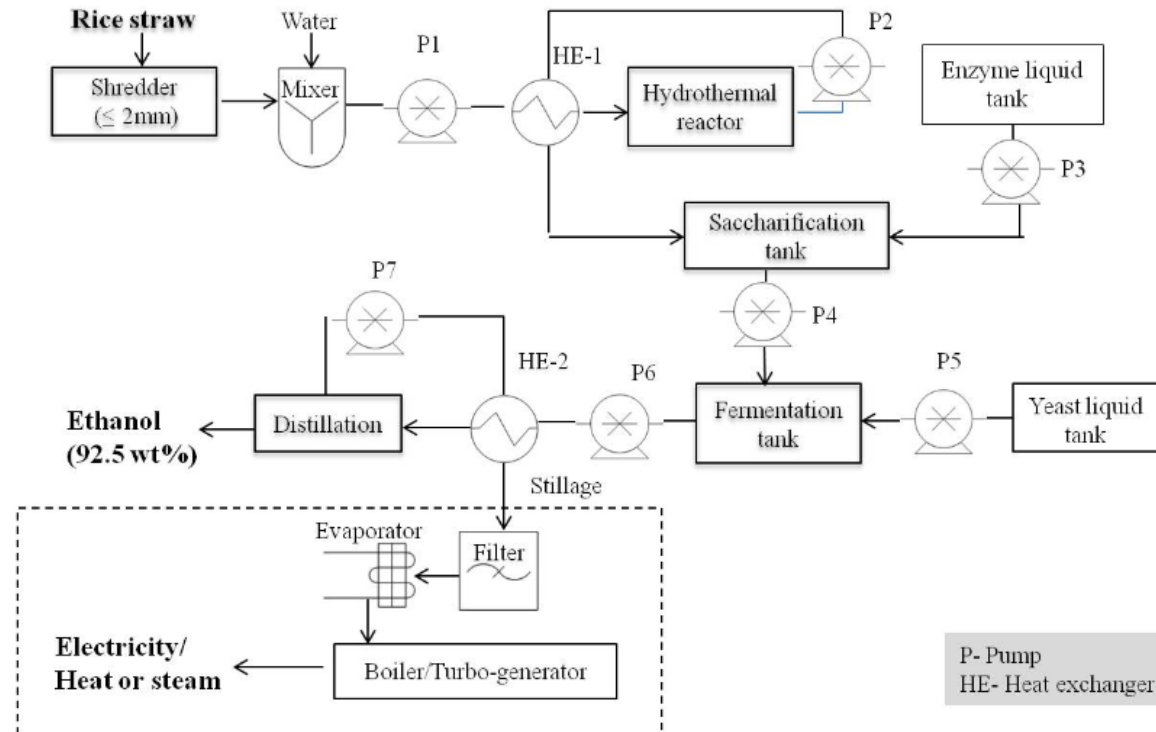


Figure shows the steps for obtaining ethanol using rice stalk.

Also using rice stalks for incineration is an option for producing electricity and heat energy.

Conclusion

- Valencia is a city that heavily relies on foreign energy supply
- Based on results Valencia could increase its self sufficiency by using the residues of one of its agricultural products, helping the city to achieve European renewable energy supply standards.