Elqui Global Energy

Chile: Nopal Cactus as Biomass for Alternative Energy

by Leslie Kleiner

Sources of alternative renewable energy are of current interest worldwide. To learn more about Nopal Cactus as a biomass source for biogas production in Chile, I interviewed Sandra Mella MBA, commercial engineer) and Rodrigo Wayland ,food engineer, from Elqui Global Energy , Santiago, Chile.

Q: What is bioenergy, and how can Nopal be used to provide it?

A: Bioenergy is energy produced from organic and/ or industrial waste; generally this waste contains living organisms and their by-products. Bionergy is obtained from applied technology for the development of "non-conventional renewable energy" (NRCE). Biodiesel, bioethanol, and biogas are some examples of biofuels obtained from biomass and NRCE technology.
In this sense, biomass is the set of renewable organic material (plants and/ or animals and/or their respective natural or artificial transformation products). The biomass can be obtained from waste or by culturing it, and can have various sources such as corn, sunflower, and nopal to list some agricultural sources.

Nopal or prickly pear, (*Opuntia ficus indica*) is a cactus plant species that grows in warm, arid and semi-arid regions, such as those encountered in Chile. This plant is highly resistant to extreme temperature variations, requires very little water compared to other crops, and its agricultural implementation is quite simple.

Q: Is there large scale production of Nopal cactus bioenergy in Chile? What are its advantages over other biomass sources?

A: In Santiago, Chile, in the year 2000, the company Elqui Global Energy built the first biogas plant using nopal cactus as the biomass. The biogas from nopal obtained contains methane (92%) Methane, (7%) carbon dioxide and (1%) hydrogen and other gases, such as nitrogen; its heating capacity is 8,800 kcal/ m^3.

Regarding advantages of nopal biomass for alternative energy, nopal has very rapid degradation leading to rapid biogas production. For example, for the same volume of biogas production and the same usage of equipment, nopal degrades 5-10 times faster than animal manure, leading to higher productivity. Furthermore, nopal biomass does not produce hydrogen sulfide during the process. Other advantages are its low water consumption and its ability to grow in extreme drought conditions. From a workforce perspective, the implementation of nopal as biomass for bioenergy creates local permanent jobs in traditionally rural areas. Local employees can

guarantee 24h x 365 days production at ~ 90% efficeny.

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Q: How does nopal biomass compare to other plant biomasses in terms of fuel and energy produced? How does it compare to other alternative energy production methods in Chile (e.g. wind power, photovoltaic)?

A: This is exemplified in Tables 1 and 2.

Table 1. Equivalent Power for Biomass Sources

Equivalent power

CROP	Efficiency (L/hect-year)	Fuel	Energy (Mcal/hect-year)	Energy Kcal	Relative Energy Efficiency Base: Nopal
Nopal (*Opuntia*)	**52.000 (1)**	**Biogas (1)**	**364.000**	**7.000 kcal/M^3 (2)**	**100%**
Palm	5.550	Biodiesel	51.393	9,260 Kcal / L	14%
Cocotero	4.200	Biodiesel	38.892	9.260 Kcal / L	11%
Higuerilla	2.600	Biodiesel	24.076	9.260 Kcal / L	7%
Avocado	2.460	Biodiesel	22.780	9.260 Kcal / L	6%
Jatropha	1.559	Biodiesel	14.436	9.260 Kcal / L	4%
Rape	1.100	Biodiesel	10.186	9.260 Kcal / L	3%
Soy	840	Biodiesel	7.778	9.260 Kcal / L	2%
Sugar cane	9.000	Bioethanol	45.000	5.000 Kcal /L	12%
Beet	5.000	Bioethanol	25.000	5.000 Kcal /L	7%
Yucca	4.500	Bioethanol	22.500	5.000 Kcal /L	6%
sweet sorghum	4.400	Bioethanol	22.000	5.000 Kcal /L	6%
Corn	3.200	Bioethanol	16.000	5.000 Kcal /L	4%

(1) m^3 Biogas

(2) 75% biogás Methane

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Table 2. Nopal Biomass, Wind Power, and Photovoltaic Energy

Characteristic	Energy nopal	Wind power	photovoltaics
Availability	Continuous 24 X 365 days	Irregular depending on the time of day. 8 hours / day	Irregular depending on the time of day. 6 hours / day
Annual energy / 1 MW installed capacity	8,000 MWh	2,920 MWh	2,190 MWh
KW installed cost	US1400 / KW	US2.200 / KW	US1.700 / KW
Payback	1 to 2 years	5-8 years	8 years
Investment / Energy produced annually	175 (US 1.400.000 / 8.000 MWh)	753 (US 2.200.000 / 2.920MWh)	776 (US 1.700.000 / 2190 MWh)
Type of power generated	Electricity, biogas, thermal (hot water)	power	power
Power generation efficiency	90%	30% of installed capacity on the ground.	10 -20% depending on the cost of cell
Duration equipment	20 years	20 years	20 years
environmental benefit	It generates soil, organic fertilizers. Change the water retaining soil microclimate. Extracted carbon dioxide atmosphere.	It does not emit carbon dioxide. neutral effect on the environment.	Not generate carbon dioxide. neutral effect on the environment.
environmental damage	Unknown	High impact on bird migration routes, noisy energy production by aspas.Visualmente aggressive.	Batteries and cell construction is highly polluting.
Availability of spare parts	Available in domestic market immediately.	They must be imported	They must be imported dependence importer and distributor.