BIO-ENERGY in CENTRAL AMERICA

"Market survey of the Costa Rican bio-energy sector, with additional information on market opportunities in El Salvador and Panama"

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de los Países Bajos

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EXECUTIVE SUMMARY

Origin of study

This report presents the results of a sector study for bio-energy sources in Central America, specifically Costa Rica, Panama and El Salvador. The study was commissioned by the EVD in The Netherlands (Ministry of Economics), coordinated by the Royal Netherlands Embassy in Costa Rica and executed by Transfer Latin Business Consultancy and BUN-CA.

Goals

The goals of the study are to map the Central American market for bio-energy sources (biomass, biogas) and to assess resulting business opportunities for Dutch providers of both equipment and technology in this area. Costa Rica forms the centre point of the study, the main bio-energy issues for Panama and El Salvador are also described in the report.

Costa Rica

The 'República de Costa Rica' with approx. 4 mln inhabitants is Central America's most prosperous country. The country experiences steady growth and has a GDP per capita of $ 4.116. The country is abundant in natural resources, a strong agro and agro industrial sector and boosts the world's largest percentage of area dedicated to national parks.

El Salvador

El Salvador counts approx. 6.4 mln inhabitants, with a large concentration in the capital San Salvador. After a turbulent civil war period, the country has been highly successful in rebuilding its economy around agro-industry, services and tourism. GDP per capita stands at $ 2.200 and will no doubt go up due to foreign investment and continuous economic growth.

Panama

The 'República de Panamá' is well known for its oceans-connecting canal. With close to 3 mln inhabitants, the country is relatively well off with a GDP of $ 3.600. Panama has a large tradition in trade (free-trade zones) and agro industrial activities. It also has developed a strong service industry, pushed by foreign investments in telecom and informatics.

Strong growth in energy use…

Economic growth in most Central American countries is expected to pick up in '03-'04, due to increased exports and foreign direct investment. The demand for electricity in the region is expected to grow between 5-6% yearly for the coming 10 years.

… will require private investment

The region faces pressures on their existing power supply systems, mostly public in nature. A lack of public funds to invest in upgrades, will make it necessary for governments to invite the private sector. El Salvador and Panama currently seem more open towards private sector involvement than Costa Rica, although this might change in the coming years.

Renewables could play an important role…

The use of more renewable energy would be an important step forward in achieving better environmental conditions in the region, as well as take advantage of a readily available pool of natural resources, which many people currently consider as waste.

… although ample experience exists

Hydroelectricity has historically been the most important renewable in the region. Costa Rica counts with an installed hydro capacity of approx. 1.150 MW. This equals 80% of the country's electricity generation, while another renewable, geothermic, provides 15%. Panama receives 49% of its electricity through hydro, and El Salvador counts with 34% hydro and 14% geothermic as generation sources.

Biomass and biogas look promising…

The climate and soil conditions provide Central America with ideal conditions for agriculture and a strong agro-industrial base to process organic materials is already in place. The natural waste coming from agriculture (bagasse, coffee, rice husks, wood, excrements) and industry (waste water, sludge) contains a high caloric value which is not fully taken advantage of.

… but legal framework still impede boost

Legislation for private generation exists, but apart from use for self supply, a contract with the national state electricity company is needed. Costa Rican law does not allow for private generation to constitute more than 15% of the country's total potential. El Salvador and Panama have less restrictions. There remains a debate on tariffs and more private sector involvement, although necessary, depends on each country's rules of play.

Opportunities for biogas projects exist…

A first biogas-from-landfill project in Costa Rica (Río Azul) looks very promising. Surrounding countries have shown concrete interest to develop more of these projects. A huge potential also exists in the area of waste water from agro industry for which a case study is included in the report. Additional opportunities exist for biogas projects at large cow and pig farms.

… biomass already presents additional growth potential

Even though Costa Rica and neighbours boost a huge production of bagasse, wood and other agro products, the market for biomass applications has yet to take off. More restrictive environmental legislation is slowly forcing companies to adopt new technologies. However, the most important reason for investment remains cost reduction. Reusing organic material prevents waste, at the same time saving water and generating steam or electricity.

Main challenges in cost-effective solutions

Apart from legal restrictions, the main barrier for growth in the application of renewables to date is the high upfront investment of installations for cooperatives and agro-industries. Therefore, cost-effective solutions for biomass/biogas applications that start at a relatively small scale, but are expandable, are interesting for the Central American market. Also, once the private sector is allowed to produce electricity and sell its surplus at attractive rates to the market, a boom is expected in generation projects, all from renewable sources.

Apparent contradictions exist…

In the dry season Costa Rica's state power company produces electricity for peak demand from non-renewable sources (natural gas, oil) that have to be imported. The cost of importing and the fluctuations in world prices make the country less independent and also takes its toll on the country's dollar reserves. The argument is even more important for El Salvador and Panama. At the same time local producers harvest the sugar cane crop and could perfectly substitute the thermal plants by co-generating their bagasse.

… which add to future opportunities

Due to changing energy and environmental policies and an increasing public sector push to become less dependable on outside sources for thermal generation, a potential market is developing for renewable sources of energy. The report describes several case studies and concrete market opportunities in which companies and institutions show interest in contacting with Dutch technology providers and potential cooperation in projects for mutual benefit.

Next steps

In order to take advantage of the existing market opportunities a number of possibilities exist for Dutch entrepreneurs. A combined effort by Dutch industry would certainly be most effective in generating concrete projects. Proposals for a business fact finding mission should be considered for those Dutch providers of cost-efficient solutions related to the business opportunities that are described in the report.

INTRODUCTION

This report presents the results of a sector study for bio-energy sources in Central America, specifically Costa Rica, Panama and El Salvador. The study was commissioned by the EVD in The Netherlands (Ministry of Economics) and coordinated by the Royal Netherlands Embassy in Costa Rica. The research was carried out by TRANSFER (The Netherlands) and BUN-CA (Costa Rica).

The research was executed with a dual purpose in mind: firstly mapping the Central American market for bio-energy sources (biomass, biogas), secondly, to assess resulting business opportunities for Dutch providers of both equipment and technology in this area. The report focuses on developments in Costa Rica and to a lesser extent also provides information on El Salvador and Panama (see chapter on Methodology for details).

Since 1996 TRANSFER Latin Business Consultancy has been leading in supporting European exporting companies and government organisations looking to study market opportunities in the Spanish and Portuguese speaking countries of Europe and Latin America. Contracted by EVD, Chambers of Commerce, trade or sector organisations, Dutch Embassies and of course exporting companies, TRANSFER provides essential services for successful market entry in close co-operation with local partners. In the recent past, TRANSFER has engaged in a number of studies in the field of renewable energy sources and environmental technology in Brazil, Central America, Mexico, Portugal and Spain.

Biomass Users Network, Inc. (BUN) is a non-governmental organization, founded in 1985 by leaders from various developing countries who recognized that sustainable use of natural resources promotes comprehensive development of urban and rural communities and is a source of income for local economies. The mission of BUN is to improve the production and rational use of natural resources, to promote energy efficiency and the use of renewable energy sources, as a means to achieve economic development, and social well being, especially in rural areas. In 1991, the Central American regional office was established in San José. Today, BUN-Central America (BUN-CA), has established its presence in Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.

The authors are grateful to the different interviewees for their valuable input and cooperation.

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METHODOLOGY

Structure

The general structure of the report was laid out by the EVD of The Hague in cooperation with the Embassy of The Netherlands in Costa Rica. The main focus was to research the Costa Rican market, as it is most developed in terms of renewable energy use within Central America. The research with regard to Panama and El Salvador was restricted to more general observations of the market for renewables and possible resulting market opportunities. It is important to stress the fact that this report is a starting point for Dutch companies to take advantage of arising market opportunities in Central America in the area of renewable energies. For any Dutch company that wishes to enter local projects, it is recommended to analyse each specific situation in more detail before contacting counterparts.

The report will provide the reader with information regarding:

- Background of Costa Rica, Panama and El Salvador
- Growth in energy sector
- Legal issues and barriers for renewable energy sources
- Market segments of biomass and biogas
- Overview of projects in bio-energy
- Market opportunities for Dutch companies

To provide as much clarity as possible, the first chapters of the report exclusively deal with Costa Rica. Then El Salvador is discussed, followed by Panama. For the more general chapters on technology providers, Central American projects and government programs, information about all three countries is collectively presented.

Approach in Costa Rica

Besides the gathering of international and national publications regarding the sector, more than 40 interviews either personal or by telephone were conducted with decision makers from a variety of sources. The goal was to provide an in-depth overview of the potential of the sector from as many perspectives as possible. The interviewees come from:

- Ministries
- Local municipalities
- Businesses
- Technology providers/distributors
- Universities
- Sector organisations
- Semi-public organisations
- Independent consultants

Approach in El Salvador and Panama

Also for these countries a large amount of international and national publications were screened on the potential for renewable energies. Besides, interviews were held with key contacts in the area of renewables. The research in both countries was carried out by local representatives of the BUN-CA network.

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CAFTA	Central American Free Trade Agreement
CAUCA	Central American Uniform Custom Code (Spanish acronym)
CCAD	Central American Commission on Environment
COD	Chemical Oxygen Demand
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GNP	Gross National Product
GWh	Gigawatt/hour
IADB/BID	Inter American Development Bank
IMF	International Monetary Fund
kWh	Kilowatt/hour
MW	Megawatt
NAFTA	North American Free Trade Agreement
TJ	Terajoule
UNDP	United Nations Development Program
US	United States (of America)

COSTA RICA IN A NUTSHELL

Official name	República de Costa Rica
Capital	San José
Government	Democratic Republic
President	Abel Pacheco de la Espriella (since 8 May 2002)
Religion	Roman Catholic 76.3%, Evangelical 13.7%, other 6.8%, none 3.2%
Literacy	95.5%
Population	3,8 mln (2002)
Area	Total: 51,100 km^2, includes Isla del Coco (1,25 X size of The Netherlands)
Currency	Colón
Exchange rate	400 Colones (¢): 1 US$ (July 2003)
GDP	16.8 US$ billion (preliminary 2002)
GDP per capita	4.116,9 US$ (preliminary 2002)
Unemployment	6.4% (July 2002) plus considerable underemployment

Key Economic figures	2001	2002	2003 (F)
Real GDP growth (%)	1,1	3,0	3,3
Consumer price inflation (%)	11,0	9,7	10,0
Exports FOB (US$ mn)*	5.021	5.253	5.442
Imports CIF (US$ mn)*	6.569	7.175	6.676

F = Forecast (Programa Monetario 2003, Banco Central de Costa Rica)
* Includes Free Zone's regimes (electronics)

Summary
Costa Rica's basically stable economy depends on tourism, agriculture, and electronics exports. Poverty has been substantially reduced over the past 15 years, and a strong social safety net has been put into place. Foreign investors remain attracted by the country's political stability and high education levels, and tourism continues to bring in foreign exchange. However, traditional export sectors have not kept pace. Low coffee prices and an overabundance of bananas have hurt the agricultural sector. The government continues to grapple with its large deficit and massive internal debt and with the need to modernize the state-owned electricity and telecommunications sector.

Economic performance
During the previous decade, Costa Rica made significant progress in opening its trade system and social conditions, especially education and health remained among the best in the area. These factors, together with a long history of political stability, attracted foreign direct investment, diversified exports, and sustained real GDP growth around 4,5% from 1990 to 1999, while inflation declined from 27% in 1990 to 10% nowadays. However, successive governments met strong political resistance to their efforts to reduce the overall public sector deficit on a sustained basis and total public debt. Progress in implementing structural reforms, besides trade liberalization, has also been limited.

During the 90's, the economic performance weakened. Real GDP growth slowed from the 8% a year ('98-'99) to 1% (2000). This negative evolution during 2000 to 2001 reflected in part a deterioration in terms of trade, the end of the construction phase of large Foreign Direct Investment (FDI) projects by chip maker Intel and the effect of high interest rates on domestic demand (IMF, 2002). However, 2002 and the beginning of 2003 show a slight increase (around 2% to 3%).

As a result of Intel's production in Costa Rica since 1998, a large gap has emerged between GDP and GNP. Foreign direct investment in the 90's has let to profit remittances equivalent to 8% of GDP. The growth in real GNP rose to 9% in 1998 and showed no growth in 1999 and 2000 as profit remittances picked up. As a result, production in Costa Rica is since then evaluated in two ways: including Intel's activity and (GDP) and excluding it (internal income).

The recent dynamism in GDP is due in part to the recuperated rhythm of electronic production and to a considerable growth of the already important public expenditure (fiscal deficit ascended in 2002 to 5.4% of GDP, from a 2.9% in 2001) (CEPAL, July 2003). This situation has forced the Government to a stronger control of the monetary sector in order to maintain the internal and external stability.

Inflation has reached in 2002 9,7%, less than the original Central Bank's goal and the same two digit figure is now expected for 2003. In order to maintain the external competitiveness of Costa Rican export products, the daily rate of adjustment of the exchange rate has been gradually incremented. Costa Rica has adopted a "Minidevaluaciones" policy: a daily fixed adjustment of the exchange rate colones/US$ (crawling peg) has been carried out by the Central Bank in order to depreciate the colón to offset the differential between the domestic inflation and estimated foreign inflation (Actualidad Económica, July 2003).

Foreign Direct Investment (FDI) grows

The external sector shows in recent data important variations. During 2002 foreign investment increased 68,2 compared to 2001 data. This phenomenon positions the US$ 642 million of FDI as a historic level. In this evolution has been extremely significant the purchase of Heineken International from The Netherlands of the 25% (US$ 218 million) of Florida Bebidas S.A., a subsidiary of the national company Florida Ice and Farm. The exports reached in 2002 the 31.4% of the GDP and shows a considerable 7.2% annual growth. This behaviour reflects an important change after the 25% drop perceived during 2000-2001, due to the external difficult situation of world economy that had an important negative effect on the exports of agricultural traditional products.

Costa Rican efforts to diversify its productive structure have led to a particular combination of exportable goods. Traditional agricultural products such as coffee and bananas (15% of total FOB exports) have taken nowadays a secondary role in the "top export products" ranking. Non traditional industrial exports (electronic micro-components, medicines) and agricultural (flowers and ornament plants, pine apple, melon) occupy nowadays an important place in Costa Rican export force.

Importance of Trade

In 2002 three new Free Trade Agreements were implemented (Chile, Canada and Dominican Republic) as well as two promotion and reciprocal protection of investments (Switzerland and Republic of Corea). Furthermore, the negotiations for new agreements with Panama and Trinidad and Tobago continue. Preparatory activities for a Central American Free Trade Agreement (CAFTA) with the United States started. Costa Rica expects to obtain important advantages after the successful first negotiation round: this instrument represents a greater legal security for the access of Costa Rican products to the US market, as well as the growth of the American and other countries' FDI into the domestic market and the assembly industry.

Trade with the US is extremely relevant for Costa Rican exports structure (around 50% of Costa Rican exports and imports were related to the US in 2001) (Netherlands Embassy in Costa Rica, July 2003). The second partner is the Central American region, followed by the EU. Among European countries the Netherlands and Germany occupy a very important place. According to the Foreign Commerce Promoter data, the Netherlands are, after the US, the second destiny of Costa Rican products (6% or US$251,2 million in 2001). These trade is mostly composed by electric and circuits modules (65%), plants, fruits and coffee. Dutch Foreign Investment in the country has grown during the last two years (specially through the Heineken acquisition). After the US, and at a large distance, the Netherlands have recently positioned themselves as the second international investor and trader in Costa Rica. With regard to FDI in the renewable energy sector, no clear examples are known. One or two projects are known where US companies have invested in Costa Rican hydro power plants, but no foreign investments in bio-energy capacity are known. In some cases, foreign aid agencies support local projects (see for example the case study on Río Azul further on) in bio-energy, whoever these cannot be counted as FDI.

Structural reform process under pressure

New Presidential elections were held in 2002 and actual President Abel Pachecho, from the Partido Unidad Social Cristiana, has promised poverty reduction, growth, jobs, restructuring of the energy and telecommunications sector and fiscal reform among other things. However, in mid-2003 his government has difficulties delivering on most promises, as governmental cabinet has suffered multiple transformations and congress nature and conformation does not allow speedy reforms. The proposals for tax reform have become a failure as well as the rest of economic and structural reforms. In particular the new agenda of the reform of the telecommunication and electricity sector has not been agreed on, after the failure of the opening of energy and telecommunications market to foreign and private investment in 2001. Strong popular opposition and an unfavourable supreme court ruling stopped this reform. The new administration has manifested its intention in furthering roads, airports and ports concessions but not their privatisation.

View of San José, Costa Rica's capital

ENVIRONMENTAL ISSUES AND LEGISLATION COSTA RICA

Costa Rica is well known for its natural parks, biodiversity and projects that put sustainable development into practice. Behind the green image however, the country faces several environmental issues (Estado de la Nación, October 25 2002). Deforestation remains an important challenge for the government, as illegal logging in natural parks and protected areas increases year by year. A large extension of protected area, approx. 1,1% of national territory, is privately held and the government owned a cumulative debt of $ 55 mln in 2002 to private owners for forest management and protection.

The increasing pressure of urbanisation, industry and agriculture has put a strain on the chances of survival of many threatened species, some of which can only be found in Costa Rica. A positive development is the growth in biological corridors through which animals can migrate more freely, these projects are among others financed through the United Nations Development Program (UNDP).

According to surveys, the environmental awareness of the average Costa Rican or *Tico* (as Costa Ricans use to call themselves) could also be improved, projects for recycling, energy saving or responsible waste disposal have great difficulties in getting of the ground. An important problem are the illegal deposits of waste, especially plastics are often transported nationwide through the extensive river system. Also, the metropolitan area of San José (1,5 mln inhabitants) has no serious waste water treatment system in place, all sewage water is directly discharged into the river system with all corresponding problems. The big rivers Virilla and María Aguilar which run through San José are virtually 'dead'. Contaminated aquifers and illegally drilled wells form a serious threat to the availability and quality of (drinking) water. Air pollution is especially present in the metropolitan area. With 70% of the country's cars and 85% of industry in this area, the amount of air pollution is staggering. Even the introduction of lead-free gasoline in 1996 has done little to improve air quality. Pilot projects are currently initiated to mix gasoline with naturally derived ethanol to create a less contaminating fuel.

Overfishing in Costa Rican territorial waters and the run-off of contaminated ground waters have taken its toll on the quality and amount of fish on both on the Pacific and Caribbean coasts. The fishing law, last changed in 1948, needs an urgent update to prevent any further damage. Due to the heavy raining season and increasing radical weather changes (El Niño), Costa Rica has always experienced floodings and natural disasters. However, in 2001 close to 72% of floodings and 74% of land slides could not be accounted for by extreme weather, they were men induced through such reasons as bad planning, insufficient urbane discharge systems and clogging waste.

There are also many positive developments in terms of reaching a more sustainable development in Costa Rica, especially if compared to other Central American countries. An extensive national park system and protected areas related to a high hydrological potential have created a tradition of nature conservation. The country has the highest GDP in the region which leaves room for environmental measures, companies increasingly understand the advantages of cleaner production practices, a large number of biodiversity and nature conservation projects are executed yearly, the sale of carbon credits has given rise to innovative environmental projects (Castro Salazar, May 25, 2003). Well established education campaigns to protect natural resources and growth in responsible eco-tourism projects have made more and more inhabitants aware of the value of 'green'. Additionally, the provision of different environmental services (including debt swaps for nature, green tax to gasoline consumption, etc.) put the country at the frontline of 'best practices' in sustainable development.

The next chapter explains the historical importance of hydro power in Costa Rica and the challenges of other renewable energy sources to play a more significant role in the country's electricity production. First, the most important environmental laws currently in place, are listed in summary form.

Table 1: Main environmental legislation of Costa Rica

Type	Number	Name and Description
Laws	Law No. 276	Law of Water: States public dominion for water use. Water concessions include (wells, irrigation use, electricity production, etc).
	Law No. 5395	General Health Law: General health bylaws stating that health public interest protected by the State. Title III. It is referred to the Environmental Pollution, Disposal and Management of Solid Residues (Chapter II). Residential and industrial waters (Chapter III) Restrictions for human use and avoidance of the environmental contamination (Chapter IV) Industrial Activities (Chapter V).
	Law No. 7554	Organic Law of the Environment: "it deals with the rational use of the environmental resources in order to protect the quality of life of the Costa Ricans". Article 17. Evaluation of the Environmental Impact by the Secretary of National Environmental Office. Article 60. Prevention and Control of the contamination. Article 62, refers to atmospheric contamination. Articles 64 to 71 refer to contamination of water and soils.
	Law No. 7575	Forest Law: "it comprises technical norms that regulate the actions by developing forest plantations according to the rational principle of use of the renewable natural resources guaranteeing the sustainability of the resource". Law 7575 also includes the forest certification procedures and the environmental services payment plan.
	Ley No. 7788	Law of Biodiversity. The concept of biodiversity, and the protection of information knowledge on biological diversity. Article 7 defines the evaluation of the environmental impact and its importance to determine the effects to the environment by any activity. Article 92. Application of the Environmental Impact Assessment (EIA)
	Ley No. 7317	Wild Life Conservation Law: It refers to environmental management of wildlife and flora. Articles 26,82,132 to the EIA.
Decrees	DE-26435	Regulations to the Law of Conservation of the Wildlife.
	DE-25721	Regulations to the Forest Law.
	DE-25705	Procedures of the Environmental National Technical Office (SETENA). The present regulation considers the requirements and procedures by which the presentation will be governed and approved for the execution of activities that alter or destroy elements of the environment or generate residues, material toxic of impact in the environment, without diminishing the role to other institutions of the State.
	DE-26042	Regulation of disposed and re-utilisation of Residual Water: Limit permissible of DQO, DBO as well as the features to install the systems of water treatment and processing.

Elaborated by BUN-CA

Many of Costa Rican's environmental laws follow the framework as set by the American EPA (Environmental Protection Agency), however, the actual permitted levels of a certain pollution may vary. In general, experts agree the environmental legislation to be sufficiently advanced to push companies to adapt process improvements and environmental technologies to limit their impact on the natural environment. However, the most difficult problem is to have companies complying existing laws, especially with a small number of environmental inspectors. For example, even if a company is suspected of illegally draining waste water into a river, is difficult to prove the case and if convicted, the company pays a relatively small fine.

In the last five years, both control and the level of fines have been raised significantly, and as public opinion plays an ever increasing role in a company's image, a positive change can be noted. The most important area of environmental control in Costa Rica is waste water, all production companies are now controlled and in order to be permitted to produce all must possess some kind of waste water treatment solution. This forms an increasingly interesting market opportunity for Dutch companies with integrated and low-cost solutions as will be further explained in this report.

POWER GENERATION AND ROLE OF RENEWABLES

Costa Rican tradition of renewable energy use

Costa Rica is a country with an almost unlimited potential of renewable energy sources. The country also has a large tradition in the utilisation of renewables in generating electricity. It was engineer Victor Manuel Dengo who installed the first hydro-electricity plant in Costa Rica in 1884 and in the process provided San José as one of the first cities in the world with electrified illumination. The large tradition of development of renewable energy sources was continued by the state's national electricity company ICE, CNFL (the distributing company in San José metropolitan area) and other regional distribution companies. Recently, with the added generating capacity from the private sector, Costa Rica boosts the largest electrical system in Central America (Alvarado, April 2001).

The National Energy Plan 2002-2016 sums up the government's general views on energy policy (DSE, February 2003):

1. Maintain the role of the state in activities related to the utilisation of energy resources
2. Assure development of energy to contribute to maintaining social, economic and political equilibrium
3. Protect the national sovereignty and prevent excessive dependency on external resources
4. Maintain and improve the quality of life of the Costa Rican society.

It is even stated in the Political Constitution that: "… the State must always exercise its power over a) the potential of water/rivers in public domains and national territory, b) the carbon deposits, oil wells and any other hydrocarbon substances, as well as any mineral (radio active) deposits within the national territory…". The common objective of the government is to "assure the provision of sufficient energy for the integral development of Costa Rican society". This has lead to the remarkable feat that today over 97% of Costa Rica's residencies have access to electricity.

Strong growth expected in energy use

As can be seen in the table below, the expected growth of energy consumption will put a huge strain on resources. The combination of a desire to be self-sufficient in energy and a large tradition of public production and distribution capacity, explains in part the difficulties for private companies to enter the market for renewable electricity production, even though from a capacity point of view it would be necessary (La República, June 13, 2003). This issue will be dealt with in more detail in the chapter on legislation and structure of the energy sector.

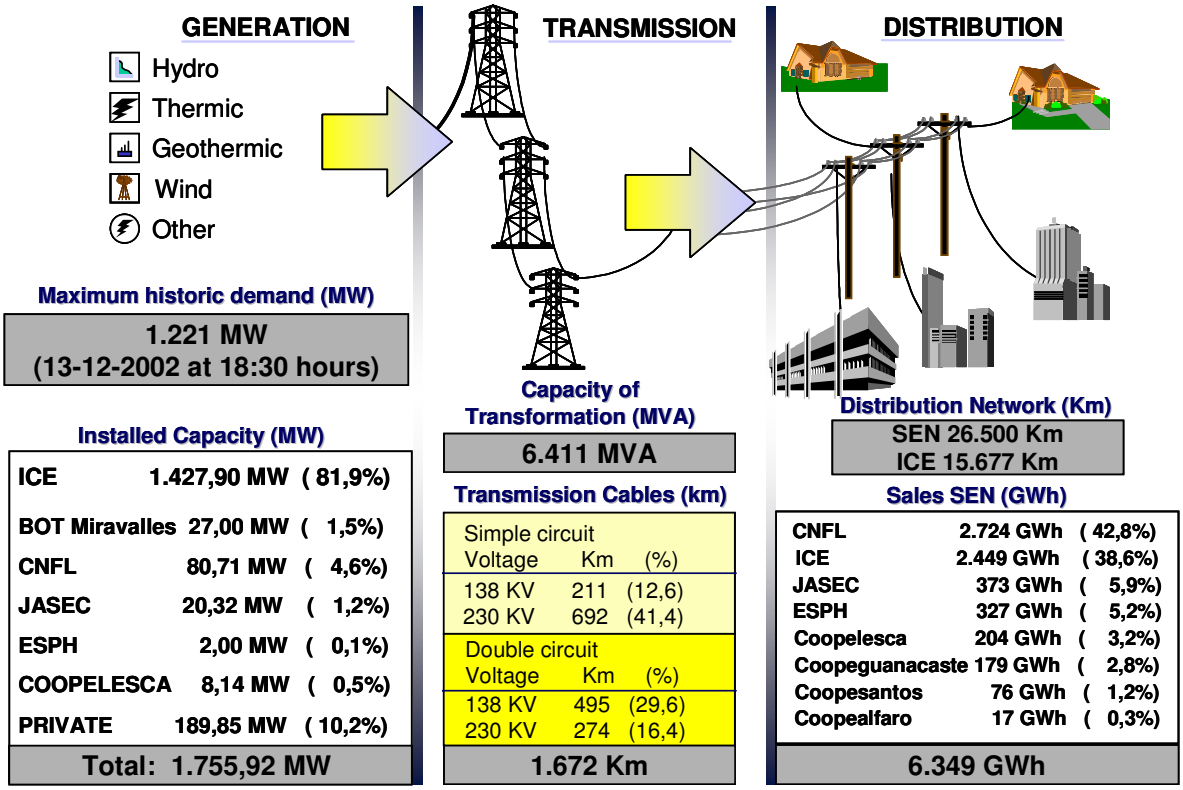
Table 2: Expected growth in energy consumption in Costa Rica

Year	Residential	Commercial	Public	Services	Transport	Industry	Agriculture	Other	Total	ICE	TOTAL
2002	13.954	4.840	1.038	2.890	52.670	22.201	4.569	8.016	110.178	3.503	**113.681**
2005	15.740	5.584	1.170	3.346	58.215	23.811	4.955	8.805	121.626	3.503	**125.129**
2010	20.319	7.176	1.456	4.366	69.389	27.738	5.701	10.129	146.274	8.347	**154.621**
2016	28.605	9.780	1.887	5.932	87.831	33.866	6.800	11.672	186.373	7.710	**194.083**
Av. growth/year	4.9%	4.8%	4.1%	4.9%	3.5%	2.9%	2.7%	2.5%	3.6%	5.4%	**3.6%**

Source: DSE, Dirección Sectoral de Energía (February 2003), elaborated by Transfer

The next figure gives an overview of the different actors, and generating and distributing capacities in Costa Rica's electricity sector.

Figure 1: Actual situation Electricity Sector in Costa Rica (December 31, 2002)



Explanations: CNFL, JASEC, ESPH, Coopelesca, Coopeguanacaste, Coopesantos, Coopealfaro are all regional electricity distribution companies, some also have generation capacity. BOT Miravalles is a geothermic installation conceived under a concession model (BOT). SEN = National Energetic System.
Source: ICE (April 9, 2003), translated by Transfer

ICE is Costa Rica's main producer of electricity with about 82% of total generating capacity. The following table splits out the sources of its generating capacity. The importance of hydro as an input source is evident.

Table 3: ICE's installed generating capacity (December 31, 2002)

Source	Capacity (MW)	% of total	Plants
Hydro	1.018,68	71,3%	16
Thermic	274,19	19,2%	5
Geothermic	115,00	8,1%	3
Wind	20,00	1,4%	1
Total	**1.427,87**	**100%**	**25**

Source: ICE (April 9, 2003), elaborated by Transfer

As ICE does not produce up to full installed capacity, the actual generating mix is even more to the advantage of hydro power. At the end of 2002, 81,5% of actually generated power by ICE came from hydro, 15,4% from geothermic, 2,1% from thermic sources and 1% from wind. It can safely be concluded that Costa Rica boasts one of the highest percentages of renewable energy use in Latin America if not in the whole world. The next chapter will look at the legal structure of the sector and barriers for private producers to generate electricity from biomass sources.

STRUCTURE AND LEGISLATION ENERGY SECTOR

The public sector related to all energy and electricity matters is headed by MINAE, the Ministry of Energy and Environment. Apart from the crucial function of guaranteeing sufficient electricity capacity at acceptable prices, it presides over ICE, the national electricity producing company. The historic importance of ICE within the Costa Rican society explains the fierce opposition to deregulation of the energy sector, let alone privatisation. Apart from ICE also distributing company CNFL (95% owned by ICE) and other regional distributing companies are state monopolies. Although even between these organisations an occasional power battle takes place, they still form an important block towards the government. Led by ICE, these organisations have an important influence on the direction and speed of deregulation.

With regard to the regulatory framework of the electricity generation and distribution sector, the Autoridad Reguladora de los Servicios Públicos (ARESP), stands out. This watchdog's function is to keep a close eye on rate hikes and quality of service of all public services. It is also in charge of fixing the yearly rate for what ICE has to pay to the private sector. In practice, this institution is said to lack power, as it is also publicly funded and no competition exists in the market, due to ICE's monopoly.

Subsequent steps over the years have been taken to slowly liberalise the sector. Also an impulse was given to the application of biomass, as many small companies and cooperatives exist with a large potential of natural resources to generate electricity for self-sufficiency. However, many restrictions remain to date.

The current situation with regard to private initiatives is as follows:

1. Generation for self-sufficiency (autoabastecimiento / autoconsumo)
   a. for an individual company: examples include small installations for the use of biomass, mini-hydro, wind or solar power, often in remote areas for domestic electricity or water pumps;
   b. for a group of companies: a holding which has a daughter company producing electricity may give or sell this electricity to other daughter companies. This scheme is especially attractive for those companies that consume a lot of electricity during peak hours.
2. Co-generation: for companies that either produce sub products in their processes with high caloric value that could be burned or gassed to generate electricity, either for geothermic or small wind power applications. All applications should work again for self-sufficiency. The application for biomass in the sense of direct burning of trees, organic waste, etc. to generate electricity is not part of the above definition.
3. Small production: it is allowed to set up power plants between 2 - 20 MW, but the company is only allowed to sell the electricity to ICE, the national electricity company, from which it first has to get a contract. Costa Rican law allows for a maximum of 15% of total electricity demand to be generated privately. See further on for other barriers.
4. Export of electricity: to date, only one company has been granted the right to export its electricity. This is Ingenio Taboga, which exports 11,7 MWh to ENEL, Nicaragua's electrical power company.

Not all of the above possibilities for generation have explicitly been regulated. Existing legislation for the energy sector in Costa Rica is summarised at the end of this chapter.

The actual price mechanism for deciding on the marginal cost that ICE pays to other electricity producers is unclear and differs from situation to situation. At peak times ICE will pay more per kW than off-peak, also the dry or wet season influence the prices. The prices charged to its clients also differ on these factors, as can be witnessed in the following table.

Table 4: Price of electricity for end user

Type of end user	Average (kWh)
Domestic – dry season	$0.108
Domestic – wet season	$0.104
Industry – dry season	$0,034
Industry – wet season	$0,033

Average exchange rate of 380 colones for 1 US$. Monthly fixed fees apply for industrial users.
Source: DSE, Pliego Tarifario del ICE, 2002, elaborated by Transfer

As the law obligates ICE to pay the lowest possible price to private producers, it is to do date rather unattractive to become an electricity generator to only supply electricity to ICE. Another problem is that ICE might not even be interested in buying electricity from private generators. That at least can be concluded from the complaints of the private sector. The main issue is that every generator has to sign a separate contract with ICE, the state electricity company negotiates with each party differently over quantity and pricing. The following table gives an overview of which companies have actual contracts with ICE and how much they earn on their generating capacity. In total ICE paid out almost ¢ 30.000 mln ($ 78 mln) to private generators, on average they paid ¢ 24,57 per generated kWh or approx. $ 0,05-0,06/kWh. ICE supporters claim that the state company can produce electricity at much cheaper rates and should therefore not stimulate more private generation. More critical insiders claim that ICE does not internalise all relevant costs related to a project, so that marginal costs are artificially low.

Table 5: Overview of private electricity generators (2002)

Companies	ICE pay out (¢ mln)	Capacity (MW)	Tariff (¢ kWh)	Source
Miravalles*	6.551	27,0	29,21	Geothermic
Tierras Morenas	N.a.	20,0	N.a.	Wind
Tilarán	N.a.	19,8	N.a.	Wind
Doña Julia	2.826	16,0	26,67	Hydro
Platanar	2.421	15,0	26,25	Hydro
Volcán	2.243	17,0	29,56	Hydro
Mosava	2.179	N.a.	26,24	N.a.
Pesa	2.161	N.a.	26,83	N.a.
San Lorenzo	2.152	15,0	26,30	Hydro
Don Pedro	2.044	14,0	28,98	Hydro
Aguas Zarcas	1.804	13,1	23,97	Hydro
Río Lajas	1.411	10,0	27,42	Hydro
Aeroenergía	674	4,0	21,32	Wind
La Esperanza	601	5,0	23,79	Hydro
Matamoros	466	4,0	22,43	Hydro
El Viejo Azucarera	N.a.	4,0	N.a.	Biomass
Caño Grande and Caño Grande III	423	4,2	23,61	Hydro
Suerkata	406	2,7	23,51	Hydro
El Angel	400	3,9	19,09	Hydro
Hidrovenecia	313	N.a.	22,98	Hydro
Tuis	216	1,5	21,29	Hydro
Poás I and II	210	1,9	26,35	Hydro
Embalse	210	1,5	21,94	Hydro
Río Segundo II	72	0,7	22,43	Hydro
La Lucha	41	0,4	24,47	Hydro
San Gabriel	33	0,2	23,36	Hydro
Montezuma	29	0,9	16,56	Hydro
Quebrada Azul	17	0,3	18,35	Hydro
Tapezco	12	0,1	22,36	Hydro
Rebeca	7	0,1	18,31	Hydro
Los Negritos	5	0,1	18,84	Hydro
Total	**29.927**			

N.a. = Not available. * Miravalles (geothermic) according to Build-Operate-Transfer (BOT) scheme
Sources: ICE (April 9, 2003), La República (June 13, 2003), elaborated by Transfer

Costa Rican law allows for a maximum of 15% of total electricity demand to be generated privately. From a total demand of approx. 1.300 MW in 2002, this means that ICE could buy up to 195 MW from private generators. Currently, the above producers generate some 173 MW (La República, June 13, 2003). ICE has allowed a new type of projects though, the Build-Operate-Transfer projects, which have already increased 'private' capacity with 27 MW (Miravalles project). The following table gives an overview of which companies have applied for contracts with ICE in the past.

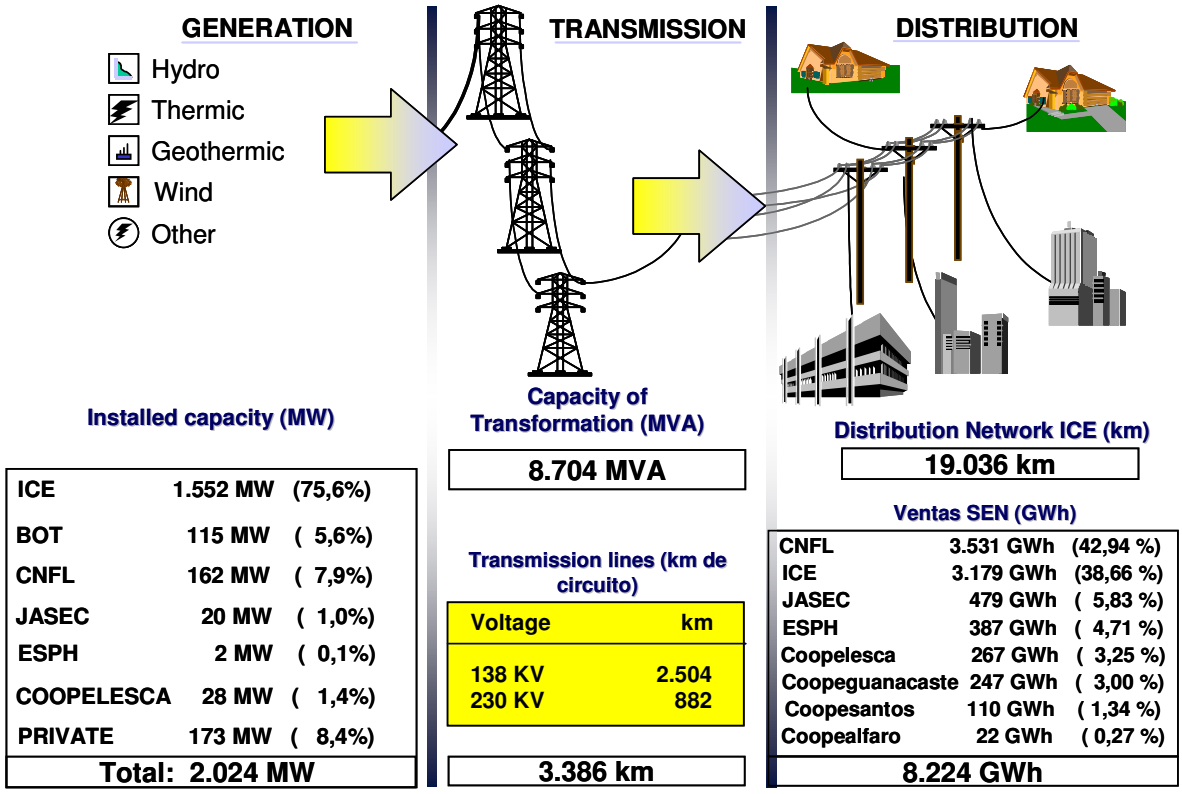
Table 6: Private companies interested in generating electricity

Companies	Capacity (MW)	Permit solicitation
Bagaces	15,0	Sept. '97
Guácimo	12,0	May '99
Río Esquinas	2,7	Apr. '00
Orosi	4,4	May '00
Mena	5,6	May '00
Sábalo	7,7	May '00
Parritón	20,0	May '00
Río Hule	3,3	May '00
Santa Clara	9,0	June '00
La Misión	4,5	June '00
Los Negritos II	1,9	June '00
Caño Grande	0,5	June '00
Singrí	15,4	July '00
Cotón	15,0	Sept. '00
Parismina	7,5	Sept. '00
San Luis II	19,9	Oct. '00
Capulín	20,0	Oct. '00
Bella Vista	20,0	Oct. '00
Noble	6,0	Oct. '00
Angelita	1,0	Oct. '00
Poás El Angel	4,5	Oct. '00
Chuta	0,8	Dec. '00
Río Blanco	13,0	Dec. '00
Corinto	4,2	Jan. '01
Chachagua	4,1	Jan. '01
Caño Grande III	1,4	Jan. '01
El Embalse	0,5	Mar. '01
Las Juntas	0,6	June '01
Parcelas	15,4	Oct. '01
El Viejo Azucarera	5,0	Jan. '02
Florencia	20,0	Feb. '02
Total	**261**	

Source: ACOPE, quoted in La República (June 13, 2003)

ICE has recently acknowledged that it is also delaying negotiations with current contract holders, of whom many have contracts that expire within one or two years. That is a clear sign that ICE is discarding the involvement of more private generation for the coming years. Further evidence can be found in the following figure, presented during an ICE presentation before the National Assembly. Here it becomes clear that ICE foresees the total capacity generated by the private sector to actually diminish.

Figure 2: Future situation Electricity Sector in Costa Rica (projection for 2007)



Source: ICE (April 9, 2003), translated by Transfer

However, in order for ICE to come to meet the future demands of electricity (average yearly growth of 6%), it is estimated that between $ 300-400 mln have to be invested. ICE does not have the funds to live up to these investments and has stated its interest to finance these projects through Build-Operate-Transfer (BOT) schemes or lease constructions.

According to some experts, Costa Rica should grab the golden opportunity to produce as much electricity from renewable sources as possible. It would position the country as a sustainable electricity exporter to the whole region of Central America, where countries like Panama, Honduras and Nicaragua depend much more on expensive gas and oil resources for their electricity generation (Castro Salazar, May 25, 2003).

Lack of a level playing field for private sector generation initiatives, seriously impedes the possibilities for large companies to generate electricity in a profitable way. As such, many sugar refineries for example, have postponed further investments in co-generating facilities. In addition, there is a gap in the existing legislation for the use of hydro resources. As a result of a rule from the Constitutional Jury, no one but the State of Costa Rica through ICE, can use streams and rivers for hydro power generation. There is currently a new law proposal submitted to Congress which has been under discussion for about two years without getting the final legislative resolution. The waiting is for ICE to become more interested in private sector contracts or the government to change the law for private generation. In all cases, there has to come a clearer rate policy and guarantees of long-term contracts to justify new investments (Alvarado and Cabezas, May 2001). Even though large scale electricity production from biomass is currently ruled out, enough interesting possibilities exist for bio-energy technologies to be applied for *autoconsumo*. The chapter on bio-energy will look at the different sectors, potential and applications. First, the legislation with regard to the electricity sector for Costa Rica is summarised in the following table.

Table 7: Summary Energy Legislation Costa Rica

Generating Capacity	Concession time span	Licences Permits EIA studies	Incentives	Tariffs	Market
2 – 20 MW for Ley 7200, private generation Up to 50 MW for Ley 7508, Build-Operate-Transfer projects	Maximum of 20 years (Ley 7200 and 7508)	Plants with a capacity > 2MW require an Environmental Impact Assessment study	• Article 17 –18 of Ley 7200: producers are exempt from corporate tax (ISR) of the following activities: importing equipment and machines, installing turbines, generate, control, regulate, transform and transmit the energy • Also incentives apply from Ley 7017, part 2) of the Annex 3 of the Ley de Incentivos de Producción Industrial (Law on Incentives for Industrial Production) • The CIE can declare an electricity generation project eligible, within the concept of parallel generation, but never surpassing 15% of the total generation potential of the National Electricity System	• The regulating body ARESP decides yearly on the rates that ICE has to pay out • When ICE applies for rate changes, they have to be most favourable to the general public, within the principle of avoiding costs in investments and operation of the National Interconnectivity System, and with a national economic criterion	ICE and related companies have a state monopoly for electricity generation and distribution. ICE has the authority to contract electricity from third parties as part of its activities. Electricity cooperatives and private companies with at least 35% of Costa Rican capital can participate as third parties. ICE can buy electricity coming from plants of private property, from sources ranging from hydro, geothermic, wind or any other non-conventional source, in blocks of no more than 50.000 kW of potential, up to a maximum of 15% of the total generation potential of the National Electricity System (meaning the total generation for Costa Rica)

Source: Elaborated by BUN-CA

BIO-ENERGY IN COSTA RICA

This chapter gives an overview of the types of biomass materials and existing applications to take advantage of its high caloric value. Where relevant, case studies have been included to explain certain developments or market opportunities in more detail.

Agriculture

The agricultural sector is Costa Rica's second most important, with a contribution of 18% to GDP, only surpassed by the industrial sector (21,5%). The most important export products are banana, coffee, pineapple, citric fruits and juices, and melon. All agricultural and agro industrial activities generate a huge amount of organic waste, to date few examples exist of effective treatment. The following table shows an overview of the most important input sources that were researched.

Table 8: Determination of biomass potential in Costa Rica

Production residues	Total solid waste (1.000 kg)	Treatment system	Projection of methane production (m^3)	Waste water (m^3)	Systems treatment of liquid waste
Cattle[1]	8.918	20% of producers treats waste, rest into river system. Drying: compost	Milk: 157.444 Beef and Milk: 172.545	N.a.	N.a.
Pigs[2]	1.200	4.500 small farms (1-30 pigs) Bio-digesters	62.400	N.a.	30-150 pigs: 57% lagoon 37% solid waste separators 13% septic tank
Rice[3]	66.150 ton/husk (year 2000)	60% as input material for oven 40% soil improvement, compost	N.a.	N.a.	N.a.
Coffee[4]	318.638 ton/pulp 34.253 ton/husk	Pulp is used for compost and worm composting Husk is used as combustible for drying ovens	N.a.	251.888	Lagoon (oxidation), Sludge lagoons, Anaerobic lagoons
Sugarcane[5]	1.040.000 ton/bagasse	Dried and used as combustible for boilers Fed to cattle	N.a.	N.a.	Open air lagoons

N.a. = Not Available
1) www.infoagro.go.cr/sector_pecuario.htm
2) Desempeño de la Gandería Porcina 1996 –2001
3) Oficina del Arroz de Costa Rica
4) ICAFE, 2002
5) LAICA, 2003
Source: Compiled by BUN-CA


Sugar cane harvesting

Cattle

Costa Rica has a history of extensive cattle breeding, especially since the '60s and '70s when large areas of rainforest were cut down and turned into pasture. This process is now being reversed, one reason is the low prices for meat, another the continuing (government) interest in reforestation projects. To date, a large number of cattle are still present, close to 1,4 mln in 2000 according to the Ministry of Agriculture and Animal Breeding. The biggest concentrations of intensive breeding can be found in the provinces of Guanacaste (milk and meat), San Carlos (milk) and central regions like San Ramón and Cartago (milk and meat). The next table sums up the type of cattle and amount that can be found in Costa Rica, as well as some estimates as to quantities of manure and biogas that is produced.

Table 9: Overview of manure and biogas from cattle (2000)

Type of cattle	Total # cattle	Daily manure production (tons)	Daily biogas production (m^3)
Cows (milk)	425.524	4.255	157.444
Cows (milk and meat)	932.675	4.663	172.545

Source: MAG, 2000. Elaborated by BUN-CA

It is estimated that each milk cow produces an average of 10 kg of manure each day. For cattle with a double purpose this averages some 5 kg per day. For every kilo of manure some 0,037 m^3 of biogas are produced (Castillo Araya, 1985). On a yearly basis this leads to an escape of some 120 mln m^3 of biogas for Costa Rican cattle. Few projects are known that take advantage of cow manure. BTG (The Netherlands) implemented an anaerobic digestion plant for treatment of cow manure and production of electricity in a biogas engine/generator set in Virgen de Sarapiqui (1999-2001). The manure digestion plant handled 500 m^3 of manure of which 15 kW electricity could be generated. Part of the problem is the fact that it is such an extensive business. Also, many farmers are small scale and use the manure as fertiliser, without treating it first in a bio-digester. The Ministry of Health is much less concerned about water contamination by cows than it is by pigs, as will be shown in the next section.

Pigs

According to a census by the Ministry of Agriculture and Animal Breeding in 2001 close to 285.000 pigs were being held in Costa Rica, as can be seen in the following table. There is a clear trend towards a more intensive breeding in the sector, with less producers that own larger farms. According to the *Cámara de Porcicultores*, the sector organisation, most farms are still small scale though. They estimate there are 120 farms with 100 or more pigs, just 3 to 4 with 1.000 or more and just 1 that has 3.500 pigs. Cartago is an important region, also Grecia/Alajuela, Guápiles and some southern regions are said to accommodate pig farming due to a fresh climate.

Table 10: Evolution of pig production (2001)

Year	Total # pigs	Number of Producers	Average # pigs per Producer
1994	221.047	7.039	31.4
2001	284.485	5.575	51.0

Source: MAG, 2001

With regard to the renewable energy source 'biogas' from pig excrement mostly small scale projects have been undertaken. Mainly due to the Ministry of Health which has to regulate the *Reglamento de Aguas Residuales* or waste water rules, which has to issue a permit for each farm that has 10 or more pigs. In the past all pig manure was either used as fertiliser or directly dumped into rivers, with a lot of health problems. Farms that breed over 1.000 pigs need an Environmental Impact Assessment, including checks on waste water treatment facilities, separation of waste and quality of waste.

This process is overviewed by Setena, which also issues the permit. This is a commission, housed within the Ministry of Environment and Energy, in which also representatives of the Ministry of Health and Ministry of Agriculture and Animal Breeding have a seat. Due to non-compliance there have been 2 closings in the past, one in Coronado, the other close to Golfito in the south. There have been many warnings to other large pig farm holders, but it is hard to prove which exact company is responsible for a specific spill. In general the attitude of the farmers is that they will try to comply with legislation, but then want to be left alone. Suggestions for new and improved waster water treatment facilities (with biogas applications) will only have a interest if they are cost-effective and prove a quick return on investment. One application that could be interesting, according to the *Cámara de Porcicultores*, is using the biogas for heating for newborn piglets. These have to stay at 30^{o} C for a certain period of time. As pigs cannot stand the heat, most farms are in areas where it is fairly cold at night, so that consumes a lot of electricity. It is estimated that farmers spend approx. $ 3 per piglet a month, using light bulbs or heating through propane gas. The following case study presents the reader with concrete biogas projects.

Case study: small scale biogas projects for pig excrement

The NGO Adessaru, in cooperation with a local branch of the Ministry of Agriculture have developed a successful biogas project in the cantons Mora, Puriscal, Turrubares and Acosta (Central Valley of San José). Financed by FUNDECOOPERACION (within the bilateral treaty for sustainable development between Costa Rica and The Netherlands), the project won the National Energy Price in 2001. During a period of 16 months, about 100 small scale farmers were trained in a series of workshops on pig breeding and the construction of biogas installations or bio-digesters. During the project, 26 bio-digesters were built at an average price of just $ 170. A hole is dug, in which the excrement is deposited through a pipe. The pit is covered with a special kind of plastic, and all air is withdrawn. Once the anaerobic process starts working, the methane gas fills the plastic cover and can be transferred through a simple pipeline. The system has an intake capacity of 150 litres of excrement per day. Every 30 to 40 days the debris has to be removed. The resulting fertiliser or *bioabono* has to be aired for several days, but is odourless and provides excellent fertilizer.

The methane gas is led to the farmer's house and used for cooking and in some cases for lighting. The family lowers it energy costs significantly as firewood or propane gas have become increasingly expensive. The project thus also contributes to fighting deforestation as less firewood is consumed. As the Costa Rican Ministry of Health issues permits for any farmer breeding more than 10 pigs, more and more farmers are following their successful colleague pioneers. In 2002 over 25 new bio-digesters were installed in the region. A video and information folder were made of the project and distributed to a large number of farmers, farming associations and NGOs throughout Costa Rica and Central America. With the help of UNDP an agro-tourism initiative was developed in the region. Among other things an eco-lodge was constructed in which tourists are shown the results of the biogas project.

In another bio-digester project, Gabriel Castillo of the Industrial Design faculty of the ITCR, Technical University of Costa Rica, improved the design of small scale installations. He has been working since 1985 on the introduction of solutions for pig and cow excrement. In cooperation with NGO Vision Mundial, some 15 bio-digesters were installed in Upala, in the north of Costa Rica. After extensive preparation and with the full involvement of local pig farmers during a series of workshops, the bio-digesters were built, using large plastic bins that can be completely sealed off to guard the biogas. In this way, a much safer system is developed compared to the one using a plastic shield. The installations were tested and successfully installed at farms ranging from 10 to 40 pigs. The cost for the complete installation is approx. $ 100 for the treatment of each m3 of waste (1.000 litres). Families use the gas for cooking, lighting, heating of new born piglets and cooking of roots for pig feed. The project will be repeated in the region of Los Chiles and Nicoya.

Source: Interviews Transfer, Adessaru (2001), InformaTech (March 2003)

Infoagro estimates that each pig produces some 4 kg of manure daily, and each kilo of manure is responsible for approx. 0.052 m^3 of biogas. The following table sums up the implications. Costa Rica thus counts with a yearly production of approx. 21,6 mln m^3 of biogas.

Table 11: Manure and biogas from pig production (2001)

Total # of pigs	Daily manure production (tons)	Daily biogas production (m^3)
284.485	1.138	59.173

Source: Elaborated by BUN-CA (based on www.infoagro.go.cr/sector_pecuario.htm)

The type of projects described in the case study can be found in more regions in Costa Rica. Most sector insiders agree it is now time to scale up these biodigestors to the larger farms. On that note, representatives of the *Cámara de Porcicultores* showed a concrete interest in cooperating with a Dutch technology provider or organisation interested in this area. The Chamber would offer the premises of a member farmer with at least 100 pigs, and all local support necessary. It would have to be clear on the outside for which purposes the gas can be used, if it can be stored, etc. A requirement from the Chamber is that the project includes a training budget, so that other members can take advantage of the experience gained in the project and results be diffused to other pig farmers.

Rice

No accurate figures can be found in Central America on the bio-energetic potential of rice and its sub products. In 1999, 25 rice producers operated in the country: 3 in the region Brunca, 6 in the Central region, 4 in the Pacific Central area, 11 in Chorotega and one in the northern region Huetar Norte. In Costa Rica the area used for rice production comprised approx. 73.000 hectares in 2002. In that year close to 220 mln tons of rice were produced (La República, June 16, 2003). Research shows that 20,4% of the rice production consists of husk (cascarilla), in total some 45.000 tons each year which is separated from the harvest.

The husk has a high energetic potential, according to the Office for Rice the value is estimated at 13,75 x 10^3 TJ per ton (DSE, February 2003). Traditionally it is burned to heat the factory's boilers and for drying. Also sometimes it is mixed as a fertiliser. Other applications are developed by among other people Gabriel Castillo of the Technical University of Costa Rica. A successful project was done by compressing the rice husks and mixing it with a natural thickener, such as yuca paste. It is a very light, strong and highly cost-effective material, that could be used as construction material. As the rice husks are highly voluminous, the production would have to be localised next to the rice production sites.

Coffee

Costa Rica has a long tradition of coffee production. The country has an ideal soil structure and hilly mountains with a perfect climate for the coffee bean to mature. Main production regions are the central valley. The following table sums up the evolution of harvests in the last three seasons.

Table 12: Coffee production (raw fruit) Costa Rica

	Harvest 00-01 (tons)	Harvest 01-02 (tons)	Harvest 02-03 (tons)
Expected	847.519	796.600	739.586
Final harvest	847.519	796.600	691.739*

* To date the harvest for 2003 is still in progress

Source: ICAFE - Unidad de Liquidaciones. Elaborated by BUN-CA

Due to depressed market prices in the last 10-15 years, producers have long been looking for solutions to lower costs. One solution has been to take advantage of the high caloric value of the pulp, husk, and coffee film which are separated when the coffee fruit is treated to isolate the coffee bean. The following table gives an overview of quantities of sub products and water consumption that will result from the most recent harvest of close to 700.000 tons of 'raw' coffee fruit.

Table 13: Sub products coffee production (2002-2003)

Total Production (tons)	Production pulp (tons)	Production coffee film (m^3)	Production husk (tons)	Water consumption (m^3)
691.739	276.696	218.732	34.587	2.734.146*

* Legislation allows for 1 m^3 is used per processed fanega, a measure unit which represents 253 kilos or 400 litres of raw coffee fruit (ICAFE 2000). In practice the average is about 750 litres per treated fanega.
Source: Elaborated by BUN-CA

The pulp (broza) of the coffee fruit forms up to 40% of the volume of the fruit. In modern production plants it is separated and together with other waste water treated in a bio-digester. The anaerobic process results in biogas (mixture of methane and carbon dioxide) and natural, odourless fertiliser. BTG of The Netherlands implemented several systems in Costa Rica during the '90s, some with mixed result. Treatment capacity ranges from 5.000 – 15.000 kg COD/day (Chemical Oxygen Demand), with 1.100 to 4.000 m^3 of biogas being obtained daily. This has lead to electricity generating capacity of 62–281 kW at the different plants (BTG, 2002).

The coffee film (mucílago) that forms part of the fruit can also be treated in the bio-digester, in the past it has also been used as cattle feed. The husk (cascarilla) that surrounds the coffee bean is separated, isolated and dried. It forms an excellent combustible for the dryers and/or boilers that are part of the industrial process.

In the past all these sub products were left to rot, left to decompose in lagoons or simply dumped into adjacent rivers. Due to the acid ness of the waste materials the quality of the river water was seriously affected, with some rivers virtually 'dead' during the harvesting season. Tougher legislation and self regulation within the coffee sector during the '90s have led to a number of improvements (similar to other agro industrial sectors). Among other things, projects were set up to rationalise water use, to install water treatment systems and separate liquid and solid wastes. The improvement of the production process, with integrated measures to take advantage of the caloric value of the waste, has not only reduced the producers' energy bill, it has also lead to the production of high quality and very cheap fertiliser, as well as prevented a huge source of potential contamination to soils and rivers.

Bagasse

Bagasse is the fuel used almost exclusively to fire the boilers in the sugar industry. It is the residue after juice is extracted from sugarcane in the sugarcane milling process; when it is discharged from the final mill of a train of mills, it is called 'final bagasse' or simply 'bagasse'. The ready availability of bagasse, as a by-product of sugar production, has always made it an attractive fuel for the sugar industry, which has a long history in Costa Rica. The industry consists of 16 factories with a total year crushing capacity of around 3,4 mln tons of cane per harvest, a figure that has been constant for the last 5 years (LAICA, 2002). The following table gives an overview of the cane and bagasse production.

Table 14: Sugar cane production (2003 harvest)

Total Production of cane (tons)	Percentage of bagasse from cane	Total Bagasse production (tons)
3.470.000	30%	1.040.000

Source: LAICA, 2002. Elaborated by Transfer

In general, it is difficult to give a value of cogeneration potential because the capacity depends on the size of the mill, the age of the refining technology, and the pressure of the boilers. For example in Costa Rica, the market potential varies from 50 MW to 100 MW, depending on low pressure (225 – 400 psi), half (400 – 600 psi), or high pressure (600 – 800 psi). Most factories used to burn the bagasse to heat their boilers, all surplus waste material was fed to cattle or burned in open air.

To date 3 Costa Rican *ingenios* or sugarcane processing factories have taken advantage of the caloric value of the bagasse by investing in co-generation installations, El Viejo, Tabago and San Ramón. El Viejo has a contract with ICE to sell its surplus electricity, Tabago has a special permit to export the electricity to Nicaragua. Many other owners of sugarcane factories are interested in investing in co-gen installations. As prices for sugar are depressed, the sale of electricity can form an interesting additional source of revenue. The biggest problem in getting these installations of the ground is ICE's reluctance in signing new contracts (see Chapter Structure and Legislation in Costa Rica).

According to LAICA, the sector organisation, ICE could save a lot of money by getting the sugar refineries involved in producing electricity. This is the time when the water reservoirs for hydro are low, while the refineries are harvesting their crop. Currently, ICE burns bunker and diesel in thermal generation plants, this is more costly and much less 'renewable' than buying from the ingenios. According to LAICA, the future goal of many sugar refineries is to burn the bagasse, generate heat for the boilers to produce sugar and ethanol (see further on) and generate electricity from the surplus heat. This would make for an integrated and sustainable business for the ingenios with different sources of income and without any waste.

Other natural resources for biomass applications

In Costa Rica a great number of other biomass applications can be thought of, as the country is abundant in natural resources. Below short descriptions of areas of interest are described.

Pineapple

Due to the success of Costa Rican pineapples on export markets, the fruit has been one of the fastest growing segments in the country's agricultural sector. In 2003 the area for pineapple plantations will grow to 12.000 hectares, compared to 10.000 hectares in 2002 (La República, June 21, 2003). In Costa Rica, most pineapple production takes place in the south, also the San Carlos region has a growing number of producers.

The leaves are currently being left on the fields or burned in open air. The fibres that can be extracted from pineapple leaves are of excellent quality. In Japan, fashion designers use it to make clothes, and the product fetches a high price. To date, no one has taken advantage of the leaves. In dried form, it would also form a good input material to incinerate in co-gen installations.

Palm oil

Especially in the south of Costa Rica, large palm oil plantations can be found. Due to high prices in the '70s and '80s many crops were planted. In 2001 close to 40.000 hectares were in production (DSE, February 2003). The dried coconut shells prove an excellent combustible and are used to heat boilers for distillation. Volatility in market prices has hit the investments in co-gen installations in this sector. Some palm oil producers have now switched back to selling their oil instead of burning it to generate electricity. In the quest to develop 'greener' fuels for vehicles, currently tests are done to introduce the palm oil as biodiesel, as the material has the same characteristics, contains almost no sulphur and is much cheaper than ordinary diesel.

Bio ethanol

There is increasing interest from companies and ministries to investigate the opportunities for mixing ethanol with gasoline to create a cheaper and less polluting product. Also, it would provide an alternative source of income for sugar refineries. MINAE, the Ministry of Environment and Mining has signed a convention in April 2003 with other parties (Ministry of Agriculture and Recope, the state refinery company) to develop pilot projects. The goal is to have a strategy and implementation plan before the end of 2003.

As Texaco, the US oil company, has been doing an extensive study to secure suppliers of alcohol in Central America (to mix it with petrol for the US market), this sector is expected to generate a lot of investment the coming years. One of the technical issues to be addressed according to insiders is the composition of ethanol in gasoline. As it is used to up the octane level, it also thickens the gasoline which can be bad for the motor. Also, in earlier tests some 20 years ago, the mix proved very instable in the presence of small quantities of water, which additionally affected the motor.

Water plants

The region of Tortuguero in the northeast of Costa Rica houses an important biodiversity of both plants and animals. It is a unique structure with waterways provides for an interesting fauna. The 'lirio de agua' or water iris is a non-indigenous water plant that has been growing at extreme speeds. Apart from clogging the rivers and canals for boats it is killing a lot of animal life due to the lack of oxygen in the water. The tons of material that are being removed each month are now being piled on spots next to the canals and left to rot. As the water iris grows faster than it can be removed, this problem has become really urgent for local authorities.

Gabriel Castillo of the Industrial Design faculty of the ITCR, Technical University of Costa Rica, in cooperation with CONICIT (National Science and Technology Center) has developed a technology to take advantage of this natural resource. The plant contains fibres that provide for excellent packaging material. Also, alcohol can be generated from the plant. Other applications could be incineration or use in craftsmanship. As the plant contains a high amount of liquid, the plants first have to be dried. By incinerating parts of the waste, this could be done without needing additional fuel or electricity. The developed technology has proved that valuable material can be extracted at a cost-effective rate. The need is for a partner to be able to scale the project technologically. Investment firms to co-finance the project are also more than welcome.

Citric fruits

Costa Rica has many regions with an ideal climate to grow fruits. Banana production has traditionally been the biggest export earner, however, due to the humidity of the banana plant and leaves, there is little potential for bio-energy utilisation. Currently, banana residues are used as fertiliser or fed to cows. Most commercial projects related to banana leaves are in the area of isolation of fibres, which can be used for production of paper and cloths.

Citric fruits and especially the productions of concentrated juices also forms an important sector, although the waste is too humid to burn in co-gen installations. Most fruit residues are left to rot, fed to cattle or dumped into rivers. There exists an successful example of composting in the north of Costa Rica, which is described in the following case study.

Case Study: Citric production and composting

Del Oro is a large orange and juice producing company, owned by the Commonwealth Development Corporation (CDC), a British government development agency. CDC's orange farms cover close to 3.000 hectares, and the company protects an equal area in native forests located between La Cruz and Santa Cecilia, near Costa Rica's border with Nicaragua. All five of the company's farms border the Guanacaste Conservation Area, comprised of dry forest, rainforest and cloud forest ecosystems, three rare and endangered types of forest.

As a tree crop it holds many advantages for the environment. It is a better use of land than cattle ranching and can be a means of "reforesting" pasture areas. Additionally, the fruit pulp waste generated easily degenerates into nutrient-rich compost. Also it was found out that placing the pulp on the dry, depleted land bought for forest restoration efficiently killed stubborn pasture grasses and nourished the soil. Del Oro's management was thrilled with this finding, since it could dispose of its pulp without having to build a costly, and polluting, processing plant. Instead, insects and bacteria would do the job. Finally, some part of the citrus waste is fed to cattle.

Del Oro is regarded by many as the only company in the world to completely take advantage of its waste stream. The company has been certified for ISO 14.001, although this certificate was almost withdrawn at the end of the '90s after competing orange juice firm, TicoFrut, complained that Del Oro had created a garbage dump in a national park.

Del Oro has now also submitted its orange farms in Costa Rica to the Rainforest Alliance's audits, a large NGO for nature conservation. As part of the certification, Del Oro was required to meet comprehensive standards on a range of issues, including native forest protection, a requirement to reforest certain areas, pollution prevention, strict controls on agrochemical use, waste management and worker training, health and safety.

Source: Sector interviews Transfer, Rainforest Alliance (August 14, 2002), Latin Trade (July, 2001)

Landfills

Costa Ricans generate an average of 1 kg of waste each day, in the San José area approx. 1,2 kg. During the past decades the nature of the garbage changed from being dense and almost completely organic, to voluminous and less biodegradable. In the region of San José the organic component of this waste is estimated at 57%, in more rural areas this figure still mounts to 70%. Yearly, approx. 1 mln tons of organic waste is generated in Costa Rica. The municipalities collect 785.000 tons of organic waste, of which some 510.000 tons are deposited in landfills (CNP+L, December 2002). There is also evidence of waste dumping practices in rivers or other illegal terrains. Due to the hot and humid climate, the anaerobic processes on landfills generate a lot of methane. It is estimated that some 37.300 tons of methane gas are produced each year in Costa Rican landfills. Now all of the escaping methane directly contributes to the greenhouse effect.

The potential for capturing this gas and recovering the energetic value by generating electricity is huge. In Costa Rica people are finally becoming more aware of the potential that garbage disposal offers, particularly urban, taken into consideration the volumes handled in the San José region. However, other areas with large landfills containing principally organic materials offer similar potential to develop (Puntarenas, San Carlos). The following case study on Río Azul, San José's biggest waste dump, describes Costa Rica's first project in this area.

Case Study: Río Azul

Río Azul is the name of San José's largest landfill, located in the municipality of San Antonio de Desamparados. Started as a unregulated dumping site some 25 years ago, the site has been managed more carefully in the last 10 to 15 years. In total, it is estimated that some 4 mln metric tons of solid residues have been deposited at the site. During 60% of the operation period the placement of residues was done without any type of technical criteria, without respirators for the biogas produced and without treatments for the generated lixiviates. Now, the site has reached its capacity and is officially said to be closed down. To date however, new garbage is being admitted to the site. In the closing down process passive ventilations system and some sort of protection system was installed to prevent more groundwater pollution.

The circumstances in which the Río Azul biogas project developed has a lot to tell about the barriers that exist to enter these type of business opportunities. The site is officially owned by the surrounding municipalities, but the city of San José has special powers over the solid waste stream that goes into it. The Ministry of Health is involved due to the health issues, as well as the Ministry of Environment due to its environmental impact. Finally, by law the generated electricity has to be sold the state electricity company, in this case CNFL, the daughter company of ICE. The involvement of private companies in the management and generation of electricity also needs approval of the Controloría, Costa Rica's government body that regulates government spending.

Grupo Saret is one of Costa Rica's largest building groups, with a strong interest in environmentally related projects. They have built several infrastructures for hydro and geothermal electricity generating plants, and landfill projects. In the past, the company has also constructed regular power plants for ICE in several Costa Rican cities. Their first completed biogas project is the currently operating plant at Monterrey's landfill in the north of Mexico. In cooperation with CLP (UK) and local public entity SIMEPRODESO, close to 6 MW of electricity are produced and sold to the CFE, Mexico's state electricity company. The price of just $ 0,03 kWh CFE pays to the consortium was not enough for the project to generate a sufficient return on investment. A payment of the GEF (Worldbank) for the CERs generated in preventing methane to escape into the atmosphere (CO_2 certificates under the Clean Development Mechanism) proved highly important for the project to go ahead. Naturally, as a local company, the company was very interested to bid for potential landfill projects in its home country.

Although all actors were convinced that the Río Azul project would be important for the environment, as well as provide a cheap source of renewable energy, the project took a mere five years to being approved. After a lot of legal procedures and two tenders, Grupo Saret, again in cooperation with CLP was awarded the right to produce electricity from Río Azul's biogas. The contract involves a 10 year guaranteed period of payments of $ 0,0495 kWh. The project which is expected to generate between 4 to 5 MW is scheduled to start producing in April of 2004. The pipes to collect the gas will be drilled to a depth of 30 metres, the biogas is centralized through a tube system, cleaned and then burned in 4 gas motors. The total value of the investment is approx. $ 3,7 mln.

In total it is expected that this project prevents the evaporation of 25.000 tons of methane during the next 10 years. This represents a reduction of some 950.000 tons of CO2 being emitted. The project has therefore been awarded with approx. $ 2 mln from CERUPT (the Dutch program under the Clean Development Mechanism in which VROM will invest up to € 700 mln till 2010. It supports projects that capture CO_2 or other gas that contribute to the greenhouse effect). This money is important for the return on investment of Grupo Saret and its partners and the additional funds can be compared to those obtained in the Monterrey project. Currently, the company is in talks with GE Electricity (GE Jenbacher) about buying and co-financing the project. The attractive credit conditions that GE is willing to give, is according to Saret the most important reason behind a possible contract. Other suppliers they have talked to in the past include Deutz (Germany), Caterpillar and Waukesha (both of the US).

Grupo Saret is highly interested in meeting Dutch suppliers of gas powered turbines that could fit into new landfill projects. The prospect of turning dumping sites into well managed landfills while at the same time generating electricity of biogas has attracted the full attention of municipalities and city councils in Latin America. Apart from other landfills in Costa Rica, the company has received invitations from Mexico, Colombia and neighbouring Central American countries, to engage in feasibility studies. A strong partner is needed for Grupo Saret to expand on its track record and provide adequate technology and financing to make this market a reality.

Source: Interviews Transfer and BUN-CA, (La República May 9, 2003)

Río Azul: waste is being put up on terraces

With regard to the opportunities for composting, no commercial operations are known that provide the service in Costa Rica. Also no municipalities are known to operate a composting plant. The case study on Del Oro fruit composting which was mentioned earlier is one of the few examples of large scale composting, even though it is only meant for the company's internally generated waste. With regard to the problems of solid waste and energy recuperation only one example exists in Costa Rica. It is described in the following case study on Holcim.

Case study: Solid waste incineration by Holcim S.A.

A few years ago, Holcim, a Swiss producer of cement and other construction materials, bought Costa Rica's National Cement Industry S.A. and started an important revamping of facilities and services. The company is both horizontally and vertically integrated, and as such provides much of the energy for its cement factories from its own operations. To that extent the company has inaugurated a modern waste incinerator in the Cartago province. All materials with caloric value and without any chloral components (dioxin danger) are incinerated, such as recycled oils, tyres, contaminated plastics from agriculture use, and biomass waste.

At the rate of approx. $ 200 per ton of treated material this is a high margin business for Holcim. Most of its suppliers are international firms that have strict environmental policies and wish to dispose securely of their waste materials. One such client for example, banana producer Corbana, finds itself with huge volumes of plastic sheets that are contaminated with pesticides. The burning of those plastics at Holcim's plant is a more sustainable solution than burying them or burning them in open air as has happened in the past.

Holcim uses part of the energy from the process to fire its incinerator, the remaining energy is used in its cement plant. Other wastes from the process can to some extent also be used as an input material for making cement or asphalt. Due to the fact that Holcim's incinerator and improved production processes imply that less energy is used and less greenhouse gases are produced, the project was awarded through the Dutch carbon credit program. By saving the emission of 500.000 tons of CO2 in the 10 year during contract, the company receives some $ 2 mln.

Source: Sector interviews Transfer, La República (May 8 and 9, 2003)

Finally, an interesting market opportunity related to waste and organic materials was identified by the authors. The following case study describes the opportunity in more detail.

Case study: Organic waste at CNFL's Brazil hydro plant

CNFL, "Compañía Nacional de Fuerza y Luz, S.A." is the main local utility that distributes electricity in the most densely populated area of the country, the central region or Great Metropolitan Area. Apart from distributing electricity, CNFL also has built up some generating capacity related to renewables. One of their projects is the Brazil hydro plant, which uses water from one of the big rivers that crosses San José. This project for renewable energy is seriously obstructed due to the fact that waste materials flowing in the river clog the basin. Before the water goes into the hydro plant it has to pass a series of rosters to sift out any wastes that could damage the power engines.

In the case of the Brazil hydro plant this is proving an incredible challenge as on days with heavy rain (where a lot of material flows downstream) up to 30 or 40 tons of waste have to be removed. In 2002 alone, some 6.200 tons of waste were collected by 3 huge hoisting cranes that operate during the day. The waste is transported and deposited at a landfill. In total the cleaning operation costs CNFL close to $ 150.000 each year.

The waste material is partly plastics, partly organic (trees, natural debris). CNFL is very interested in receiving proposals for feasibility studies on how to take advantage of the caloric value of large parts of the waste, for example through pyrolysis and other gasification techniques. CNFL believes it would not only seriously lower the operating cost of cleaning the waste, but also lower the downtime and delays of operating the hydro plant. The project has to be studied more in-depth, for which for example the PESP-instrument could be put into service.

Source: Company interview Transfer and BUN-CA

Waste water

Heavy industry and large agro-industrial companies are obliged by law to deal responsibly with their waste waters. Some do this in open-air lagoons, most companies, especially those close to urban areas have waste water treatment facilities. However, the ones that apply anaerobic processes to clean waste water are not known to take advantage of the resulting biogas. As companies do complain about the high energy use of treatment facilities, the integration of biogas utilisation technologies could possibly create an interesting new market segment for suppliers of waste water technology.

Currently, the Ministry of Planning has proposed to develop the project “Monitoring of the Residual and Sewage Waters Treatment Systems in Costa Rica”. Up to now, the country has about 1.069 functioning treatment systems in different sectors. By the year 2005, with a stronger enforcement of the different environmental laws and a more conscious population, it is foreseen that about 5.400 treatment systems will be in operation in the whole country.

The following case study on Dos Pinos describes the challenges this large cooperative faces in treating its waste waters. It is exemplary for agro industrial companies in Costa Rica and Central America, many who face similar problems. The resulting market opportunities for Dutch companies in this area are evident.

Case Study: Waste Water treatment

Dos Pinos is Costa Rica’s largest dairy cooperative. It was started some 55 years ago and now comprises 1.500 farms throughout the whole of Costa Rica. The size of the farms ranges from 150 to 1.000 milk cows. The cooperative was set up to provide a centralised and specialised organization that would also add value to the members basic product, milk. The result has been a spectacular success. Over 300 different products are not only marketed in Costa Rica, but also in neighbouring Central American and Caribbean countries.

Dos Pinos is a well known and highly respected company in Costa Rica. The company engages in many social and environmental activities to uphold its positive image. In terms of environment most efforts have concentrated on the production facilities, the farmers have largely been left to themselves as they operate fairly autonomous. Some farmers have installed bio-digesters, but these have mainly been private initiatives, sometimes imposed by the Ministry of Health. As cow breeding in Costa Rica in general is an extensive business, the cow manure problems is not really visible.

On the contrary, at Dos Pinos production facilities many investments have been made to guarantee a green production process. Measures range from electricity savings projects to studies on biodegradable packages. The most important problem however, has to do with the treatment of waste water. The company owns 3 facilities, one in Pavas where mainly animal feed is produced. A second one is based in San Carlos, where milk powder and cheeses are produced. Finally, the factory in Alajuela has a very broad product mix, ranging from ice cream and yoghurts to fruit juices.

In the Alajuela plant up to 1.000 m3 of waste water is treated each day. Some 500 tons of solid waste is generated in this process each month. A mere 400 tons is mainly protein which can be mixed for animal feed. The remaining 100 tons is a highly greasy waste for which the company is looking for a sustainable solution. The problem is that this waste decomposes quickly and emits foul smells. To let it oxidize in a large open air pool is therefore not a good solution. They have done tests with dehydratation, which costs too much energy. Also, adding special types of soap to mix the materials resulted unsatisfactory. Currently, a recycling company is paid to collect the waste and treat it.

However, the company is very interested to get in touch with a Dutch provider of technology that could treat and extract value from this waste stream. As the water treatment facility consumes a lot of energy, any solution that would burn parts of this waste and generate electricity in the process would be most relevant.

For their San Carlos plant, a new waste water treatment facility is currently being studied. As the production of milk powder generates even more grease in the waste stream, the treatment of the solid waste will also be an important feature in an overall solution. During the process of cheese production large amounts of cheese serum is being generated. Currently, the waste is being mixed for animal feed, but Dos Pinos would also be interested in innovative Dutch solutions to take advantage of this specific waste stream.

Finally, Dos Pinos is looking at the possibilities to establish a small wind park in Costa Rica, the function would mainly be to support its green image.

Source: Transfer interview

Wood

Firewood or *leña* is mainly used in rural areas for cooking and small industrial processes (f.e. to heat boilers). The Ministry of Environment and Energy has researched this sector in 1996, but found that this is a very 'grey' and informal market and hard to quantify. It became clear that the practice of using wood for cooking leads to more pressure on wood resources and adds to deforestation. However, it was also found that the use of leña for cooking is much less dispersed in Costa Rica than surrounding countries. One of the reasons is that some 97% of Costa Rican homes have access to electricity.

The principal sources for firewood come from small pieces of forest, bushes, pastureland, coffee plantations, wood plantations, waste from pruning in municipalities, and waste from sawing and wood operations. Most applied techniques are inefficient, which has added to the scarcity of wood materials. The next table shows the dendro-energetic[1] potential of wood resources in Costa Rica with dates from 1987. As no new research is available and insiders foresee similar figures for the current situation, the authors have maintained the figures. It is estimated that the potential amount of wood comes close to 25 mln m^3, equivalent to 327.688 Terajoule (TJ) in the period of 1986-1987.

Table 15: Energetic potential of wood (1987)

Source	Volume (m^3)	Terajoules (TJ)	
Coffee Plantations	787.940	10.453	3%
Bushes	2.660.518	35.294	11%
Woods, pastureland	17.391.162	230.711	70%
Living fences, natural wind barriers	985.065	13.068	4%
Wood production	657.374	8.721	3%
Sawing operations	314.310	4.170	1%
Forest plantations 2)	1.905.000	25.272	8%
Total	**24.701.369**	**327.688**	**100%**

Source: DSE, 2003 (quoting Canet and Hernández. Potencial Dendro-energético de Costa Rica, DSE, 1990)

Even though the contribution of wood from coffee plantations is relatively low, it is still one of the most used forms of firewood. This is due to the fact that it is readily available and easy to transport. Other wood sources, much more readily available, are often located in far away regions, and therefore too expensive to transport. The result is that regions with high demand for firewood often lack supply. The Ministry of Environment and Energy has calculated that a commercial potential of approx. 2,530 MW exists for electricity generation from wood sources (DSE, February 2003).

Case study: Bio-energy project Ston Forestal

Multinational Stone Container Corporation of the US, is a major paper and pulp producer and has a daughter company in Costa Rica called Ston Forestal. They own a series of plantations, mainly in the south part (Peninsula Osa). Main variety of wood used in the plantations is melina, a fast growing species. Managing the plantations, a huge amount of organic material is collected. Ston Forestal is now interested in setting up a project to burn parts of that waste and generate electricity. The plans are for an 10-15 MW co-gen installation, but smaller could also be possible. A part of the generated electricity will be used for the plant's chipping mill and saw mills, the remainder would be returned to the electricity grid. The surplus heat will be used for their drying ovens.

The main reason why the project has not been started is the fact that Ston Forestal has not been able to close a contract with ICE about the surplus electricity. Currently, the company is in touch with providers of Canada and Austria about the co-gen installation, but is interested to hear about potential Dutch providers. The company is additionally interested in projects related to carbon credits programs.

Source: Interview Transfer

[1] Biomass feedstocks for energy can be provided either by so-called short rotation or tree plantations or plantations of herbaceous plants. Dendro-energy is a form to transform energy from these stocks. Source: BUN-CA.

OTHER RENEWABLE SOURCES IN COSTA RICA

Apart from the described sources of renewable energy (biomass, biogas) several other sources are being exploited in Costa Rica, namely hydro, wind, solar and geothermal power. A short introduction is given to provide an overview of developments in these related sub sectors.

Hydroelectricity

Hydro power is Costa Rica's best known and most important source of electricity generation. The total commercial potential has been put at approx. 9.600 MW. However, much of this potential is located in protected rainforest or indigenous areas that cannot be developed. Several new projects are under construction and one of the most important hydro power installation (Boruca) is told to be approved by authorities. The Boruca hydro plant has been controversial for several years, as the valley where the reservoir will be built is in indigenous territory. Local people will now be compensated and the project is scheduled to be completed by 2013. It will add an impressive 841 MW of potential to ICE's capacity and the plant will yearly generate up to 3.168 GWh. According to industry experts, this project will give Costa Rica so much hydro-capacity that it will be able to export large parts of its electricity within the whole Central American region. Import and export of electricity within Central American countries is expected to grow fast in the coming years, especially pushed by the economic development program "Puebla-Panamá" and CAFTA, the currently negotiated free trade agreement between the US and the region. A possible negative result of the success of hydro within the Costa Rican energy mix is that other green alternatives might easily be overlooked.

Geothermal

The utilization of hot water in the earth as a source of energy has been proved in Costa Rica which boasts many volcanic areas and deep hot water wells. In total 865 MW of total 'gross' capacity have been identified, of which just 235 MW are economically feasible to exploit. Also the issue of protected areas plays a role as many potential production sites are located in national parks. Currently, 145 MW of geothermic power is installed, the most important being the projects Miravalles. Running costs of a geothermic power plant are very low, which makes it an very interesting source for power generation.

Windpower

Energía eólica formed an important area of growth during the '90s. The total commercial potential is estimated at approx. 600 MW, which in current terms would provide some 40% of total electricity consumption. About 10% of this potential is currently exploited, namely 62,3 MW. This still makes Costa Rica one of Latin America's largest wind power producers. Within the power generation matrix of Costa Rica, some 4% of all electricity being generated now comes from wind power. Some 46 MW is generated through private companies, Essent of The Netherlands being one of them. The wind secure region of Tilarán, around the Arenal reservoir, boasts the largest amount of wind mills. Operational issues and increasing complaints regarding noise and horizon pollution from citizens and some environmentalists, have ICE currently led to ban any new wind power projects.

Photo Voltaic (PV)

The utilisation of the sun's energy for electricity generation is still infant in Costa Rica. To date, some 660 PV systems (60 to 120 W) have been installed by ICE and Coopeguanacaste, a regional distribution company in the northwest of Costa Rica. Also, dispersed throughout Costa Rica examples can be found of small PV installations, mainly where the local grid is not available. It is estimated that Costa Rica has a potential of some 10.000 MW solar power. The general view is that costs for PV systems will have to fall much further before large scale investments can be expected in this area.

EL SALVADOR IN A NUTSHELL

Official name	República de El Salvador
Capital	San Salvador
Government	Republic
President	Francisco Flores Perez (since 1 June 1999)
Religion	Roman Catholic 83%, Protestant 17%
Literacy	71%
Population	6,4 mln (2002)
Area	Total: 21,040 km^2 (0,5 X size of The Netherlands)
Currency	Salvadoran colon (SVC); US dollar (USD)
Exchange rate	8,75 SVC : 1 US$ (fixed since January 2001)
GDP	14,1 US$ billion (preliminary 2002)
GDP per capita	2.194 US$ (preliminary 2002)
Unemployment	10% (2001 est.) plus considerable underemployment

	2000	2001	2002	2003 (F)
Real GDP growth (%)	2,2	1,8	2,5	2,3
Consumer price inflation	4,3	1,4	2,8	2,4
Exports FOB (US$ bln)	2,9	2,9	3,0	N.a.
Imports CIF (US$ bln)	5,6	5,9	5,2	N.a.

F = Forecast, N.a. = Not available

Source: EVD, CEPAL (April 2003), Banco Central El Salvador website (Statistics)

El Salvador achieved independence from Spain in 1821 and from the Central American Federation in 1839. A 12-year civil war, which cost about 75.000 lives, was brought to a close in 1992 when the government and leftist rebels signed a treaty that provided for military and political reforms. The peace accords made provisions for land transfers to all qualified ex-combatants, as well as to landless peasants living in former conflict areas. El Salvador has made remarkable progress in the economic, social, and political fronts since it emerged from the civil war, but the earthquakes of 2001 have brought new challenges. During the 1990s, growth and stable prices replaced economic decline and inflation. Trade liberalization, financial sector and pension reforms, privatisation, and the decision to move to a bi-monetarist regime in 2001 have all contributed to a strengthened economy.

Nowadays, El Salvador has a more deregulated and diversified economy than in the past, is less dependent on agriculture and is developing strong service and manufacturing sectors. As a consequence, standards of living improved and poverty declined markedly during the last decade. Enrolment in primary education increased by close to 10%, infant mortality declined by 40%, population without access to safe water was halved and extreme poverty was reduced by half. In the year 2002 growth picked up to 2,5%, but 2003 will again put pressure on growth goals. One of the reasons is the dependency of the economy on exports to the US, another one is the restrictive fiscal policy under pressure from the IMF, which will see the fiscal deficit fall from 3,5% in 2002 to 2,0% in 2003 (CEPAL, April 2003).

On the political front, democratic consolidation has advanced with three peaceful, broadly-based elections since 1989. The Alianza Republicana Nacionalista (ARENA) won both presidential elections during the 1990s (1994 and 1999), but lost its legislative majority to the Frente Farabundo Martí para la Liberación Nacional (FMLN) in 2000. Although reaching consensus has been difficult since peace was signed, El Salvador's ability to agree on a National Development Plan (Plan de la Nación), endorsed by the authorities in the Four Pillars Government Plan (Alianzas), and by civil society in 2000, and to function under a divided Congress are signs of a healthy democracy.

Economy

The Salvadoran economy continues to benefit from a commitment to free markets and careful fiscal management. The impact of the civil war on the country's economy was devastating; from 1979-90, losses from damage to infrastructure and means of production due to guerrilla sabotage as well as from reduced export earnings totalled about $2.2 billion. But since attacks on economic targets ended in 1992, improved investor confidence has led to increased private investment. Rich soil, moderate climate, and a hard-working and enterprising labour pool comprise El Salvador's greatest assets. Much of the economic improvement is due to free market policy initiatives carried out by the Cristiani and Calderon Sol governments, including the privatisation of the banking system, telecommunications, public pensions, electrical distribution and some electrical generation, reduction of import duties, elimination of price controls on virtually all consumer products, and enhancing the investment climate.

The post-war boom in the Salvadoran economy began to fade in July 1995 after an abrupt shift in monetary policy was followed by a June increase in the value added tax (VAT) and price hikes in basic public services. The slowdown lingered into 1996. In 1998, El Salvador's economy grew by 3,2% compared to the 4,2% growth posted in 1997. The damage caused by Hurricane Mitch to infrastructure and to agricultural production reduced 1998 growth by an estimated 0,5%. Growth weakened further in 1999 due to poor international prices for El Salvador's principal export commodities, weak exports to Central American neighbours recovering from Hurricane Mitch, and an investment slowdown caused by the March 1999 presidential elections and delays in legislative approval of a national budget. It picked up slightly to 3% in 2000. Because of the earthquakes that struck the country in January and February, the economy grew less than 2% in 2001. Inflation for 1998 was 4% and remained stable in 1999-2000. Thanks to the introduction of the US dollar as legal tender and despite the earthquakes, inflation in 2001 was only 1.4% (Central Bank statistics). The stability of the Salvadoran economy was demonstrated after its quick and dynamic recovery after the earthquakes.

Large inflows of dollars in the form of family remittances from Salvadorans working in the United States offset a substantial trade deficit and support the exchange rate. The monthly average of remittances reported by the Central Bank is around US$150 mln, with the total estimated at more than US$1,9 bln for 2001. As of December 1999, net international reserves equalled US$1,8 bln or roughly 5 months of imports. Having this hard currency buffer to work with, the Salvadoran Government undertook a "monetary integration plan" beginning January 1, 2001, by which the dollar became legal tender alongside the national currency.

El Salvador historically has been the most industrialized nation in Central America, though a decade of war eroded this position. In 2002, manufacturing accounted for just 24% of GDP. The industrial sector has shifted since 1993 from a primarily domestic orientation to include free zone (maquiladora) manufacturing for export. Maquila exports have led the growth in the export sector and in the last 3 years have made an important contribution to the Salvadoran economy. The goals of Miguel Lacayo, El Salvador's Minister of Economy is to further strengthen the service economy (call centres, financial services) and tourism, in order to provide a more diversified economic base (Latin Trade, July 2003). The following chapter gives an overview of energy and environmental legislation in El Salvador, after which a more detailed view on the potential for bio-energy is described.

LEGAL FRAMEWORK IN EL SALVADOR

Table 16: Main environmental legislation El Salvador

Type	Number	Name and Description
Laws	DE-No. 233	Law of Environment which considers objection matters to develop requirements by the Constitution of the Republic, that refer to the protection, conservation and restoration of the environment; the sustainable use of the natural resources that improve the quality of life of the presents and future generations.
	DE-No.844	Wildlife Conservation Law. It considers object protection restoration, management, utilisation and conservation of the wildlife. This includes the regulation of activities such as hunting, harvesting and commercialisation, as well as other forms of use and utilization of this resource.
Regulations	DE-No. 17	General Law of Environment, which considers norms and contained precepts for the protection and sustainable use of the environmental resources.
	DE-No. 39	Special regulation for water residues that do not alter the quality to different beneficiaries, to contribute to recovery, protection and sustainable use of resources.
	DE-No. 41	Special regulation in Material of Substances, Residues and Dangerous Wastes. The application of this Regulation competes to the Department of Environment and Natural Resources, in coordination with the other institutions that have competences, according to its respective laws.
	DE-No. 38	Special regulation on substances affecting the ozone layer. "The present Regulation considers regular objects in the country the importing and the consumption of the exhausting substances of the ozone layer, to contribute to the protection of the layer of Ozone Stratospheric and fulfilment of the obligations that emanate of the international instruments that El Salvador has ratified in the matter".
	DE-No.42	Special regulation on the Management of the Solid Waste.
	DE-No. 40	Special regulation of Technical Norms of Environmental Quality

Elaborated by BUN-CA

Table 17: Summary energy legislation El Salvador

Generating Capacity	Concession time span	Licences Permits, EIA studies	Incentives	Tariffs	Market
Minimum capacity of 5 MW	Permanent (Decree 843)	Without importing the size, the following have to arranged at SIGET: • licences for use of water sources and permits to generate • environmental impact studies • all costs to cover the emission of permits	• It is expected that a system will be developed for permits, on the basis of size and type of projects • No clear indication of incentives for small producers	Prices in tariff sheets should be based: a) prices and capacity as stated in long term contracts approved by SIGET. Contracts are public and tendered (free competition) b) the average price for energy according to the MRS published in the previous year c) the charges for use of the distribution network d) the costs for service to clients	Regulated by the Wholesale Market, with a capacity of more than 5 MW. The Wholesale Market is made up of at least the Contract Market and Regulating Body (MRS). Other participants include generating companies, the Network provider, Distributing companies, the Transaction Unit (Unidad de Transacciones), and Commercialisers

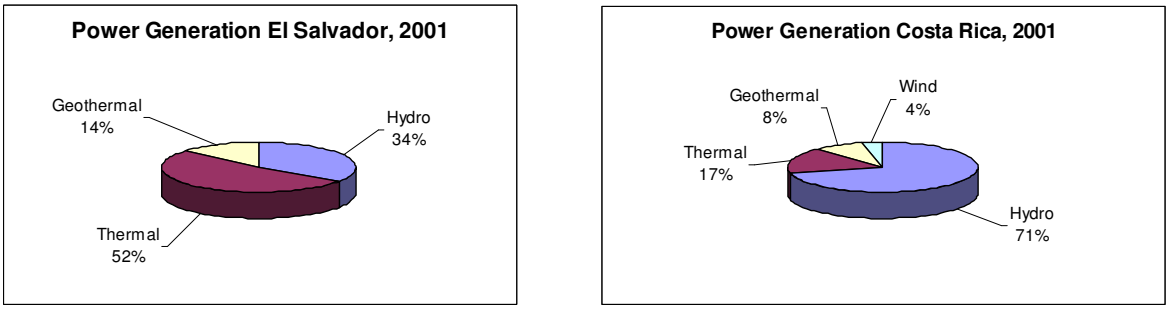
Source: Elaborated by BUN-CA

El Salvador's environmental laws are mostly in line with those in Costa Rica, although enforcement of the law forms a constant challenge. The framework of energy laws are one of the most liberal in Central America. With a fast growing industrial economy, the government is eager to allow private producers to get involved in the generation sector, especially in renewable energies. This creates opportunities for Dutch providers of bio-energy equipment.

BIOMASS IN EL SALVADOR

Due to the differences in availability of natural resources and historic growth of the electricity supply, the input sources for power generation vary considerably between Central American countries. The following figure gives an insight into comparable data between El Salvador and Costa Rica.

Figure 3: Different sources for power generation El Salvador – Costa Rica



Source: OLADE, 2001

It is clear that El Salvador is much more dependent on thermal resources (diesel, oil, gas) than Costa Rica, but that it's geothermal capacity is comparatively better developed. The most important reason for the relative low figure of hydro energy is the low availability of adequate rivers compared to Costa Rica. Within the generation 'mix' no other renewable sources than hydro and geothermal enter El Salvador's statistics.

Still, in the following sections it will be demonstrated that biomass applications are taking off, especially in the bagasse sector. The more liberal regulatory framework with regard to private sector electricity generation will no doubt give a boost to the utilisation of many more biomass sources in El Salvador.

Introduction

In El Salvador, the agricultural sector contributes 10% to the Gross Domestic Product (GDP). Exports of this sector for the year 2001, according to the sector of origin of the economy, represent 23% of total exports. Coffee (4,1%) and sugar (2,4%) are the main export products.

In overall, preliminary calculations by the Ministry of Environment of El Salvador (MARN), has calculated the solid waste volume at about 1,500 metric tons (MT) per day for the year 2000.

The chapter on biomass in Costa Rica summarised the bio-energy potential of its main agro-industrial activities, i.e.: coffee, sugarcane, rice, and cattle and pig raising. For El Salvador and Panama this information was not elaborated the same way, as the raw information is not yet available from official and private statistics. In this regard, more research is needed at the in-country level. The following table gives an overview of available bio-energy potential for El Salvador.

Table 18: Determination of biomass potential in El Salvador

Production residues	Total solid waste (1.000 kg)	Treatment system	Projection of methane production (m^3)	Waste water (m^3)	Systems treatment of liquid waste
Cattle[1]	9.128	N.a.	337.717	N.a.	No data still available or technology treatment not in use yet
Pigs[2]	612	N.a.	31.824	N.a.	
Rice[3]	4.896	Used as direct fuel for heating production	N.a.	N.a.	
Coffee	194.709 (tons/pulp) 20.126 (tons/husk)	Coffee pulp used in compost. All coffee husk is used as a fuel	N.a.	N.a.	
Bagasse from sugarcane[4]	1.479.755	Co-generation and self power generation	N.a.	N.a.	

[1)] and [2)] http://www.terra.com.gt/nacionales/articulo/html/nac3148.htm
[3)] La República Newspaper, Monday June 16, 2003
[4)] www.asociacionazucarera.com/agroindustria.asp
Elaborated by BUN-CA

In terms of bio-energy potential, the Salvadorian situation mainly points towards the coffee and sugar cane sector. Additionally, the potential for wood resources will be discussed separately.

Coffee

El Salvador, as most Central American countries, has a long tradition of coffee production. For a large part of its foreign currency supply the country could always count on coffee exports. However, due to depressed coffee prices in the last 10 years, the sector has suffered and production volumes have been going down. One of the more successful initiatives to curb this trend is the certification of 'organic coffee beans' which are more valuable on international markets. Close to 10% of El Salvador's plantations are now certified. Also, through international projects, several cooperatives have entered in 'fair trade coffee programs', which guarantees an honest price for coffee produced by small farmers.

Table 19: Coffee production (raw fruit) El Salvador

	Harvest 00-01 (tons)	Harvest 01-02 (tons)	Harvest 02-03 (tons)*
Final harvest	608.718	605.303	468.050

* Estimated: to date the harvest for 2003 is still in progress
Source: Consejo Salvadoreño del Café (www.consejocafe.org.sv)
Elaborated by BUN-CA

Table 20: Sub products coffee production El Salvador (2002-2003)

Total Production (tons)*	Production pulp (tons)	Production coffee film (m^3)	Production husk (tons)
468.050	194.709	115.440	20.126

* Estimated: to date the harvest for 2003 is still in progress
Source: Elaborated by BUN-CA

Bagasse-to-power co-generation

Mainly, investments of the energy sector in El Salvador have been primarily geared to the construction of large hydropower and thermal plants, oil refineries and facilities for storage of petroleum and its derivatives. Up to the late 1990s, these investments were a responsibility of the state owned companies, mainly CEL, the national power utility. Before its privatisation in the '90s, this public institution was also in charge of energy planning.

With the bilateral assistance of the IDB, CEL carried out an analysis of El Salvador's energy potential by means of satellite images. More recently, the newly created Ministry of Environment has undertaken much of this previous work and has begun to expand it to other sources and sectors in a more integral way. Since 1987, as a result of an energy crisis in the power sector that ended in black outs, CEL became supportive of cogeneration projects in the sugarcane industry. As a result, there are currently several projects in operation or still planned for power cogeneration in El Salvador connected to the public grid. Traditionally, sugar mill facilities have produced its own power generators driven by steam from the burning of sugarcane in low pressure boilers. In the 1991-92 season, La Cabaña and Injiboa sugar mills started utilising some bagasse for fuel and the surplus was stored in the form of bulks for post-season burning. In this season, both mills supplied to the grid 686.480 kWh at a price of $ 0,055 kWh. For the season of 1993-94, the San Francisco sugar mill put in line another unit of 800 kW to deliver to the grid 33.286 kWh under the modality of power interconnection in synchronism.

Witnessing a growing interest of the sugarcane industry to participate in the power market, CEL in 1994 proposed a new price scheme to consolidate the interest of the private sector and push forward the development of co-generation. The Sugarcane Producer Association of El Salvador agreed a price for power cogeneration of $ 0,056 kWh, and in 1995, two sugarcane mills, Izalco and San Francisco, signed a long-term power purchase agreement, delivering a total of 1.163.268 kWh during the season of 94-95, a significant effort for a system highly monopolized by a state-owned utility.

Figure 4: Bagasse co-generation projects in Central America

Sugar Mill/Country	Mill Capacity (TCD average)	Project Size (MW average)	Status
Santa Ana / GUAT.	9,492	30	Operational
Pantaleón/ GUAT.	13,683	32.5	Operational
Concepción/ GUAT.	6,845	22.5	Operational
La Unión/ GUAT.	8,125	26	Operational
Magdalena/ GUAT.	7,051	12.5	Operational
Madre Tierra/ GUAT.	6.409	25	Operational
Yoioa / HOND.	3.000	4	First phase operational. prefes.
Santa Matilde / HOND.	7.000	10	Prefeasibility
Central Progreso/ HOND.	4,500	9	Pre-invest. in boiler
Central Izalco / ES	8,500	20	Pre investment
San Fransisco / ES	4,500	5	Under construction
La Magdalena / ES	3,000	8	Project Concept (DPR)
Victoria de Julio / NIC	7,700	24	Eng. Design, PPA negotiation.
San Antonio / NIC	10,000	40	Financing
Monte Rosa / NIC	3.000	6	Prefeasibility
Montelimar / NIC	2,300	6	Prefeasibility
Javier Guerra / NIC	1,500	3	Prefeasibility
CoopeVictoria / CR	2,650	2	Project Concept (DPR)
El Viejo / CR	6,000	5	Operational
Taboga / CR	6,000	11	Operational
Quebrada Azul / CR	2,000	0.4	Implementing
Juan Viñas / CR	1,800	5	Feasibility

Sources: 1. BUN-CA, Central American Sugar Diversification Initiative, Country Reports, 1997.

Comments: 1. The portfolio size of identified projects is 283 MW under some form of development.
2. Guatemalan mills are expanding off-season generation capacity and investing in air pollutio particulate controls.

As a result of a consolidated private market in the power industry and some lessons learned in the last 5 years, now more opportunities for private sector interventions in the power market exist for bio-energy power production –rather than bagasse cogeneration- to diversify the supply of biomass resources. BUN-CA carried out a study on the bagasse-to-energy co-generation potential for the whole of Central America (see above figure). The power generation capacity in El Salvador ranks very well within the region, especially considering the size of the country.

Wood

El Salvador is one of Central America's countries with the least amount of primary forest left. For this reason, it is generally accepted in this country that trees used for shading in coffee plantations are considered forest. The next two tables include some figures to reference various levels of potential biomass from forest. The data of surface and potential volume for extraction are the result of in-country analysis of dendro-energy potential from satellite images elaborated by the national power utility (CEL), with assistance from the International Development Bank (IDB).

Table 21: Energetic potential in El Salvador (1987)

Cover	Surface (ha)	Production per hectare (m^3)	Standing potential volume (m^3)	Potential extraction (m^3/ha-year)	Estimated supply (m^3)
Plantations of coffee	184.951	38,1	7.052.181	9,5 [1)]	1.762.583
Salty forest	45.008	126,5	5.692.162	12,6 [2)]	568.901
Vegetation of conifers	28.334	371,0	10.511.914	5,6 [3)]	151.870
"Vegetation latifoliada"	251.790	490,0	123.377.100	26,8 [4)]	2.747.972
"Vegetation arbustiva"	180.302	22,6	4.074.825	22,6 [5)]	4.074.825
Thicket	451.776	7,8	3.523.852	7,8 [5)]	3.523.853
Total			**154.232.034**		**16.830.004**

[1)] extraction average in plantation coffee, taken of the 5 year plan, fishing and agrarian development. Ministry of Agriculture (1985)
[2)] a most minimum capacity of annual extraction from 10% of the unit production is esteemed
[3)] average estimation based on data of the Forest Service and of Fauna from the Ministry of Agriculture. Assuming that only 20% of the half annual increment calculated corresponds to a potential utilisation for firewood production
[4)] average estimation increment based on field surveys. CEL (1986)
[5)] average volume of production was obtained from a sample. CEL (1987)
Elaborated by BUN-CA

As a result of the information shown above, the potential supply of forest residues and energy value of dendro-energy production is presented in the next table:

Table 22: Potential Supply and Energy Value in El Salvador (1987)

Cover	Surface (ha)	Potential of extraction (m^3/ha/year)	Potential supply (m^3)	Tons [3)]	Equivalent energy (tera calories) [4)]
Plantations of coffee	184.951	9,5	1.762.583	1.376.577	4.199
Salty forest	45.008	12,6	568.901	444.317	1.355
Vegetation of conifers	28.334	5,6	151.870	118.615	362
"Vegetation latifoliada"	251.790	26,8 [1)]	2.747.972	1.317.542	4.017
"Vegetation arbustiva"	180.302	22,6 [2)]	4.074.825	636.488	1.941
Thicket	451.776	7,8 [2)]	3.523.853	917.376	2.798
Total			**16.830.004**	481.095	14.673

[1)] it is assumed that of this value, at least 25% corresponds to a potential utilization for firewood
[2)] for the "vegetation arbustiva", is assumed that the volume of extraction is 20% of the value of the surface occupied in the period of 5 years (average for lands in rest and for thickets, a third of its respective value)
[3)] tons estimated based on density of 0,781 grams per cm^3 at 24,6% of humidity, as an average obtained from CEL laboratories of dry samples of firewood
[4)] caloric value of 3052 kcal/kg. Calculation is based on parameters using the formula of E. Hugot (3.052×10^6 lime t).
Elaborated by BUN-CA

The biggest interest detected in El Salvador for power generation from biomass comes from bagasse and wood sources. The specific case of firewood is described in more detail below.

Firewood

The main source of energy in the rural sector of El Salvador is firewood, which has not been easily substituted by another energy source, due to cultural traditions and particular socio-economic context of the rural population. According to a study carried out in the Department of Chalatenango, only the 0,6% of the local population utilises electricity for food cooking. There exist ample opportunities to prompt a program to reduce firewood consumption in the suburban and rural sectors, given that the consumption of this last one currently presents a growing demand against an ever decreasing supply.

The next table compares dendro-energy potential with estimated demand. As is shown, there exists a deficit that increases overtime as demand tends to grow.

Table 23: Projection of supply vs demand of firewood in El Salvador (1987-2000)

Year	Supply		Demand		Demand not attended	
	tons	TCAL	tons	TCAL	tons	TCAL
1987	2.654.998	8.076	3.232.910	9.867	(586.912)	(1.791)
1990	2.554.742	7.797	3.370.608	10.287	(815.866)	(2.490)
1995	2.465.372	7.524	3.718.763	11.350	(1.253.391)	(3.825)
2000	2.368.626	7.229	4.113.535	12.555	(1.744.909)	(5.325)

Source: CEL/BID (1987)

Specifically, for the firewood sector, several recommendations have been discussed over time in the context of the energy sector in El Salvador, i.e.:

- Development of forestry projects for energy production in priority zones.
- Study and technical characterization of biomass parameters for a sustainable supply of firewood in the industrial and residential sectors, including marketing and commercialisation.
- Develop means of reducing firewood consumption in the sub-urban and rural sectors.

Specific information on suppliers and other bio-energy contacts in El Salvador can be found in the annex.

PANAMA IN A NUTSHELL

Official name	República de Panamá
Capital	Panama City
Government	Constitutional Republic
President	Mireya Elisa Moscoso Rodriguez (since 1 September 1999)
Religion	Roman Catholic 83%, Protestant 15%
Literacy	91%
Population	2,9 mln (2002)
Area	Total: 75,990 km^2 (1,8 X size of The Netherlands)
Currency	1 balboa = 100 centesimos; US dollar (USD)
Exchange rate	1 balboa : 1 US$ (fixed rate)
GDP	10,4 US$ billion (preliminary 2002)
GDP per capita	3.588 US$ (preliminary 2002)
Unemployment	13% (2001 est.) plus considerable underemployment

	2000	2001	2002	2003 (F)
Real GDP growth (%)	2,5	0,3	2,0	1,5
Consumer price inflation	1,4	0,2	N.a.	N.a.
Exports FOB (US$ bln)	3,4	3,4	N.a.	N.a.
Imports CIF (US$ bln)	3,9	3,5	N.a.	N.a.

F = Forecast, N.a. = Not available
Source: EVD, CEPAL (April 2003)

The Canal

Modern Panamanian history has been shaped by its ocean connecting canal, which had been a dream since the beginning of Spanish colonization. From 1880 to 1900, a French company under Ferdinand de Lesseps attempted unsuccessfully to construct a sea-level canal on the site of the present Panama Canal. In November 1903, with US encouragement and French financial support, Panama proclaimed its independence and concluded the Hay/Bunau-Varilla Treaty with the United States. The treaty granted rights to the United States “as if it were sovereign” in a zone roughly 10 miles wide and 50 miles long. In 1914, the US completed the existing 83-kilometer lock canal. The early 1960s saw the beginning of sustained pressure in Panama for the renegotiation of this treaty. On 7 September 1977, an agreement was signed for the complete transfer of the Canal from the US to Panama by the end of 1999. Certain portions of the Zone and increasing responsibility over the Canal were turned over in the intervening years. The entire Canal, the area supporting it, and remaining US military bases were turned over to Panama by or on 31 December 1999.

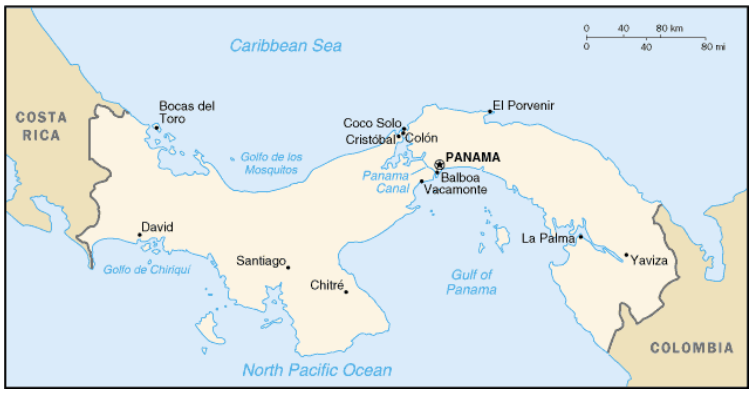
Government

After dictator Manuel Noriega was deposed in 1989, Panamanians moved quickly to rebuild their civilian constitutional government. On December 27, 1989, Panama’s Electoral Tribunal invalidated the Noriega regime’s annulment of the May 1989 election and confirmed the victory of opposition candidates. President Endara took office as the head of a four-party minority government, pledging to foster Panama’s economic recovery, transform the Panamanian military into a police force under civilian control, and strengthen democratic institutions. Ernesto Perez Balladares was sworn in as President on September 1, 1994, after an internationally monitored election campaign. Perez Balladares ran as the candidate for a three-party coalition dominated by the Democratic Revolutionary Party (PRD). His administration carried out economic reforms and often worked closely with the U.S. on implementation of the Canal treaties.

On May 2, 1999, Mireya Moscoso, the widow of former President Arnulfo Arias Madrid became President in what were considered free and fair elections. Moscoso took office on September 1, 1999. During her administration, Moscoso has attempted to strengthen social programs, especially for child and youth development, protection, and general welfare. Education programs have also been highlighted. More recently, Moscoso was focused on bilateral and multilateral free trade initiatives with the hemisphere. Moscoso's administration successfully handled the Panama Canal transfer and has been effective in the administration of the Canal. A major challenge facing the current government under President Mireya Moscoso is turning to productive use the 70.000 acres of former US military land and the more than 5.000 buildings that reverted to Panama at the end of 1999. Administratively, this job falls to the Panamanian Inter-Oceanic Regional Authority (ARI).

Panama's counter narcotics cooperation with the US has met with success, and the Panamanian Government has expanded money-laundering legislation and concluded with the US a Counter narcotics Maritime Agreement and a Stolen Vehicles Agreement. In the economic investment arena, the Panamanian Government has been successful in the enforcement of intellectual property rights and has concluded with the U.S. a very important Bilateral Investment Treaty Amendment and an agreement with the Overseas Private Investment Corporation (OPIC).

Economy



Panama's economy is based primarily on a well-developed services sector that accounts for three-fourths of GDP. Because of its key geographic location, Panama's economy is heavily weighted toward banking, commerce and tourism. Most important services include the Panama Canal, the Colon Free Zone, banking, insurance, container ports, and flagship registry and tourism. The previous administration, under President Perez Balladares, advanced an economic reform program designed to liberalize the trade regime, attract foreign investment, privatise state-owned enterprises, institute fiscal reform, and encourage job creation through labour code reform. The government privatised its two remaining ports along the Panama Canal in 1997 and approved the sale of the railroad in early 1998. Panama also joined the World Trade Organization (WTO) and approved a tariff reduction that will give the country the lowest average tariff rates in Latin America. A banking reform law was approved by the legislature in early 1998. However, the most important sectors driving growth have been the Panama Canal and other shipping and port activities. Panama's main industries are construction, petrol refining, brewing, cement and other construction materials and sugar milling.

A slump in Colon Free Zone and agricultural exports, the global slowdown, and the withdrawal of US military forces held back economic growth in 2000-01. The government plans public works programs, tax reforms, and new regional trade agreements in order to stimulate growth. GDP growth for 2000 was about 2,3% compared to 3,0% in 1999. Though Panama has one of the highest GDP per capita in Central America, about 40% of its population lives in poverty. Growth is slowing in 2003 to an expected 1,5%, mainly due to a slump in exports, as well as a lack of private investment (CEPAL, April 2003). The following chapter gives an overview of energy and environmental legislation in Panama, after which a more detailed view on bio-energy follows.

LEGAL FRAMEWORK IN PANAMA

Table 24: Main environmental legislation of Panama

Type	Number	Name and Description
Laws	Law No. 41	General law of the Environment and the National Authority of Environment is Created. Published in the official newspaper No. 23, 578, 3 of July, 98.
	Law No. 1	Forest legislation for the Republic of Panama. It was published in the official newspaper No. 22, 470, 7 of February, 1994.
	Law No. 24, Nov. 23, 1992	It provides incentives and regulations for reforestation in the Republic of Panama.
	Law No. 24, Jun. 7, 1995	Legislation of the Wild Life in the Republic of Panama. It published in the official newspaper No. 22, 801, 9 of June, 1995.
Regulations	DE-No. 57	It regulates the conformation and operation of different Environmental Consultative Commissions. Published in the official newspaper No. 24, 014, March. 21, 2000.
	DE-No. 58	It regulates the Environmental Norms of Quality and Limits Permits. Published in the official newspaper No. 24, March 21, 2000.
	DE-No. 59	It regulates the Environmental Impact Evaluation processes for all productive companies into three levels. Published on March 20, 2000
	DE-No. 35	Use of water. Published on Oct. 14, 1966
	DE- Executive No. 89	Published on Nov. 23, 1992
Codes	RE-TEC DGNTI-COPANIT 24-99	Re-utilization of the Residual Waters.
	RE-TEC DGNTI-COPANIT 35-2000	Water, discharges of effluents to the main bodies of water at the surface and underground.
	RE-TEC GNTI-COPANIT 39-2000	Discharges of effluents by different sewage treatments
	RE-TEC DGNTI-COPANIT 47-2000	Water: norms of use and final disposal of sludge
	RE-PREMIOS AMBIENTALES	Codes for environmental awards promoted by the Government of Panama.
Laws	No. AG 026-2002	Deadlines for administrative fulfilment of water residues procedures. Norms DGNTI – COPANIT 35-2000 y DGNTI- COPANIT 39-2000.
	No. AG 0151-2000	Minimum technical parameters for reforestation submitted to the ANAM.
	J.D – 009 – 94	It establishes the National System of Areas Protected and is defined some categories. It published on Jul. 25, 1994

Elaborated by BUN-CA

Panama's environmental law framework is fairly elaborated, although its actual compliance is difficult, as in most Central American countries. It's regulations for Environmental Impact Studies (EIAs) has recently been sharpened, and almost all productive companies now need to go through the EIA process for new investments or expansion. There exist three levels of EIA depending on the impact of the company's activities, each category has a specific set of requirements that companies must fulfil. In view of the country's environmental problems, which include waste water spills, excessive logging, illegal hazardous waste dumps, and coastal destruction through intensive prawn fishing, Panama still has a way to go before all of its industry is environmentally safe and sound.

Table 25: Summary energy legislation Panama

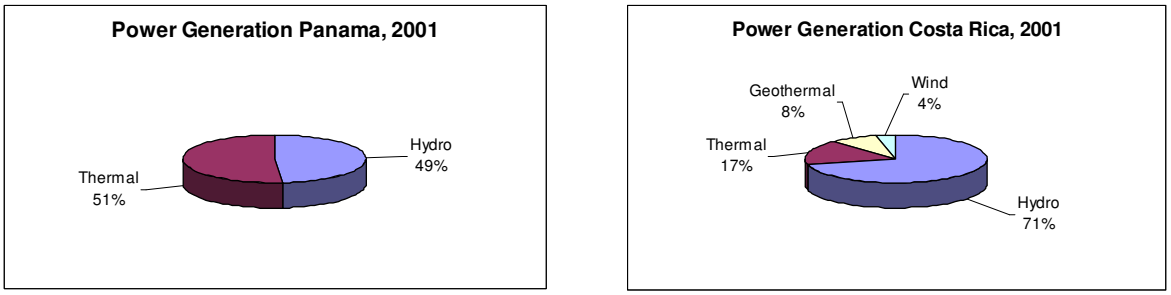
Generating Capacity	Concession time span	Licences Permits EIA studies	Incentives	Tariffs	Market
Max. 10 MW to interconnected systems and 50 MW for isolated systems	Max. 50 years for hydro and geothermic Max. 40 years for thermal units (Ley 6)	• The National Panamanian Authority of Environment (ANAM) has several levels of requirements concerning the realisation of EIAs, depending on the size and type of generation project • Thermal plants < 1 MW and hydro plants < 1,5 MW do not require an EIA. Panama counts with 4 categories for EIAs	• It is acknowledged a 5% preference in projects that generate with renewable sources, but hydro projects are limited to 3 MW • An incentive is considered of 5% for natural gas during a period of 10 years, without any capacity limit • Distributors are obliged to contract from the transmission company all involved supplies • Distributors are also obliged to follow the same preference with direct purchases	• Negotiated case by case with large clients • In general, tariffs are regulated and should cover the minimum costs of access and transmission	The electricity market according to the terms Agreement of Purchase of Energy (PPA) with a distributing company is characterised by the marginal costs at short term. The criteria and procedures in place for the purchase of potential and/or energy are established for a maximum period of 8 years for contracts. However, after the fourth year, there exists a penalty on top of the price paid. Participating companies are generators, co-generators, autogenerators, transporters, distributors, large clients and international interconnecters.

Source: Elaborated by BUN-CA

BIOMASS IN PANAMA

Panama boosts an important potential for hydro power, however, its installations have not been so developed as neighbouring Costa Rica, although the 'Fortuna hydro-power facility, is one of Central America's largest operations (300 MW). A reason is that the country's surface is more plain than that of Costa Rica, which gives it less opportunities to develop hydro power, also the government's focus and available resources in the past has not always been directed towards developing more hydro facilities. The following figure gives an insight into comparable data between both countries.

Figure 5: Different sources for power generation Panama – Costa Rica



Source: OLADE, 2001

It becomes evident that Panama, like El Salvador, is much more dependent on thermal resources than Costa Rica, especially since it does not have geothermal generating capacity. As in other Central American countries, within the generation 'mix' no biomass sources for power generation can be found in the statistics. In terms of bio-energy potential (see table), Panama mainly points towards sugar cane sector, as the volume of coffee production is relatively low.

Table 26: Determination of biomass potential in Panama

Production residues	Total solid waste (1.000 kg)	Treatment system	Projection of methane production (m^3)	Waste water (m^3)	Systems treatment of liquid waste
Coffee	42.640 (tons/pulp) 5.200 (tons/husk)	Coffee pulp used in compost. Coffee husk is used as fuel	N.a.	N.a.	Open air lagoons or no treatment
Bagasse from sugarcane	450.000	Co-generation and self power generation	N.a.	N.a.	

Elaborated by BUN-CA

Coffee

Panama is Central America's smallest coffee-growing country, producing just 270.000 100-pound (46-kg) bags in the 2000-01 season (comparable to one month's production in neighbouring Costa Rica). The employment of technologies to take advantage of the bio-energy potential has is little developed.

Table 27: Sub products coffee production (1999-2000)

Total Production (tons)	Production pulp (tons)	Production coffee film (m^3)	Production husk (tons)
104.000	42.640	24.664	5.200

Source: Elaborated by BUN-CA

Bagasse

In Panama exists a total year crushing capacity of around 1,5 mln tons of cane per harvest. The data on bagasse production are an estimated 30–32% of the processed sugar cane, the same as in other Central American countries. The following two tables give more details on the bagasse situation in Panama.

Table 28: Sugar cane production Panama (2002 harvest)

Total Production of cane (tons)	Percentage of bagasse from cane	Total Bagasse production (tons)
1.500.000	30%	450.000

Source: Elaborated by BUN-CA

Table 29: Sugar mills in Panama and Bagasse co-generation

Sugar mills	Capacity
Sugarmill Ofelina S.A.	Co-generates 7,9 million kWh/day with bagasse (about 72% of all the power required by the milling process)
Sugarmill Santa Rosa S.A.	Co-generates 5,01 million kWh/day (about 75% of all power required for milling)
Sugarmill Varela Hermanos S.A.	Used for steam production for milling and distillation processes
Sugarmill La Victoria (state owned)	Co-generates 866.100 kWh/day (about 90% of all power required by milling process)

Source: FAO, 1996 and BUN-CA 2003

Panama faces several environmental problems that require further study to evaluate the potential for bio-energy. For example, the shrimp sector which cultivates approx. 5.000 hectares is responsible for mangrove destruction and water pollution, while some sub products could be used for bio-energy applications.

Specific information on suppliers and other bio-energy contacts in Panama can be found in the annex.

TECHNOLOGY SUPPLY AND COMPETITION

This chapter gives an overview of known bio-energy technologies and suppliers that work in one (or more) Central American country(ies). It also deals with import and export issues and trade relationships with The Netherlands.

At present Central America does not boost a real market for bio-energy. Energy production by means of the organic and solid waste by-products of farming activities, industrial and productive processes are not generally seen as a potential business, most applications are for self-sufficiency (for example in the heating of boilers). Still, in the sugarcane industry in the target countries there is a strong market potential for bagasse-to-energy co-generation if the appropriate conditions were to be in place. For solid waste disposal, the idea of taking advantage of the methane gas is slowly becoming popular at local municipalities and electricity generators in Central America (La Prensa, July 31, 2003). At Central American level a series of bio-energy technologies have been identified. They are shown in the following table, together with its applications in the different countries.

Table 30: Available bio-energy technologies in Central America

Technology	Costa Rica	Panama	El Salvador
Gasification installations (< 600 Kw)	Technology almost not developed in Central America		
Bio-digesters (< 50 m^3)	Wide use in small pig farms, average capacity 3 – 50 m^3	N.a.	N.a.
Lagoons or open air treatment plants	Mainly applied in coffee industry, average capacity 160 – 15.000 m^3	N.a.	Mainly applied in coffee industry
Biomass ovens (< 150.000 m^3/h)	Widely applied in Central America		
Fluid bed dryers/ovens (< 100.000 m^3/h)	Principally used in rice industry	N.a.	N.a.
Co-generation with bagasse (1 – 20 MW)	Sugar refinery El Viejo (4 MW) is most important	N.a.	Different installations (1 – 15 MW)
Degasification plants and co-generation with methane (< 5 MW)	Pilot project in Río Azul (CNFL-Saret)	N.a.	N.a.

N.a. = Not Available
Source: Elaborated by BUN-CA

Central America does not offer a wide market yet for bio-energy applications. Hence, suppliers are also scarce. Technologies are mostly installed in stages, dimensioned and constructed at a local level to resolve specific situations and in many cases, as with bio-digesters, in a very artisan way. At the level of larger installations (motors, gas turbines, or any other heavy type of equipment related to energy production), it must be said that the US is the main supplier in all of the Central American region. The historic proximity and sometimes aggressive US sales approach has led many local companies to prefer American products. Another competitive advantage that some US suppliers wield with great success is the project financing instrument. We refer to the example mentioned in the Río Azul case study as an illustration. An extensive list of available suppliers can be found in the annex.

With regard to exports from The Netherlands to Costa Rica or any other Central American countries, very little evidence can be found of trade in 'renewable energy systems'. The following two tables give an overview of Dutch exports and imports related to Costa Rica. The main products that are traded between the nations are industrial in nature, and mostly have to do with hydrocarbon or related products. Unfortunately, no details are known from the category 'machines and transport materials'. CBS and Costa Rican institutions do not keep separate account of trade in renewable energy related technologies or machineries.

Table 31A: Trade between Costa Rica and The Netherlands

Dutch export to Costa Rica (€ mln)	1999	2000	2001	2002
TOTAL	**46,6**	**67,2**	**71,6**	**120,9**
TOTAL Agriculture	**10,4**	**13,7**	**18,6**	**16,2**
Food and living animals	7,3	10,2	14,4	12,3
Dairy products and eggs	1,5	1,4	1,6	2,3
Milk, cream and milk products, excl. butter	1,2	1,2	1,5	2,1
Wheat and wheat products	0,0	0,1	1,8	1,4
Wheat prepared products, including fruits	0,0	0,1	1,8	1,4
TOTAL Industry	**36,2**	**53,5**	**53,0**	**104,7**
Mineral fuels, lubricants	0,1	11,1	15,6	61,4
Crude oil and related products	0,1	11,1	15,6	61,3
Processed products of oil	0,0	11,1	15,0	61,3
Chemical products	20,1	18,3	22,9	25,4
Metal and peroxy salts	1,2	1,0	2,4	14,6
Pharmaceutical products	13,7	10,5	7,6	14,4

Source: CBS (Taken from Netherlands Embassy in Costa Rica, July 2003)

Table 31B: Trade between Costa Rica and The Netherlands

Dutch import from Costa Rica (€ mln)	1999	2000	2001	2002
TOTAL	**162,0**	**270,8**	**493,8**	**983,9**
TOTAL Agriculture	**113,8**	**118,4**	**127,0**	**114,8**
Raw vegetable products	63,3	69,3	73,5	73,4
Other raw animal and vegetable products	63,3	69,3	73,5	73,4
Food and living animals	50,5	49,1	53,5	41,4
Vegetables and fruit	34,2	38,3	48,7	37,7
Fruit; fresh or dried	13,2	12,4	19,3	20,8
TOTAL Industry	**48,2**	**152,4**	**366,8**	**869,1**
Machines and transport materials	46,5	149,3	362,1	865,4
Electrical instruments	1,1	65,7	360,6	862,0
Electronic tubes, transistors, chips, etc.	1,0	65,5	360,2	861,8
Office and automation supplies	45,3	83,3	1,1	3,4
Spare parts for machinery	45,2	83,2	1,1	2,9

Source: CBS (Taken from Netherlands Embassy in Costa Rica, July 2003)

Import Regulations

Two countries, Costa Rica and El Salvador, use the same import regulation in the light of the Central American Economic Common Market, the Central American Uniform Custom Code and its associated rules, called CAUCA by its Spanish acronym. A problem with the imported products, is that the information is not systematically recorded by government agencies in the three countries. Specific equipment supply for bio-energy at the Central American level is a product of combining different components, according to the engineering design of the facilities. For instance, in the light of this study, it was found that turbo generators for hydropower production, with a capacity over 5 kW, are imported from Brazil, Spain, Canada and US, among others.

Heat processing and generation equipment are generally imported as a single package, with thermal capacities ranks between 60 psi up to 900 psi for bagasse co-generation, in the sugarcane industry. The next table summarises the most important import regulations.

Table 32: Regulation for import of equipment

Statistics	Costa Rica	Panama	El Salvador
Imports (products)	Customs System, CAUCA	Any company holding a commercial license can freely import goods into Panama	Customs System, CAUCA
Importing groups	Generally, local companies directly import their equipment. Some project developers, such as SARET and ESCO, require equipment which is procured based on detailed specifications and norms depending on the specific project (case of turbo-machinery for degasification)	There are no customs records available. The most common reference is similar to the Costa Rican situation for the sugarcane industry.	N.a.
Codes for clients	National Entity in charge of Appraisal and Customs Verification	General Direction of the Income of Customs	N.a.
Projections for the following years	Incipient market, however, it is a good time for the representation of foreign equipment suppliers at the local level, which may offer cost-efficient environmental solutions with emphasis on bio-energy power generation. It also coincides with the trend around new regulations enforced by the European markets on commerce and the environmental restrictions on products before they can enter the EU.	Incipient market, no specific importers for equipment exist, neither in technology or bio-energy	Incipient market, no specific importers for equipment exist, neither in technology or bio-energy

N.a = Not Available
Elaborated by BUN-CA

Detailed information for each import regulation is available in Spanish, please contact the authors in case of interest. A good manual for foreign investors that wish to do business or trade with Costa Rica is available free of charge at: http://www.empresas.co.cr/cgi-bin/links/jump.cgi?ID=496. The manual is in English and includes information on requirements, forms, and procedures required by the Public Administration. Also, the Dutch Embassy's Tico Paper (see source list) offers a number of suggestions on how to prevent problems in doing business in Costa Rica and Central America.

GOVERNMENT PROGRAMS AND FINANCING OF PROJECTS

There exists no systematised source of information about the main sources of funding for investments. It is through earlier projects and contacts with suppliers that this information can be gathered throughout the region. At the regional level, several multi and bilateral organisations facilitate access to potential investors, providing capital resources in the form of equity and debt. Some of these stakeholders are included in the next table.

Table 33: Financial sources at regional level

Main Development Institutions	Main Financial Institutions
UNDP/PNUD: United Nations Development Program COSUDE: Switzerland Cooperation for International Development GTZ: German Technical Cooperation Dutch Embassy GEF: Global Environment Fund	IADB/BID: Inter American Development Bank CABEI/BCIE: Central American Bank of Economic Integration E+Co Spanish Cooperation and EU investment groups World Bank

Source: Elaborated by BUN-CA

To get an idea of government programs that are in place or in planning, the next table summarises several initiatives.

Table 34: Government programmes at regional level

Government Program	Costa Rica	Panama	El Salvador
Existing programs and plans on incentives for the development focused mainly on environment issues	MINAE: Follow up to the implementation of the National Plan of Forest Development (PNDF) MINAE: National Strategy of Environmental Management MINAE/MIDEPLAN: Consolidation of the planning system of the MINAE in the central and regional level MINAE/MINSALUD: To elaborate a strategy for the administration and handling of the hydro resources	GESTATES: regional project GTZ CCAD, to see the page web: http: //gesta.sgsica.org FOGAPEMI: national project of the GTZ MARN, Promotion to the Environmental Management and cleaner Production in PYMES	ANAM: Climate Change MIDA: Sustainable Rural Development of Darien ANAM: Environment Management
Plans and bilateral programs of institutions and multilateral Other programs at the in-country level are CNP + L (Initiative for Cleaner Production), Clean Development Mechanisms (CDM).	CONACE: Program of Development of Renewable Power Sources ICE: Realization of the national plans to use nonconventional power sources: wind, PV, biomass and others	SNET: National Service of Studies Territorial (MARN) Covenant Basilea of Dangerous Management of Waste Integral Management of the Solid Waste Management of Residual Water Management of Air Quality Technology applications and technical norms of environmental quality Reorder of the Environmental and Natural Resources Sector Strengthen Environmental Management Promotion of cleaner technologies	ETESA: Wind Energy

Source: Elaborated by BUN-CA

Finally, the Central American Commission on Environment (CCAD) is an important institution that deals with implementing sustainable projects, among which some related to bio-energy. The following table sums up the list of actual projects.

Table 35: Regional projects related with bio-energy, executed by the CCAD

Project name	Period of execution	Financing sources / participants
Management of Solid Residues in Central America Policemen (PROARCA-SIGMA)		CARE El Salvador, USAID
Program of Modernisation of the Environmental Systems of Management in Central America (PROSIGA)	January of 1999-july 2004.	Total: $ 11,745,802 of which Holland contributed US$ 3,000,000 000 and the BID contributed US$ 1,000,000
Central American Environmental program of Legislation (COSUDE)	April of 1999- December 2002. A new fase of extension for the next 3 years starting 2003	COSUDE: US$ 890,000
Environmental management in the small and medium industries in Central America (GESTA)	January of 1999-October of 2002. A second phase is under negotiation	CCAD/GTZ: US$ 1,000,000
Evaluation of the Environmental Impact in Central America	April 2001 – April 2003	UICN/ US$ 516,636
Commerce and Environment	May 2001 – December 2002	Capacity 21 / PNUD. $US 418.400

Source: Elaborated by BUN-CA

MARKET OPPORTUNITIES IN BIO-ENERGY

Market opportunities in Costa Rica

Costa Rica counts with a strong and still growing agricultural and agro industrial sector. The excellent soil and climatic conditions provide for a constant supply of natural resources, be it sugar cane, wood, coffee, vegetables or fruits. The high caloric value of production residues are only in certain cases taken advantage of, a huge potential exists for further development. Also, the current waste water treatment systems offer opportunities to integrate new technology to take advantage of biogas. A number of large cattle and pig breeders have experimented in mostly small pilot projects with bio-digesters, where good results are achieved. The challenge is to extend and scale these projects with larger livestock producers.

Ultimately, the hope is that Costa Rica's strong industrial base centred around organic materials will create the opportunity to produce electricity, be it for self use or to sell surplus electricity to ICE. In all cases, due to a limited investment capacity of most Costa Rican companies, all solutions would have to be cost-effective and bring clearly demonstrated cost savings at short term. The following table presents a list of potential projects interesting for Dutch providers of bio-energy technology. Most of these projects were described in more detail earlier in the report (see chapter Bio-energy in Costa Rica). Please note that projects vary strongly in size and level of technology. The contacts of the corresponding projects can be found in the Annex: Contact Addresses.

Table 36: Market opportunities Costa Rica

Type (location)	Short description	Size	Timing	Contact
Gas turbines, gasification installations	In relation to gasification in industries with high carbon energy materials (wood plantations, sugar industry). Also interest in project financing	Medium-Large	Short – Medium term	CPM Ston Forestal Transfer Consultancy
Co-generation	Sugar refineries will be looking for co-generation equipment based on utilisation of sugar cane once ICE approves new contracts	Large	Medium – Long term	CPM LAICA
Biogas from landfills	High interest by companies and municipalities: innovative applications, gas turbines and project finance	Large	Short – Medium term	Saret Municipalidad Desamparados
Integrated waste water treatment systems	Solutions that include capture and utilisation of biogas, also treat (greasy) waste left over	Medium Large	Short – Medium term	Dos Pinos Embassy Costa Rica Transfer Consultancy
Organic waste (river basin of hydro plant), Gasification/Co-gen	Possibilities for feasibility study (PESP). Gasification or other bio-energy solution. See case study	Large	Short term	CNFL BUN-CA Transfer Consultancy
Animal excrement	High interest in large scale pilot project including biogas installations and training program	Medium	Short term	Cámara de Porcicultores
Water plants 'Lario de agua'	Looking for partner in scaling of drying and gasification process	Medium	Short term	ITCR Transfer Consultancy

Source: Transfer Consultancy (based on interviews)

Market opportunities in El Salvador and Panama

Although El Salvador and Panama have been researched less intensively, certain market opportunities are worth mentioning. Both countries have much less hydro power capacity than Costa Rica and could therefore naturally be more interested in developing their bio-energy potential. An additional advantage is that both countries' electricity sector is more deregulated than Costa Rica's, offering more possibilities for private sector initiatives. A possible disadvantage could be the concentration of capital in certain companies or cooperatives, which would oblige Dutch providers to carefully select potential projects. The following two tables sum up some of the currently existing opportunities in both countries. Please contact BUN-CA for any additional information on these projects and specific opportunities for your company.

Table 37: Market opportunities El Salvador

Type (location)	Short description	Size	Timing	Contact
Biogas production from Coffee Mill wastes	Cogeneration with coffee wastes (pulp, husks, waste water)	Large	Long term	Las Quebradas Coffee Mill
Sanitary Landfills	Waste management projects in the Great Metropolitan Area of San Salvador	Large	Long Term	Municipalities and Central Government
Waste Water	Waster Water Treatment Projects with MARN, CONACYT, ANDA, OPS, and national and international ONGs	Large	Medium - Long Term	El Salvador Government and municipalities
Gas turbines, gasification installations	Gasification in agro-industries with vegetal carbon energy materials.	Medium - Large	Medium - term	Chaparral Farm
Co-generation	Sugar mills will be looking for co-generation equipment for power production based on utilisation of sugar cane Other sugar mills will be interested in co-generation.	Large	Short - Medium term	San Francisco sugarmill Chamico and Chaparrastique sugarmills

Source: BUN-CA (based on interviews)

Table 38: Market opportunities Panama

Type (location)	Short description	Size	Timing	Contact
Sanitary Landfills	Close the (open pit landfills) in Panama City to treat 1.200 tons per day of waste	Large	Large Term	Municipalities of Cocle and Panama City.
Biogas Plans	Energy generation, with installations of biogas plants in Penonomé, Province of Coclé Biogas generation, and compost	Medium Large	Medium Term Medium - Large Term	Natura Foundation Empresa de Abono Orgánico de Boquete "ABOQUETE"

Source: BUN-CA (based on interviews)

Final remarks

There exists a number of concrete projects in Central America in addition to the above mentioned, where Dutch companies active in the bio-energy field could contribute either knowledge, technologies or project financing. Great interest was shown by the business community as well the local and state governments, in for example Dutch experience and technologies in the area of responsible landfill management, small-scale solar power equipment, and CO_2 reduction certification programs. Companies can either directly contact the authors of the study or the Embassy representative.

In any case, a combined effort by Dutch industry would certainly be most effective in generating concrete projects. Proposals for a business fact finding mission should be considered for those Dutch providers of cost-efficient solutions related to above mentioned and other upcoming business opportunities. The upcoming environmental and bio-energy technology trade fair in Panama (October 2003) could be targeted for this purpose (see the Annex). As this report offers an introduction in the sector of renewable energies in Costa Rica, El Salvador and Panama, it is recommended to each Dutch company to analyse more in detail what opportunities for their products/ services are presented by the Central American market and in which way these could best be exploited by them.

ANNEXES

- Interesting Websites
- Events
- References
- Contact Addresses

INTERESTING WEBSITES

Costa Rica

Organisation	Website
ARESESP, Regulating body of public services	www.aresep.go.cr
BUNCA, Regional Biomass Users Network	www.bun-ca.org
Chamber of Industries	www.cicr.com
CNFL	www.cnfl.go.cr
Dirección Sectorial de Energía	www.dse.go.cr
ICE	www.ice.go.cr
InfoAgro, information portal agrosector	www.infoagro.go.cr
LAICA, Sector organisation sugar producers	www.laica.co.cr
Ministry of Agriculture	www.mag.go.cr
Ministry of Energy and Environment	www.minae.go.cr
Ministry of Health	www.netsalud.sa.cr/ms
Ministry of Justice, portal for published laws	www.pgr.go.cr
National Centre for Cleaner Production	www.cnpml.or.cr

El Salvador

Organisation	Website
Banco Agrícola	www.bancoagricola.com
Banco Central	www.bcr.gob.sv
Banco Multisectorial de Inversiones	www.bmi.gob.sv
Banco Salvadoreño	www.bancosal.com
Central American Bank for Economic Integration	www.bcie.org
Dirección General de Energía Eléctrica (DGEE)	www.minec.gob.sv
El Salvador Trade Portal	www.elsalvadortrade.com.sv
Energía Global International, Ltd.	www.egiltd.com
Financial Calpía	www.calpia.com
FINET (Fondo de Inversión Nacional en Electricidad y Telecomunicaciones)	www.fisdl.com.sv
Ministerio de Ambiente y Recursos Naturales (MARN)	www.marn.gob.sv
SETISA (Servicios Técnicos de Ingeniería)	www.setisa.com.sv
SIGET (Superintendencia General de Electricidad y Telecomunicaciones)	www.siget.gob.sv
UCA (Universidad José Simeón Cañas)	www.uca.edu.sv

Panama

Organisation	Website
ANAM (Autoridad Nacional de Ambiente)	www.anam.gob.pa
ANCON	www.ancon.org
APRONAD (Asociación de Promotores de Nuevas Alternativas de Desarrollo)	www.apronad.org
Banco Nacional de Panamá (BNP)	www.banconal.com.pa
Grupo MELO, S.A.	www.grupomelo.com
Ministry of Agricultural Development (MIDA)	www.mida.gob.pa
Portal Government of Panama with links to all Ministries	www.pa/gobierno/index.html
Portal Panama General	http://www.pa
Swisscontrol S.A	www.swiscontrol.com
Universidad Tecnológica de Panamá, Facultad de Ingeniería (UTP)	www.fim.utp.ac.pa

EVENTS

Central American Events:

"Energía para el futuro"
San José
Centro de Enseñanza Permanente de Conservación de la Energía (CEPSE)
Contact: Johnny Perez
E-mail: jperez@cnfl.go.cr
Date: August 21 – 23, 2003

"Soluciones Ambientales para el Desarrollo Sustentable, la experiencia en Costa Rica"
San José
Contact: Alfonso Sanabria
E-mail: alfonsosanabria@undp.org
Date: October 27- 29, 2003

"Programa de Modernización de los Sistemas de Gestión Ambiental en Centro América, PROSIGA"
Panama City
Contact: Claudia Rojas / Carlos Navarro
E-mail: info@expoambiente.com
Date: end of November, 2003

Other regional events

"Latin America Power and Gas 2002 International trade fair on energy, Monterrey"
Website: www.latinamerpower.com
E-mail: tishb@pennwell.com
Next edition: August, 2003

"Conferencia"Energías Renovables en Latino América"
Wyndham Miami Beach Resort
Website: www.lahmeyer.de
Contact: Dominique Paris-Raab
E-mail: ge_260@lahmeyer.de
Next edition: September 18-19, 2003

"Powermex, International exposition on energy sources"
Mexico City
Contact: Kara Lotto
Website: www.ejkrause.com
E-mail lotto@ejkrause.com
Next edition: October, 2003

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- **La Nación (April 12, 2003)**, Plazo para iniciar el cierre de relleno
- **La Prensa (July 31, 2003)**, Intentan generar luz con basura
- **La República (May 8, 2003)**, Holcim mantiene calificación de riesgo
- **La República (May 9, 2003)**, Costa Rica produce oxígeno a Holanda
- **La República (June 13, 2003)**, Cogeneradores condenadas al olvido
- **La República (June 16, 2003)**, Arroceros hacen frente común en Cafta
- **La República (June 19, 2003)**, Bosques, un negocio rentable
- **La República (June 21, 2003)**, Piña lidera crecimiento en ventas
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- **MAG (2001)**, Programa Nacional de Cerdos con base en censos parciales de Dirección de Salud Animal
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- **TerraNews (June 26, 2003)**, Inventory of the Cattle Raising in Central America
- **The Economist Intelligence Unit (2001)**, Environmental regulations
- **Windpower Monthly (2002)**, What chance Latin America? Country overview

CONTACT ADDRESSES

Personally interviewed organisations Costa Rica

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ACOPE, Costa Rican Association of Power Producers Apdo 270-1007 San José – Costa Rica Tel.: +506.258 41 41 Fax: +506.258 41 36 E-mail: acopecr@racsa.co.cr	**Mr Mario Alvarado M.** Executive Director
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PINHALENSE	Venta e instalación de hornos de biomasa de fuego directo e indirecto	Joao Staut	Brazil	55-196-513233	55-196-512887	peamarketing@peamarketing.com.br / www.pinhalense.com.br
WILKO TEC	Consultoría, venta e instalación de hornos de biomasa de fuego directo e indirecto	Wilfred Korte	Porvenir de Desamparados, San José	506-259-7392		will_korte@racsa.co.cr
Fluid bed dryers/ovens						
DESACAFE	Construcción y venta de maquinaria y equipos	Luis F. Castillo		506-258-1089	382-2512	desacafe@racsa.co.cr
Landfills						
EBI (Empresa Berthier)	Tratamiento de desechos sólidos	Juan Carlos Obando	Parque tecnológico la Carpio la Uruca	232-7618		
IWT/CWT (Interstate Waste/ Caribe Waste Tecnology)	Tratamiento de desechos sólidos			540-687-3177 california	540-687-3179 california	info@igclp.com
WPP	Colecta y transporte de desechos sólidos			224-3838 /225-9090		www.wppcontinental.com

List of Supplier contacts in El Salvador (elaborated by BUN-CA)

Organization	Contact	Position	Address	Telephone	Fax	E-mail
Agriculture						
Compañia Azucarera Salvadoreña	Juan Eduardo Interiano	Gerente General	Urb Santa Elena, Blvd Orden de Malta, Edificio Madre Tierra - Servinsa # 420 Antiguo Cuscatlan	503+271-5777, 289-4803, 451-6986		Sonsonatejeinter@sal.gbm.net
Consejo Salvadoreño Del Café	Ricardo Humberto Espitia	Director	7 C. Pte. 3876 col. Escalón		263-3783	respitia@consejocafe.org.com
Ingenio El Angel	José Antonio Abrego	Gerente General	Km 14 ½, Cantón Joya Galana, Carretera a Quezaltepeque, Apopa	503+216-0074, 216-0425	216-0732	elange@salnet.net
Ingenio El Carmen	Héctor Cristiani	Presidente	5a Calle PTE # 4248, Col Escalón Fte Escuela Concha Vda de Escalón	503+263-3589, 263-3286		torino@salnet.net
Ingenio La Cabaña	Alfredo Pacas	Presidente	87 Av Nte Y 9a Calle PTE # 4409, Col Escalón, San Salvador	503+263-1100	263-3637	alfredopacas@integra.com.sv
Ingenio La Cabaña	José Mardoqueo Carranza			503+2631100	2633637	Jcarranza99@hotmail.com
Ingenio La Cabaña	José Raul Figueroa	Gerente General		503+2631100	2633637	
Ingenio La Magdalena D.	Nestor Ulises Palma	Director Presidente	Blvd. Merliot, edificio Ucraprobex No.2	503+278-9410 / 278-9439 / 278-9453		
Ingenio San Francisco	José Antonio Bonet	Presidente	Blvd Del Hipódromo, # 426, Col San Benito, San Salvador	503+243-3441	243-3440	jabonet@navegante.com.sv
Ucraprobex	Israel Martínez	Gerente de Producción y Beneficiado de Café		503+278-0064	278-1311	ucracafe@es.com
Development						
CNC (Confederación Nacional Campesina)	Raúl León	Gerente Admón Financiero	45 Av Sur No 625, Col Flor Blanca, San Salvador, El Salvador	503+224-3435		Arsal_@hotmail.com
CNPML	Ricardo Pinel	Director Proyecto	Edificio ASI, Colonia Roma San Salvador	503+279-2488	298-8091	cnpml@cnpml.org.sv
REDES (Fundación salvadoreña para la reconstrucción y el desarrollo de El Salvador)	Juan David Martínez	Director Ejecutivo	Calle Cerro Verde y Av Tecana No 3028, Col Miramonte SS	503+260-1474, 260-1384, 260-1472	260-1474, 260-1384, 260-1472	inforedes@redes.org
Energy						
FUPRODEH (Fundación Pro Desarrollo Humano, Energetico y Ambiental)	Rafael Granados	Director Junta Directiva	Altos de San Francisco, Pje 1 # 112, San Salvador	503+243-5926		R.granados@esal.net
CEL (Comision Ejecutiva Hidroeléctrica Del Rio Lempa)	Balmore Amaya	Unidad Ambiental	9ª C PTE No 950 entre 15 y 17 Av Norte Atrás Bco Central de Reserva, SS	503+211-6000	211 6752	Balmore_Amaya@cel.gob.sv
Research						
UCA (Universidad Centroamericana "José Simeón Cañas")	César Villalta	Jefe de Departamento		503+210-6662	210-6664	cvillalt@ing.uca.edu.sv
Politics						
Dirección De Energía Eléctrica	Jorge Rovira	Director	Alameda Juan Pablo II y calle Guadalupe, Edificio C-1 Plan maestro, centro de Gobierno	503+281-1122 ext. 1311-1312	281 2978	jrovira@minec.gob.sv
SIGET (Superintendencia General de Electrticidad y Telecomunicaciones)	Giovanni Hernández	Gerente de Electricidad	Km 105 carretera Sta Tecla,	503+288-0066		ghernandez@siget.gob.sv
Other						
Asociación Salvadoreña de Industrtiales	Julio German Reyes	Director de Unidad Política Energetica y Desarrollo Industrial	Calle Roma y Liverpool Col. Roma.	(503) 279-2488 / 2985855 / 279-4990	279-1880	juliogrys@telemovil.com
CCAD (Comisión Centroamericana de Ambiente y Desarrollo)	Mauricio Castro Salazar	Secretario Ejecutivo		503+cel.894-8444		mcastro@sgsica.org
CEAC (Consejo de Electrificación de América Central)	José Orlando Martínez M.	Asistente Ejecutivo	9a. Calle Poniente, No. 950. Centro de Gobierno	503+211-6175 / 211-6178	211-6239	omartine@cel.gob.sv
CESTA	Andrés Agenso			503+220-0046		
Eco Carbon	Alberto José Valdivieso	Director Propietario	Final 2da. Avenida Sur Resid. El Paraiso No.6 No. 58 Q. Santa Tecla	503+229-3751	229-3751	ecochaparral@hotmail.com
GESTA /GTZ / CCAD	Ana Maria González	Asesora Técnica	Alameda Roosevelt y 55 Av. Norte	(503)260-0721 / 4393	(503) 260-4397	gesta@telesal.net

List of Supplier contacts in Panama (elaborated by BUN-CA)

Organization	Details	Contact	Position	Address	Telephone	Fax	E-mail
Agriculture							
Aboquete	Produce abono orgánico, desea producir biogás	Demetrio Javier Díaz Menéndez	Gerente General	Alto Boquete, Chiriquí Rep. De Panamá	507+720-4008 cel. 629-7402	720-1454	aboquete@hotmail.com / meme_d29@hotmail.com
Environment							
FUPASA (Fundación Panameña de Servicios Ambientales)	Cambio Climático y Mecanismos de Desarrollo Limpio	Salvador Sánchéz	Director Ejecutivo	Ed.Global Bank, Cl. 50, piso 22	507+215-2667	269-0534	fupasa@ayayai.com
ANAM (Autoridad Nacional de Ambiente)	Normaliza los Aspectos Ambientales en Panamá	Ricardo Anguizola	Administrador General	Antigua Base de Albrook 804	507+315-0668	315-0654	anan@anangob.pa www.anam.gob.pa
Fundación Natura		Yolanda Jiménez	Oficial de Proyectos	Apartado 2190, Panamá	507+ 232-7435 / 232-7615 / 232-	232-7613	proyectos@naturapanama.org
Science & Technology							
SENACYT (Secretario Nacional de Ciencia, Tecnología e Innovación)	Secretaría Nacional de Ciencia y Tecnología	Gonzálo Córdoba	Director	Clayton, Ed. 213	507+317-0014	317-0020	jespinos@senacyt.gob.pa
Universidad Tecnológica de Panamá, Facultad de Ingeniería Mecánica		Benigno Vargas	Decano	Campus Central Universidad Tecnológica de Panamá, Ricardo J. Alfaro, Cerro Patacón	507+236-4743	236-4743	bvargas@fin.utp.ac.pa
Consulting							
EPPSA (Electric Power Panama S.A.)	Tienen 4 proyectos minihidroeléctricos con conducencia aprovada por el Ente regul. De los Serv. Pub.	Humberto Alvarez	Socio	Bellavista Cl. 43 Ed. Nueva Era. No. 2B	507+225-8188 /	315-1192	zeolites@cwpanama.net
Development							
APRONAD (Asociación de Promotores de Nuevas Alternativas de Desarrollo)	Promueve nuevos enfoques para el desarrollo humano local	Isidra Meneses	Directora Ejecutiva	Calle Eusebio Morales, Edif. Luz María 3er piso	507+264-2940	264-4612	apronad@apronad.org/ isidra@apronad.org
FAS Panamá (Fundación de Acción Social por Panamá)	Tienen un Proyecto de reciclaje de papel	Marisol Landau	Representante Legal	Calle Crotton y Esperanza, Balboa # 820A	507+228-3882	228-3882	marisol@omc_pty.com
SONDEAR	Teléfono fuera de servicio	José Agustin Espino	Presidente	Urb. Los Angeles	507+223-5836	264-5841	
FUNDESPA (Fundación para el Desarrollo Sostenible de Panamá)	Promueve el desarrollo y la capacitación empresarial de la pequeña empresa	Aldo Antonio Aldeano	Gerente Ejecutivo	Urbanización Los Ángeles, Betania, al lado del Banco General	507+236-0433	260-7738	panama@fundes.org
Proyecto Pobreza Rural, Ministerio de Desarrollo Agropecuario	Trabajan con las áreas más pobres de Santiago, Herrera y Chorrera	Agustín Moscoso	Coordinador del Proyecto	Altos de Curundu, frente a TECNASA	507+232-5169	232-7508	Pobreza@orbi.net
Energy							
Facultad de ingeniería mecánica, Universidad Tecnológica de Panamá		Lino Ruíz	Decano	Campus Central Universidad Tecnológica de Panama, ricardo J.	507+236-4743	236-4743	lruiz_t@hotmail.com
Energía Renovable de Panamá	Suplidor de PV	Alejandro Arango	Gerente	Vía argentina Edif. 53 ofic. 1B; al lado de la Farmacia Arrocha nueva	507+214-7293	214-7293	energia@sinfo.net
Soluciones Energéticas	Suplidor de PV	Eduardo De La Guardia	Gerente General	Calle Federico Boyd, Edif. Escoitia, Sexto Piso	507+264-0938	2640938	Solanesa@pty.com
J & J Electric Systems, Inc.	Suplidor de PV	Juan M. De La Cruz	Gerente General	Apartado 0838-00152 Zona 12	507+290-4162	266-1295	jjelect@sinfo.net
Sistemas Alternos de Energia Renovables	Suplidor de PV	Eliécer Paredes	Ejecutivo Ventas y Promocion	Calle 17-C Norte, No. 21-C. Bethania, La Gloria	507+2368702	2368704	laisae@cwp.net.pa
Other							
Abono Organico el Trebol		Emigdio Chea	Gerente	Los canelos, Divisa	507+976-1333	976-1394	
ACP (Autoridad del Canal de Panamá)		Javier Morón Zanet	Especialista Ambiental	Balboa, Ancón República de Panamá	507+272-7830	272-5435	jmoron@pancanal.com
ACP (Autoridad del Canal de Panamá)		Juan Héctor Díaz C.	Director	Balboa, Ancón República de Panamá	507+272-4061	272-3965	jdíaz@pancanal.com
ANCON (Asociación Nacional para la Conservación de la Naturaleza)		Lider Sucre	Director Ejecutivo	Apartado 1387, Panamá 1,	507+314-0050 / 314-0060	314-0061	lsucre@ancon.org www. Ancon.org
Asociación de Porcinocultores de Panama		Luis Benjamín Rosas	Presidente	Vía Argentina	507+214-9322	264-5307	anapor.panama@terra.com
Compañía agricola Industrial		Jorge Arango	Presidente	Nvo. Arriajan	507+257-1615	257-0403	caisaofice@cwpanamá.net
COPE (Comisión de Políticas Energéticas)	Via España Ministerio de Economia y Finanzas 3 er piso del Edificio OGAWUA	Michael Mihalitsianos	Director Ejecutivo		507+264-8110	269-3123	michaelm@cwpanama.net/ mmihalitsianos@mef.gob.pa
EPPSA (Electric Power Panama)		Rolando Cuevas	Socia	Bellavista Cl. 43 Ed. Nueva Era. No.	507-2258188	315-1192	Zeolites@cwpanama.net
Fundación para el Desarrollo Integrado Sustentable		Delma Espino	Coordinadora		507+260-3108	260-3108	delmaez@sinfo.net
Porcinocultura San José		Carlos Ivan Villalaz	Gerente	San José, Las Tablas	507+960-9810	960-9810	civillalaz@hotmail.com
Producción Organica y Comercialización Solidaria		Vielka Bermedez	Directora Administrativa		507+227-4025	225-1428	vielka@eudoramail.com
SONDEAR		Glenda E. Bonamico	Gerente	Apartado 6-2045 El Dorado	(507) 279-0421	(507) 279-0423	tnspa@sinfo.net