GSR Energy Limited

(Belize LLC)

Diversifying In Energy Production:

Producing Bio-Electricity & Bio-Ethanol

From Sugarcane, A Natural Resource of Belize

CARIMET - Regional Workshop

Renewable Energy and Climate Science: Metrology and Technology Challenges in the Americas

April 14 & 15, 2015 - Kingston, Jamaica

Agenda


System
GHG Reductions
Efficiency Interventions
Socio-Economic
Status
Challenges

Sugarcane (1.4 M tons)

Sugarcane Juice ← Process → Sugarcane Bagasse (Waste)

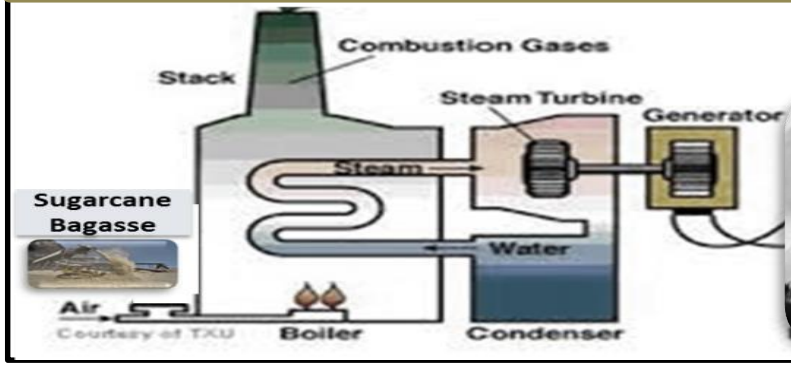
Ethanol Distillery:

Produce Ethanol Rather Than Rum

Ethanol

Electricity Plant:

Use Bagasse Rather Than Coal



Electricity

Belize National Energy Policy (NEP) 2012

Domestic

Preference on Renewable Energy

- 4 Hydros & 1 Sugarcane Bagasse Cogen
- E-10 and Bio-Diesel

Export

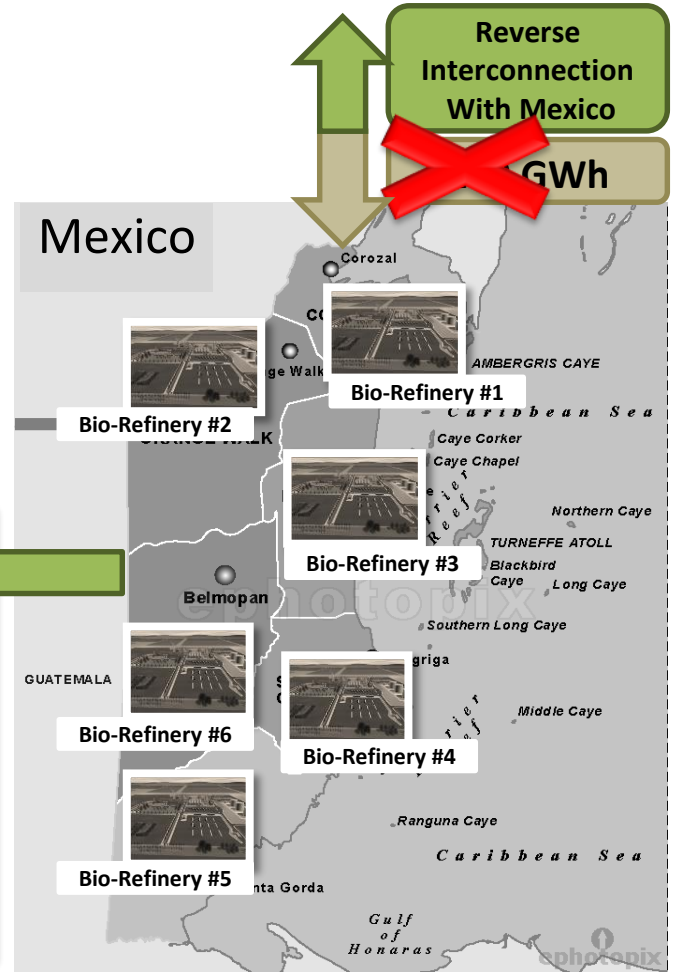
Clean Energy for Export

- Electricity: Mexico & SIEPAC
- Bio-Fuels: Ethanol & Bio-Diesel

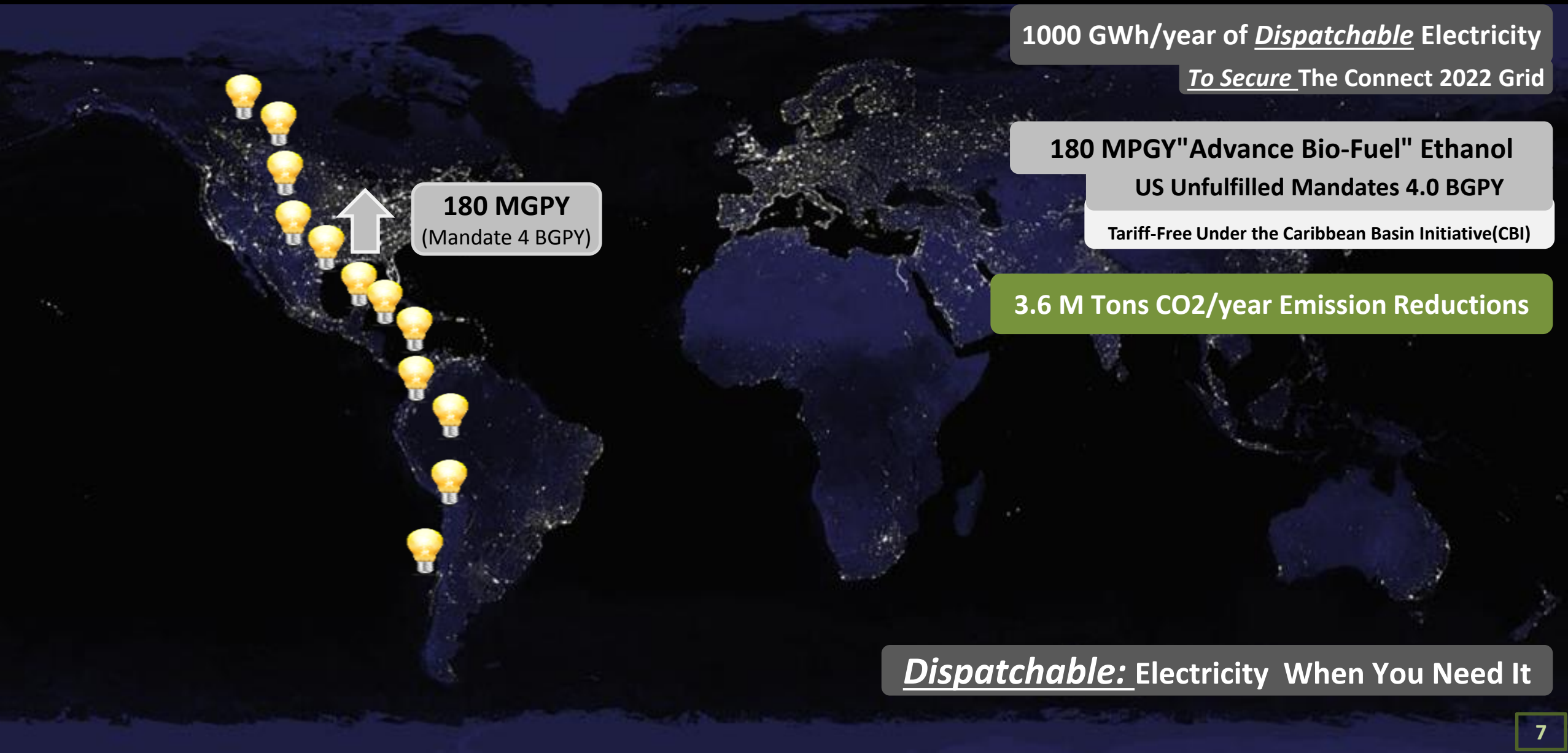
Problem and Solution

From: Belize Depends On Mexico for 75 % Dispatchable Electricity

To: A Clean Energy for Export Industry



Belize's Clean Energy for Export Industry



1000 GWh/year of *Dispatchable* Electricity

To Secure **The Connect 2022 Grid**

180 MPGY"Advance Bio-Fuel" Ethanol

US Unfulfilled Mandates 4.0 BGPY

Tariff-Free Under the Caribbean Basin Initiative(CBI)

3.6 M Tons CO2/year Emission Reductions

Dispatchable: **Electricity When You Need It**

GHG Reductions

1. Bio-Electricity
2. Recycle Bio-Gas
3. Ethanol
4. Anaerobic Digestion
5. Mechanical Harvesting

Emissions Are Contained

Gaseous Waste: **No** Venting to the Atmosphere

Solid Waste: **No** Diluting in Rivers & **No** Ponds

Waste Water: **No** Dirty Water Dumped Back in the River

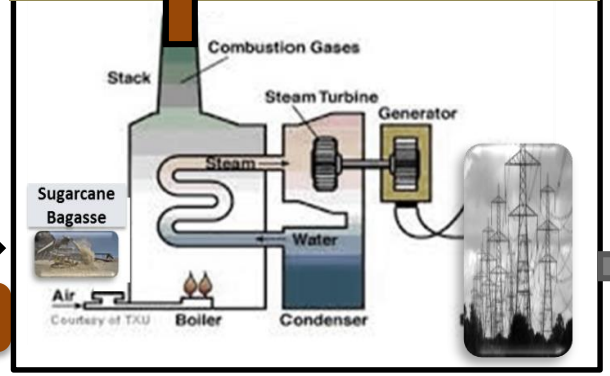
Bio-Refinery Waste Streams: Biogas, Solids and Liquids (standard piping used for waste)

Biogas: Recycled Into Electricity

Waste Water: Recycled & Returned Same or Better Via a 2-Stage Treatment Process

Waste Water

Electricity Plant



Biogas

Solids: Recycled Into Fertilizer for Cane Via Anaerobic Digestion Unit

Ash

Filter Cake

Vinasse

Fertilizer

Cane Fields

Ethanol Distillery

Waste Water

Primary

Secondary

Same or Better

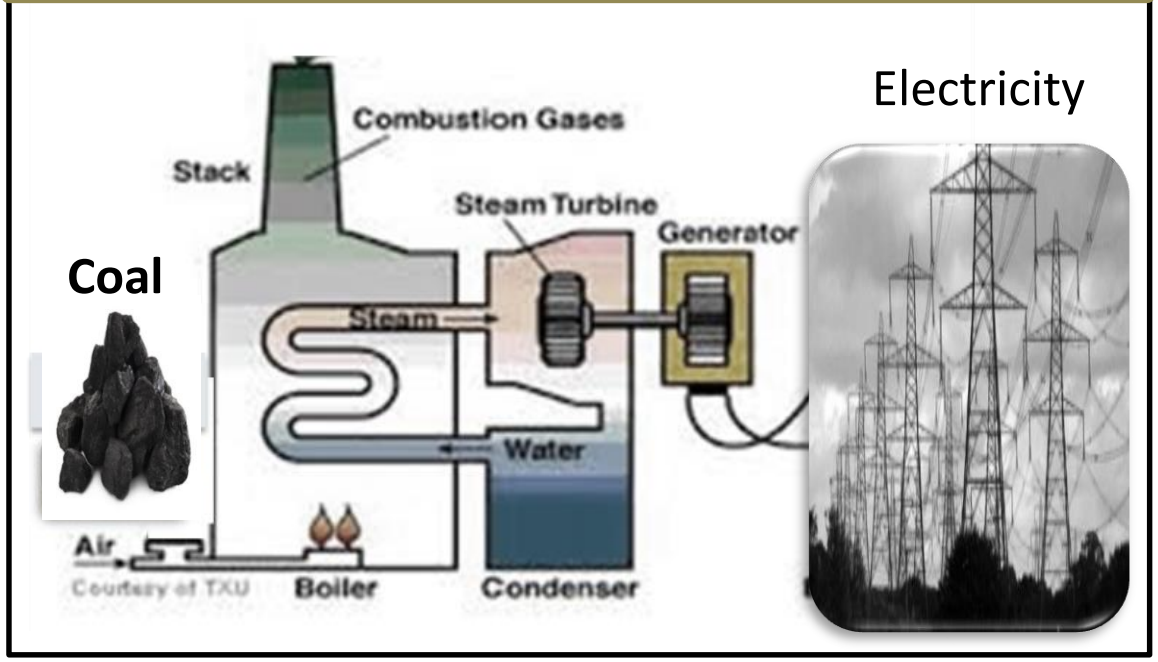
GHG Reductions: Bio-Electricity Production In Lieu of Coal

GHG Reductions:

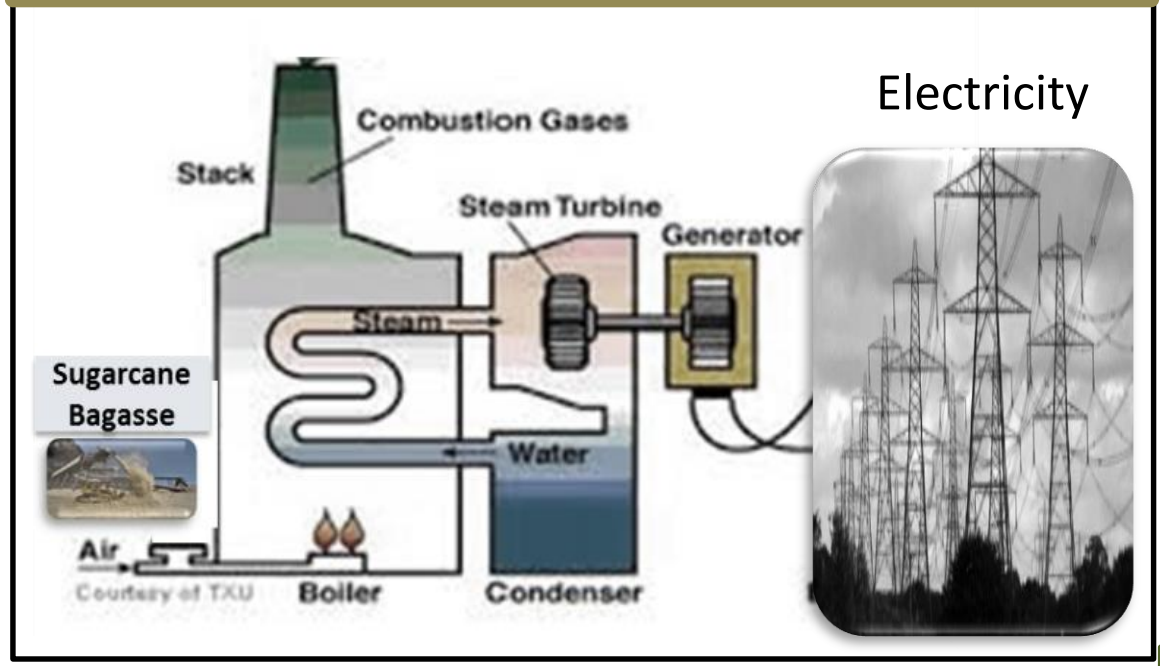
233,000 MWh

= 222,000 tons CO_2/yr

Electricity Plant:
Coal Fired



Electricity Plant:
Use Bagasse Rather Than Coal



GHG Reductions: Recycle Bio-Gas In Lieu of Vent

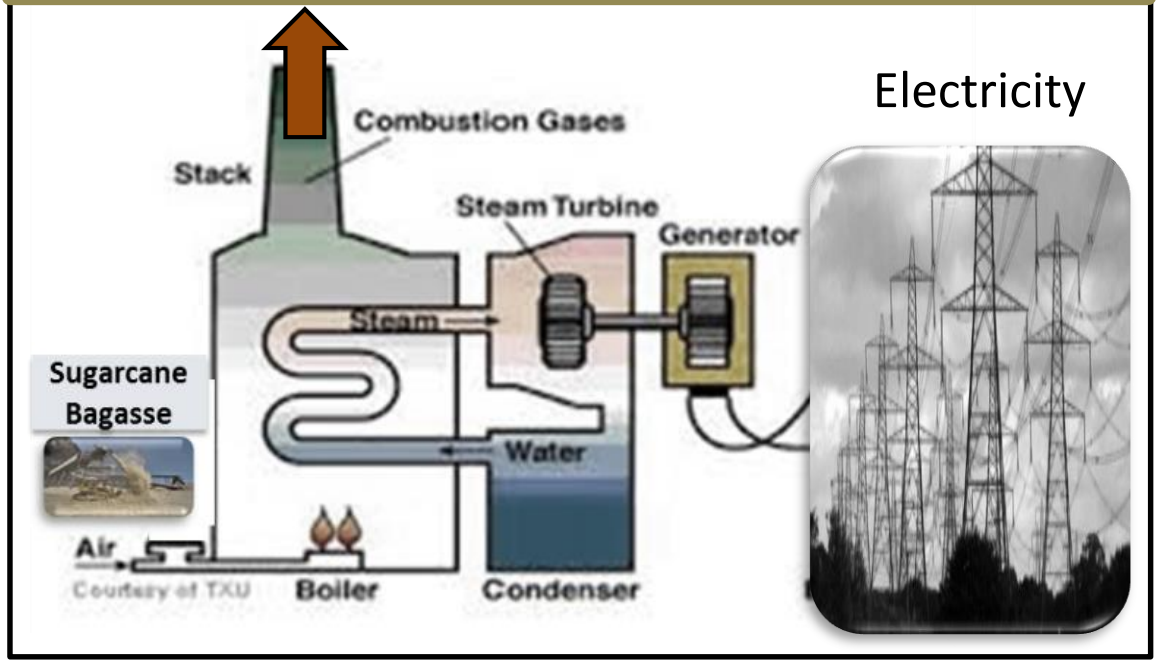
GHG Reductions:

24,000 MWh

= 23,000 tons CO_2/yr

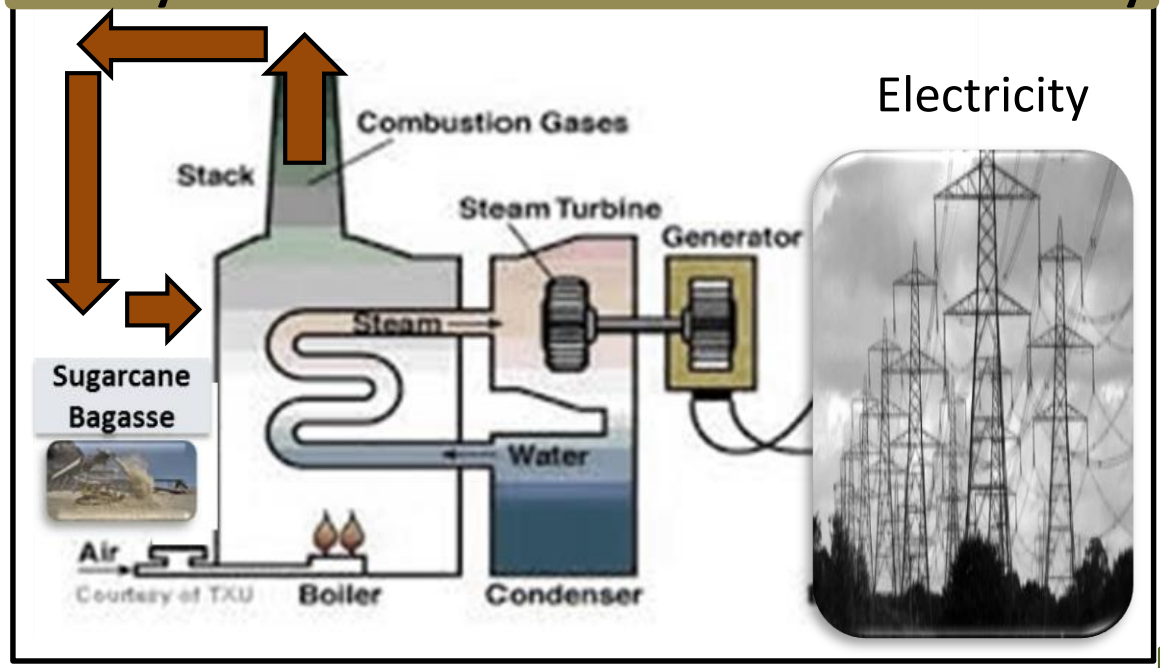
Electricity Plant:

Vent Bio-Gas to Atmosphere



Electricity Plant:

Recycle Bio-Gas to Produce Additional Electricity



GHG Reductions: Ethanol In Lieu of Gasoline

Gasoline

GHG Reductions:

30.8 MGPY

= 88,000 tons CO_2/yr

Corn Ethanol

GHG Reductions:

30.8 MGPY

= 220,000 tons CO_2/yr

Sugarcane Ethanol

GHG Reductions: Anaerobic Digestion of Solid Waste In Lieu of Ponds

GHG Reductions:

Ash, Filter Cake, Vinasse

= 120,000 tons CO_2/yr

Ponds

Anaerobic Digestion Into Fertilizer

Anaerobic Digestion

Fertilizer To Cane Fields

GHG Reductions: Mechanical Harvest Cane In Lieu of Slash & Burn

GHG Reductions:

40,000 Acres

= 27,000 tons CO_2/yr

Slash & Burn

Mechanical Harvest

GHG Reductions: Tons of CO_2/year

	Tons of CO_2/yr
1. Bio-Electricity	222,000
2. Recycle Bio-Gas	23,000
3. Ethanol	220,000
4. Anaerobic Digestion	120,000
5. Mechanical Harvesting	27,000
TOTAL	**612,000**

Electricity Plant

25.4 MW

1.4 M

Barrels of Crude Oil Per Year

Efficiency Interventions

1. Mechanical Harvest
2. Medium Pressure Boilers
3. Fuel-Grade Processing
4. Electricity Price Higher and Fixed
5. Sugarcane Cost Fixed
6. The WEG Automation System

Cost Of Production for Ethanol

$$COPE = \frac{\text{Total Operating Costs} - \text{Electricity Revenue}}{\text{Gallons of Ethanol Produced}}$$

Brazil

US$ 1.35

per gal

GSR

US$ 0.70

per gal

Efficiency Intervention: Mechanical Harvest

Sugarcane (1.4 M tons)

Sugarcane Trash (0.07 M tons)

Sugarcane Juice

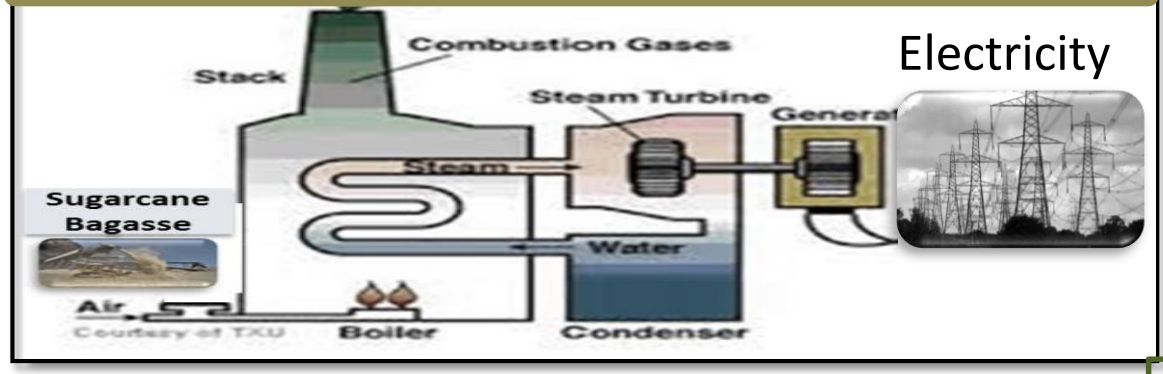
Process

Sugarcane Bagasse (Waste)

Ethanol Distillery

Ethanol

Electricity Plant



Electricity

Efficiency Intervention: Medium Pressure Boilers

Sugarcane (1.4 M tons)

Sugarcane Trash (0.07 M tons)

Sugarcane Juice

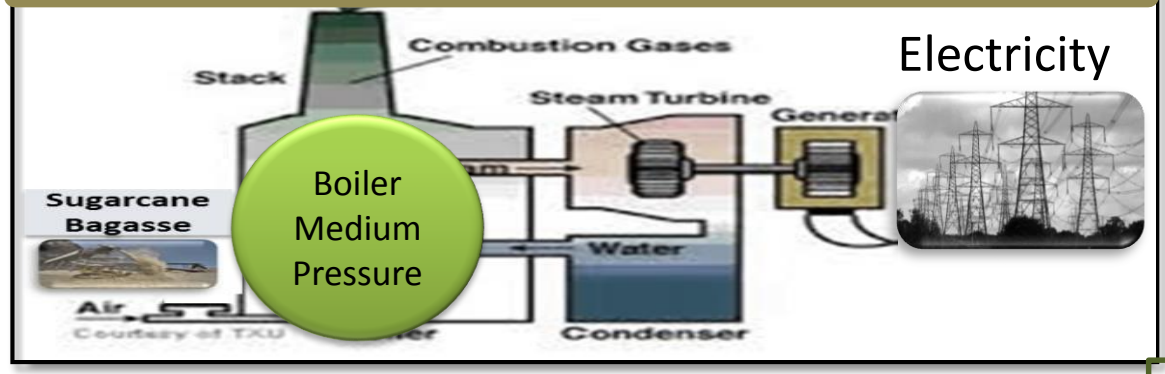
Process

Sugarcane Bagasse (Waste)

Ethanol Distillery

Ethanol

Electricity Plant



Electricity

Efficiency Intervention: Fuel-Grade Processing

Sugarcane (1.4 M tons)

Sugarcane Trash (0.07 M tons)

Sugarcane Juice

Process

30.8 MGPY VS 25 MGPY

Fuel-Grade VS Food-Grade

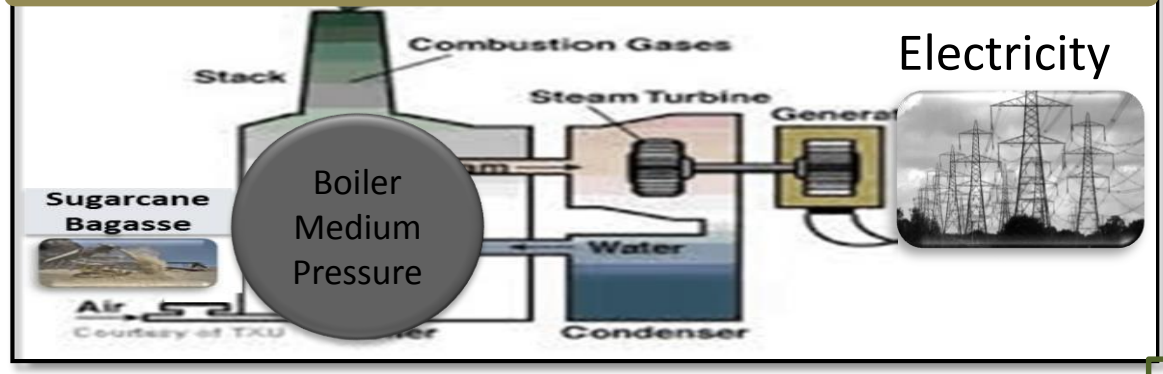
203 GWh VS 150 GWh

Sugarcane Bagasse (Waste)

Ethanol Distillery

Ethanol

Electricity Plant



Efficiency Intervention: 50 % Higher Electricity Price & Fixed Via PPA

Sugarcane (1.4 M tons)

Sugarcane Trash (0.07 M tons)

Sugarcane Juice

Process

30.8 MGPY VS 25 MGPY

Fuel-Grade VS Food-Grade

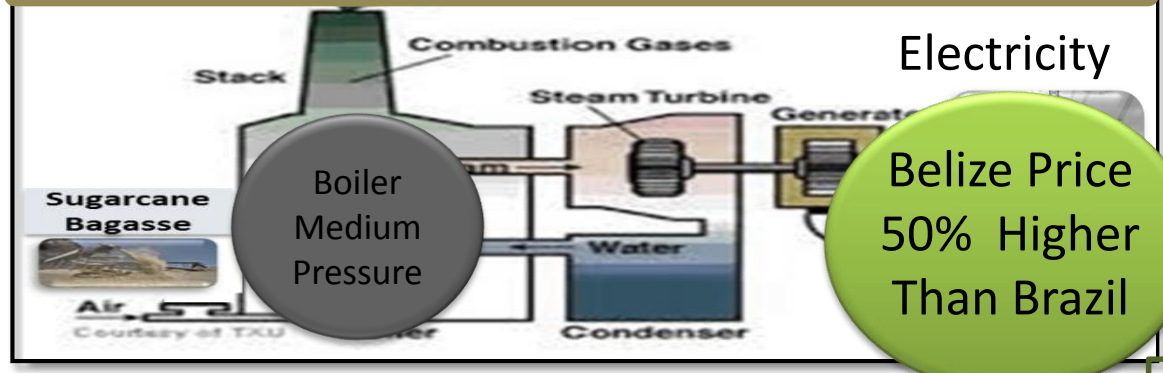
203 GWh VS 150 GWh

Sugarcane Bagasse (Waste)

Ethanol Distillery

Ethanol

Electricity Plant



Electricity

Belize Price 50% Higher Than Brazil

Efficiency Intervention: Sugarcane Cost Is Fixed

Cost Is Fixed

Sugarcane (1.4 M tons)

Sugarcane Trash (0.07 M tons)

Sugarcane Juice

Process

30.8 MGPY VS 25 MGPY

Fuel-Grade VS Food-Grade

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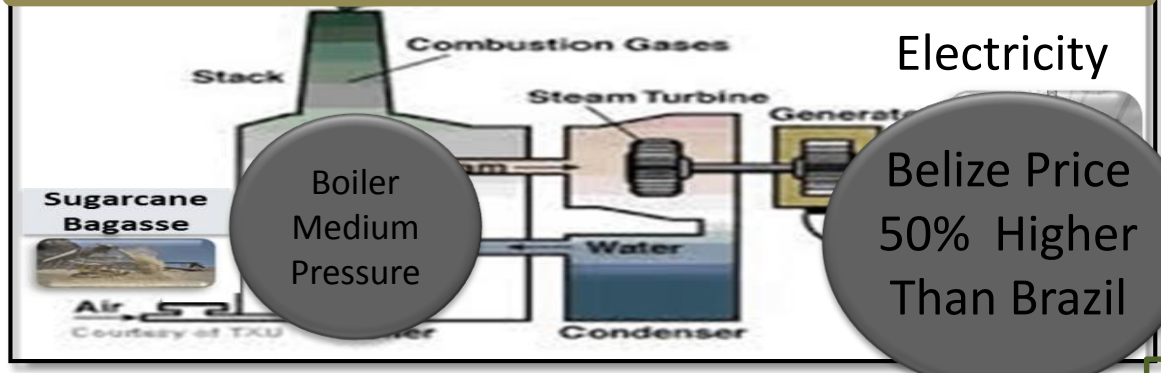
Sugarcane Bagasse (Waste)

Ethanol Distillery

Ethanol

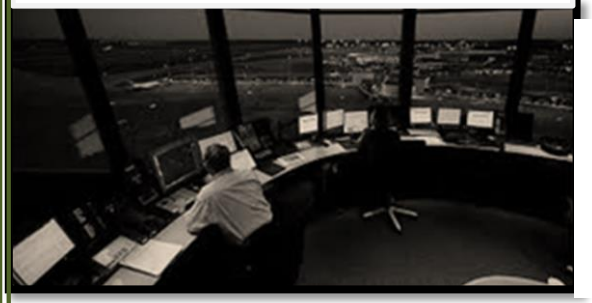
Electricity Plant



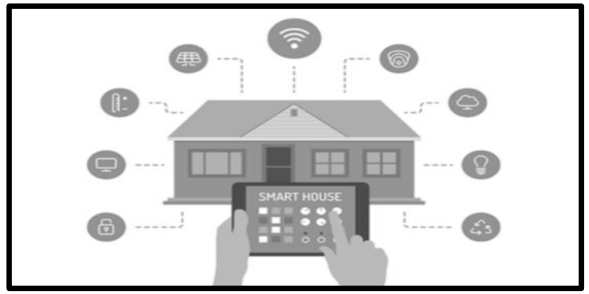
The WEG Automation System: 24/7 Monitoring of Supply Chain

Inbound Logistics → Bio-Refinery O & M → Outbound Logistics → Sales Electricity & Ethanol

Control Tower



Smart House



GPS

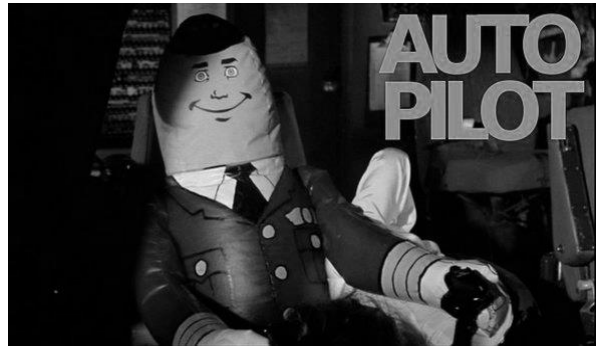
Message Board

On-Board Computer

Auto-Pilot

99%

of the Time



WEG Industries: Awards

Top Companies for Leaders 2014 Study - Hewitt Associates

WEG ranked the 15th

best global companies in Leadership and Talent Development,

and the only company from Latin America to be included in the ranking.

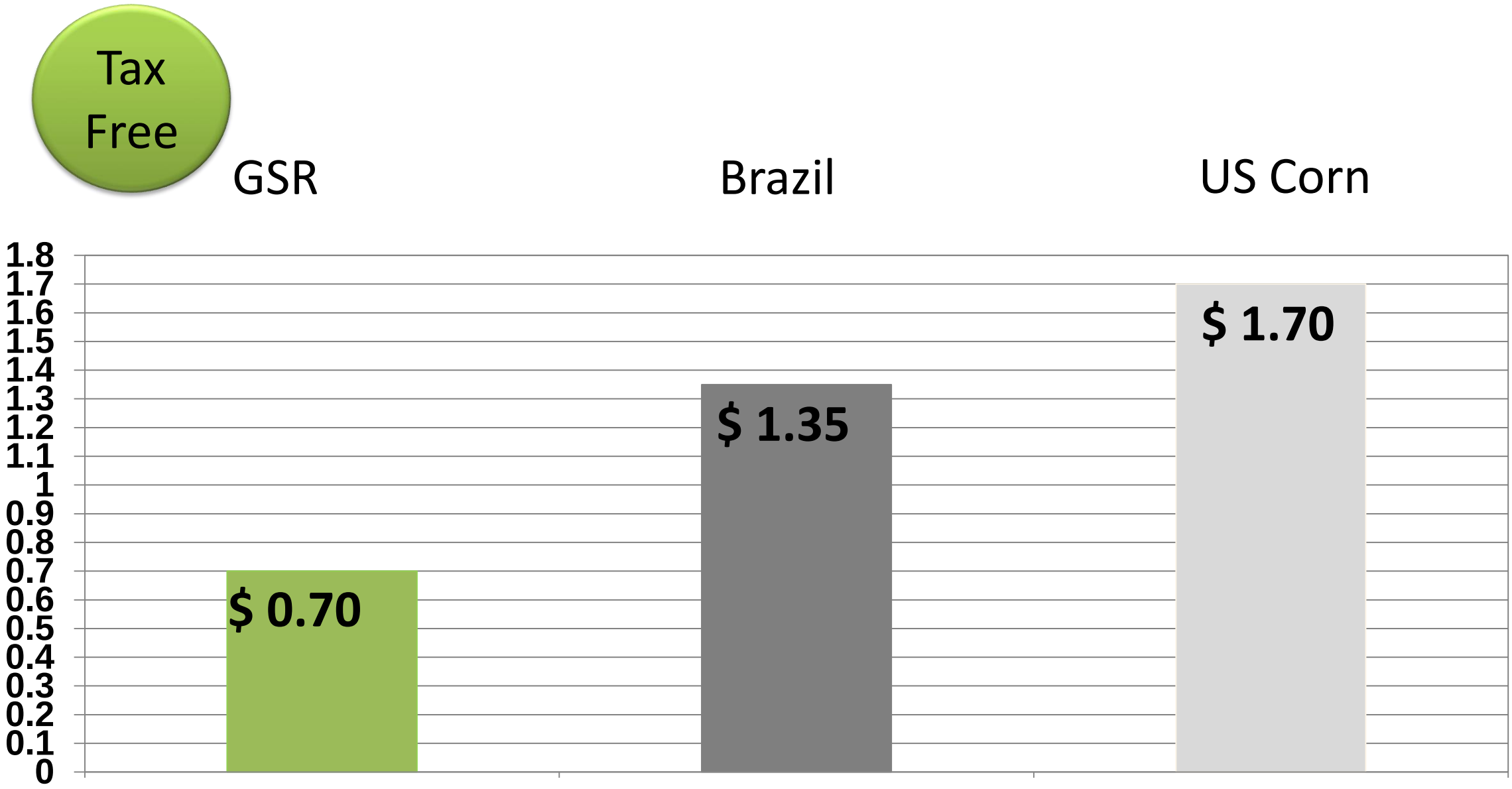
CNN Expansión Magazine 2014

WEG Mexico is Again Ranked as a Super Company,

for the second year in a row

Efficiency Interventions: GSR Has the Lowest COPE (US$/gal)

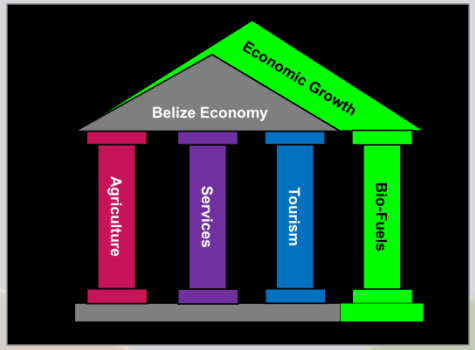
Tax Free



Socio-Economic Impacts

Economic

Builds An Economic Pillar



Social

Builds A Safety Net

Millennium Development Goals

1 ERADICATE EXTREME POVERTY AND HUNGER

3 Gender Equality

Environmental

Reduces 611,000 tons CO_2/yr

Millennium Development Goals

7 ENSURE ENVIRONMENTAL SUSTAINABILITY

PIN Accepted By the CDM

Status: 5 Key Contracts

In-Bound Logistics
(Sugarcane)

Bio-Refinery EPC and O&M

Out-Bound Logistics
(Ethanol)

Sales

#1 Corozal Sugar Cane Producers Association (CSCPA)

#2

#3 CARIBBEAN SHIPPING AGENCIES, LTD.

#4 Electricity: 203 GWh

BELIZE ELECTRICITY LIMITED

#5 Ethanol: 30.8 MGPY

Shell

Status: The Permits, Licenses & EIA, The Market Share

Power Purchase Agreement (PPA)

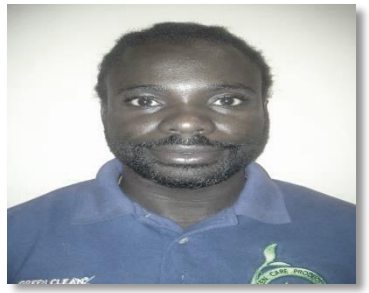
Additional Benefits

- Expedited Permits, Licenses & Environmental Impact Assessment (EIA)
- Monopoly Until the Net RFP in 2023

→ Markets: Electricity, Ethanol & Sugar Cane

Status: GSR Management Team

William Usher
VP Agriculture



In-Bound Logistics

Corozal Sugar Cane Producers Association (CSCPA)

Sharon Hughes
CEO

Bio-Refinery EPC and O&M

UNI-SYSTEMS

Glenford Eiley
President

Out-Bound Logistics

CARIBBEAN SHIPPING AGENCIES, LTD.

Robert Wise
VP Human Resources

Human Resources

Winner: 2012 IDEAS Energy Innovation for the Caribbean

Sponsors: Inter-American Development Bank, UK DFID, GVEP, Government of South Korea

Winner: 2014 Central American Forum for Clean Energy Financing (CAFCEF)

Sponsors: US AID, Climate Technology Initiative - Private Financing Advisory Network (CTI-PFAN)

Challenges

1. Perception That Two Cane Processors Have Never Co-Existed In Northern Belize

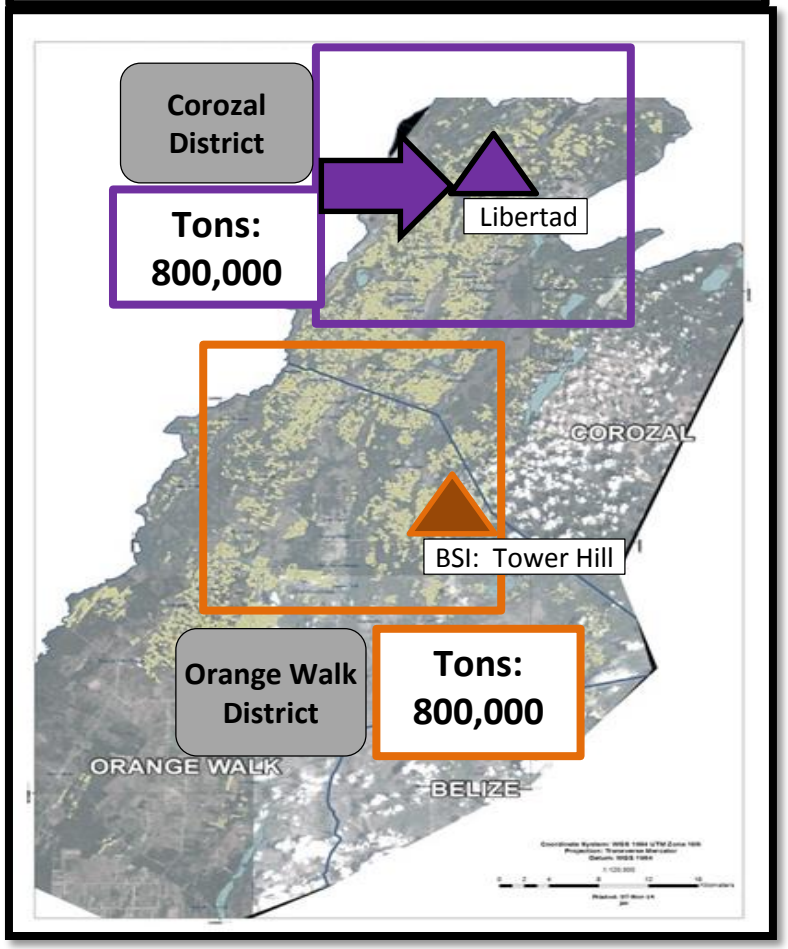
2. Sourcing Final Development Funds

3. Sourcing Project Equity

Challenge: Organizing Farmers & Land That Has Been Out of Service

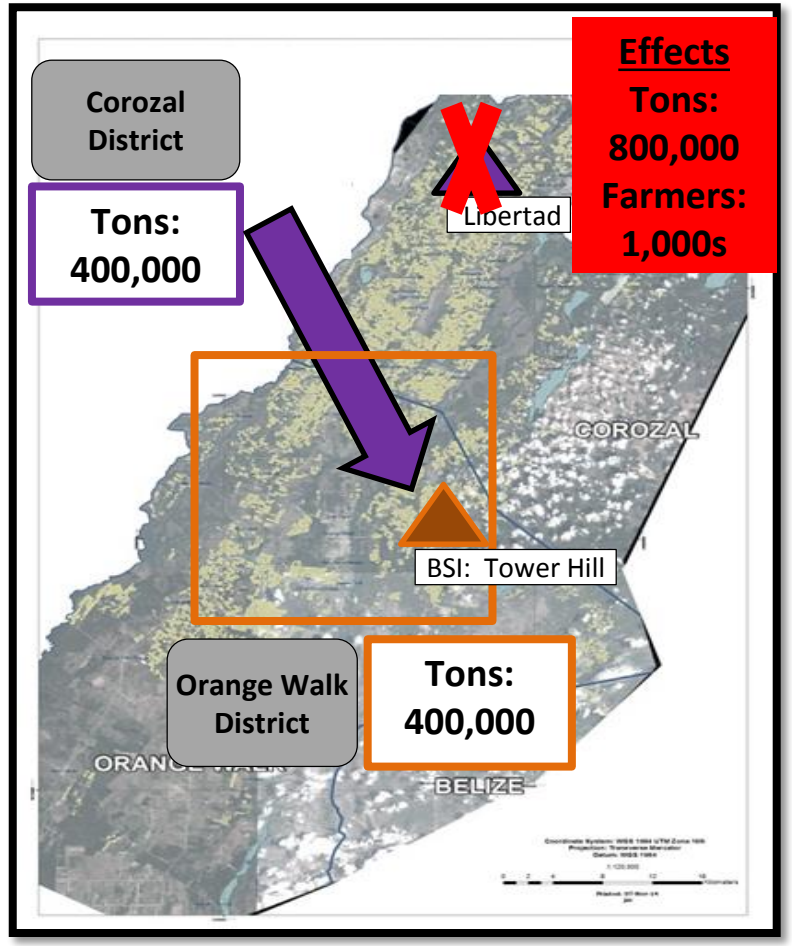
1937 - 1986

2 Sugar Mills



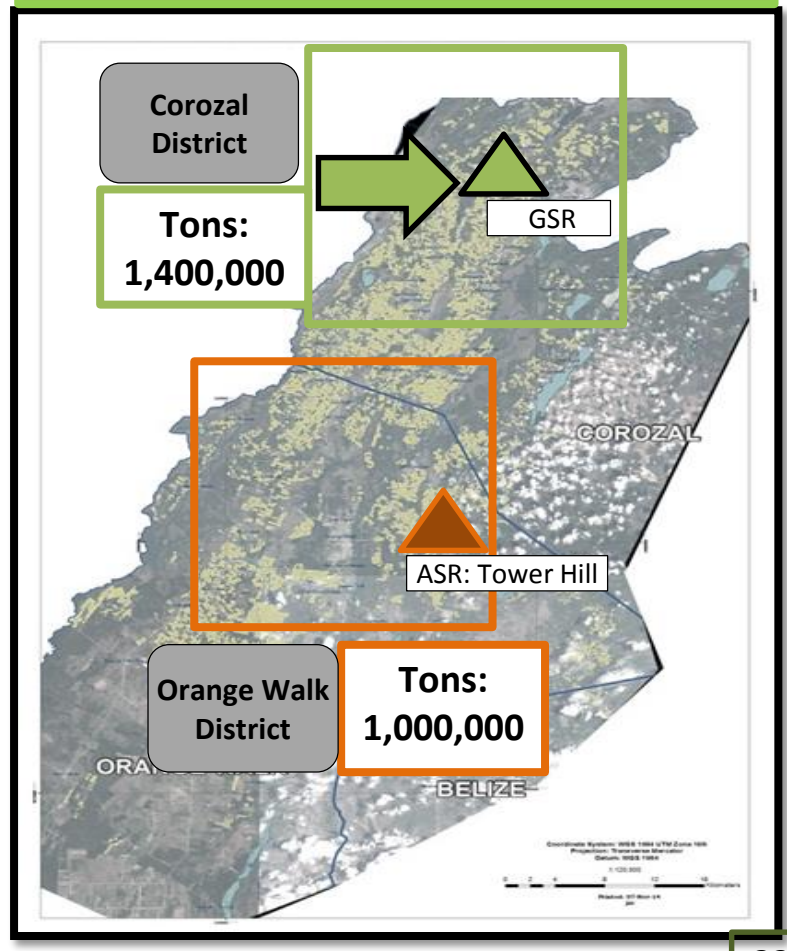
1986 - Current

Libertad Shut Down



2017

Replace Libertad Mill



Challenge: Sourcing Final Development Funds

Capital Requirements: $ 197.0 M

		Percent of Development Costs
Project Development Costs (5 % of Capital):	$ 9.85 M	100 %
Project Development By GSR:	$ 9.45 M	96 %
IDEAS Grant 2012:	$ 0.20 M	2 %
Final Development Funds Needed:	$ 0.20 M	2 %

Challenge: Sourcing Project Equity (US$ M)

Capital Requirements: **$ 197.0 M**

PROEX Loan (72 %) : **$ 142.0 M (4.9 % for 10 Years)**

Project Equity Requirements: **$ 55.0 M**

IRR: 29.5 %

Payback: 2 Years

Summary: GSR's Cost Per tCO_2 Reduction is Lower & IRR Is Higher

MW	Project Number* Clean Development Mechanism (CDM)	Technology	t CO_2 Reduced Over 21 Years (Three 7-Year Periods)	Captial Cost (US$ M)	Capital Cost per t CO_2 Reduced (US $)	IRR Without Certified Emission Reduction s (CERs)
20.0	9817	Solar PV	585,000	$ 32	$32 M / 0.585 M = **$ 54**	6.7 %
49.5	8431	Wind	4,170,000	$ 115	$ 115 M / 4.17 M = **$ 27**	9.9 %
6.0	9896	Hydro: Small	419,000	$ 11	$ 11 M / 0.42 M = **$ 26**	7.1 %
111.0	8556	Hydro: Large	5,677,000	$ 107	$ 107 M / 5.68 M = **$19**	7.8 %
25.4		GSR Bio-Refinery	12,852,000	$ 197	$ 197 M / 12.8 M = **$ 15**	29.5 %

GSR Cost Is Lower

GSR Returns Are Higher

*Source for Project Number:
http://cdm.unfccc.int/Projects/projsearch.html

"Thank You"

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