



# SUGARCANE

ONE PLANT, MANY SOLUTIONS

Sugar, Ethanol, Bioelectricity & Beyond



# UNLOCKING THE POWER OF SUGARCANE

**The sugarcane industry in Brazil provides clean and renewable solutions to our most pressing challenges,**

including climate change mitigation and diversification of energy sources. This is made possible thanks to sugarcane's unique versatility. While it was first used to produce sugar, sugarcane is now diversifying into an extraordinarily wide range of value-added products that go beyond **food**, **ethanol** and **bioelectricity** to also include **bioplastics**, **biohydrocarbons** and **biochemicals**. Sugarcane-derived products are produced in the same facilities, which are powered by clean energy from leftover cane fiber (known as bagasse), reducing greenhouse gas (GHG) emissions and transportation costs.

In addition to reducing GHG emissions, sugarcane has the potential to diversify energy supplies and create jobs. This single plant offers an expanding array of solutions for a cleaner, healthier planet.

**For more information on the Brazilian sugarcane industry, visit:**  
[www.unica.com.br/en](http://www.unica.com.br/en), [www.unicadata.com.br](http://www.unicadata.com.br) and [sugarcane.org](http://sugarcane.org)





# SUGAR

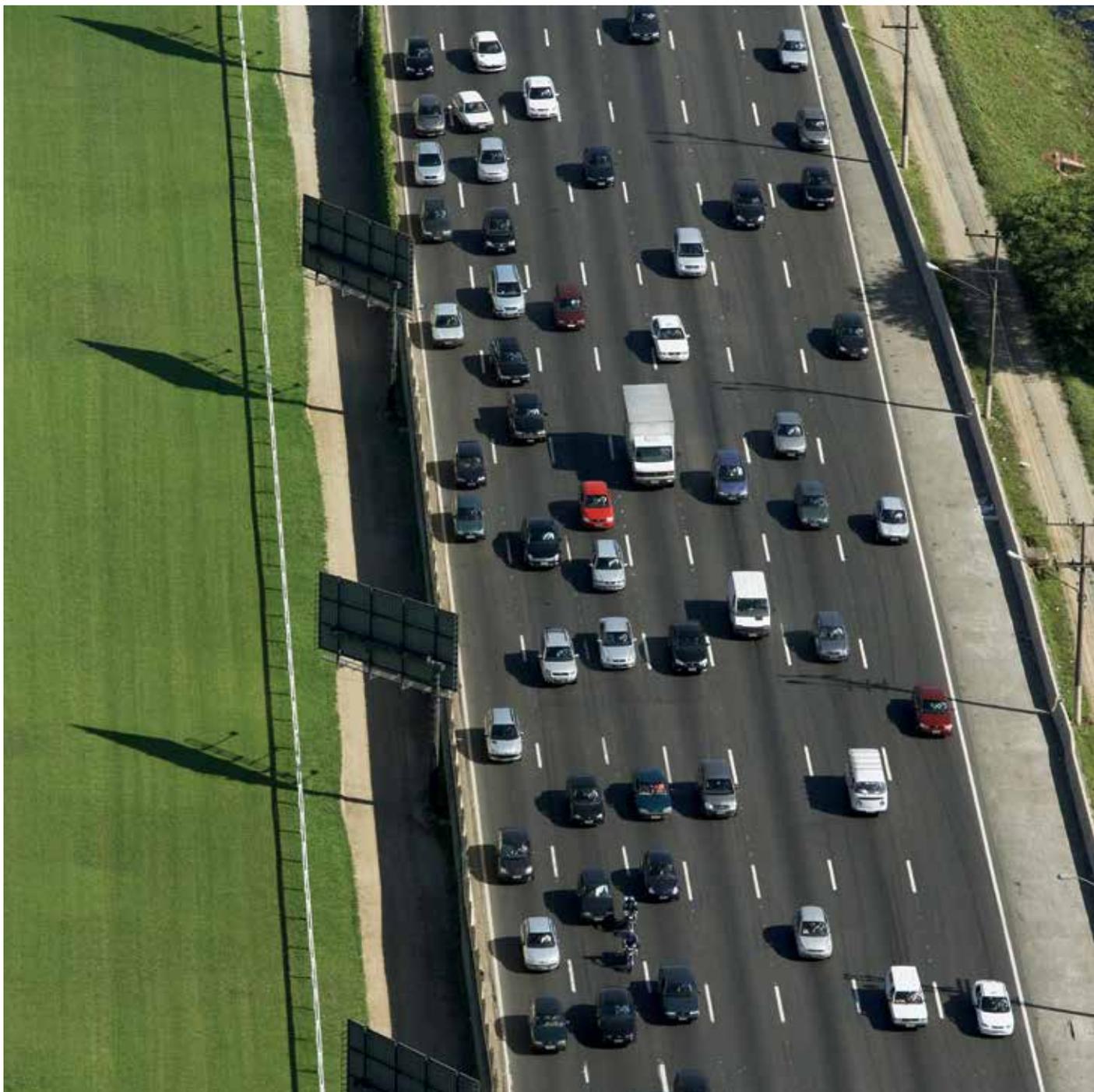
**Sugar is the most traditional product made from sugarcane.**

It has been a popular sweetener for centuries. Portuguese settlers started to plant sugarcane in Brazil in the 1530s without knowing that the product would become a key pillar of Brazil's economy.

Today Brazilian sugar production accounts for approximately 25% of global production and 50% of world exports. Approximately 2/3 of all sugar produced in Brazil is exported to more than 100 countries around the world. Virtually all exports are traded in the free market—with the exception of developed countries that tend to protect their sugar markets by granting very small tariff-rate quotas to Brazil.

Brazil is a member of the Global Alliance for Sugar Trade Reform and Liberalization, which seeks to improve the world's sugar trading environment.





## FLEX FUEL VEHICLES: A BRAZILIAN SUCCESS STORY



The National Ethanol Program, known as Proálcool, was launched in 1975 by the Brazilian government and set the basis of Brazil's successful biofuels policy. It was in 2003 that sugarcane ethanol use increased significantly with the introduction of Flex Fuel Vehicles (FFVs). FFVs can run on 100% ethanol, gasoline, or any blend of the two, giving Brazilian consumers a unique choice at the pump. Drivers' decision on the type of fuel they use is based on price and environmental benefits. In 2012, FFVs accounted for 57% of the light vehicle fleet and for 92% of new car sales in Brazil. This success paved the way for the launch of flex fuel motorcycles in 2009 and ethanol-powered buses.

# ETHANOL

**Sugarcane ethanol is a clean and affordable** renewable fuel that significantly reduces GHG emissions and helps diversify energy supplies, while at the same time respecting the environment. It is an alcohol-based fuel produced by the fermentation of sugarcane juice and molasses. A cost-competitive and low-carbon option, sugarcane ethanol has emerged as a leading renewable fuel in the transport sector. Moreover, it offers the best environmental performance of any biofuel produced on a commercial scale.

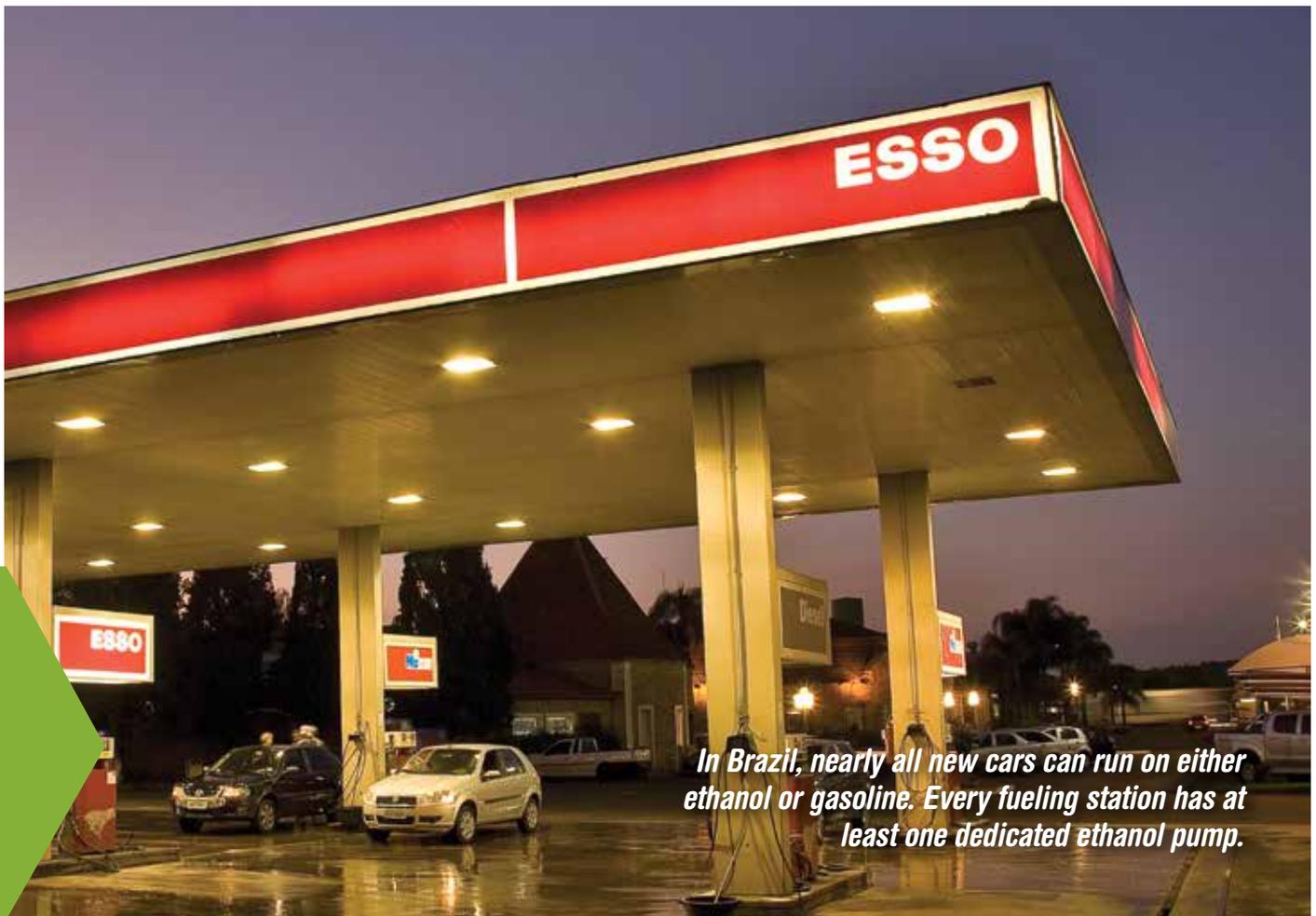
## Benefits of Ethanol:

- **Cleaner Air.** Ethanol adds oxygen to gasoline, which helps reduce air pollution and harmful emissions.
- **Reduced GHG Emissions.** Compared to gasoline, sugarcane ethanol cuts CO<sub>2</sub> emissions by an average of 90%.
- **Better Performance.** Ethanol is a high-octane fuel that helps prevent engine knocking and generates more horsepower than regular gasoline.

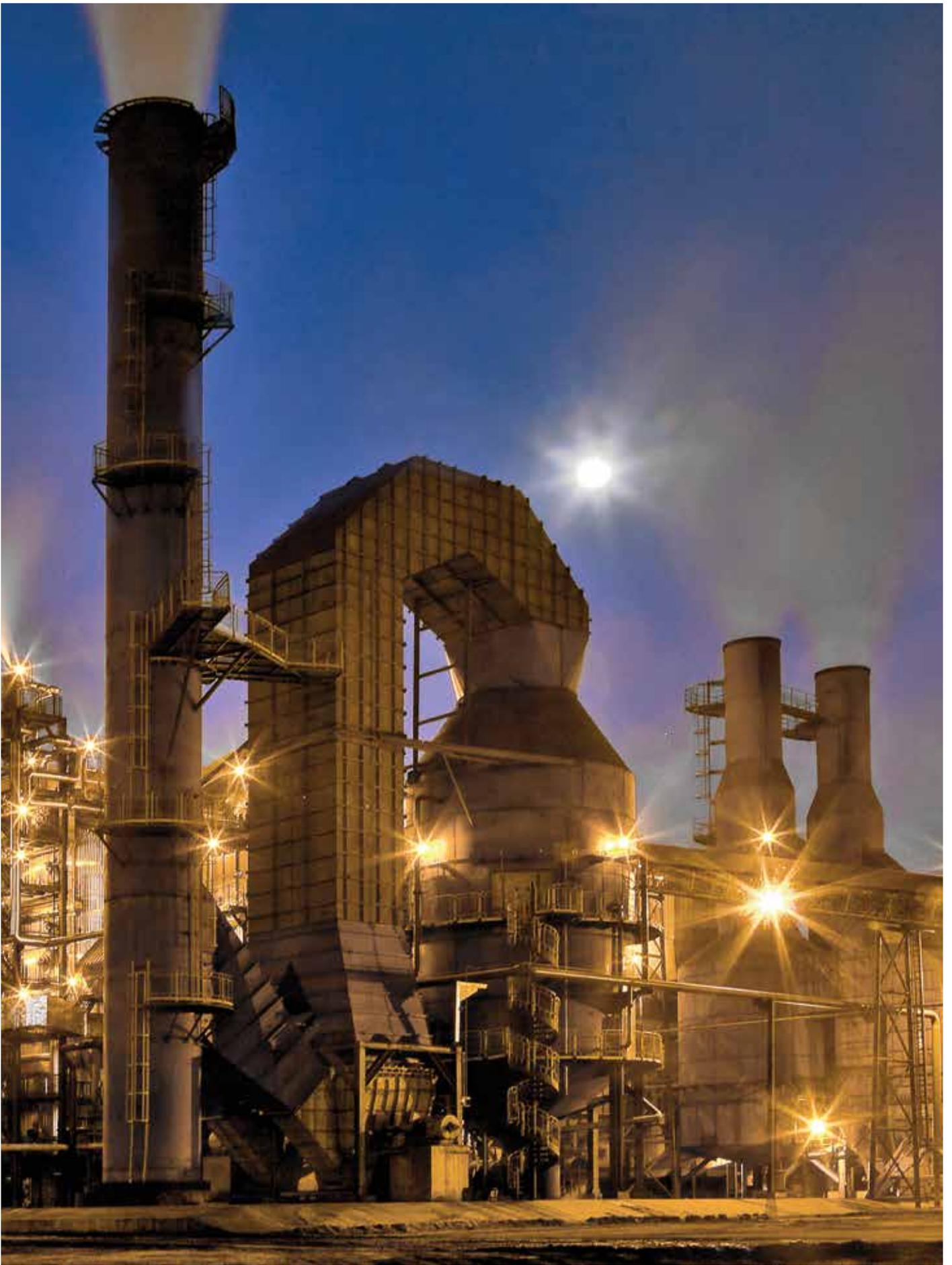
- **Lower Petroleum Usage.** Ethanol reduces global dependence on oil.

Brazil is the world's largest producer of sugarcane ethanol and a pioneer in using ethanol as a motor vehicle fuel. The country has replaced half of its gasoline needs with sugarcane ethanol. All gasoline sold in Brazil includes a blend of 18 to 25% ethanol.

Sugarcane ethanol is made from the sucrose found in cane juice and molasses. The process taps only 1/3 of the energy sugarcane can provide. The other 2/3 are locked in the bagasse, the fibrous residue that remains once cane is crushed, and the straw, which is removed from the cane harvested mechanically before it is processed. New techniques are under development to produce what is known as cellulosic ethanol from leftover plant material. Once these processes are commercially viable, cellulosic ethanol has the potential to nearly double the fuel that can be produced without increasing the area planted with sugarcane.



*In Brazil, nearly all new cars can run on either ethanol or gasoline. Every fueling station has at least one dedicated ethanol pump.*





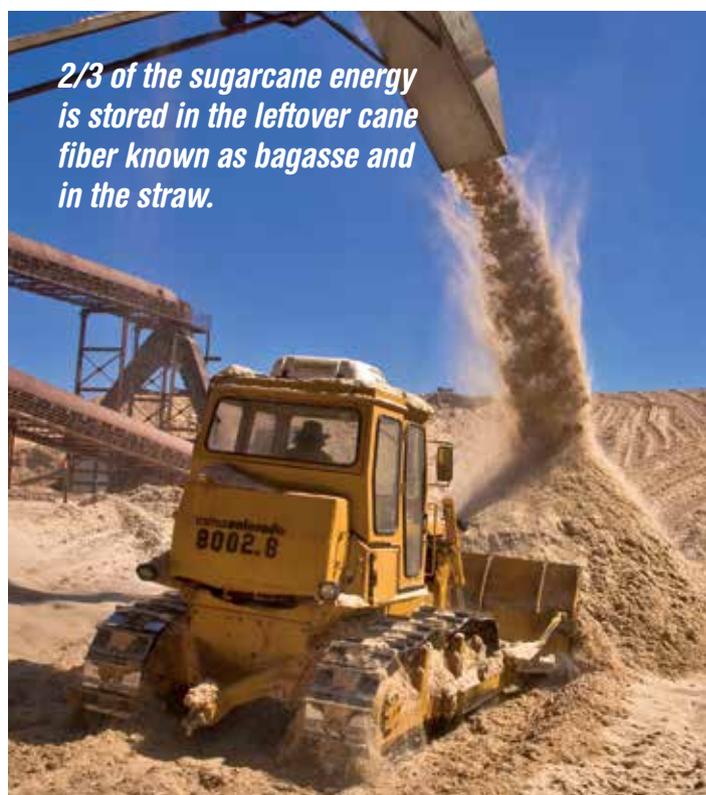
# BIOELECTRICITY

**As it grows, sugarcane converts sunlight into** chemical energy, which is stored inside the juice, the bagasse and the straw. Brazilian sugarcane mills harness the energy contained in bagasse by burning and converting it into bioelectricity. After the cane is harvested mechanically, the straw can be burned alongside bagasse in high-efficiency boilers to produce even more bioelectricity.

Sugarcane mills are leading by example in bioelectricity. They are energy self-sufficient, producing enough steam and bioelectricity to power their own operations. A growing number of mills generate an energy surplus, which is sold to distribution companies and helps to light up numerous cities throughout Brazil.

Bioelectricity from sugarcane biomass already provides more than 3% of Brazil's electricity needs, a figure that is expected to increase to 18% by 2020. By comparison, this is enough energy to power the current demand of an entire country the size of Sweden or Argentina.

In addition, bioelectricity is complementary to hydroelectricity, Brazil's main source of electric energy. Sugarcane's harvesting season, when most biomass is available, coincides with the driest period of the year, when the water reservoirs are at their lowest.



*2/3 of the sugarcane energy is stored in the leftover cane fiber known as bagasse and in the straw.*

*Since 1969, the Sugarcane Technology Center (CTC) has played an important role in the ongoing evolution of sugarcane production and processing.*



# WHAT'S NEXT?

## **Biohydrocarbons and Biochemicals**

Biohydrocarbons go beyond traditional biofuels and represent the next frontier for sugarcane. Brazil is leading the way in the development of alternative transportation fuels that could replace gasoline, diesel and jet fuel without petroleum. These biochemical molecules will be clean, low-carbon and renewable like ethanol. They are often called “drop-in fuels” because they can be used in any amount with current engines, fueling stations and pipelines. Some companies are also developing sugarcane-based biochemicals as ingredients in the production of lubricants, cosmetics and detergents.

## **Bioplastics**

Conventional plastics are becoming economically and environmentally unsustainable. As a result, sugarcane ethanol has emerged as an important ingredient to substitute for petroleum in the production of plastic to produce bioplastics. By replacing petroleum with sugarcane, beverage containers, food packaging and other consumer products emit far less GHG emissions in the atmosphere.

Bioplastics have the same physical and chemical properties as regular plastic (the most common type is known technically as PET) and are 100% recyclable.



# WHY BRAZILIAN SUGARCANE?

## ► Greenhouse Gas Reductions

Sugarcane ethanol cuts CO<sub>2</sub> emissions by 90%, on average, compared to gasoline, and other sugarcane products offer similar low-carbon advantages.

## ► Energy Diversity & Security

Sugarcane no longer produces just sugar. It can be used to develop multiple forms of energy, including ethanol, bioelectricity and biohydrocarbons. Expanding production of clean, renewable sugarcane products would help enhance energy security and reduce global dependence on fossil fuels.

## ► Cultivation Best Practices

The sugarcane sector works with a wide range of stakeholders to share best practices for sustainable production. It employs modern agronomic management techniques to enhance productivity and protect the environment. Brazilian mills have low soil erosion, water and agrochemicals use. Brazilian sugarcane needs fewer soil inputs due to the innovative use of organic fertilizers created throughout the sugarcane processing.

## ► Economic Growth & Job Creation

The sugarcane industry is a key segment in the Brazilian economy, generating US \$36 billion in gross annual revenue and employing more than 1 million people. Beyond Brazil, many cane-growing nations are located in the tropics and are often developing countries in search of new economic opportunities. Sugarcane expansion can create rural jobs and increase access to electricity.



### São Paulo's Green Protocol: An Industry Best Practice

The Brazilian Sugarcane Industry Association (UNICA) has partnered with the government of the São Paulo State, where 60% of Brazilian sugarcane is grown, to create the Green Protocol.

Technological advances and environmental concerns have increased demand for mechanized harvesting because it eliminates the need to burn fields. Mechanization is increasing and by 2014 approximately 90% of the harvest will be mechanized. By 2017, it will be the only means of harvesting.



### RenovAção Program: Boosting Skills Through Training

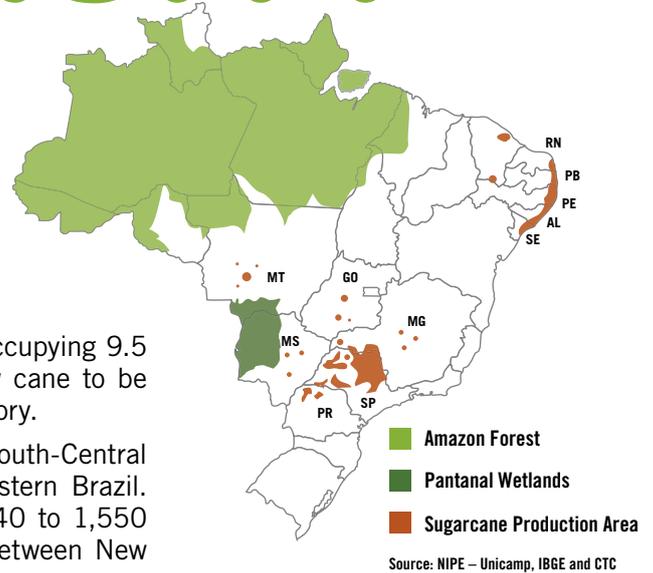
With mechanization advancing and rapidly replacing manual harvesting, the sugarcane industry has focused on retraining workers so they can find suitable jobs within the sector or work in other segments of the economy. Since the launch of the 'RenovAção' program (2010/11), UNICA, its member companies, and partners have trained almost 23,000 workers through local requalification programs.

# PRESERVING BIODIVERSITY

**Sugarcane production is growing to accommodate** the booming demand for sugarcane-derived products, and especially for clean and renewable ethanol. Essential to managing this growth is proper land use planning, while at the same time protecting precious natural resources. Brazil recognizes this challenge and has taken the lead in establishing agro-ecological zonings across its territory to allow for the sustainable expansion of food and bioenergy production.

Sugarcane is grown on a small amount of Brazil's farmland, occupying 9.5 million hectares. Of that amount, 4.6 million is used to grow cane to be processed into ethanol. This is only 0.5% of the Brazilian territory.

Almost 90% of Brazilian sugarcane production takes place in South-Central Brazil, with the remainder grown along the coast of Northeastern Brazil. Both producing regions are located 2,000 to 2,500 km (1,240 to 1,550 miles) away from the Amazon. That is roughly the distance between New York City and Dallas, or Paris and Moscow.

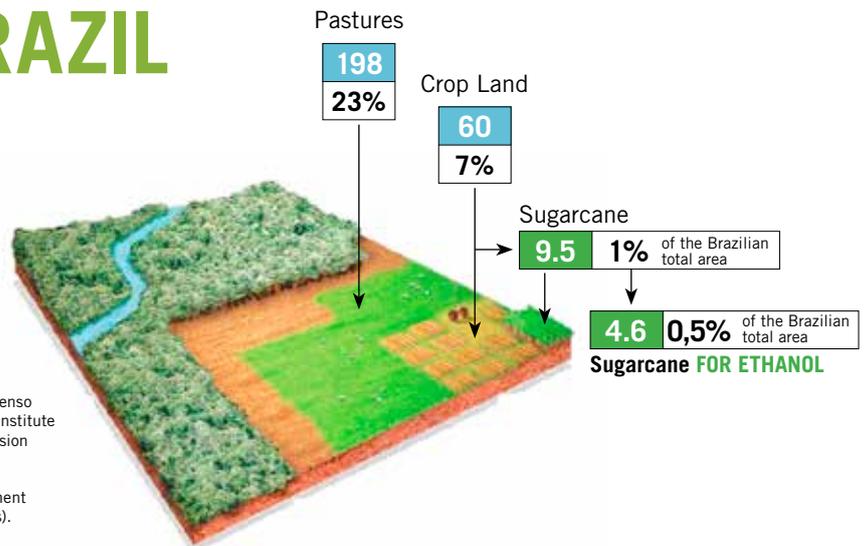


## LAND USE IN BRAZIL

In Million Hectares

Total Area	Native Vegetation	Crop and Pasture Land	Other Uses*
851	554	258	39
100%	65%	30%	5%

\* Other uses: urbanization and hydrography  
 Sources: Institute for International Trade Negotiations – ICONE; The Brazilian Institute of Geography and Statistics – IBGE (PAM 2010 and Censo Agropecuário 2006); Brazilian Ministry of the Environment – MMA; National Institute for Space Research - INPE (TerraClass) and Agricultural Land Use and Expansion Model Brazil Ag-LUE-BR (Gerd Sparovek, ESALQ/USP).  
 Compiled by: UNICA and Cosan.  
 Note: Native vegetation include Conservation Units, Indigenous Land, Permanent Protected Areas (APPS) and other native vegetation (including Legal Reserves).



### SUGARCANE AGRO-ECOLOGICAL ZONING: RESPONSIBLE PRODUCTION

Since 2009, Brazil ensures by law that sugarcane expansion is compatible with respect for biodiversity. The Sugarcane Agro-ecological Zoning pivots on three main rules:



- No sugarcane expansion or new ethanol production facilities in sensitive biomes like the Amazon and the Pantanal wetlands.
- No clearance of native vegetation to expand sugarcane cultivation anywhere in the country, including in native Cerrado.
- Identification of suitable areas with proper agronomic and climate conditions where sugarcane production should be prioritized over other regions.







**unica**

BRAZILIAN SUGARCANE INDUSTRY ASSOCIATION  
ETHANOL • SUGAR • ENERGY BRAZIL

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# Key Numbers of the Brazilian Sugarcane Industry | 2014/2015 Harvest

## PRODUCTION

**SUGARCANE PRODUCTION:  
532 MILLION TONS**

**SUGAR PRODUCTION: 35.5 MILLION TONS**

**Exports:** 24.2 million tons

Main markets for exports (2014/15):

China (9.6%)

United Arab Emirates (8.76%)

Bangladesh (7.7%)

Algeria (6.83%)

India (6.4%)

**Brazil accounts for 40% of global sugar exports to more than 100 countries.**

80% of exports are raw sugar, 20% are white sugar

**ETHANOL PRODUCTION: 28.4 BILLION LITERS**

**Domestic consumption:** 25 billion liters    **Exports:** 1,4 billion liters

Production of anhydrous ethanol: 12.1 billion liters

Production of hydrous ethanol: 16.3 billion liters

Main markets for exports (2014/15):

United States (52.4%)

South Korea (32.06%)

Japan (7.08%)

Nigeria (3.3%)

Singapore (1.1%)

**Brazil is the world's second largest producer of ethanol behind the United States.**

**BIOELECTRICITY: 1,000 AVERAGE MEGAWATTS**

Equivalent to 4% of Brazil's energy consumption

**PRODUCTION MIX<sup>1</sup>: 43% SUGAR, 57% ETHANOL**

**SUGARCANE QUALITY**

Kg of TRS<sup>2</sup>/ton of sugarcane: 135.7

<sup>1</sup> Share of sugarcane utilized to produce sugar and ethanol.

<sup>2</sup> TRS: Total Recoverable Sugars (ATR in Portuguese). TRS is the actual sugar content in harvested cane, which determines how much sugar and ethanol can be produced.



# THE ECONOMICS OF THE SUGARCANE INDUSTRY IN BRAZIL (2015)

## ANNUAL REVENUE OF THE SECTOR:

**More than US \$70 billion**

## EXPORT EARNINGS:

**US \$10.2 billion**

Sugarcane-derived products (sugar and ethanol) rank third in Brazilian agribusiness exports, just after soy products

## NUMBER OF MILLS:

**369 nationwide**

## NUMBER OF INDEPENDENT SUGARCANE GROWERS:

**70,000**

## SHARE OF SUGARCANE IN BRAZIL'S ENERGY MATRIX:

**15.7%**

## DIRECT EMPLOYMENT:

**1.02 million workers**

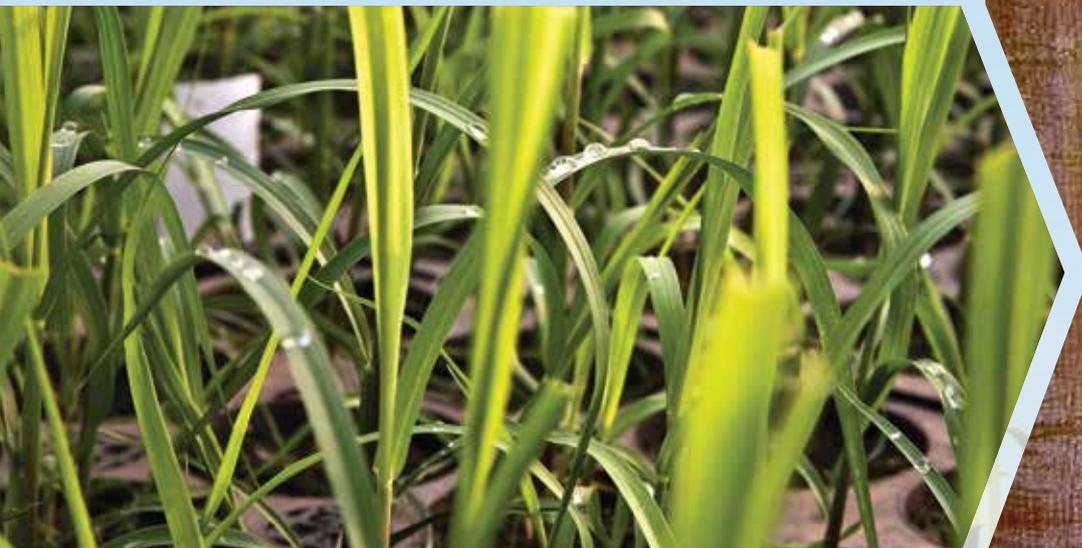
## NUMBER OF FLEX FUEL VEHICLES<sup>3</sup>:

**24 million vehicles (2014)**

57% of total light vehicle fleet

Approximately 290 million tons of CO<sub>2</sub> have been avoided since March 2003

<sup>3</sup> Flex Fuel Vehicles (FFVs) can run on 100% ethanol, gasoline or any blend of the two.



# UNICA MEMBER COMPANIES

## GROUPS

### ADECOAGRO

[www.adecoagro.com.br](http://www.adecoagro.com.br)

Adecoagro Vale do Ivinhema - Angélica - MG  
Monte Alegre - MG

### ARALCO

[www.aralco.com.br](http://www.aralco.com.br)

Aralco - Matriz  
Generalco - Aralco  
Figueira - Aralco

### BAZAN

Bazan  
Bela Vista - Pontal

### BUNGE

[www.bunge.com.br](http://www.bunge.com.br)

Moema  
Guariroba  
Ouroeste  
Frutal - MG  
Itapagipe - MG  
Santa Juliana - MG  
Monteverde - MS

### CERRADINHO

Usina Porto das Águas / GO

### COLOMBO

[www.acucarcaravelas.com.br](http://www.acucarcaravelas.com.br)

Colombo - Matriz  
Colombo - Unidade Palestina  
Colombo - Unidade Albertina

### COPERSUCAR

Ferrari - [www.usinaferrari.com.br](http://www.usinaferrari.com.br)

Santa Lucia - [www.usinasantalucia.com.br](http://www.usinasantalucia.com.br)

Santa Maria - J. Pilon

São José da Estiva - [www.estiva.com.br](http://www.estiva.com.br)

São Luiz - Ourinhos - [www.usinasaloiz.com.br](http://www.usinasaloiz.com.br)

São Manoel - [www.usinasomanoel.com.br](http://www.usinasomanoel.com.br)

Balbo - [www.canaverde.com.br](http://www.canaverde.com.br)

Santo Antonio - Sertãozinho

São Francisco - Sertãozinho

Batatais - [www.usinabatatais.com.br](http://www.usinabatatais.com.br)

Batatais

Batatais - Lins

Cocal - [www.cocal.com.br](http://www.cocal.com.br)

Cocal

Cocal II - Narandiba - SP

Furlan - [www.usinafurlan.com.br](http://www.usinafurlan.com.br)

Furlan

Furlan - Unidade Avaré

Pedra - [www.uspedra.com.br](http://www.uspedra.com.br)

Da Pedra - Buriti

Da Pedra - Ibirá

Da Pedra - Serrana

Da Pedra - Ipê

Santa Adélia - [www.usinasantaadelia.com.br](http://www.usinasantaadelia.com.br)

Santa Adélia

Santa Adélia - Interlagos

Pioneiros

Ipiranga

Ipiranga

Ipiranga - Unid. Mococa

Iacanga

Zilor - [www.zilor.com.br](http://www.zilor.com.br)

Barra Grande

Quatá

São José - Macatuba

Viralcool - [www.viralcool.com.br](http://www.viralcool.com.br)

Santa Inês

Viralcool

Viralcool II

Grupo Pitangueiras - [www.pitaa.com.br](http://www.pitaa.com.br)

Pitangueiras

Umoe Bioenergy - [www.umoebioenergy.com.br](http://www.umoebioenergy.com.br)

UMOEB Bioenergy

### ETH

[www.odebrechtagroindustrial.com](http://www.odebrechtagroindustrial.com)

Alcidia

Eldorado - MS

Usina Conquista - SP

Rio Claro Agroindustrial - GO

Brenco / Usina Morro Vermelho - GO

Brenco / Usina Alto Taquari - MT

Santa Luzia - MS

### GUARANI

[www.aguarani.com.br](http://www.aguarani.com.br)

Andrade

Energética São José - Colina

Guarani - Cruz Alta

Guarani - Filial Mandú

Guarani - Filial Tanabi

Guarani - Severinia

Vertente

### LDC BIOENERGIA

[www.biosev.com](http://www.biosev.com)

LDC Sev Bioenergia - Jardest

LDC Sev Bioenergia - Santa Elisa

LDC Sev Bioenergia - MB

LDC Sev Bioenergia - Vale do Rosário

LDC Bioenergia - Cresciumal

LDC Bioenergia - Filial Lagoa da Prata - MG

LDC Bioenergia - Filial Maracaju - MS

LDC Bioenergia - Filial Passa Tempo - MS

LDC Bioenergia - Filial Rio Brilhante - MS

LDC Bioenergia - São Carlos

Usina Continental

### NOBLE GROUP

[www.thisisnoble.com.br](http://www.thisisnoble.com.br)

NG Bioenergia - Unid. Catanduva

NG Bioenergia - Unid. Narandiba

Noble Brasil - ex Noroeste Paulista

Noble Brasil - Meridiano

### J. PESSOA

CBAA - Ex. Sanagro

### RAIZEN

[www.raizen.com](http://www.raizen.com)

Raizen Araraquara

Raizen Paraguaçu

Raizen Tarumã

Raizem Tarumã - Filial Maracai

Raízen Energia - Filial Benalcool

Raízen Energia - Filial Bom Retiro

Raízen Energia - Filial Bonfim

Raízen Energia - Filial Costa Pinto

Raízen Energia - Filial Barra

Raízen Energia - Filial Destivale

Raízen Energia - Filial Diamante

Raízen Energia - Filial Dois Córregos

Raízen Energia - Filial Gasa

Raízen Energia - Filial Ibaté

Raízen Energia - Filial Ipaussu

Raízen Energia - Filial Junqueira

Raízen Energia - Filial Mundial

Raízen Energia - Filial Rafard

Raízen Energia - Filial Santa Helena

Raízen Energia - Filial São Francisco

Raízen Energia - Filial Tamoio

Raízen Energia - Filial Univalem

Raízen Caarapo - MS

Cosan Centroeste Jataí - GO

### RENUKA

[www.renukadobrasil.com.br](http://www.renukadobrasil.com.br)

Renuka

Revati

### SÃO MARTINHO

[www.saomartinho.ind.br](http://www.saomartinho.ind.br)

São Martinho - Iracemópolis

São Martinho - Pradópolis

Usina Boa Vista - GO

Santa Cruz

### U.S.J - SÃO JOÃO ARARAS

[www.usj.com.br](http://www.usj.com.br)

U.S.J. - São João Araras

SJC - São Francisco - GO

### INDIVIDUAL UNITS

Água Bonita - [www.aguabonita.com.br](http://www.aguabonita.com.br)

Central Paulista

Cevasa - [www.cevasa.com.br](http://www.cevasa.com.br)

Della Coletta Bioenergia - [www.coletta.com.br](http://www.coletta.com.br)

Ester - [www.usinaester.com.br](http://www.usinaester.com.br)

Irmãos Malosso

Nardini - [www.nardini.ind.br](http://www.nardini.ind.br)

Paraíso Bioenergia

Santa Rosa - [www.usinasantarosa.com.br](http://www.usinasantarosa.com.br)

São Domingos - [www.usinasadomingos.com.br](http://www.usinasadomingos.com.br)

Cabrera Energética - MG

Usina Rio Pardo - [www.urp.ind.br](http://www.urp.ind.br)

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