CRAB & TAUR

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Global Ethanol Trends and Optimal Technologies for Each Region

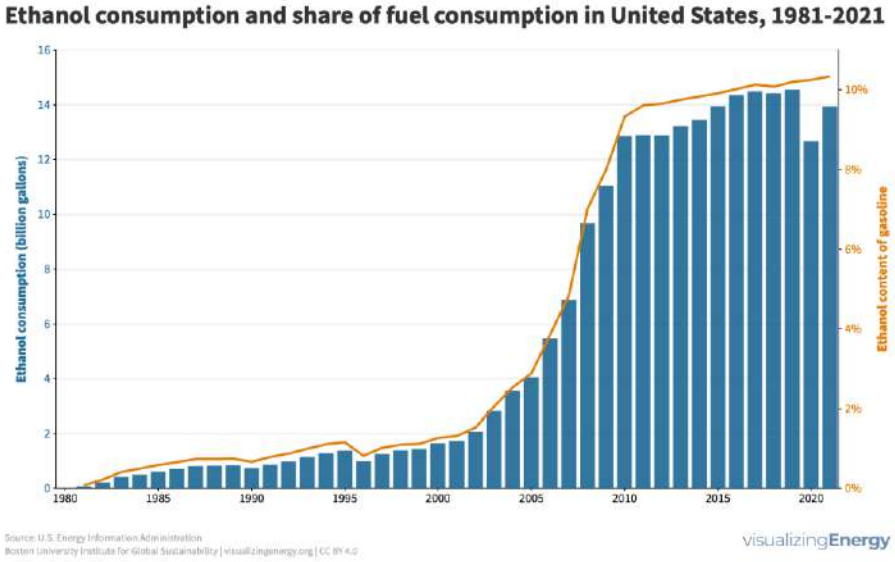
Hugo Morais
Business Development

Key Players in Ethanol Worldwide

Region	2020	2021	2022	2023	2024	%	Growth
United States	52.77	56.84	58.14	58.97	61.39	52%	**16.3%**
Brazil	30.66	27.71	28.01	32.06	33.23	28%	**8.4%**
India	2.01	3.60	4.62	5.72	6.17	5%	**207.5%**
European Union	4.96	5.22	5.37	5.26	5.45	5%	**9.9%**
China	3.56	3.41	3.63	4.05	4.54	4%	**27.7%**
Canada	1.62	1.64	1.69	1.72	1.76	1%	**8.2%**
Thailand	1.48	1.32	1.44	1.29	1.36	1%	**-7.7%**
Argentina	0.79	1.02	1.17	1.17	1.17	1%	**47.6%**
Rest of World	2.38	2.61	2.73	3.05	3.05	3%	**28.1%**
Total	100.23	103.37	106.81	113.29	118.13		

Source: RFA

Ethanol in USA



52% of world market-share

Demand increased due to **E10 Mandate** 2005 ~ 2007

Record 61.4 billion liters

- Domestic usage increased to **54.3 bl**
- Exports surged to **7.2 bl**

Source: RFA

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Steam is produced **from Natural Gas (NG)**

Electricity comes **from the Grid**

In 2019, 98% of ethanol in USA was produced from CORN

1% grain sorghum
1% cellulosic fiber

45% of all corn is used to produce ethanol

45% goes for animal feed

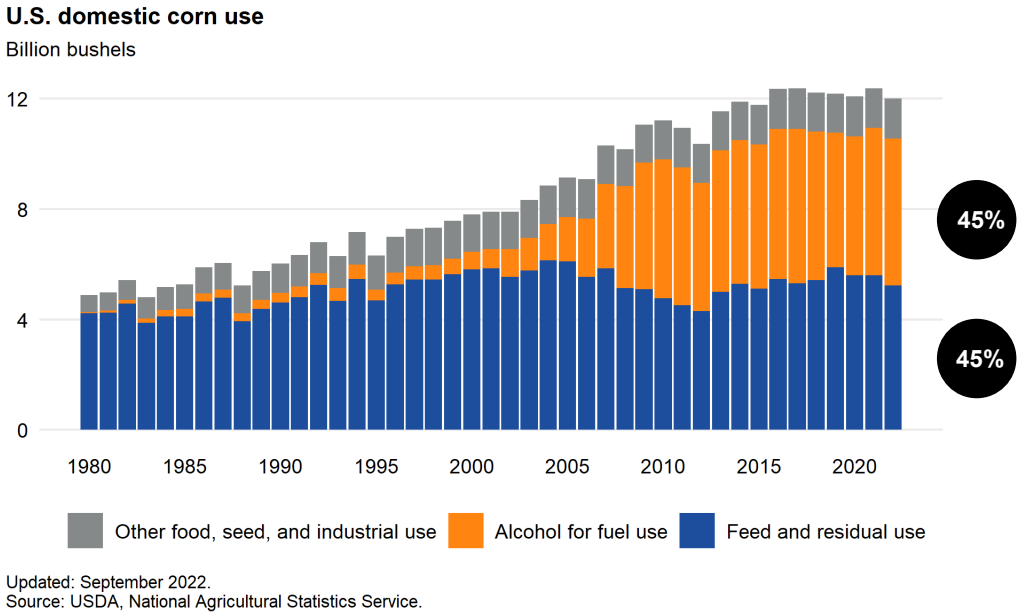
10% for human food and industrial uses

45% of all corn is used to produce ethanol

45% goes for animal feed

10% for human food and industrial uses

No food vs Fuel

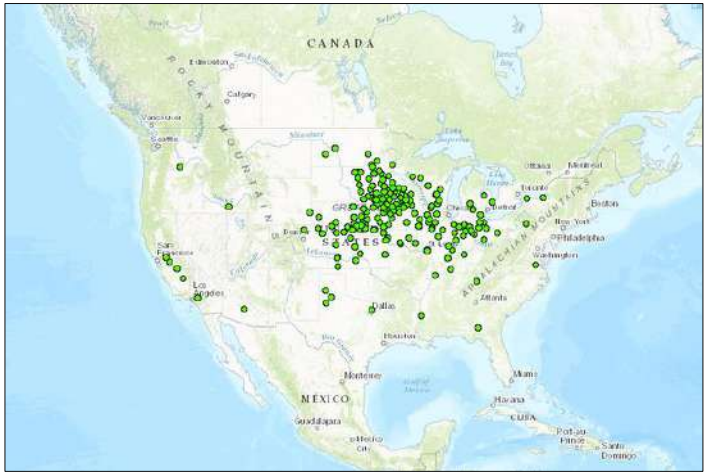


Updated: September 2022.
Source: USDA, National Agricultural Statistics Service.

6 states account for more than 70% of corn production

Plants concentrated in the corn-belt

(major feedstock availability)



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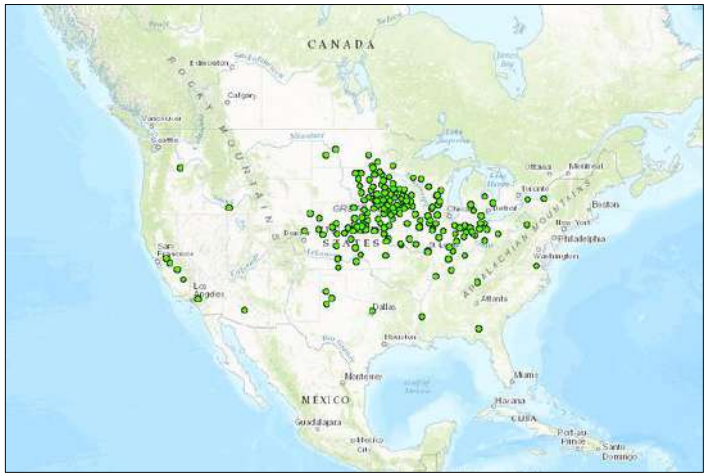

Importance of Proximity

Logistics

~ 27% of corn dry-matter will be converted in CO2

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If E15 in place of E10

a commonsense solution to increase demand for corn

boost demand by 15.3% of corn

Reduce the petroleum usage by additional 5%

Ethanol production increasing in 45%

Installed Capacity must increase at least 30%

Higher availability of DDGS and Corn Oil, that can be used in animal feed and biodiesel

Additional 3% reduction in greenhouse gas missions

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Ethanol in Brazil

The largest sugarcane producer and sugar exporter in the world

Sugarcane availability as a limiting factor for market growth

Steam is produced from **biomass** (bagasse or woodchip)

Electricity generate **in turbines**

In other words:

- 3rd largest top corn producer
- 2nd largest exporter
- A major **global player in meat production**
- Animal feed accounts for 60 to 80% of corn consumption

DDGS as an opportunity!

Total of **133 million** metric ton of corn per year

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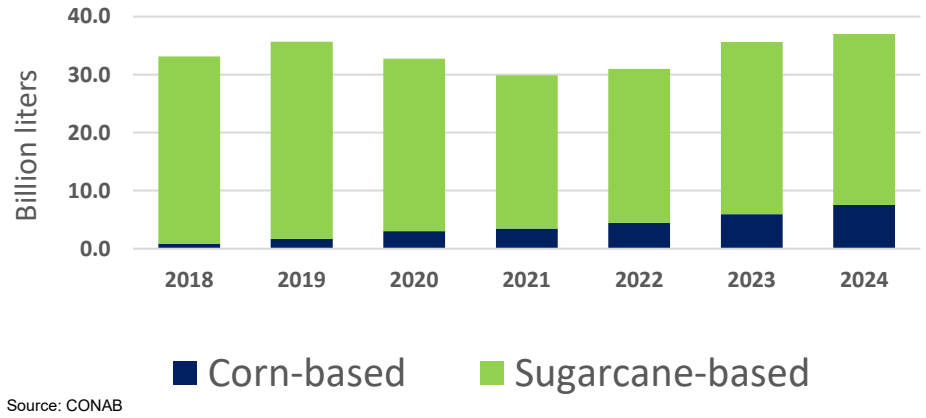
2nd largest ethanol producer in the world

28% of market-share



Source: CONAB

Season 2024

- 38.15 billion liters produced
- 30.6 billion liters from sugar-cane
- 7.55 billion liters from cereals, **mostly corn**

Corn-based ethanol raised 1,000% since 2018

Corn ethanol already represent 20% of the market

Expected to reach 33% in 2032

Currently, Consumes 11% of corn produced in Brazil

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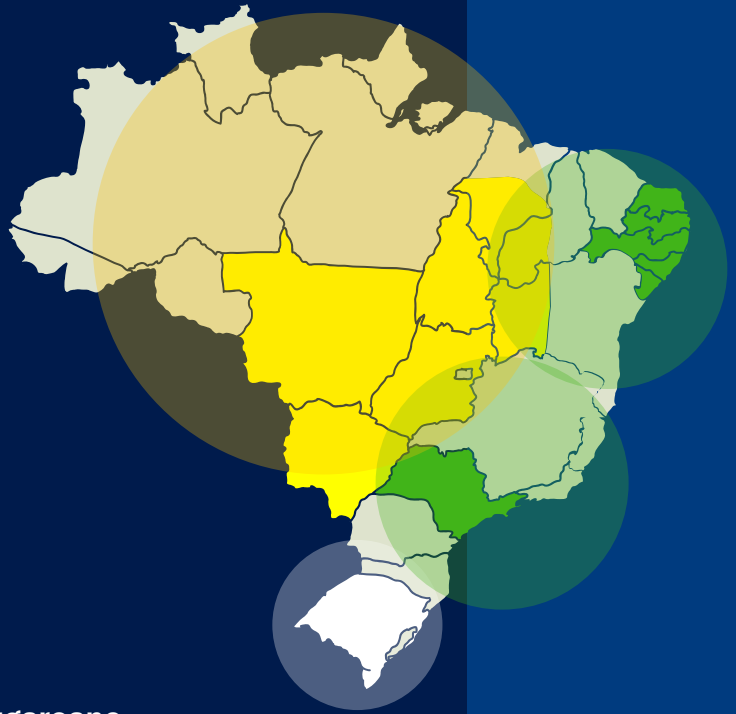
What about corn-based ethanol in Brazil before 2017?

They said: “It will not work here.”

Regional Markets



Northeast focused on sugar for export

◆

Sao Paulo state still accounts for 60% of entire market

◆

Southern region capable for local consumption only

◆

Midwest with potential to supply the entire interior of Brazil

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Regional Markets

How we know that?

KATZEN-design plants account for **60%**
of all Brazilian cereal-based
ethanol market

18 plants in the last 6 years

12 in operation

6 under construction & design

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Regional Markets

		Anhydrous capacity in KLPD (m^3/day)
2025	**CONFIDENTIAL**	**2,600**
2025	**CONFIDENTIAL**	**600**
2024	**3TENTOS**	**1,000**
2024	**INPASA** LEM	**1,250**
2023	**INPASA** Balsas I and II	**2,500**
2023	**INPASA** Sidrolandia I and II	**2,500**
2021	**INPASA** Dourados I, II and neutral	**2,500**
2019	**INPASA** Nova Mutum I and II	**2,500**
2019	**INPASA** Sinop I, II, III and IV	**5,600**
	Total	**21,450**

5.2 billion liters in operation
2.3 billion liters under design & construction

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Yields Demonstrated in Brazil for 1 ton of Corn*

440 liters of anhydrous (99.3% w/w)

248 tons of DDGS (12% w/w)

20 kg of Corn Oil

687 liters of Anhydrous Ethanol
ton of starch

using 2,69 kg of steam per liter of anhydrous ethanol

**Anhydrous ethanol yield considering the kernel of corn with 62% starch and 2.2% fermentable sugars and biotechnology based on genetically modified organisms (GMO), typically in Brazil.*

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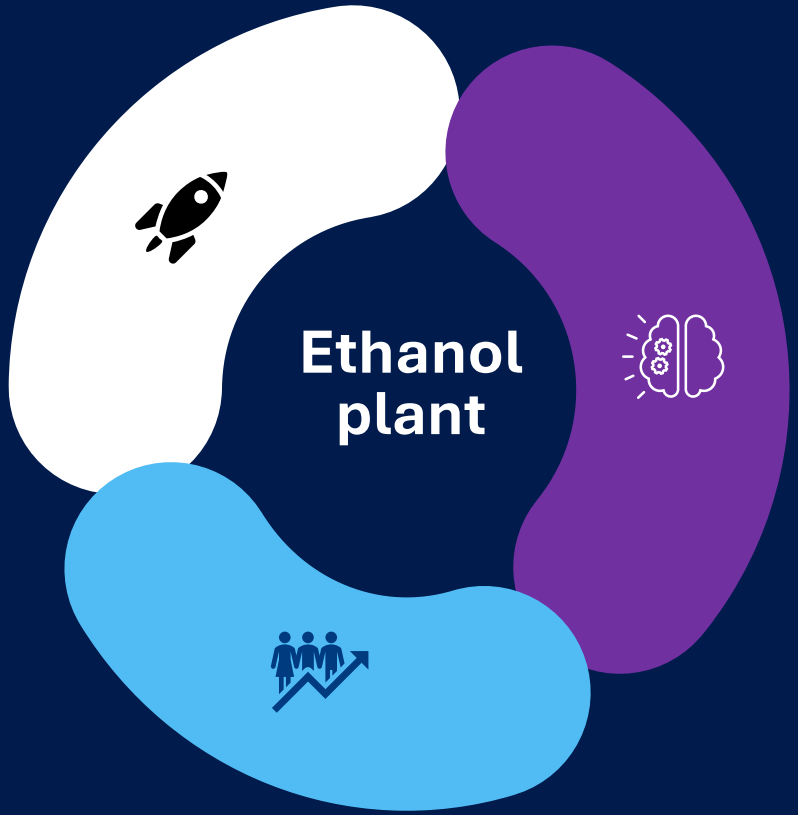

Technology

Biotechnology

Operations

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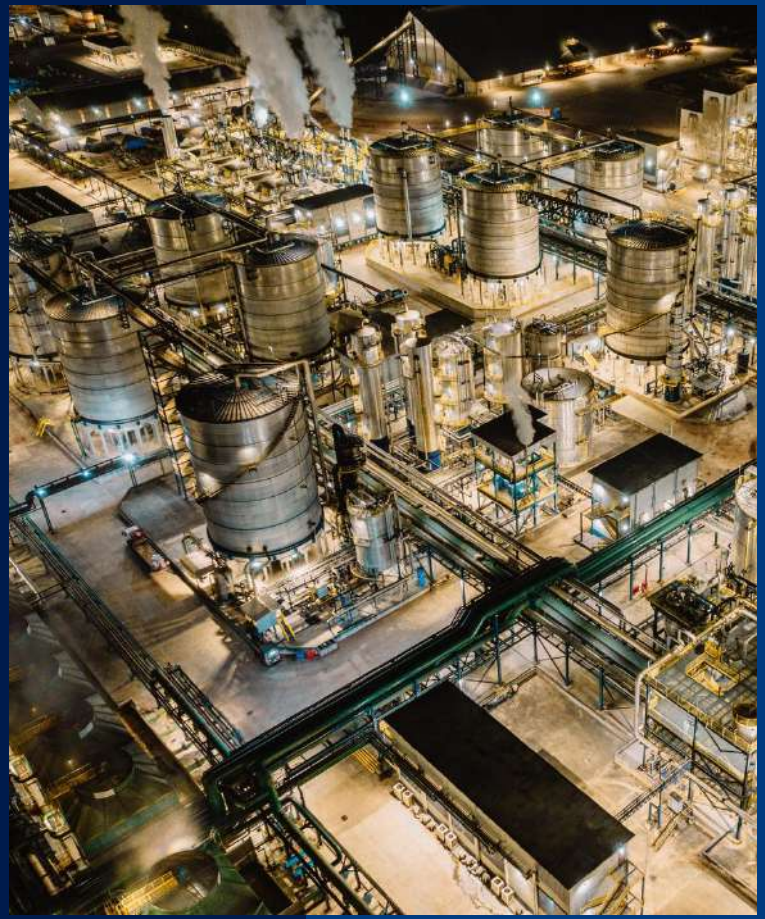
INPASA SINOP



The biggest dry-mill ethanol facility in the world

4 trains

1x 1,700	klpd
3x 1,300	klpd

5,600 klpd

12,000 ton of corn/day

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Ethanol in Europe

Nowadays, **most** of the plants **operate with corn.** Also, **wheat**, barley, rye, and sugar beet

Currently low ethanol blends
E5 and E10
E10 currently available in 19 of 27 EU countries

Feedstock is the limitation!

Steam is produced from **natural gas (NG)**

Electricity comes **from the grid**

Less Carbon
Less Steam
Less Electricity
Less Water

The European Union aims to be **climate-neutral by 2050** – an economy with net-zero greenhouse gas emissions

greenhouse gas emissions must **decline 43%** by **2030**

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Ethanol in Europe

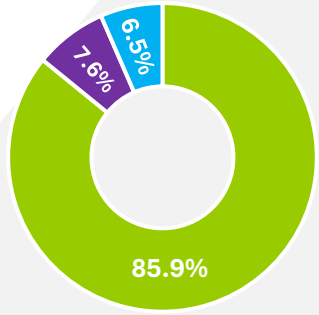
KATZEN-design plants

			Capacity in KLPD (m^3/day)
2024	*Confidential (under construction)*		**350**
2024 (2004)	Turkey	**Tarkim**	**110**
2022 (2008)	Belgium	**Alco**	**950**
2022 (2005)	Spain	**Vertex** BCyL	**750**
2020 (2009)	Poland	**Bioagra**	**760**
2010	The Netherlands	**Alco**	**2,200**
	United Kingdom	**Ensus**	**1,200**
2007	Austria	**Agrana**	**800**
2007 (2002)	Spain	**Vertex** Galicia	**570**
2006	France	**Vertex** Bio du Sud-Ouest	**700**
		Total	**8,390**

Estimated production **2.9 Bi liters per year**

European Production in 2023[1]

6.44 billion liters



- **Fuel** 5.53 billion liters
- **Industrial** 0.49 billion liters
- **Food and Beverages** 0.42 billion liters

KATZEN-designed plants were responsible for 45% of all European ethanol production in 2023

[1]*Source: ePURE aggregated and audited data for 2023. Ethanol volumes in pure alcohol*

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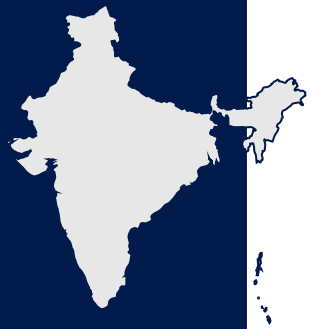

Ethanol in India

Similar to Brazil,

Sugarcane availability/climate conditions as a limiting factor for market growth

- **India** is a **global leader** in agriculture
- 2nd largest producer of **sugar** and a major consumer
- 2nd largest producer of **wheat** and **rice**
- 5th largest top **corn** producer
- A major **global player in livestock** → **DDGS as an opportunity!**

Total of **42 million** metric ton of corn per year, aiming **86 mt in 2047**

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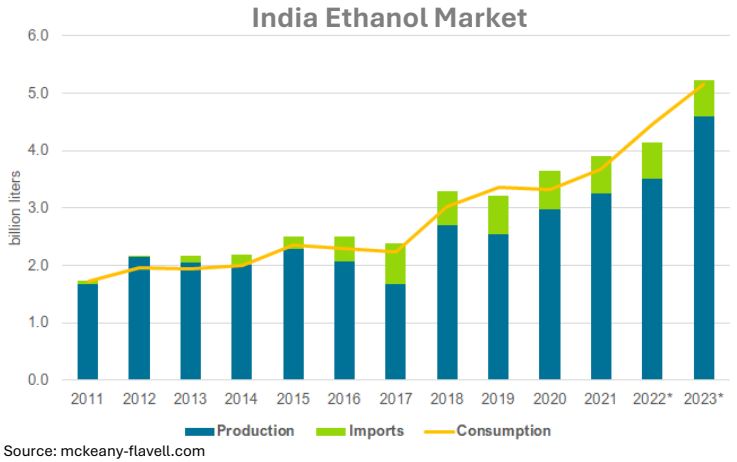
Ethanol in India

Biofuel policies

E10 by April 2022
E20 by April 2025

This rapid growth requires
- **Proven Technology Solutions**
- **Feedstock strategy**
- **Scalable capacity**



Source: mckeany-flavell.com

Steam is produced from **biomass** (bagasse or woodchip)

Electricity generated **in turbines**

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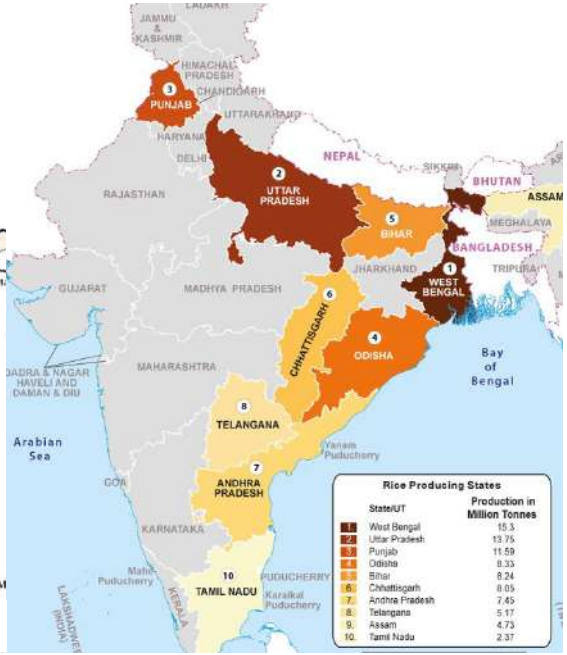
Regional Markets



Wheat

Corn

Rice

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Multiple Feedstocks

Corn

Small Grains
wheat, sorghum, barley, rye

Tubers
cassava, potatoes

Molasses / Sugar beet

Cheese Whey Permeate





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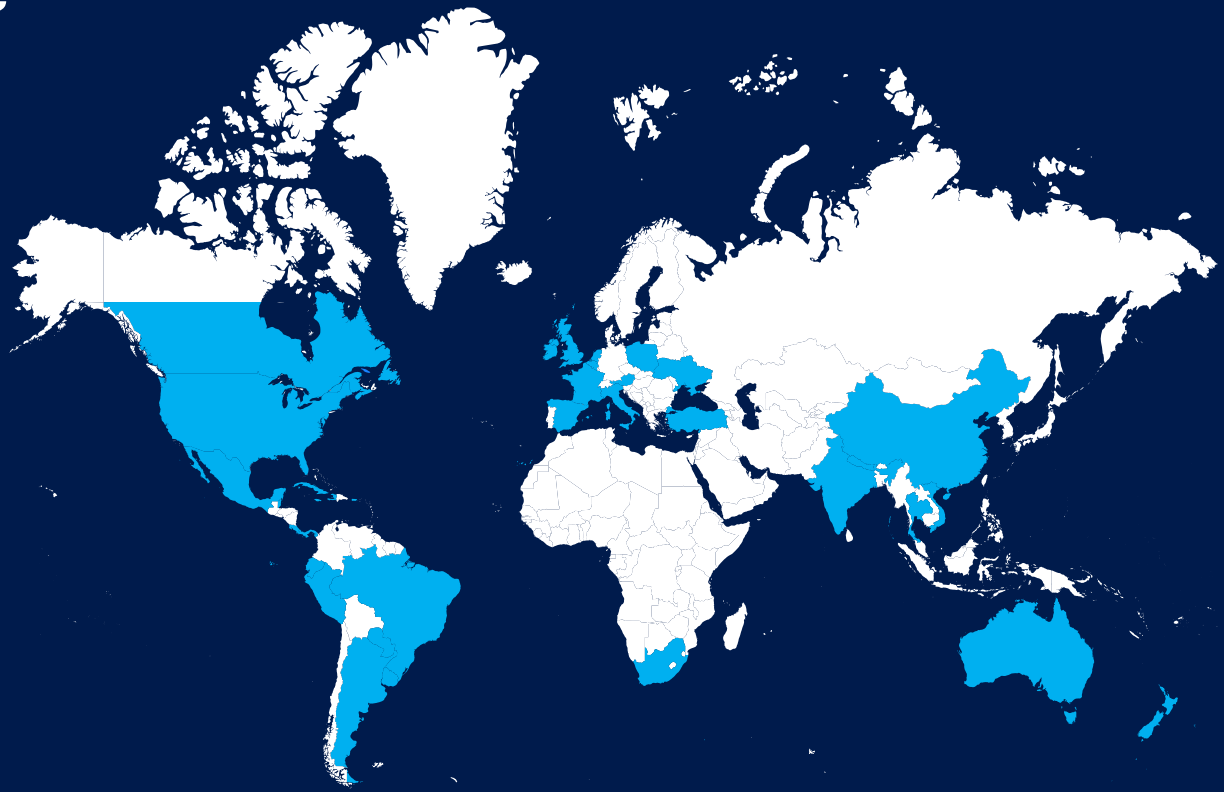
Global Presence



More than
150 projects
in over
40 countries

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VHQ™ True Neutral Spirit

Meticulously **developed in over three decades**

True Neutral Spirit
with < 1 ppm of impurities
and no detectable organoleptic

In last 5 years,
09 new successful installations
operating globally, with nameplate production and
ranging from 94 KLPD to 330 KLPD

Neutral Alcohol in last 5 years

Poland
750 m^3/day (complete plant expansion)
High Quality Pharmaceutical and Industrial

USA
329 m^3/day
Industrial/Pharmaceutical

Spain
128 m^3/day
High Quality
Premium Industrial

USA
165 m^3/day
VHQ beverage and pharmaceutical

Mexico
300 m^3/day
High-Quality Tequila Spirit

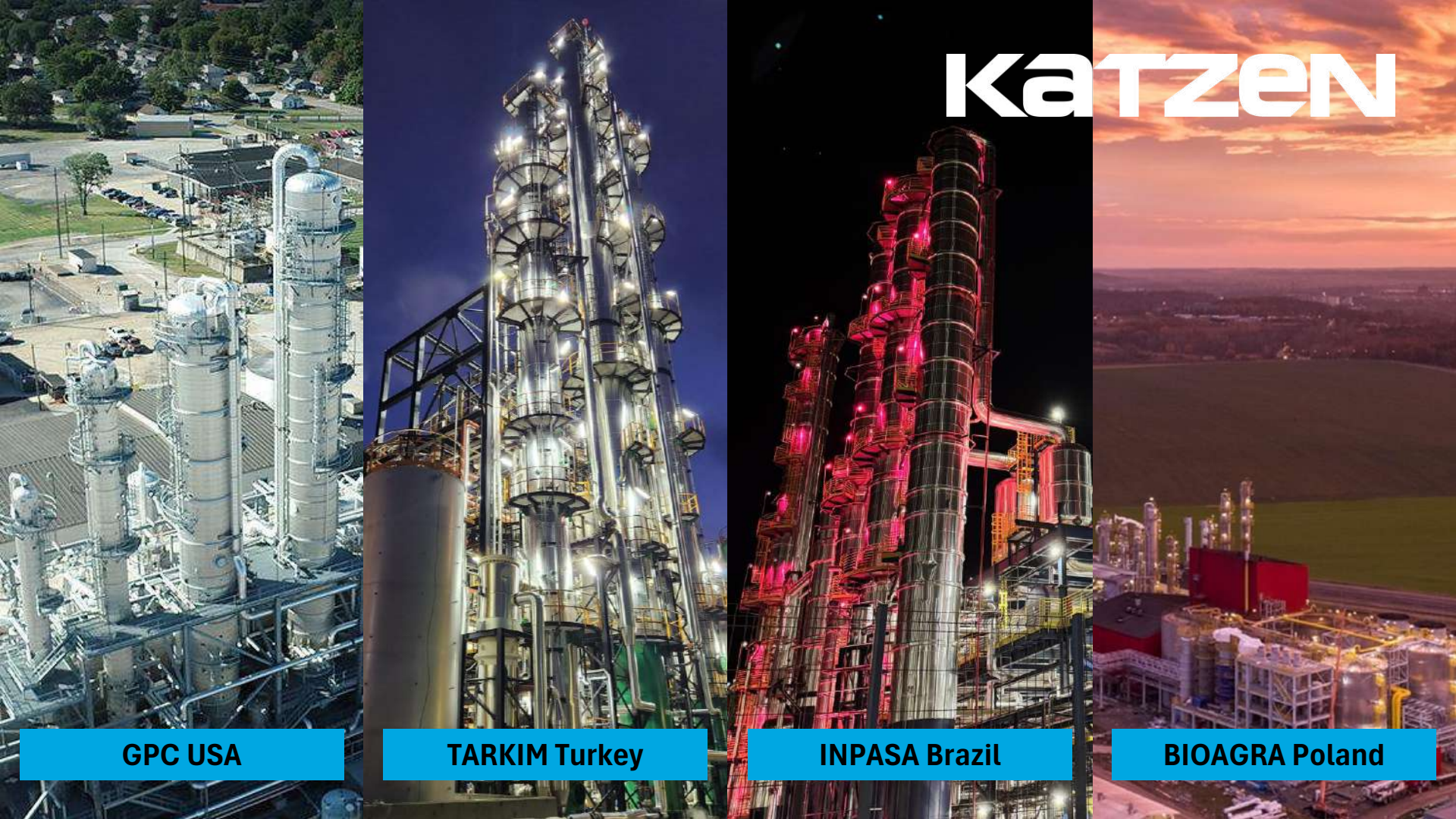
Canda
329 m^3/day
VHQ beverage and pharmaceutical

Turkey
94 m^3/day
VHQ beverage and pharmaceutical

Brazil
300 m^3/day
Industrial / Neutral Spirit

USA
541 m^3/day
VHQ beverage

KATZEN INTERNATIONAL, INC.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GPC USA
TARKIM Turkey
INPASA Brazil
BIOAGRA Poland

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