



Role of Sorghum in BIOFUELS

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AGENDA: The Role of Sorghum in Biofuels

- **Introduction**
 - Global biofuel landscape
 - Importance of alternative feedstocks
- **Economic viability**
 - Sorghum Grain in Bioethanol Production
 - Market scenarios across regions (USA, India, Australia)
 - Co-products: DDGS, CO₂
- **Agronomic advantages**
 - Sweet Sorghum for First-Generation (1G) Ethanol
 - Ethanol yield potential
 - Integration with sugar mills
- **High biomass varieties**
 - Lignocellulosic feedstock potential
 - Applications in SAF (Sustainable Aviation Fuel)
- **Conclusion & Discussion**
 - Strategic fit for climate-resilient bioenergy
 - Policy and industry collaboration
 - Q&A



About Alta seeds





Alta Seeds is the premium brand of Advanta Seeds. The Seed Business unit of Group UPL, adapting to rapidly increasing food insecurity and climate change by providing farmers with innovation and new technologies.

 **Production**
25 Sites

 **R&D**
21 stations, winter Nurseries Stations & Technology centers

 **Commercial**
87 Countries



Our brands:

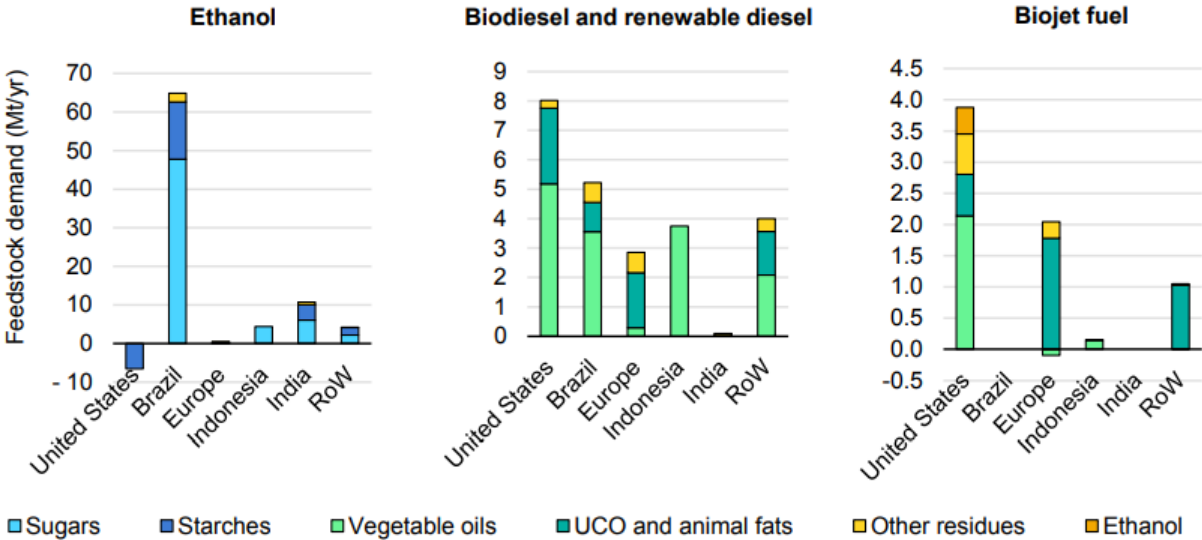
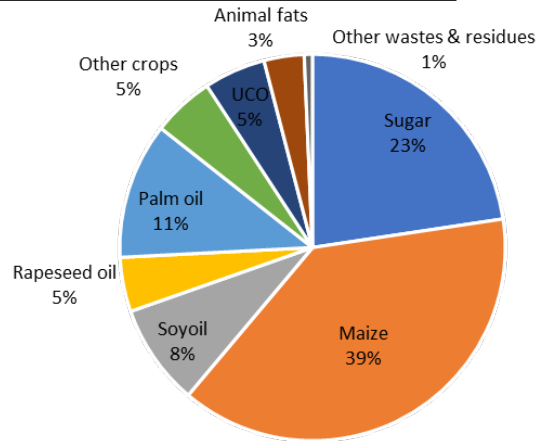




Global Biofuel market

Biofuel feedstock demand growth by fuel and region: 2023-2028

2021: 160 BnL/yr Biofuel by feedstock



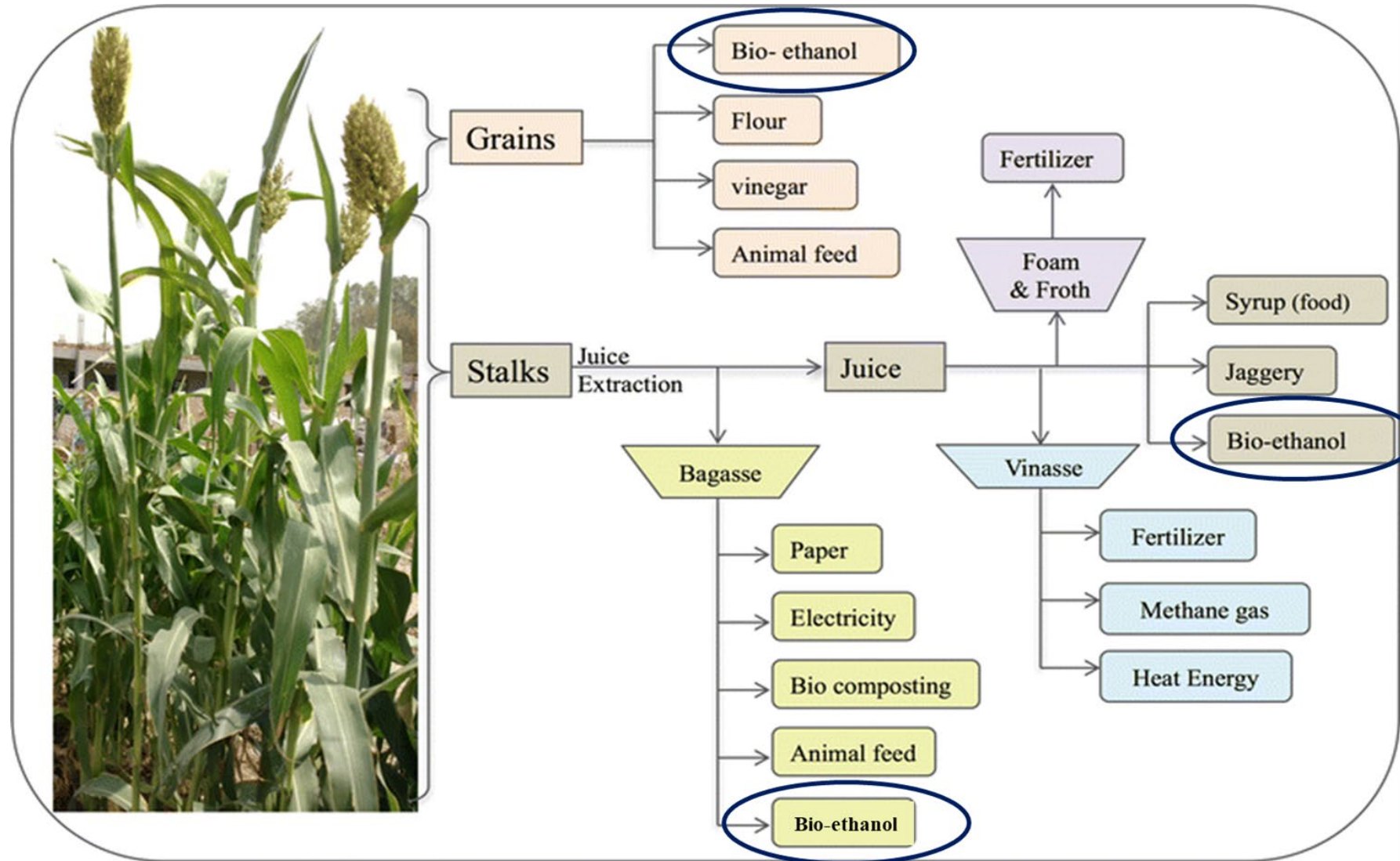
Biofuel Type	2023 (\$ bln)	2028 (\$ bln)	2033 (\$ bln)	CAGR
Bioethanol	83	115	131	5.10%
SAF	1.7	75	105	58.10%
CBG	61	81	87	4.00%
Total	190	327	389	2X

Why Sorghum for Biofuels

- **High Efficiency & Versatility:**
 - Sorghum efficiently converts CO₂ to sugars and can outperform sugarcane and corn under certain conditions, offering grain, sugary juice, and biomass from a single crop.
- **Multipurpose Bioenergy Crop:**
 - It supports food, fodder, and fuel production—providing grain, ethanol from juice, and bagasse for 2G ethanol, animal feed, gasification, organic fertilizer, and even paper.
- **Resilience & Global Potential:**
 - As a C4 plant with high resource-use efficiency and wide adaptability, sorghum is ideal for both developing nations (food-energy security) and temperate regions like Europe (2G ethanol feedstock).
 - The carbon intensity score of sorghum grain 0.25 kg CO₂e per kg of sorghum. This value represents the average carbon footprint from cradle to farm gate, specifically for sorghum grown primarily for ethanol production across the U.S.A.



SORGHUM – use of whole plant





Sorghum Grain to Bioethanol

Economics and market scenario

USA case study

India demand versus constraints

Other countries

Monetization: Ethanol yield – DDGS – Co₂

Sorghum Grain to Bioethanol – Economics and Market Overview

Economics and Market Scenario:

- Sorghum is a cost-effective and sustainable feedstock for bioethanol production.
- Lower water and fertilizer requirements compared to other grains (e.g., maize).

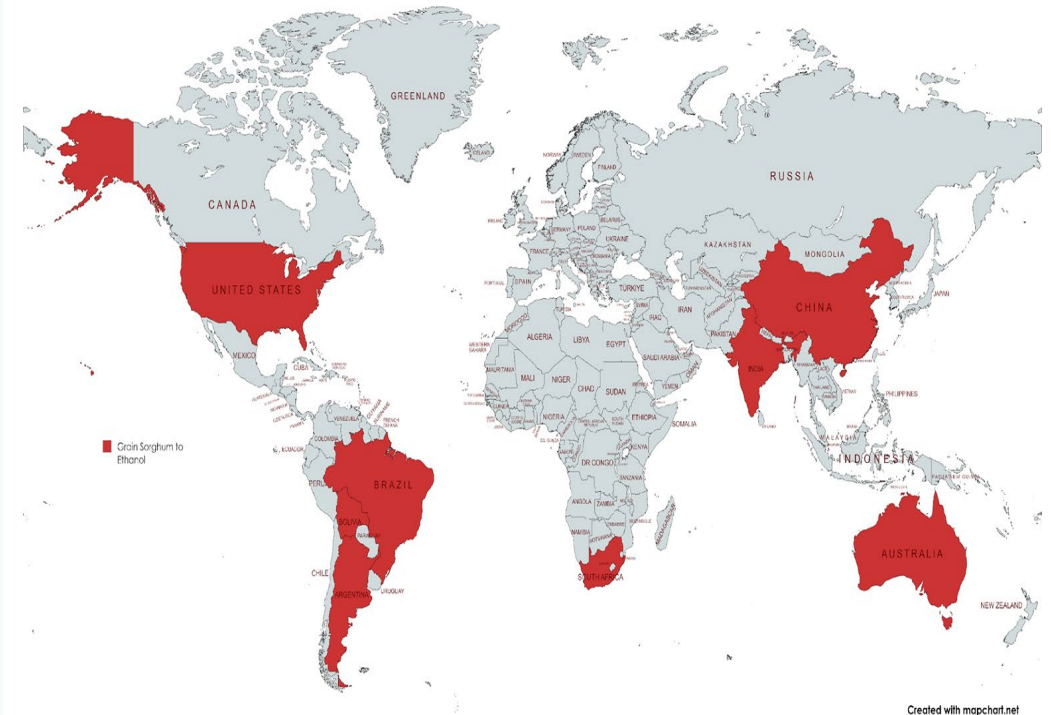
Grain sorghum yields approximately 380–400 liters of ethanol per ton of grain, comparable to corn ethanol yields.

USA Case Study:

- Sorghum accounts for ~8% of U.S. ethanol feedstock; preferred for drought-prone regions.
- Economic Impact: Ethanol production from sorghum generates ~\$1.5 billion annually.

Other Countries:

- Brazil: Grain sorghum contributes around 495 million liters of ethanol per year.
- China: Using sorghum for ethanol to reduce dependency on imported corn.
- Africa: Sorghum ethanol projects emerging in drought-prone areas.



Created with mapchart.net

Monetization Opportunities in Sorghum Grain Bioethanol

Ethanol Yield:

Sorghum grain yields ~380-400 liters of ethanol per ton of grain.
Higher starch content leads to efficient fermentation processes.

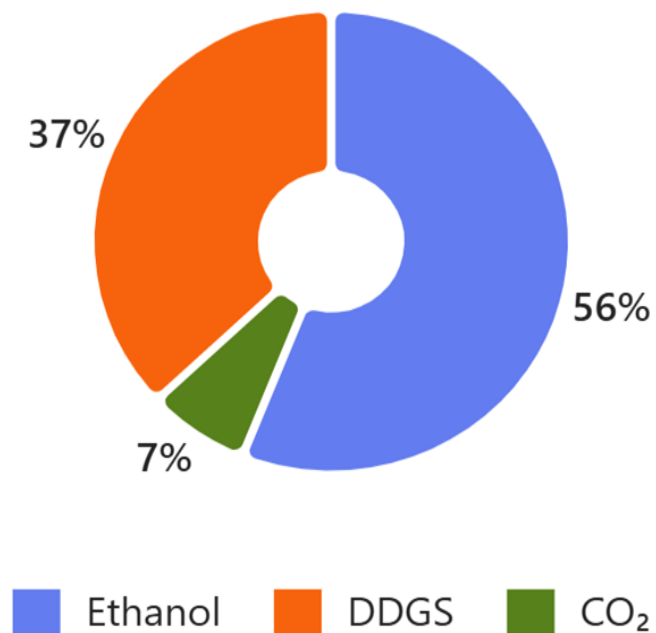
Co-Product Monetization:

Distillers Dried Grains with Solubles (DDGS):

High-protein animal feed; adds ~\$100–150 per ton in additional revenue.
Market demand growing in livestock and poultry sectors.

Carbon Dioxide (CO₂):

Captured CO₂ from fermentation can be monetized for industrial use (e.g., carbonated beverages, dry ice production).
CO₂ revenue potential: ~\$15–30 per ton.



Sweet Sorghum to Bioethanol

- Sweetfuel EU
- India surge – 2 billion liters
- Sustainability: water use – inputs CI score
- Intercropping with Sugarcane
- IG Sweet Sorghum for Brazil imidazolinone (IMI)
- herbicides tolerant
- Monetization: Ethanol yield – Baggase



Overview of the SweetFuel Project

Objective: To enhance the potential of Sweet Sorghum as a sustainable energy crop for bioethanol and bioenergy production, particularly in arid and semi-arid regions.

Funding: Supported by the European Union under the FP7 Framework Programme.

Duration: Active between 2009 and 2013.

Key Achievements

Crop Development:

Improved Sweet Sorghum varieties with higher sugar content and better drought tolerance.

Demonstrated low carbon footprint and water-use efficiency of Sweet Sorghum. Showcased its potential for second-generation biofuels (lignocellulosic ethanol) in addition to first-generation sugar-based biofuels.

Field Trials:

Conducted extensive trials in Europe, India, Brazil, and Mozambique to evaluate the crop's adaptability across diverse climates.

Results highlighted yields of 4,000–7,000 liters of ethanol per hectare under optimal conditions.

Economic Viability:

Assessed Sweet Sorghum's profitability for farmers in developing and developed regions.

Promoted its integration into existing crop rotation systems, especially in sugarcane off-seasons.



<https://cordis.europa.eu/docs/results/27/227422/final1-sweetfuel-final-summary-report.pdf>



Below are the primary reasons:



01

**Lower Yields
Compared to
Alternatives**

02

**Lack of Commercial
Scaling**

03

**Policy and Market
Limitations**

04

**imited Private
Sector Interest**



India – Sweet Sorghum to bioethanol

Sweet Sorghum to ethanol: Growing momentum

IEW 2025: BPCL and National Sugar Institute collaborate to advance sweet sorghum as sustainable biofuel source

BPCL to allocate Rs. 5 crore for R&D in bioethanol production

By **ICN Bureau** | February 15, 2025



Bharat Petroleum Corporation Limited (BPCL), an eminent integrated energy provider in India, has entered into a Memorandum of Understanding (MoU) with the National Sugar Institute (NSI) in Kanpur to collaboratively develop sweet sorghum as an eco-friendly feedstock for bioethanol

- **Sweet Sorghum: A Strategic Complement to Juice-Based Ethanol Production.**
- **Extending Production Capacity by Up to 100 Days as a complementary feedstock bridging the seasonal gaps in sugarcane availability.**
- **The potential of ethanol from sweet sorghum can go beyond 2 billion Liters.**
- **It is a non-food feedstock**



REPORT AND RECOMMENDATIONS

FROM NSI-ADVANTA SWEET SORGHUM ETHANOL PROJECT



Submitted by

National Sugar Institute

An ISO 9001:2015 Certified Institute

Ministry of Consumer Affairs, Food & Public Distribution

Department of Food & Public Distribution

Government of India

Kanpur - 208 017 (UP) India

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Sorghum high biomass – 2 G

Sorghum for 2G and Sustainable aviation fuel

Sorghum Biomass for Sustainable Aviation Fuel in the U.S.

Published by: United States Department of Energy (DOE)

Overview:

Focuses on pilot projects that use sorghum biomass for SAF production under the DOE's Bioenergy Technologies Office (BETO).

Available at: DOE Bioenergy Office

DOE has supported pilot projects that showcase the technical feasibility of converting sorghum biomass into SAF using advanced biochemical and thermochemical conversion technologies.

These projects focus on optimizing feedstock logistics, pre-treatment processes, and conversion pathways to improve efficiency and scalability.



Sorghum for 2G and Sustainable aviation fuel

"Sorghum-to-Jet Fuel Pathway for Carbon-Neutral Aviation"

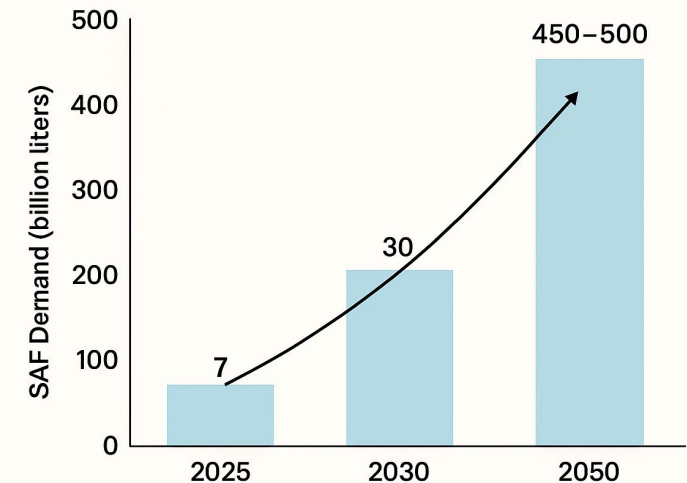
Published by: International Air Transport Association (IATA)

Overview:

Discusses the potential of sorghum biomass for reducing carbon emissions in aviation through SAF production. Provides insights into policy and economic incentives for scaling production.

Sorghum-based SAF has the potential to reduce lifecycle greenhouse gas (GHG) emissions by up to 70-80% compared to conventional fossil-based jet fuel. When coupled with carbon capture and storage (CCS) technologies, the pathway could achieve carbon-neutral or even carbon-negative outcomes for aviation fuel production.

SAF Demand Projections



BMR Sorghum for 2G ethanol Production

BMR Sorghum: A superior Feedstock for 2G Ethanol

Key Features	Benefits for CBG production
BMR Trait (Brown Midrib)	- Low lignin contents enhances digestibility and biomass conversion efficiency - Ideal for 2G ethanol production.
Biomass Yield & other Traits	- Yield potential 70-80 T/ha with good agronomy - Days to Maturity- <120 days - Plant height (cm)- Tall (>230cm)
Process	Pretreatment, hydrolysis, and fermentation to obtain simple sugars, which are then converted to ethanol by microorganisms
Total alcohol potential	Approx 288 liters per ton
Lower Enzyme Requirements	Reduced need for costly enzymes during biomass conversion
Seasonal Suitability	Thrives in diverse agro-climatic condition ensuring consistent year-round biomass supply



Bagasse

Role of Sorghum as a Bioenergy Crop–Key Takeaways



Sorghum: The 'Camel among Crops'

Thrives in semi-arid and marginal lands with minimal inputs.



Strategic Fit in Global Bioenergy Matrix

Complements existing ethanol infrastructure and supports diversified feedstock strategies



Sustainability Advantage

Aligns with global renewable energy and climate policies; reduces carbon footprint



Versatile Bioenergy Pathways

Enables production of bioethanol, biogas, power, and value-added co-products from panicle, stalk, and leaves



Future Growth Potential

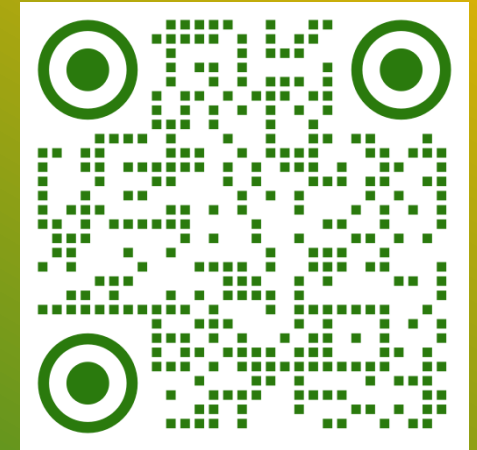
Positioned to drive biofuel production, global trade, and circular bioeconomy development

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Learn more about our sorghum business



Advanta Seeds supports the United Nations Sustainable Development Goals (SDGs).
To find out more go to: www.sustainabledevelopment.un.org

www.advantaseeds.com

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