



ARC RESEARCH HUB FOR  
**Engineering Plants to  
Replace Fossil Carbon**

Engineering  
plants to **replace  
fossil carbon**

**Robert Henry**

[plants-for-carbon.com.au](http://plants-for-carbon.com.au)



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# Approaches to Climate Change

## **Adaptation of agriculture**

**ARC Centre of Excellence for Plant Success in Nature and Agriculture**

## **Reduction in emissions from agriculture**

**CRC Zero Net Emissions from Agriculture**

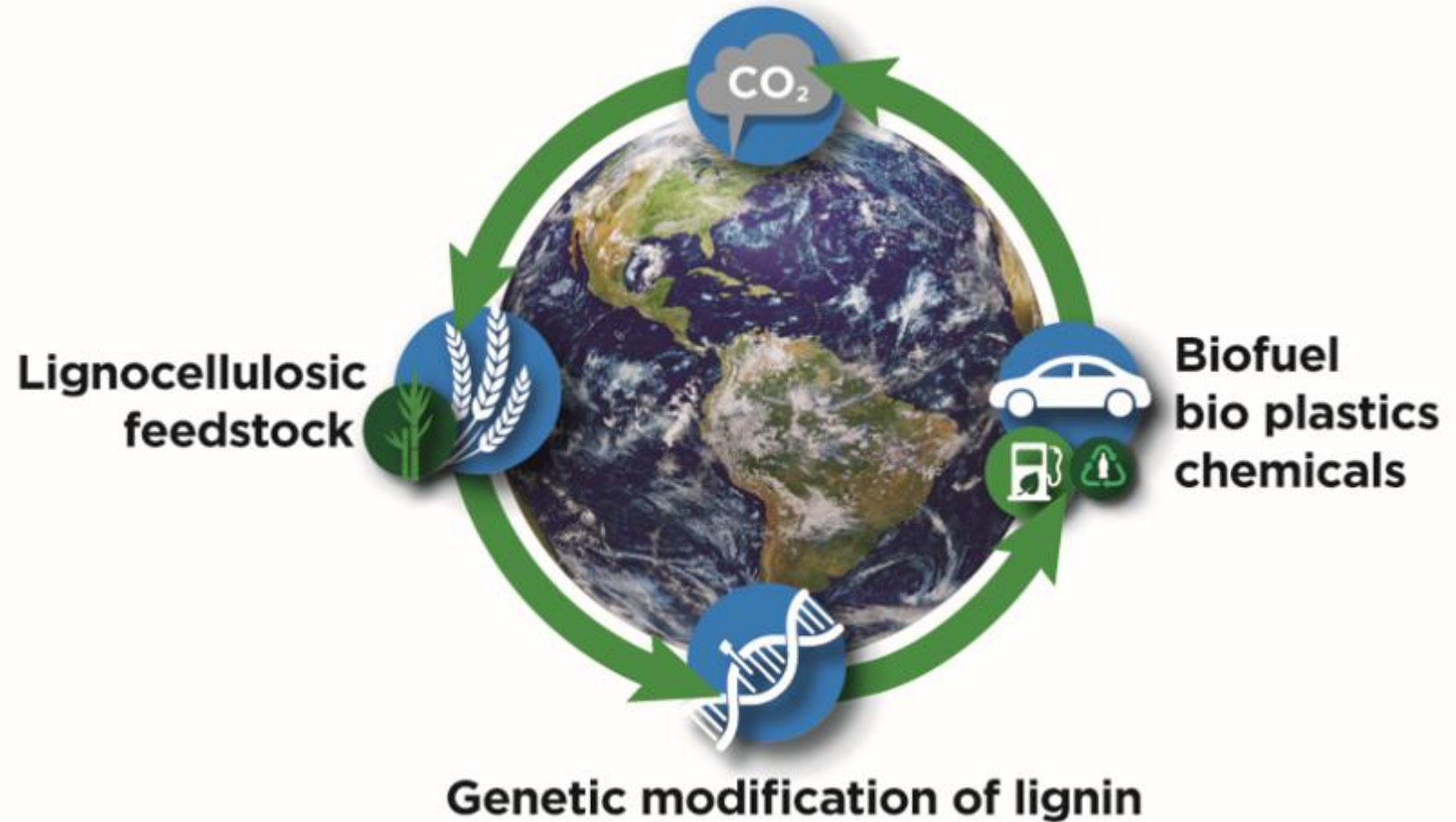
## **Using agriculture to reduce emissions in other areas**

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# Renewable Carbon Products



# Engineering Plants to Replace Fossil Carbon

ARC Industrial Transformation Research Hub



**Australian Government**

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**Australian Research Council**



**GenTech Seeds**

*Exclusive producer distributor of Pioneer® brand products*



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**PacBio**

**JBEI**

Joint BioEnergy Institute

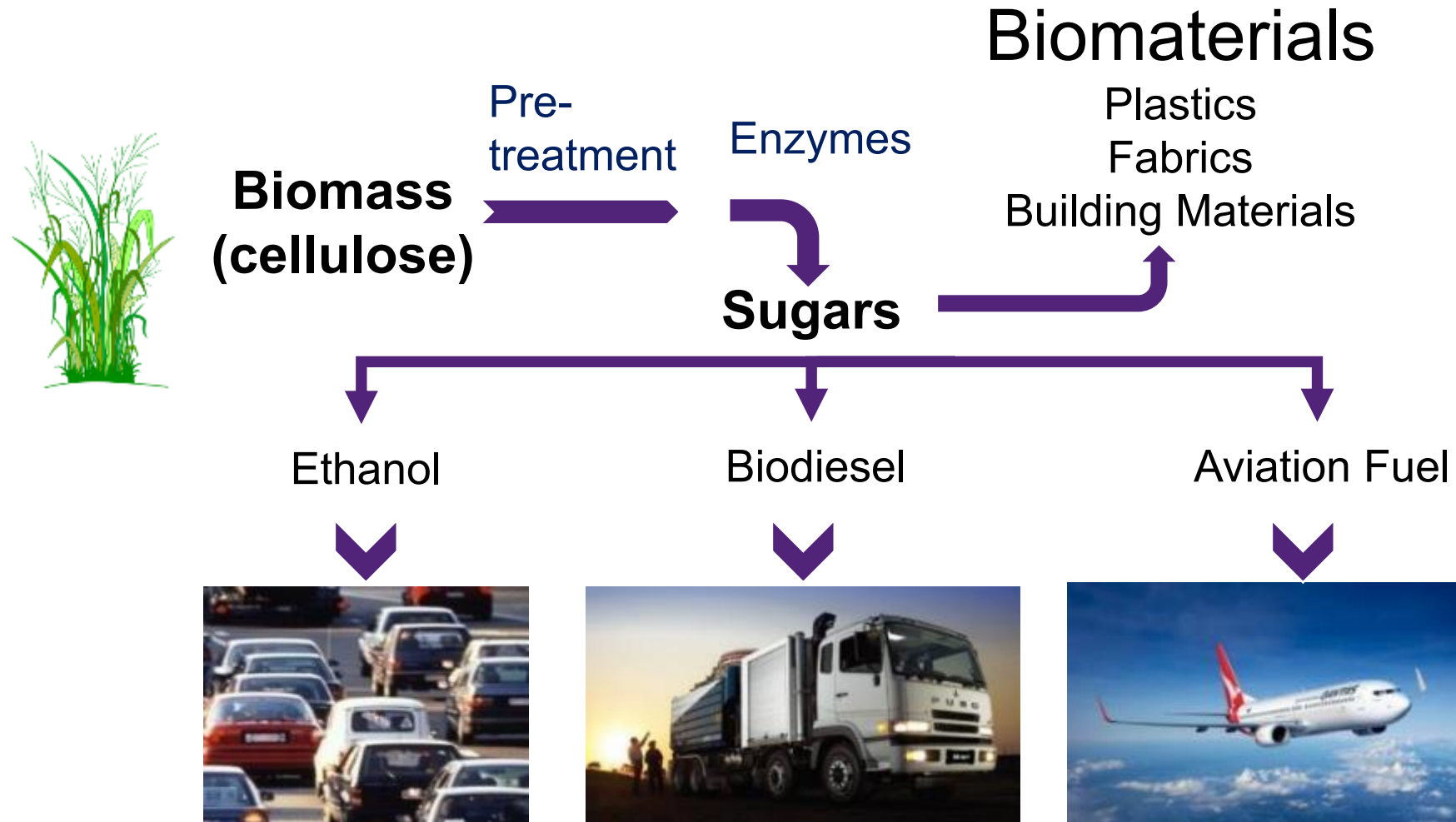


Innovate • Integrate • Deliver



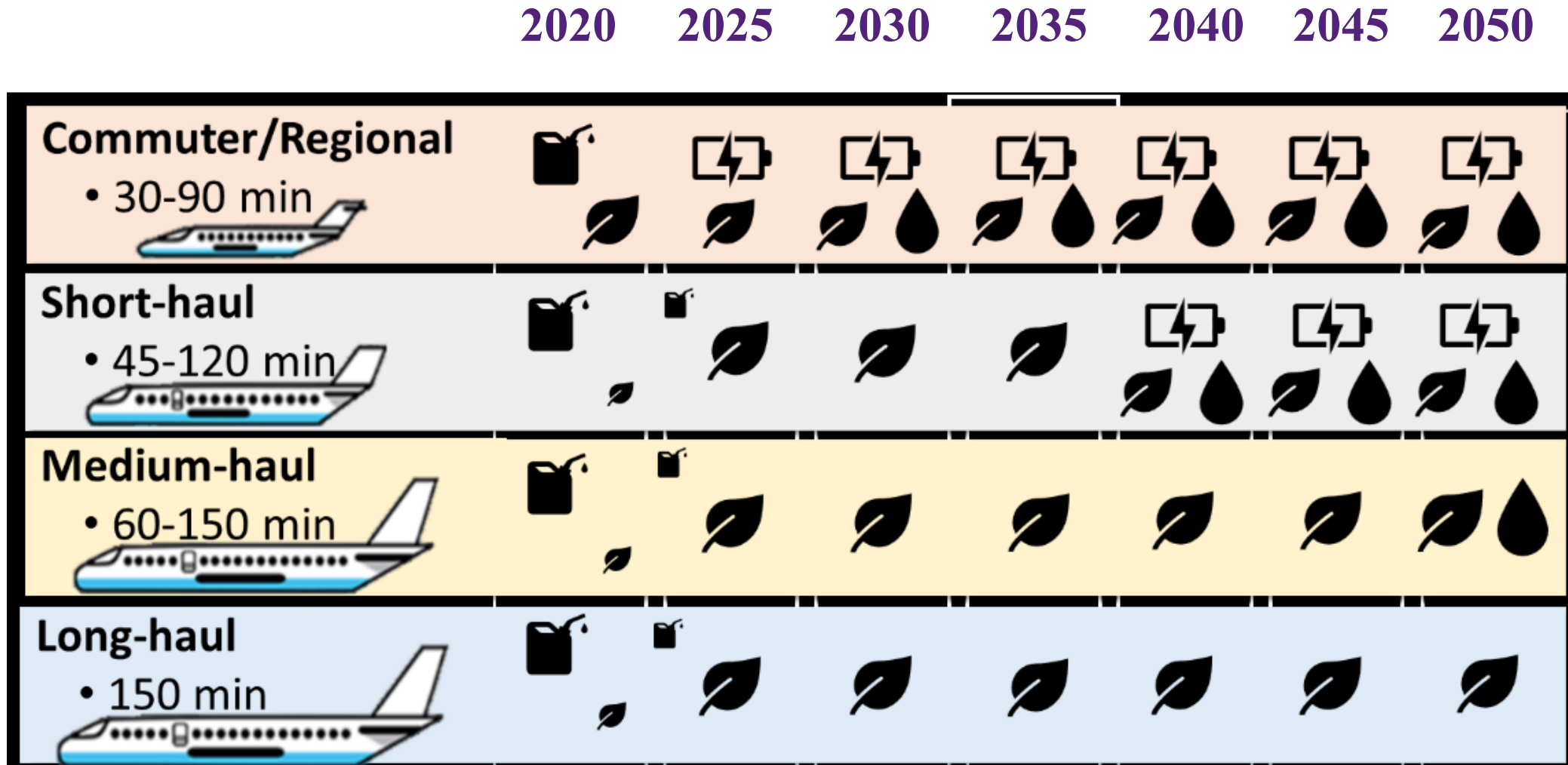
**QANTAS**

# Biofuel and biomaterials from non food plants

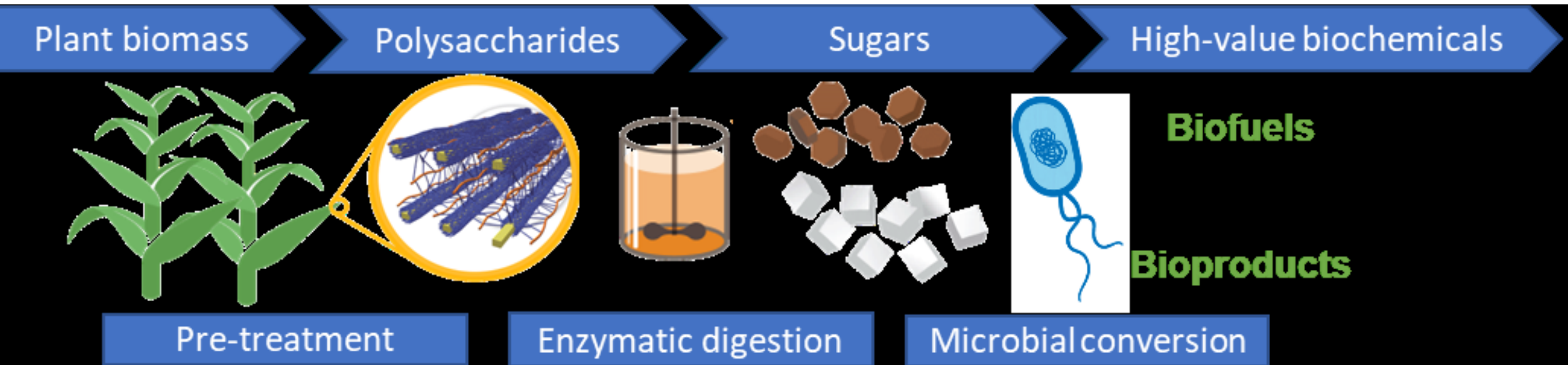


# Options for the transition from fossil fuels to sustainable options.

Sustainable aviation fuel (SAF) presents the only realistic option for longhaul through 2050



# Biochemical route



# Four Themes. Nine Projects

1: ID gene targets

2: Spatially locate gene targets

## Biomass Genomics

Increasing understanding genomics of plant crops to guide future editing and processing

9: Sugarcane population genotyping & association analysis

3: HTP sorghum screening

## Biomass Modification

Modification of plants and initial analysis of editing plant varieties

4: Edit plants & initial phenotyping

5: Biomass chemistry analysis

## Biomass Chemistry

Increasing understand of cell wall chemistry and molecular structure

6: Optimise and scale enzyme digestion

## Biomass Performance

Assessment of modified plants. Increase performance of biomass processing to fuel and other compounds

7: Optimise processing of plants to fuel

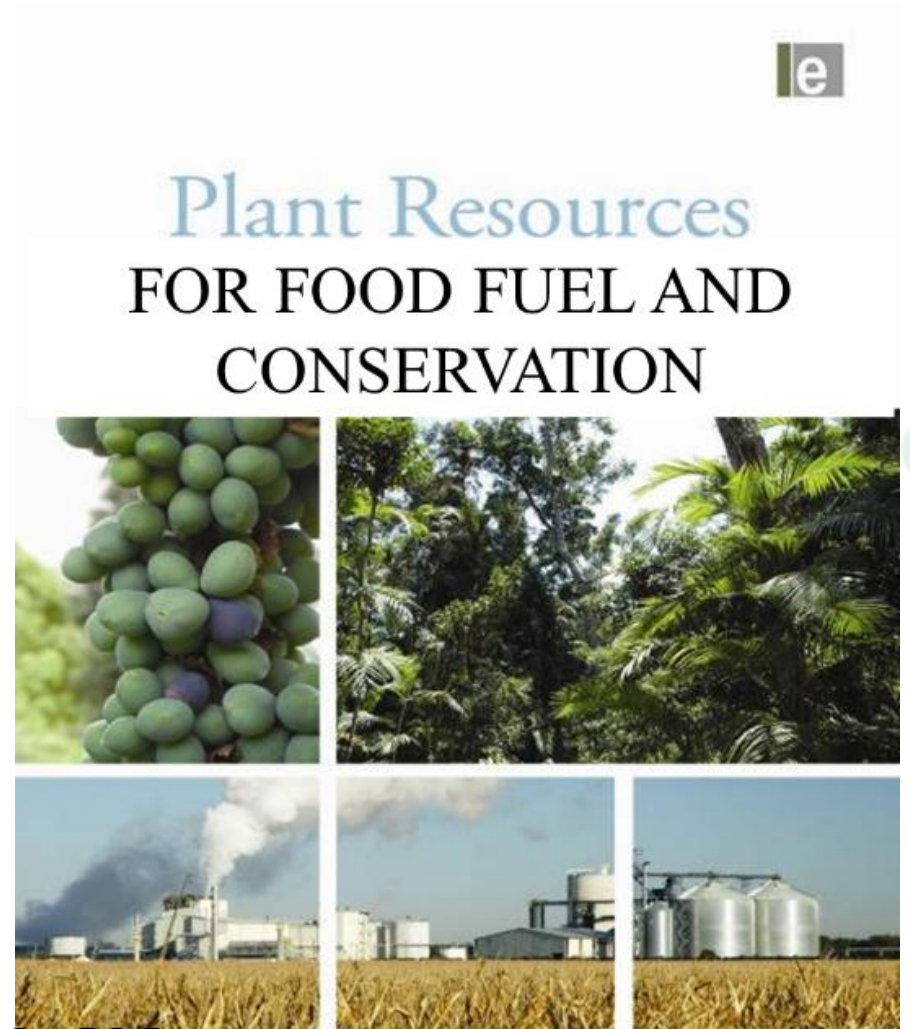
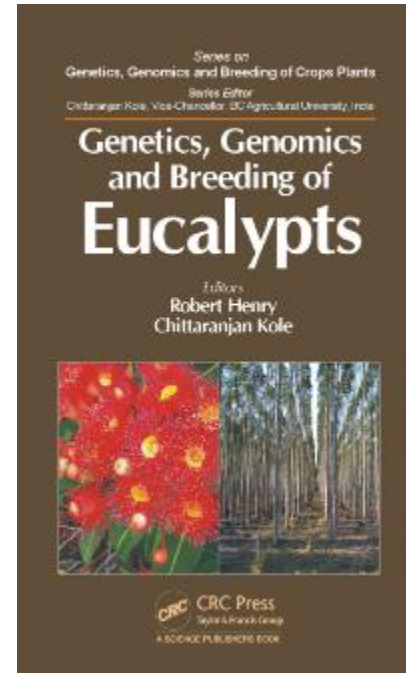
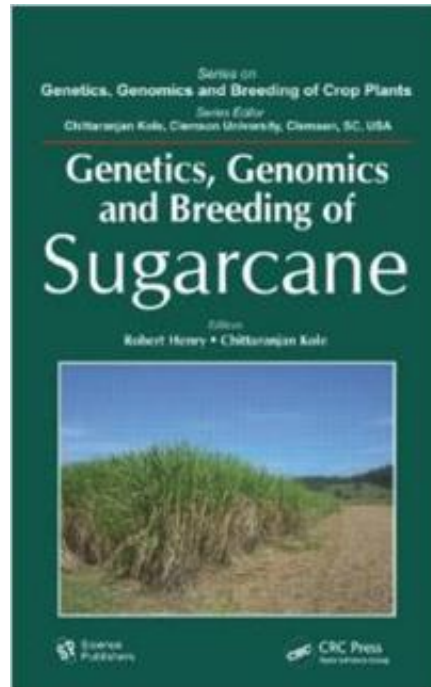
8: Assess field performance



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# Lignocellulosic biomass from Sugarcane

## Sustainable option

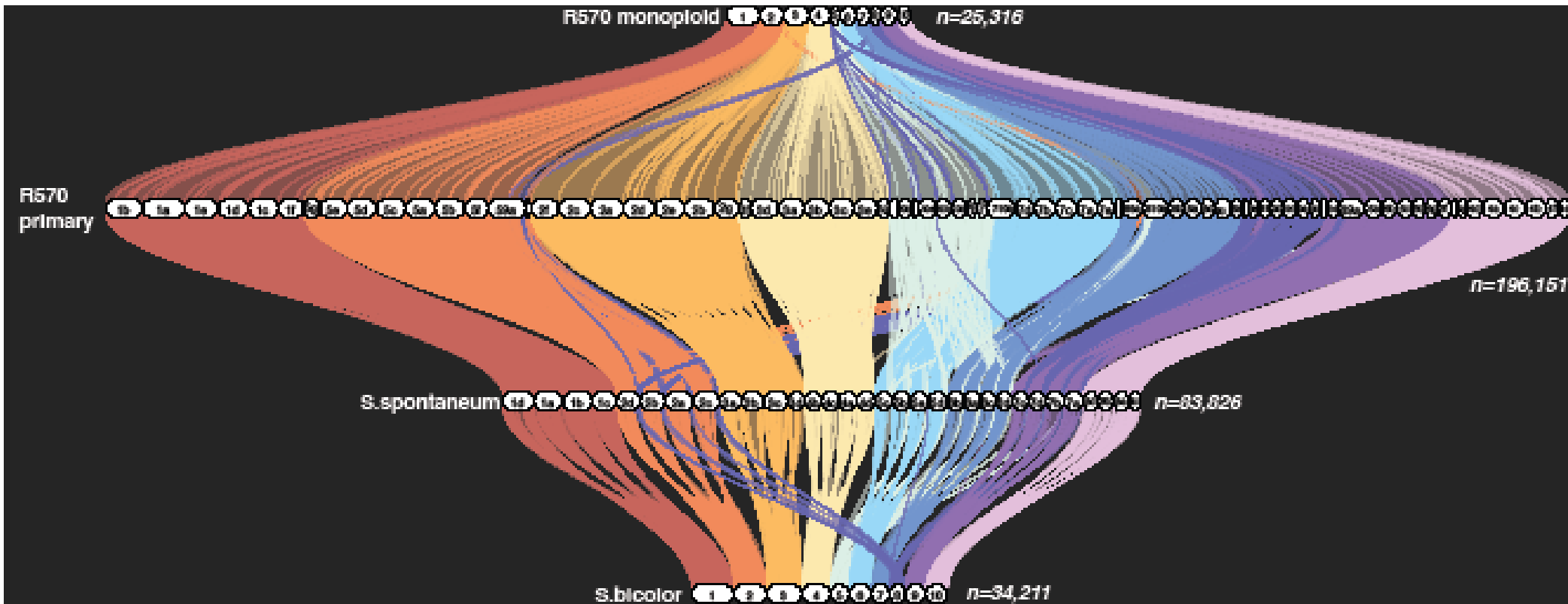


Healey AL, Shepherd M, King GJ, Baten A, Butler J, Freeman JS, Lee DJ, Potts BM, Jenkins J, Shu S, Lovell JT, Sreedasyam A, Silva OB, Grimwood J, Furtado A, Grattapaglia D, Barry KW, Hundley H, Simmons BA, Schmutz J, Vaillancourt RE and Henry RJ (2021) Pests, disease and aridity have shaped the genome of *Corymbia citriodora*. *Communications Biology*

ROBERT HENRY



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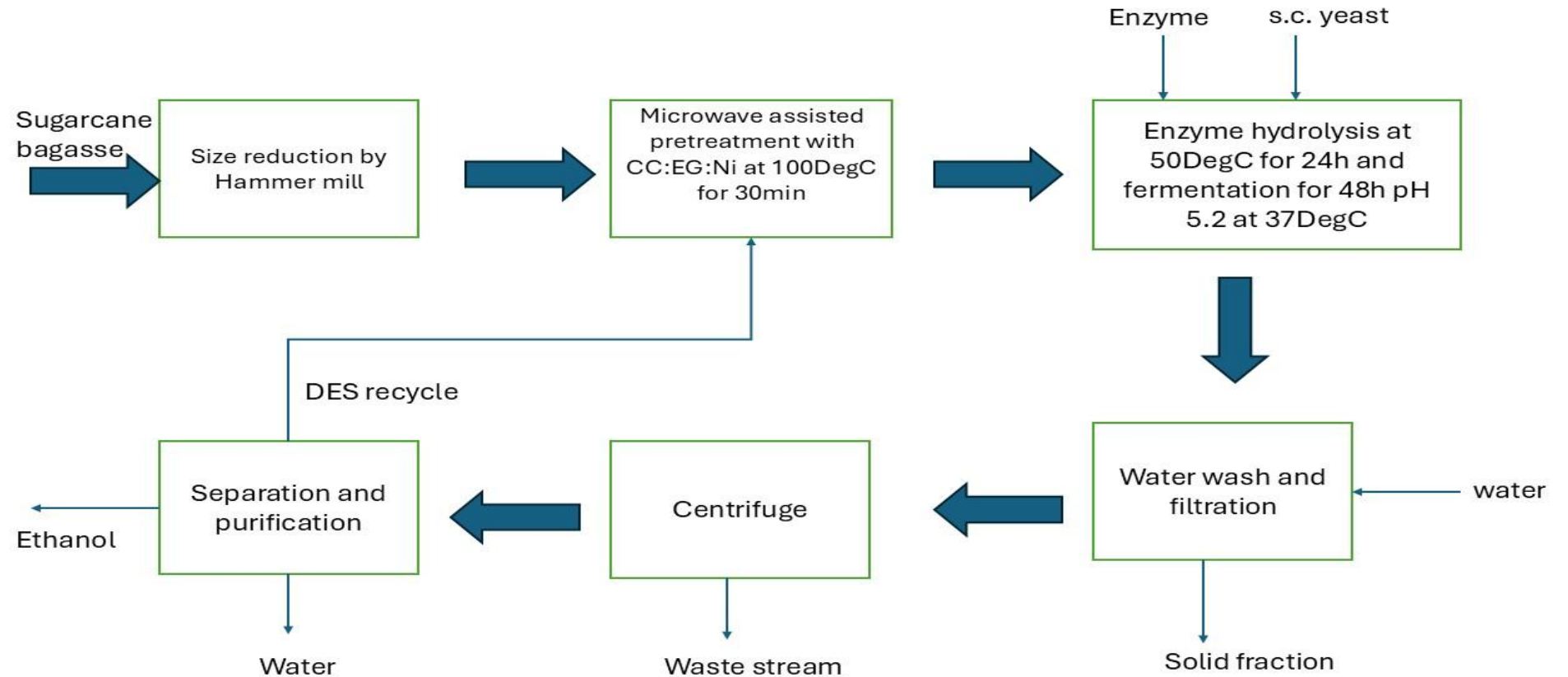


## Sugarcane Genome



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# Sugarcane Bagasse Conversion

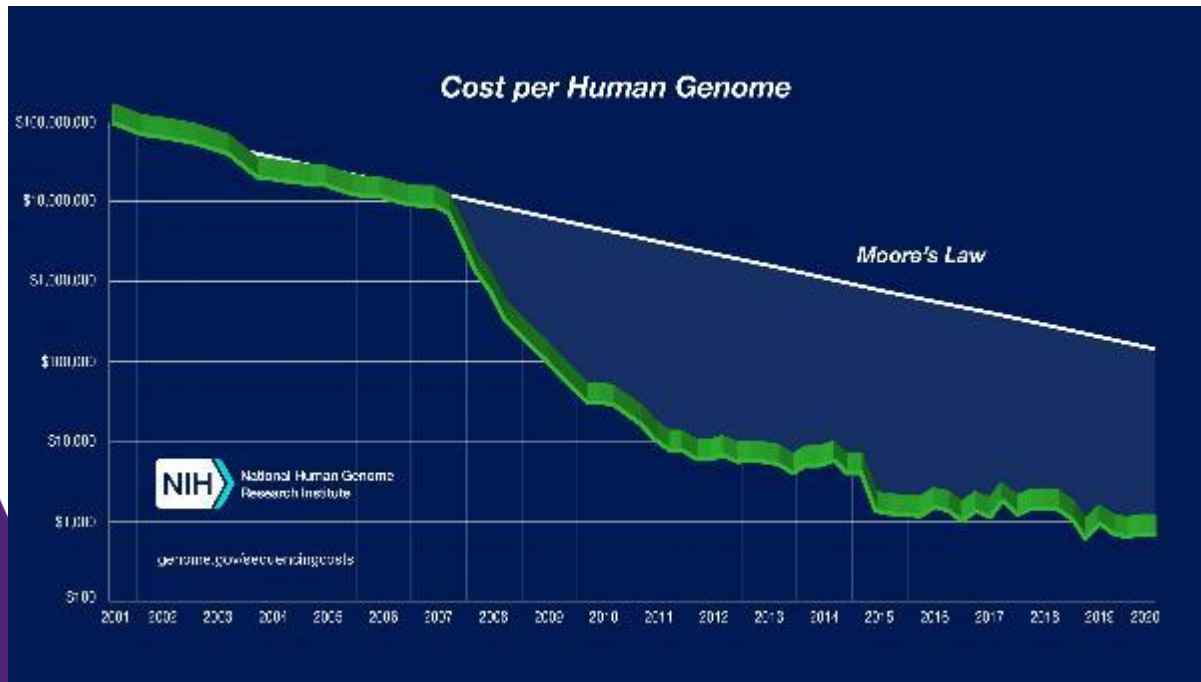


**Economic assessment and life cycle analysis of sugarcane bagasse valorization to bioethanol via one-pot deep eutectic solvent pretreatment**

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**Neethu Joshikumar Kamal Kishore Pant Frederik Botha Robert Henry Chem Eng IIT Delhi**

# Advances in genetic technologies for improvement in biomass composition

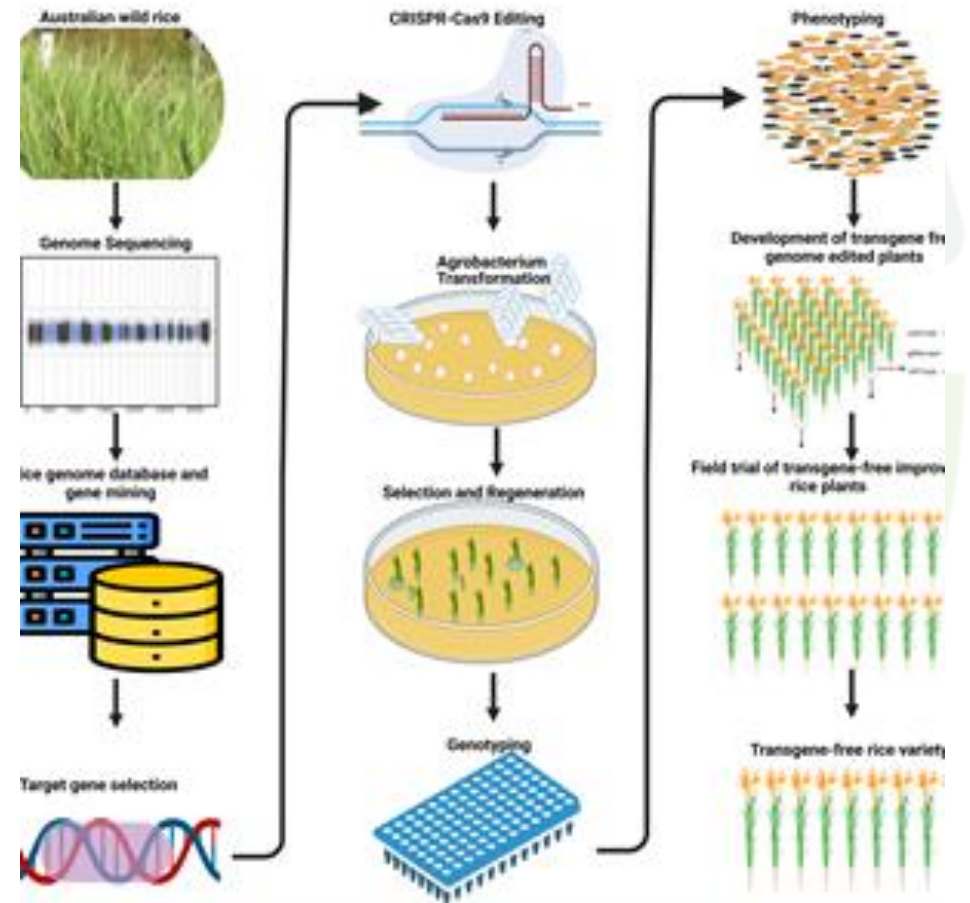


Henry RJ (2022) Applied Biosciences: Application of Biological Science and Technology  
Applied Biosciences



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# Genome Editing



**Mason PJ, Blaakmeer A, Furtado A, Stuart PN, Nomula R, Bjarnholt N, Sørensen M, Koleva Dt, Pedas PR, Knudsen S, Møller BL, Skadhaug B, Henry RJ (2024)  
Harnessing the power of an extensive EMS-Induced Sorghum Population for rapid crop improvement *Physiologia Plantarum***

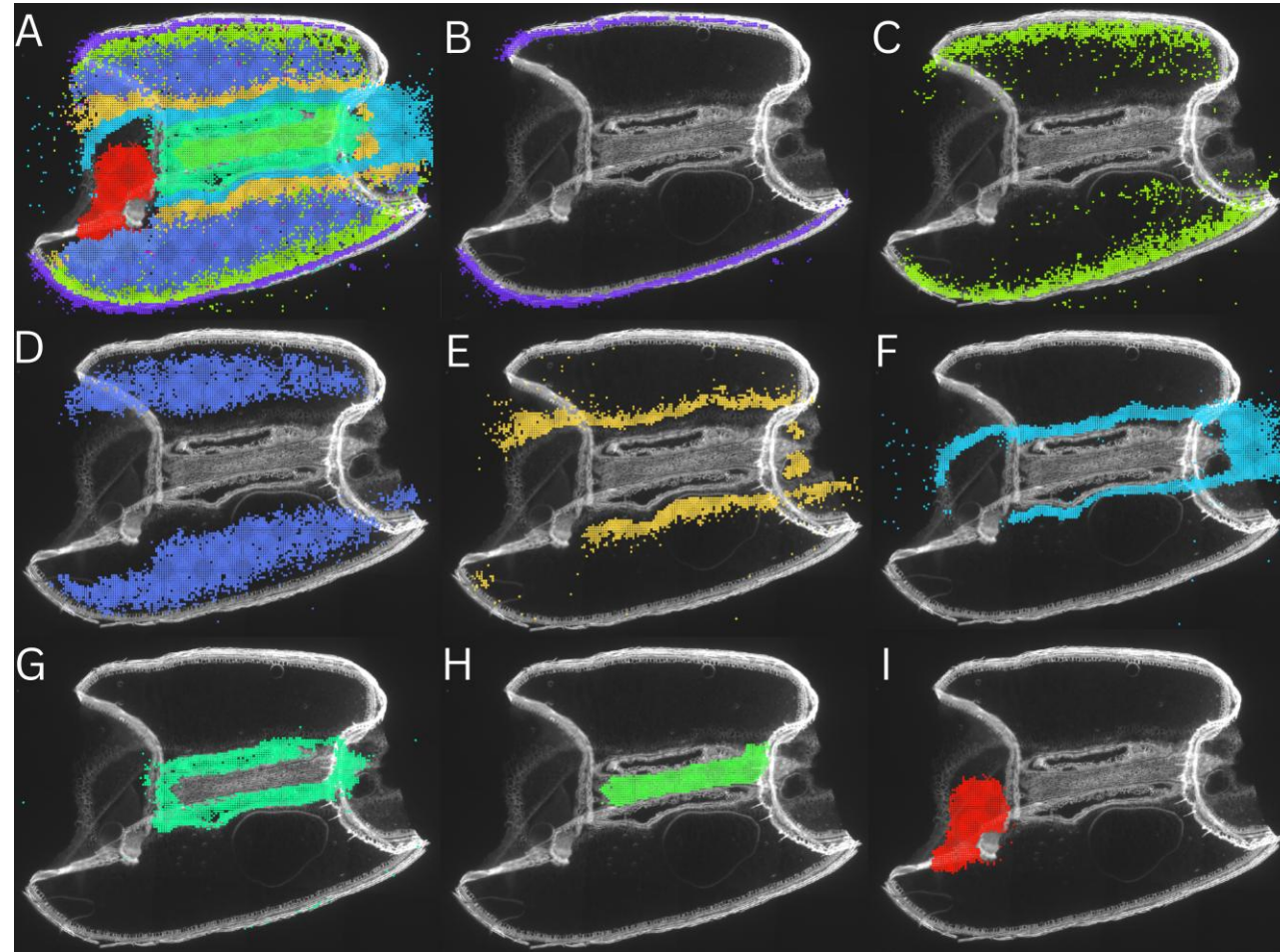


Sorghum  
Mutagenesis



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# Spatial Transcriptomics



Tori Millsted T, Sullivan R, Kainer D, Sun X, Li KL, Mao L, Henry R (2025) Spatial transcriptomics of developing wheat grain reveals cocentric gene expression zones and sub-genome biased expression of key genes *Plant Biotechnology Journal*



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# Products



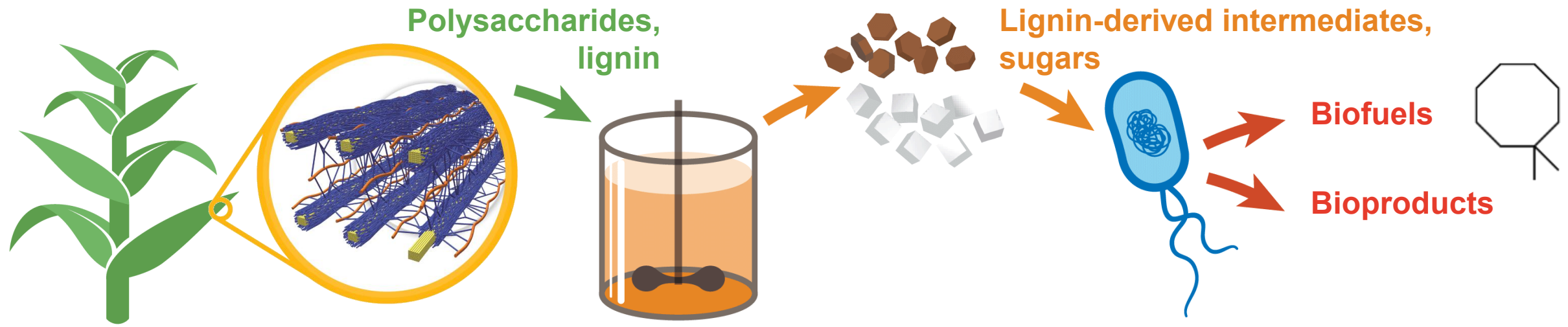
## Biomaterials

Plastics

Fabrics

Building Materials

# Research aims to make use of biomass commercially competitive with fossil fuels



Establish the **scientific knowledge** and **new technologies** to transform the maximum amount of carbon available in bioenergy crops into biofuels and bioproducts.



**Researchers**

# Investigators

Robert Henry	UQ	Biomass genomics and chemistry
Jenney Mortimer	UA	Carbohydrate analysis
Ian Godwin	UQ	Gene editing in sorghum
Gary Schenk	UQ	Enzyme engineering
Karen Massel	UQ	Gene editing
Frikkie Botha	UQ	Sugarcane biochemistry
David Jordan	UQ	Sorghum genetics
Emma Mace	UQ/DAF	Sorghum genomics
Karen Aitken	UQ	Sugarcane research
Karine Chenu	UQ	Crop physiology

Blake Simmons	Joint Bioenergy Institute/UQ	Conversion technology
Natalie Piperidis	Sugar Research Australia	Sugarcane genetics
Birger Moller	University of Copenhagen	Cell wall chemistry
Brigitte Skadhauge	Carlsberg	Sorghum mutagenesis
Soren Knudsen	Carlsberg	Mutant screening
Promod Kumbhar	Praj Industries	Biomass processing
Peter Flanders	Mackay Sugar	Sugarcane production
Jonathon Curry	Qantas	Jet fuel end user analysis
Ben Verco	GenTech	Sorghum germplasm
Hanne Nielsen	Novonesis	Enzyme technology
Neil Gardner	Jet Zero	Fuel processing
Bicheng Yang	MGI Australia	Spatial biotechnology
Paul Gooding	Millenium Science	Genome technology
James Miller	PacBio	DNA analysis technology

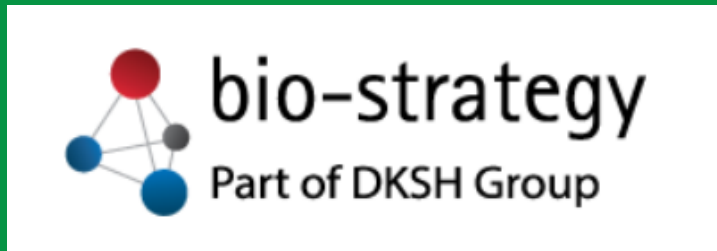


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# Partners



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Australia



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