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# No Compromise® Diesel Fuel – a future for the California market

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# Amyris Biotechnologies Inc. The Renewable Carbon Company<sup>TM</sup>



- Completed \$20+MM Gates Foundation grant platform for isoprenoid production leading to significant lives saved due to scalable supply of less expensive anti-malaria drug
- Pioneering yeast technology enabling the production of more than 50,000 hydrocarbon molecules
  - New strain of yeast turns sugar into hydrocarbons instead of ethanol
  - Feedstock agnostic
- Product portfolio diesel, jet fuel and widerange of chemicals
- Marketing and distribution channels to deliver products in the United States and other global markets



Micrograph of Amyris yeast producing diesel – August, 2008

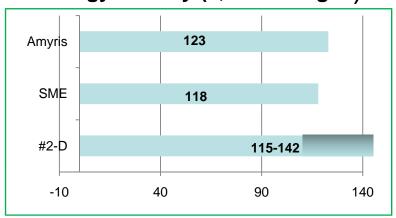
# Amyris Renewable Diesel Fuel A better renewable diesel fuel by design



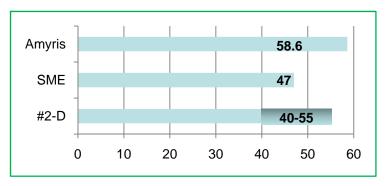
Cloud Point (°C)



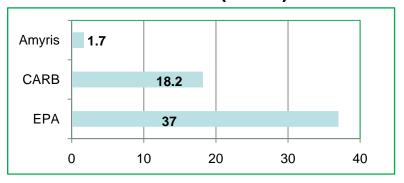
Energy Density (1,000 BTU/gal.)



**Cetane Number** 



**Aromatics (%vol.)** 



Diesel fuel registered with the EPA at a 20% blend

# Amyris Renewable Diesel Fuel Next generation No Compromise® Diesel Fuel



- Fully compliant with ASTM D975 compliant
- Fully compatible with existing distribution, storage and engine technologies
- Third-party demonstrated lower NOx, HC, CO and particulate matter exhaust emissions
- 100% reduction in life-cycle emissions (gCO<sub>2</sub>e/MJ) verses petroleum ULSD\*
- Preliminary road validation with light-duty and mediumduty vehicles
- Technology capable of utilizing future California energy feedstocks (e.g. sweet sorghum and sugarcane) and taking advantage of in-state cellulosic biomass (e.g. rice straw) when volumes become available



**Amyris Diesel** 



**Tolling production - April 2009** 

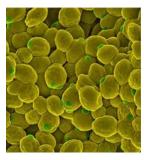
<sup>\*</sup> Life cycle analyses prepared by Life Cycle Associates, LLC, based on data provided by Amyris and using GREET default inputs where appropriate.

# **Amyris GMM Safety**



## Genetically Modified Microorganism (GMM) key features:

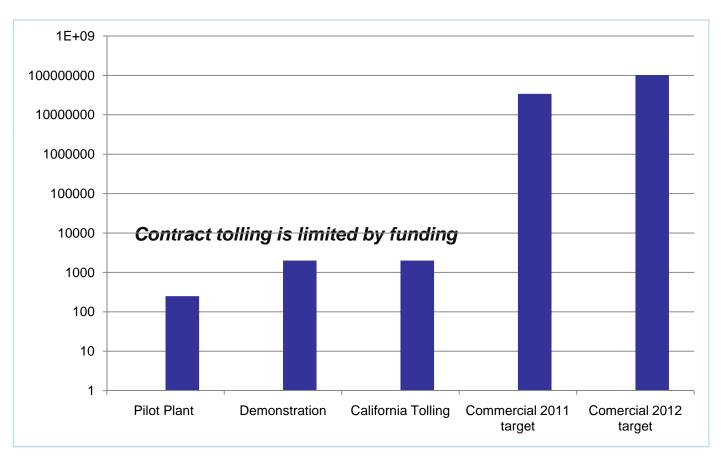
- As the host microbe is common yeast, it is Generally Recognized As Safe (GRAS) by the US EPA for beer, wine, bread-making, animal feed, etc...
- Other genetically modified yeast is similarly used in commercial applications for human use including insulin (diabetes) and vaccine (Hepatitis B) production, as well as industrial chemical (lactic acid) production
- Contains non-toxic, non-allergenic genes introduced in a highly stable manner
- Is safe for human-handling, based on third-party risk assessment, literature research and animal testing of organism and product
- Live GMM will not be released into the environment, compliant with EPA guidelines



Amyris genetically engineered yeast



#### **Gallons Per Year**





Amyris pilot scale fermentor



Amyris demo-scale fermentor

### California Production & Distribution Critical Market Issues



#### **Government Policy:**

- Stream-lined process for LCFS pathway certification
- Efficient bio-refinery plant construction permitting
- Availability of loan guarantees for in-state bio-refinery construction

#### Infrastructure:

- Access to California port terminals
- Access to distribution storage facilities

#### **Biomass Feedstock**

- Bio-refinery must be located near available sugarcane feedstock
- Availability of in-state feedstocks (e.g. sweet sorghum)

#### **Commercial Production:**

- Cost-effective hydrogen sourcing
- Production scaling R&D
  - microbe survival in industrial environments
  - improved yield rates at production scales
  - feed rate optimization
  - greater efficiencies in liquid: liquid separation
  - hydrogenation process requirements
  - process cost controls
  - non-destructive materials compatibility testing

#### **OEM Engine/Vehicle Warranty Acceptance:**

Robust on-highway demonstration

# Requested CEC Funding: 2010-2011 Investment Plan Cycle program



### Grant funding for production scaling R&D and demonstration program

Renewable Diesel Contract Production \$2,891,000

Diagnostics & Measurements \$100,000

Administration & Project Management (Amyris)

Total: \$2,991,000

Project expenditures will be fully expensed with in-state fermentors, scientific analysis, diagnostics and chemical processing.

Renewable diesel production for 20% blend rate results with fuel quantity supporting a 12 month medium to heavy duty vehicle demonstrations



California fermentation facility