



# Turning the **promise** of synthetic biology into **commercial reality** for health and energy

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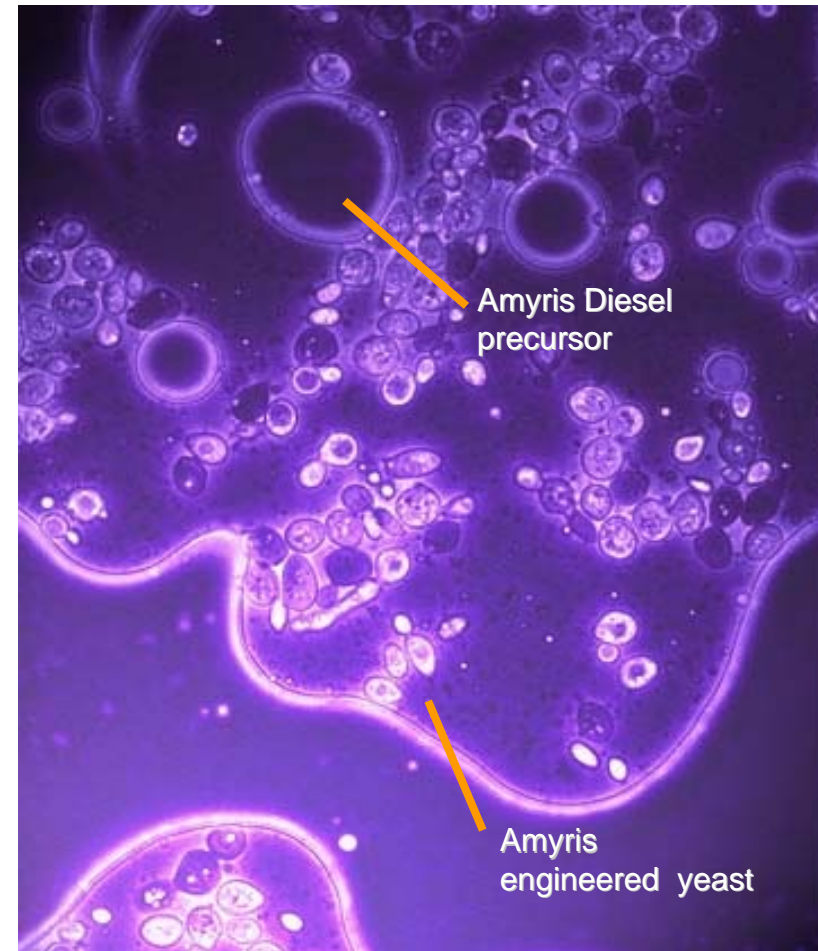
# Amyris Biotechnologies Inc.

## Leading the “next generation” of renewable products



- ▶ Started in 2004 by four postdocs from UC Berkeley Professor Jay Keasling 's lab
- ▶ Initially funded in 2005 by a grant from the Gates Foundation to develop a lower cost, consistent supply of artemisinin
- ▶ Venture funded by leading investors; over \$160MM in grants and equity financing
- ▶ Pioneering yeast technology enabling production of more than 50,000 hydrocarbon molecules
- ▶ Product portfolio - anti-malarial drug, diesel, jet fuel and a wide-range of chemicals
- ▶ Issued US patents covering diesel, jet, and lubricant products
- ▶ Marketing and distribution channels to deliver products in the United States and other global markets

Micrograph of fermentation fluids from production of Amyris Diesel (April, 2008)



## Traditional oil source



Oil

+



Refinery

=

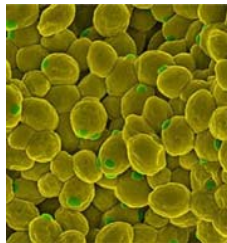
**Petroleum products**

## Amyris renewable pathway



Sugar cane

+



Amyris genetically engineered yeast

+



Cane mill

=

**> 50,000  
isoprenoid  
compounds**

## Bio-derived products

**diesel**

*2020 estimate 450 billion gallons*

**jet fuel**

*2020 estimate 124 billion gallons*

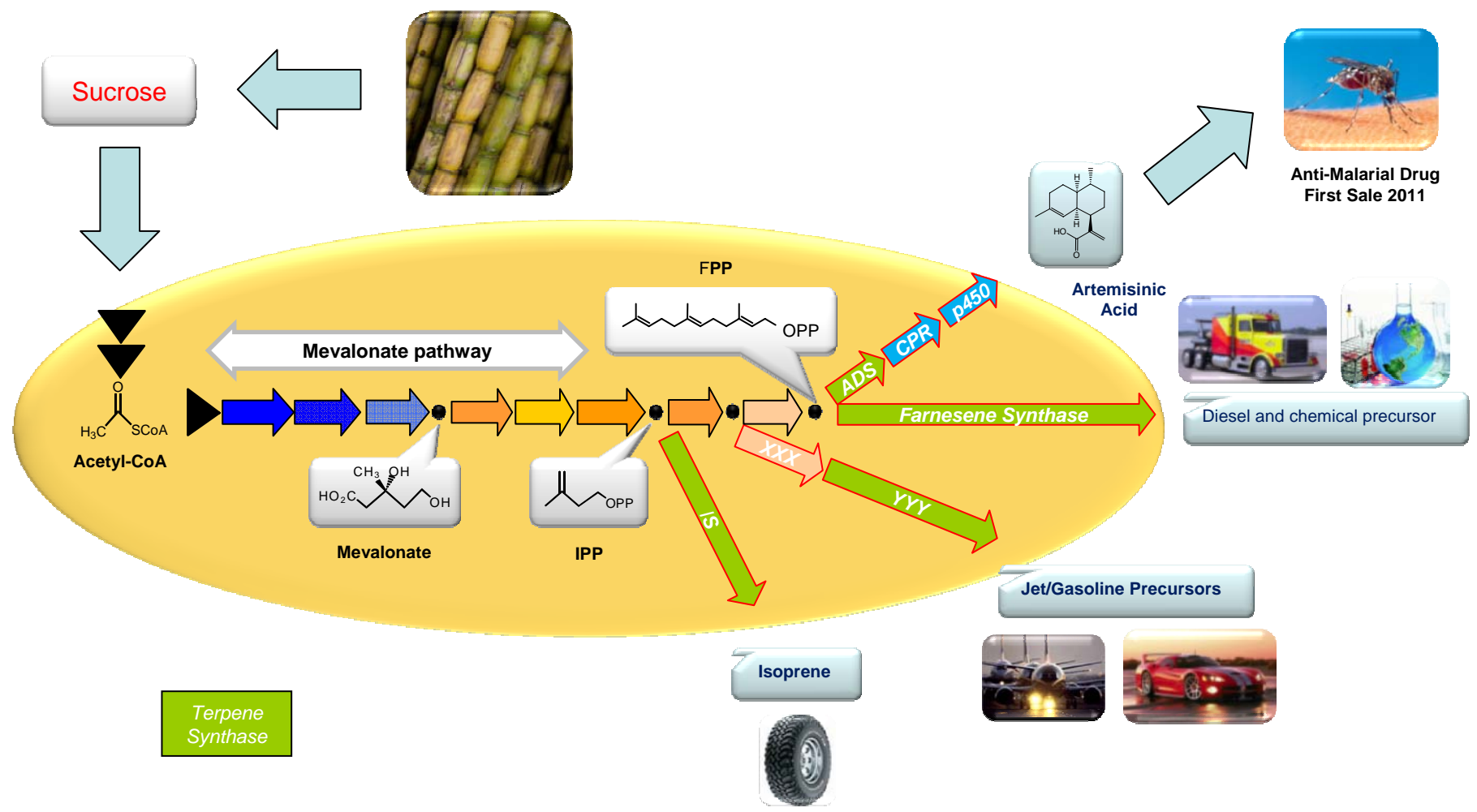
**specialty chemicals:  
synthetic rubbers,  
lubricants, etc.**

**malaria drug**

*non-profit: treat over 200 million  
people annually*

- Markets growing faster than GDP
- Chemicals price point not directly correlated to price of crude oil
- Structurally advantaged, low-cost producer

# A platform technology for production of multiple products



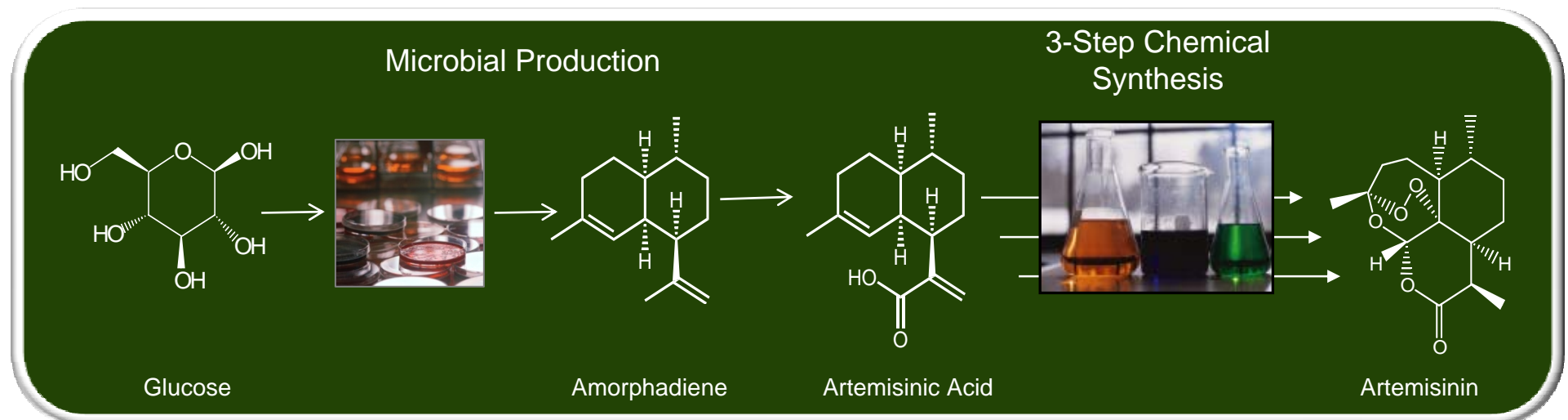
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# Artemisinin Project

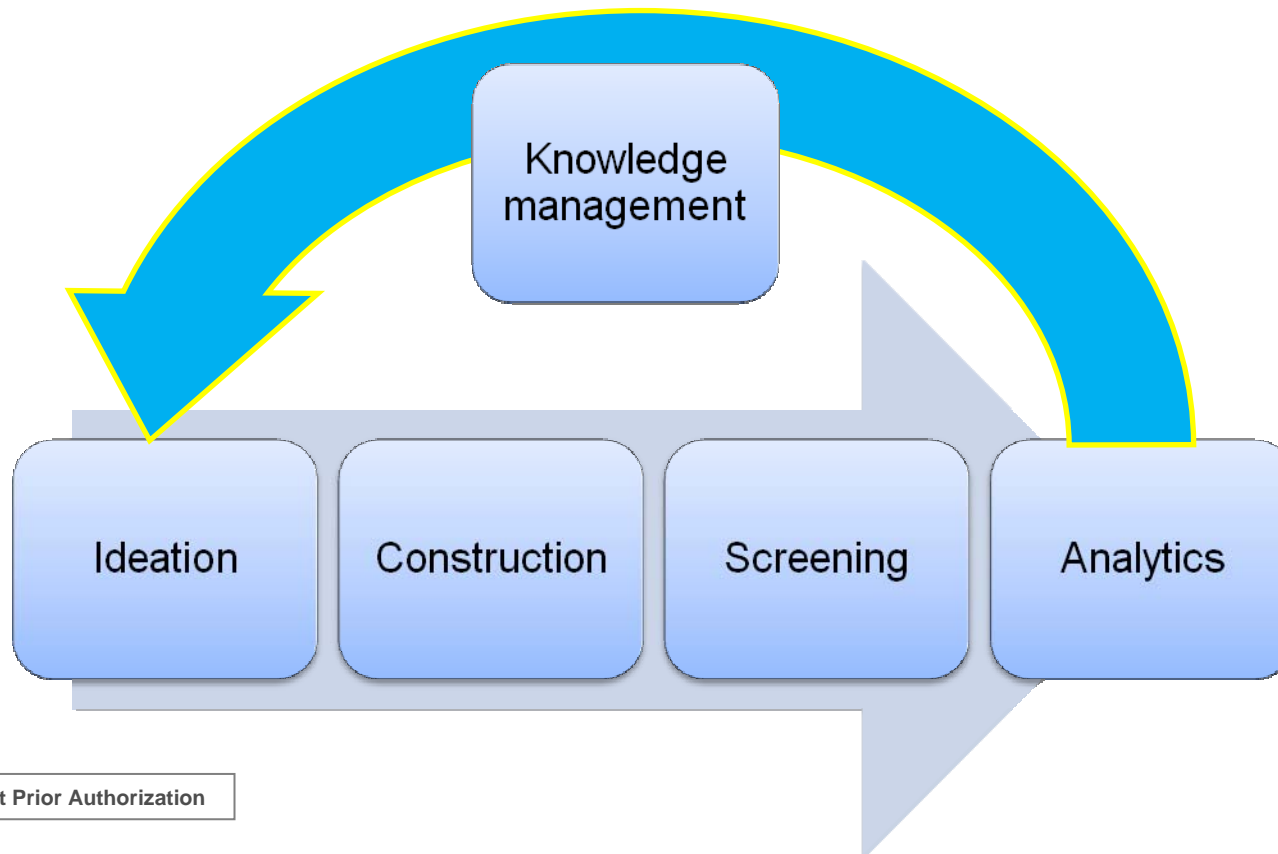
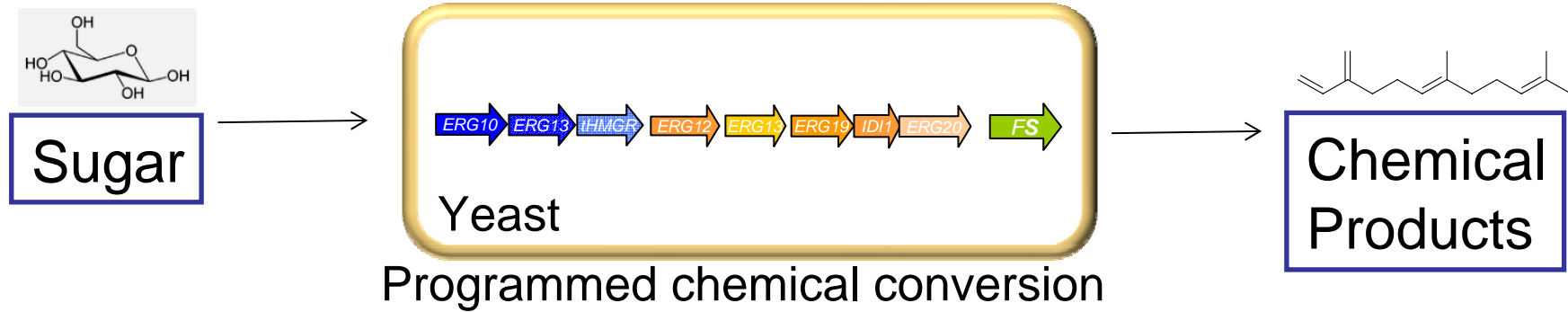


April, 2008 - Announced partnership with sanofi-aventis for microbial artemisinin

- Nonprofit project
- Lives saved due to scalable supply of inexpensive drug
- \$20+MM to develop a platform for isoprenoid production



# Amyris process for microbe development Engineering cycle to increase performance



# The heart of synthetic biology is standardization

- **Tool Standardization**

Consistent, simple and reliable enzyme and/or chemical treatments for the genetic manipulation of organisms



- **Parts Standardization**

Genetic elements that can be easily interchanged using the same or similar tools



- **Process Standardization**

Consistent, simple and reliable methods for the insertion and deletion of genetic elements

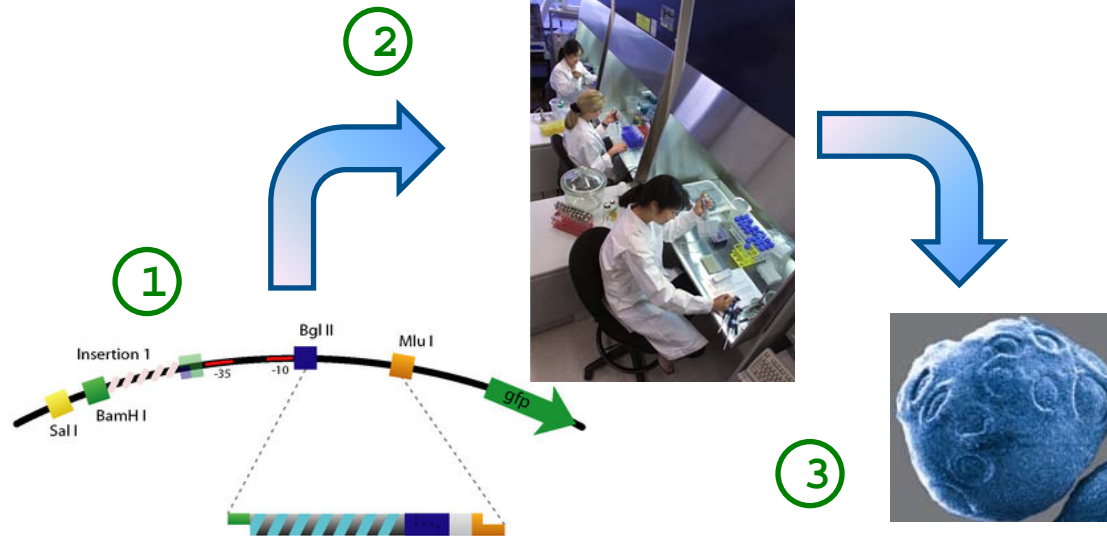


# Standardization & Automation of Strain Engineering

Rapid, reliable microbial engineering



## Standard practice



## Traditional construction

- ① Labor intensive planning
- ② Hand crafted construction
- ③ Relatively slow, expensive, error-prone
- ④ 4 week cycle, 40 strains per cycle with 4 FTEs

## Automated Strain construction

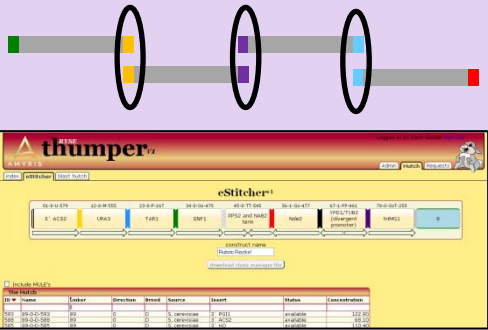


## Automated construction


- ① Computer assisted design
- ② Robotics platform for unit operations
- ③ Fast, inexpensive, reliable
- ④ 6 week cycle, 5000 strains per cycle with 4 FTEs




# Automated strain engineering is a reality at Amyris



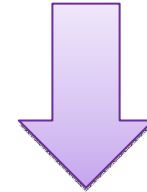
Computer aided design (CAD) & RYSE



Automated rational strain engineering



HTP Screening



Production in Brazil

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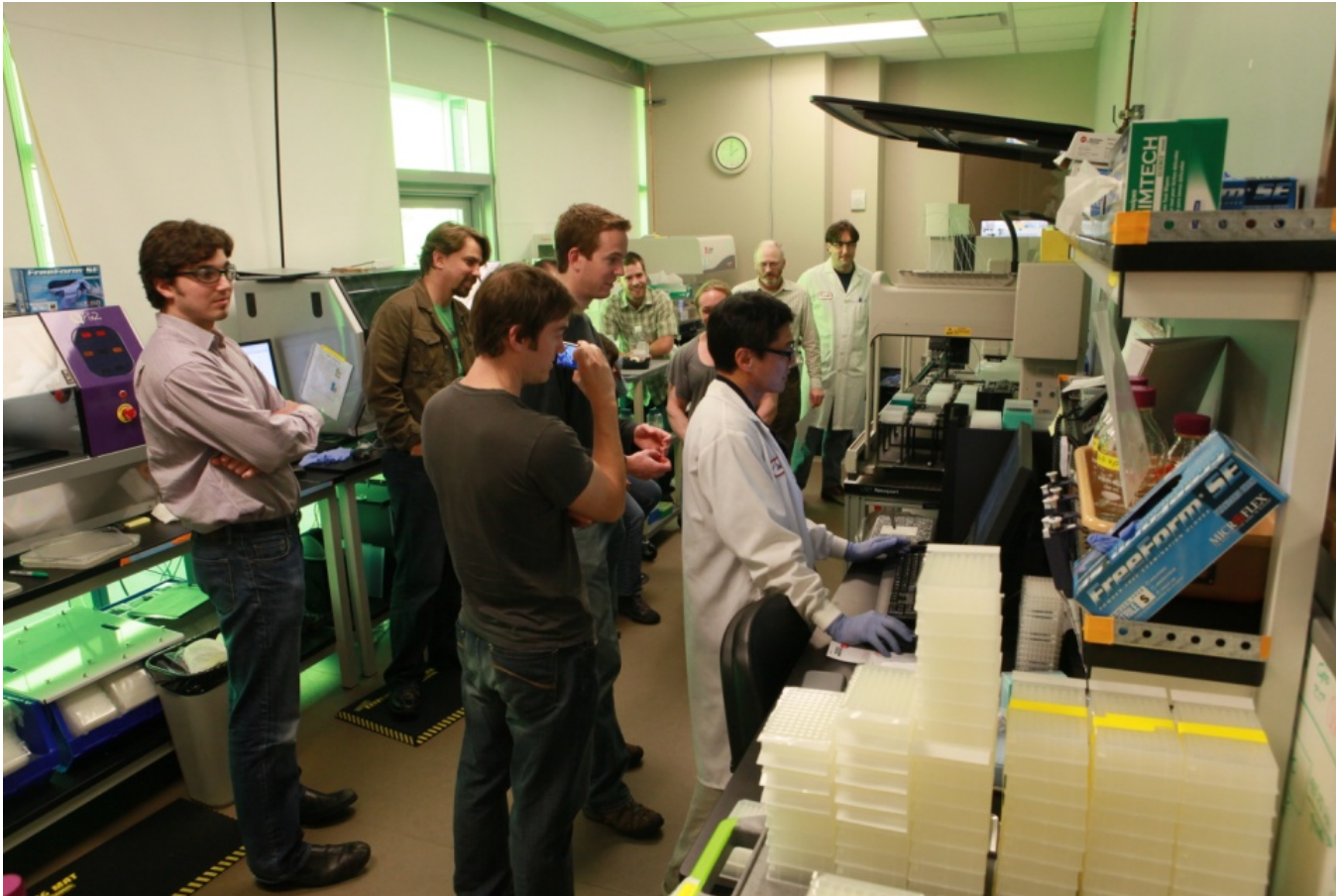


300 liter fermentation



2 liter fermentation

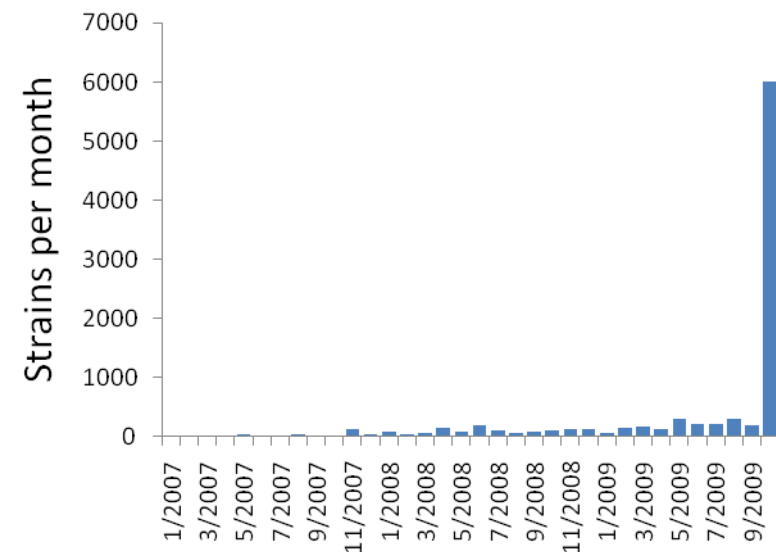
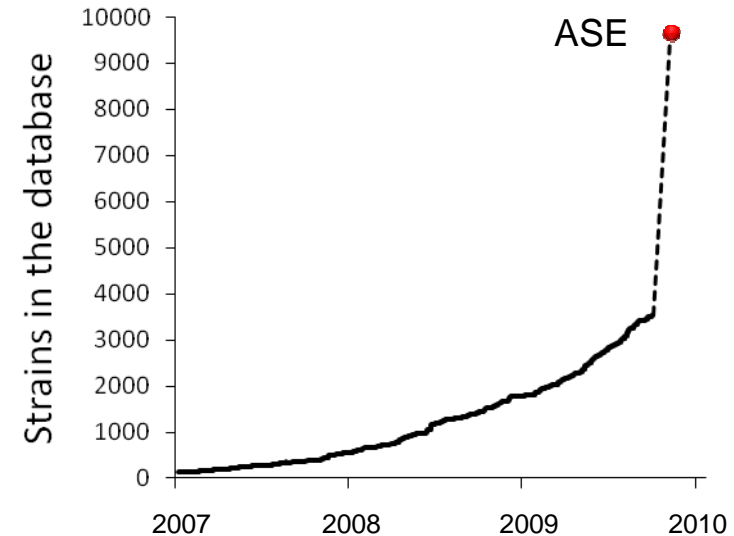
# The first run of ASE



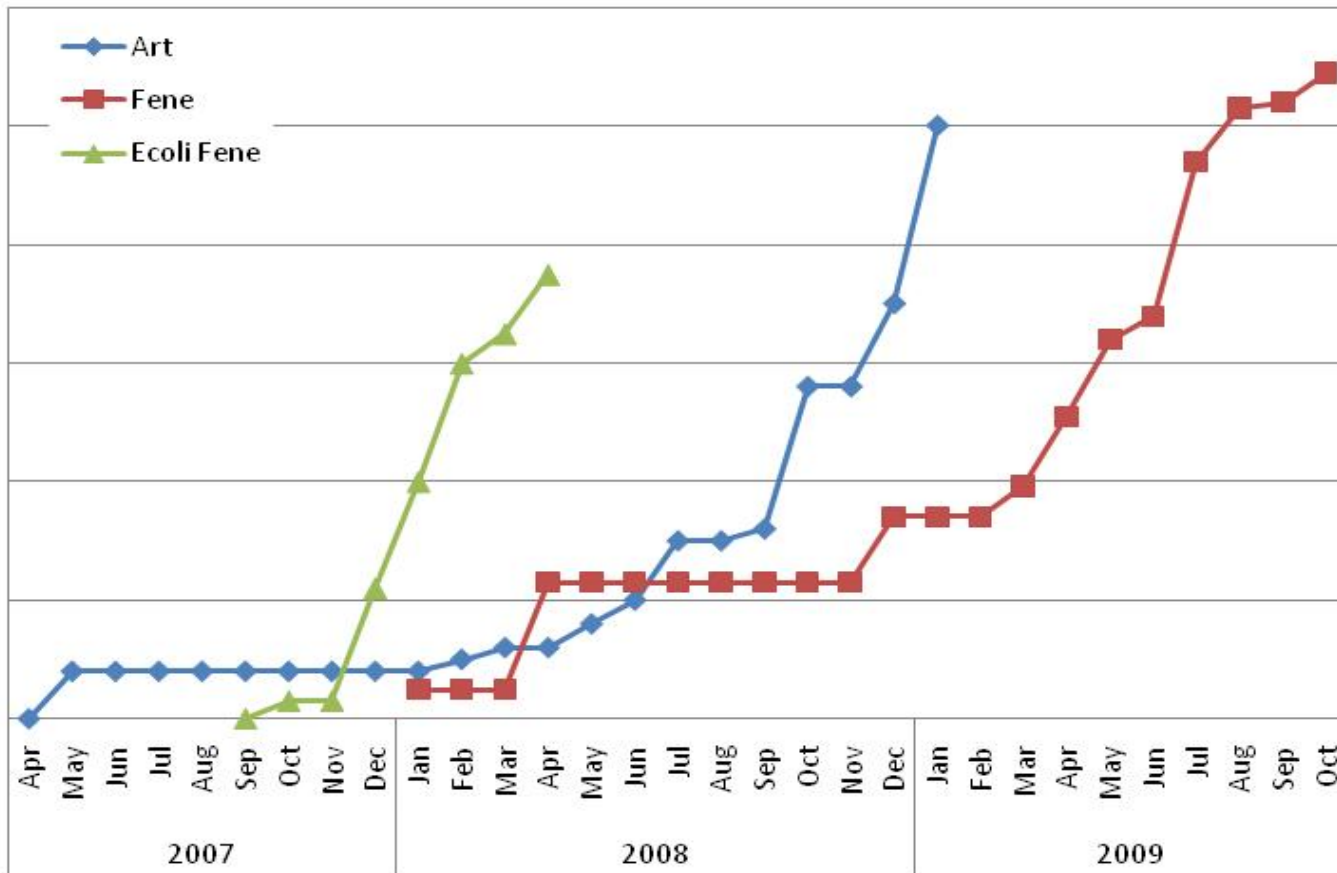
# WHY? Automated strain engineering standardizes parts, reduces failure rates, decreases costs, increases strains tested.



- Traditional strain engineering
  - 250 strains/month
  - 10 strain/biologist/month
  - \$2,400/strain
  - First attempt success rate: 70%
- Automated strain engineering
  - 5000 strains/month with 4 FTE's
  - 1000 strains/biologist/month
  - \$60/strain
  - First attempt success rate: 90%



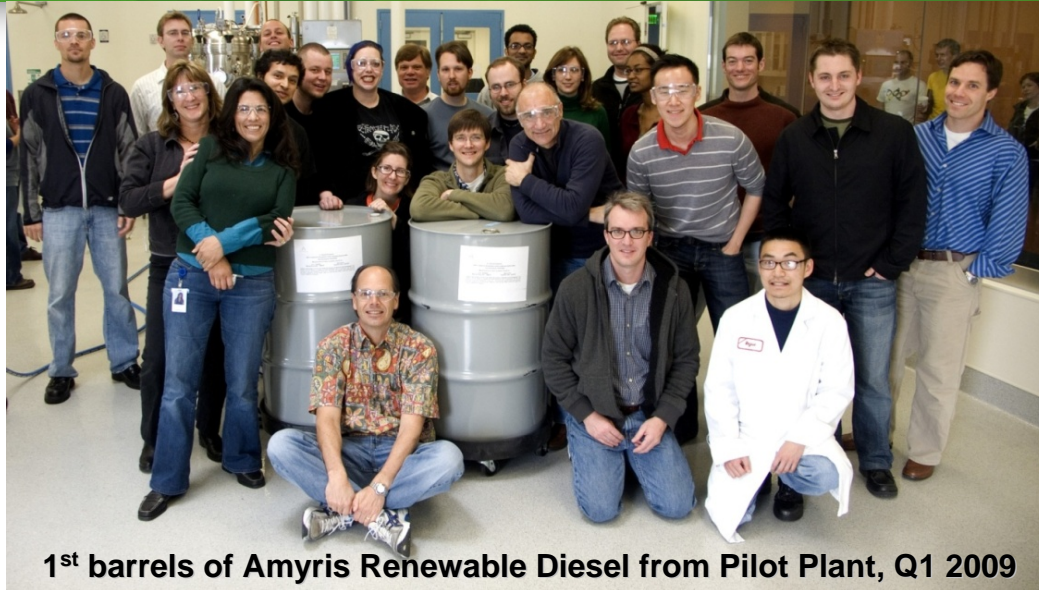
# The payoff: Better strains faster



# Fermentation derived hydrocarbons = lower processing costs



# Production at scale: lab to pilot to commercial



**1<sup>st</sup> barrels of Amyris Renewable Diesel from Pilot Plant, Q1 2009**



**Production at 60,000 L scale, Q2 2009**



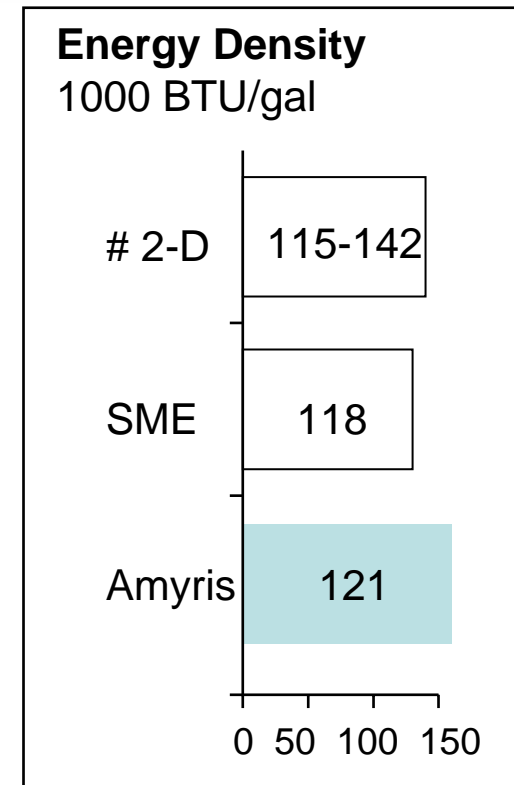
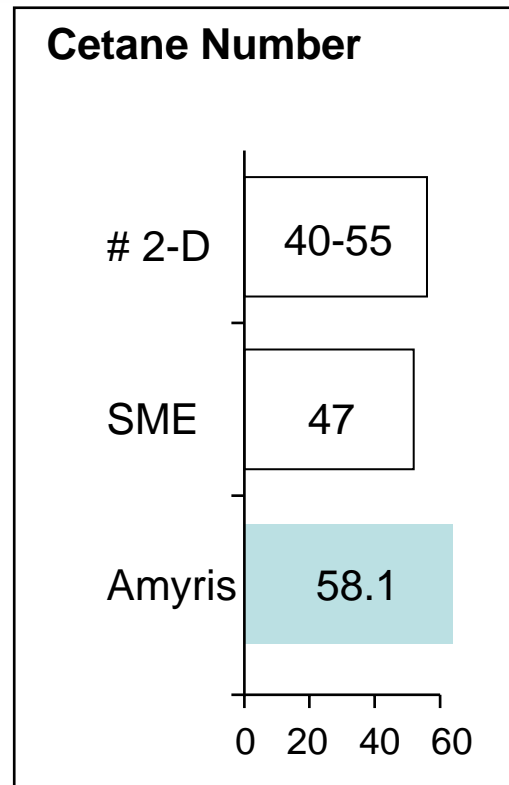
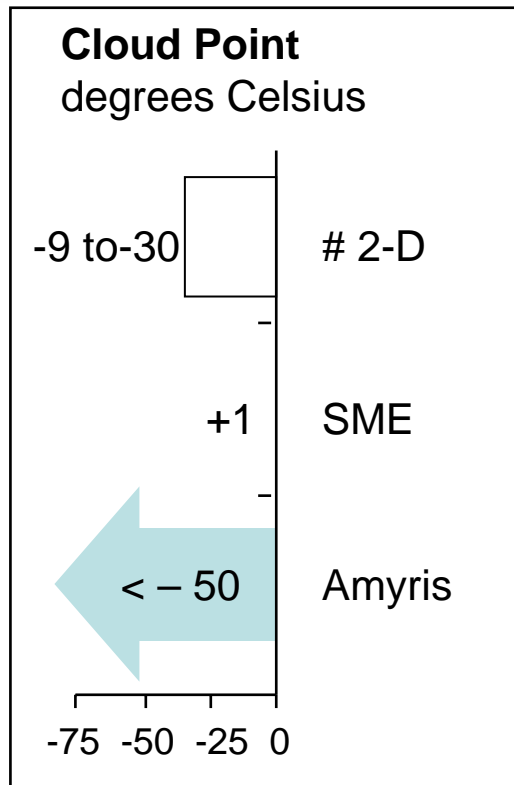
**Demo Plant Fermenter, Campinas Brazil Q2 2009**



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# Products – Renewable Fuels and Chemicals

## Diesel fuel registered with the EPA at a 20% blend



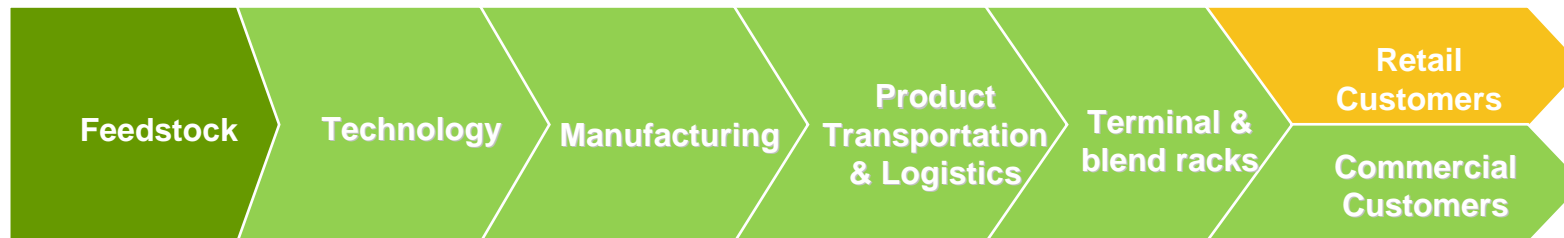
Additional benefits of Amyris renewable diesel compared to #2-Diesel

- 90%+ lower greenhouse gas emissions
- No sulfur
- produces lower NOx and particulate emissions

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Note: Amyris diesel will be used in blends with conventional fuels; values shown for Amyris diesel is for our biomass derived blending component; SME = Soy Methyl Esters

## Amyris will participate in various aspects along the biofuels value chain



*Amyris GreenLane™*

Partner with large scale manufacturer with access to low cost feedstocks

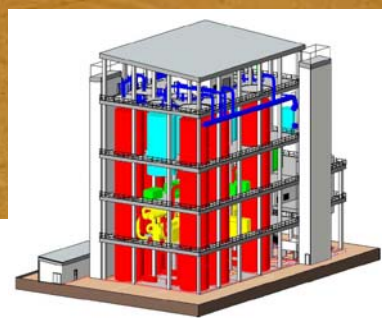
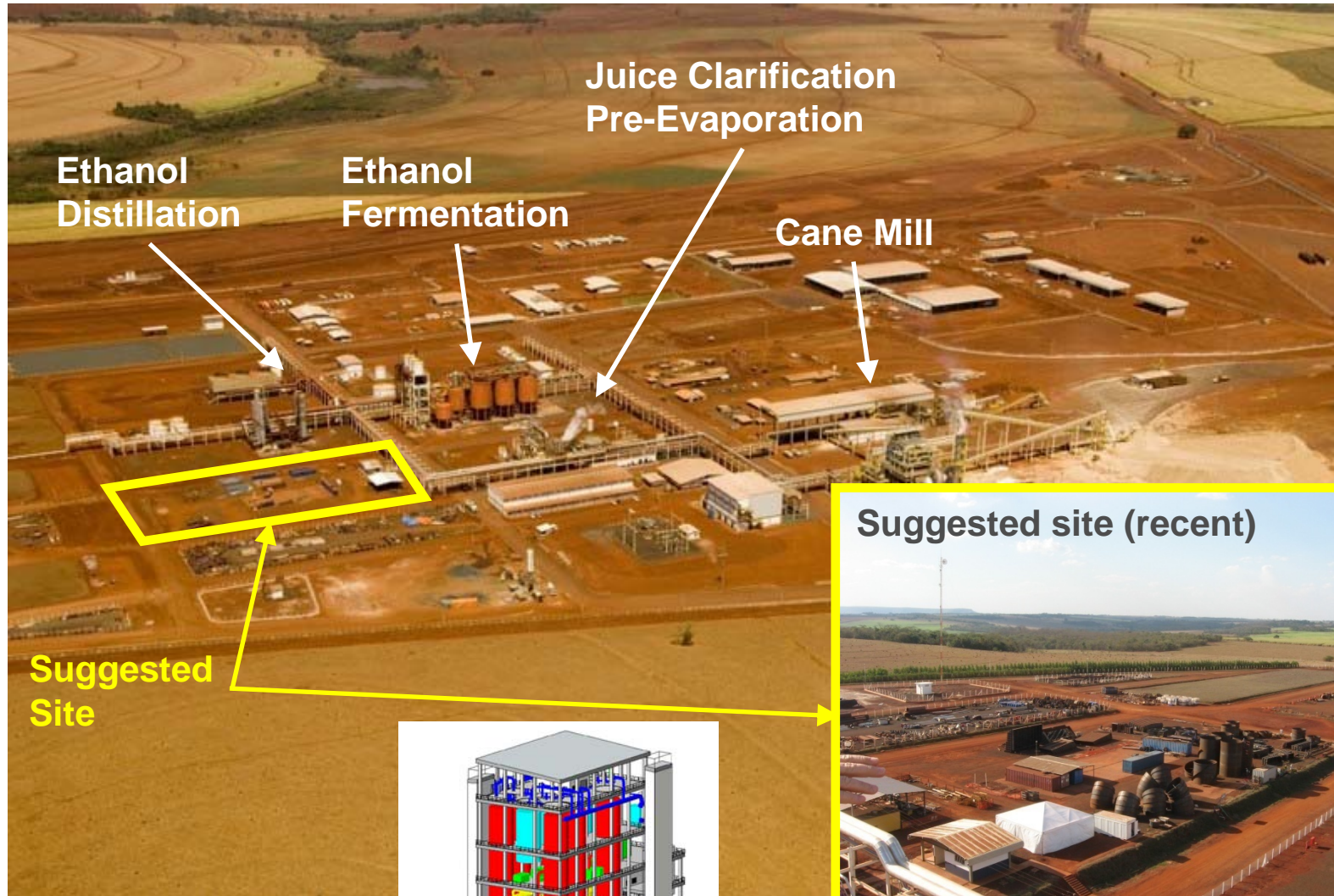
Build production platform from distressed assets

- Take product from plant gate to wholesaler
- Logistics contracts to facilitate high volume distribution

- Sell to fastest growing retail segment
  - Access to end customers (commercial accounts)



# Critical path to 2011 – commercial plant in Brazil



# Plan to commercial production – timeline



**2009**



**R&D center inaugurated in 2008 in Campinas**

**Q2: Pilot plant operational; Demo Facility opened**

**Q4: Acquire EtOH Mills**

- Ongoing operations provide immediate revenue and cash flow

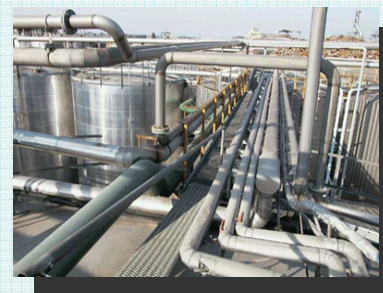
**2010**



**Begin mill conversion to produce Amyris renewable products**

- Engineering of commercial plant has been finalized and EPCM has been engaged

**2011**



**First large scale production of Amyris renewable products**

**Continue mill conversion and expansion**

**2012**



**First commercial production by third party mills under “capital light” strategy**

# Take-home messages



- Standardization of parts, tools and processes has facilitated automated strain engineering
- ASE is game changing for the development of renewables
- Amyris is on track for 2011 commercial production of diesel and chemical products



Thanks for listening



## Disclaimer



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