



CALYSTA



Methane and Methanotrophic  
Bacteria as a Biotechnological  
Platform

Lori Giver, VP Biological Engineering,  
June 24, 2015

# Calysta overview



- Founded in May, 2011; Acquired BioProtein A/S in 2014.
- Core IP and expertise in gas fermentation, bioengineering, and product development.

**CALYSTA**

# Our Mission

**Building a highly profitable company  
producing food, chemicals, and fuels from  
methane:**

**a sustainable, abundant resource that does not  
compete with the human food chain**



# Sustainable Methane



- Methane can be captured from anaerobic digestion of many waste streams
  - Municipal Wastewater
  - Landfills
  - Agricultural Activities
  - Manufacturing Activities
- EPA Renewable Fuel Standard now recognizes biogas as a cellulosic and advanced fuel pathway
- Minimal impacts on land and water usage

# Biogas is Cellulosic Carbon



Office of Transportation and Air Quality  
EPA-420-F-14-045  
July 2014

## New Pathways

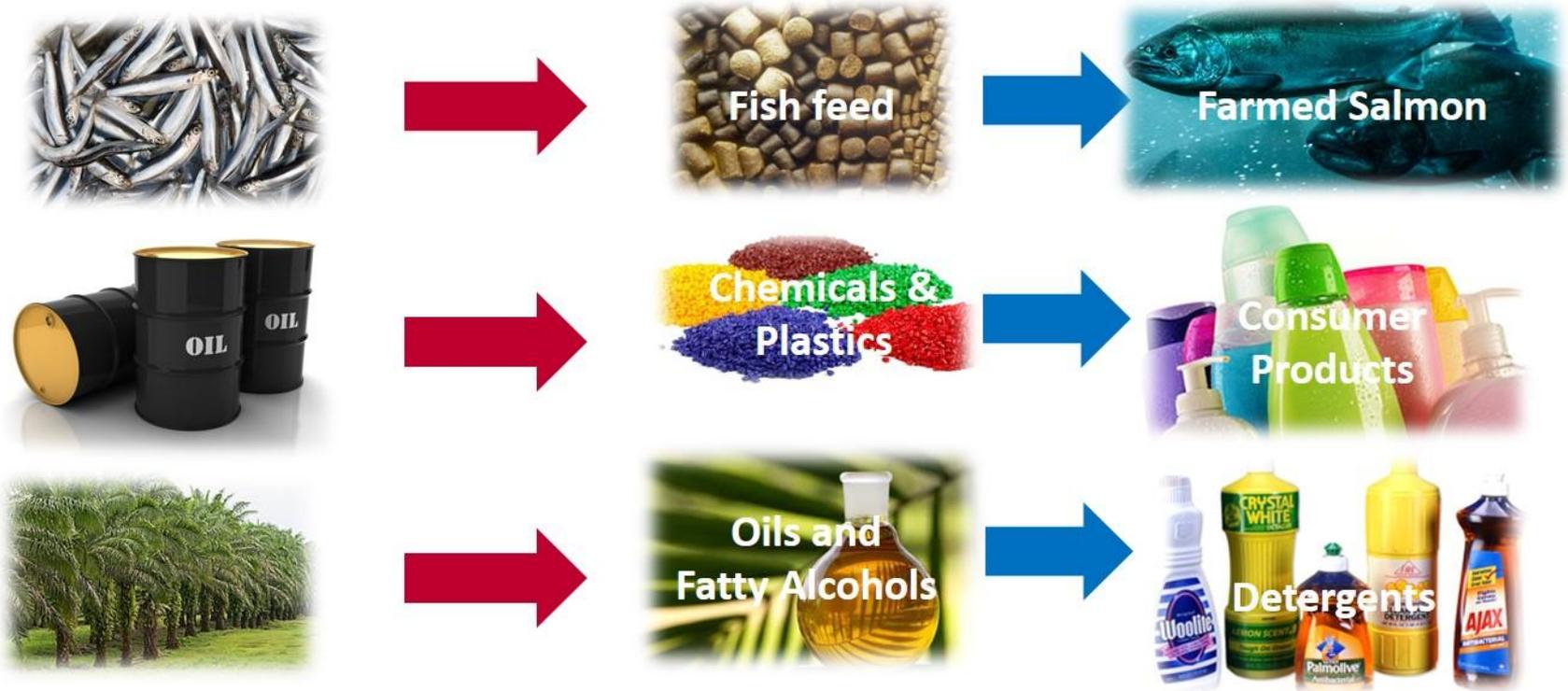
This action qualifies the following as cellulosic and advanced fuel pathways under the Renewable Fuels Standards (RFS):

- Compressed natural gas produced from biogas from landfills, municipal wastewater treatment facility digesters, agricultural digesters, and separated MSW digesters
- Liquefied natural gas produced from biogas from landfills, municipal wastewater treatment facility digesters, agricultural digesters, and separated MSW digesters

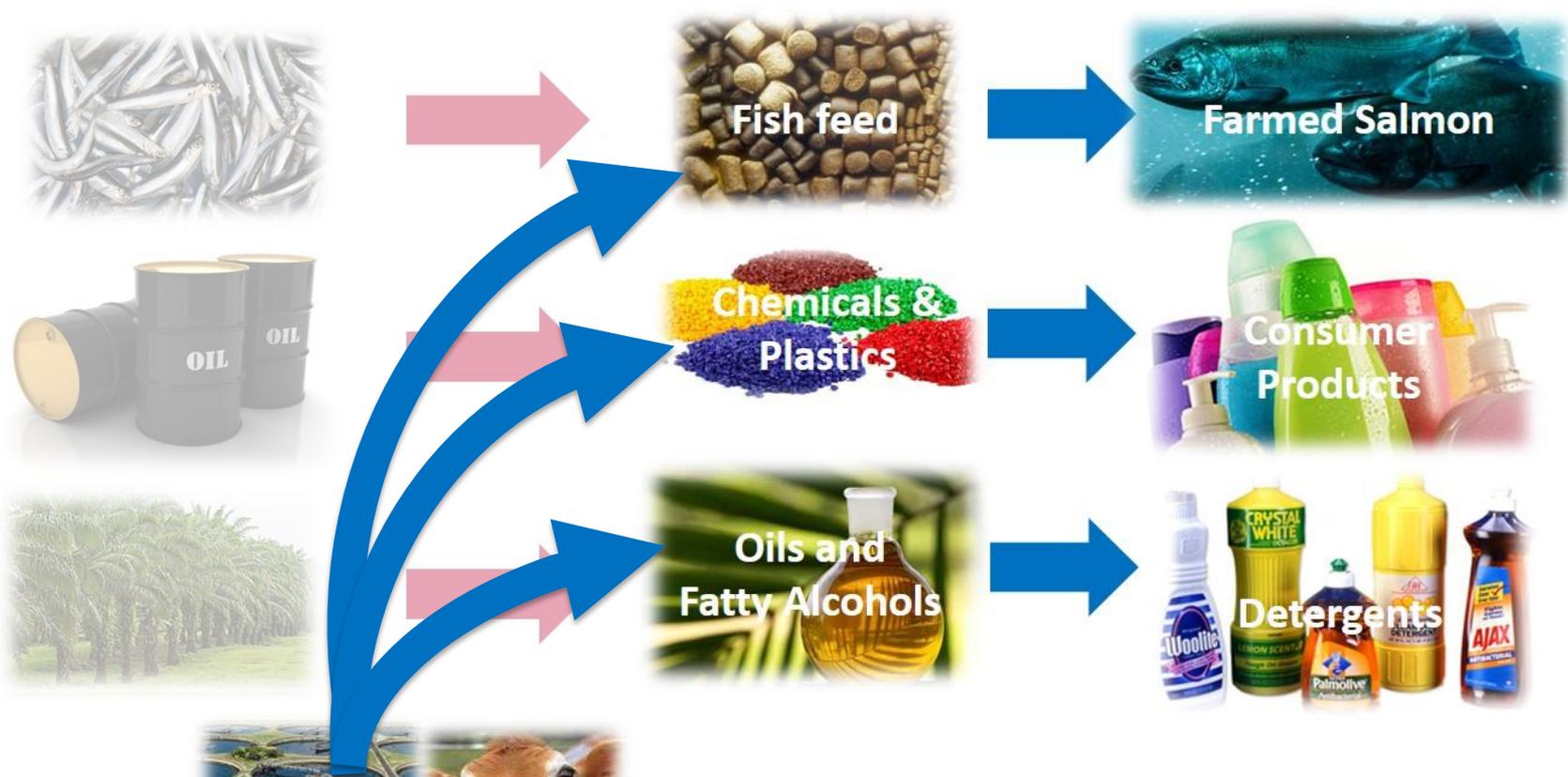
***...coupled with aggressive new rules on allowable methane emissions from landfill and other municipal sources***

**CALYSTA**

# Unsustainable Sources for Existing Products



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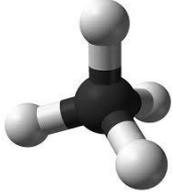


*Calysta can replace the supply chain for a wide range of consumer products using sustainable methane sources*

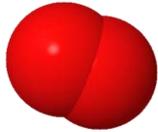
**CALYSTA**

# Platform Tech Supports Multiple Products

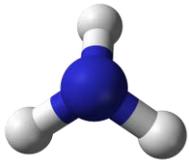
**Methane**



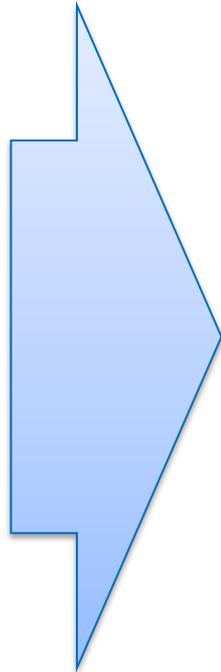
**Oxygen**



**Ammonia**



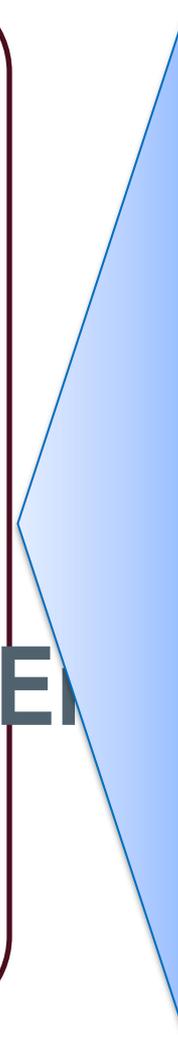
**Minerals**



**Methanotrophs**



**&  
CALYSTA Energy  
Technology**



**Protein**

**Carbohydrates**

**Fatty acids**

**Nutraceuticals**

**Lactic Acid**

**Butanediol**

**Fatty alcohols**

**Isoprene**

**N-Butanol**

**Succinic Acid**

*and more...*

**NUTRITION**

**CHEMICALS/ENERGY**

**CALYSTA**

# Calysta is Active in Two Industry Verticals

## CALYSTA NUTRITION

- High quality protein for commercial aquaculture and livestock feed
- Sustainable protein to meet a global demand

[www.calystanutrition.com](http://www.calystanutrition.com)

## CALYSTA ENERGY

- Production of essential building blocks for industrial materials and consumer products
- Collaboration with NatureWorks
- DOE funded project converting biogas to lactic acid

[www.calystaenergy.com](http://www.calystaenergy.com)

# Food Security is the Issue of the Future

- By 2050, 9.6B people will demand 75% more protein than currently available

**“Our research shows people will spend one-third of any increase in incomes on a more varied high-protein diet.”**

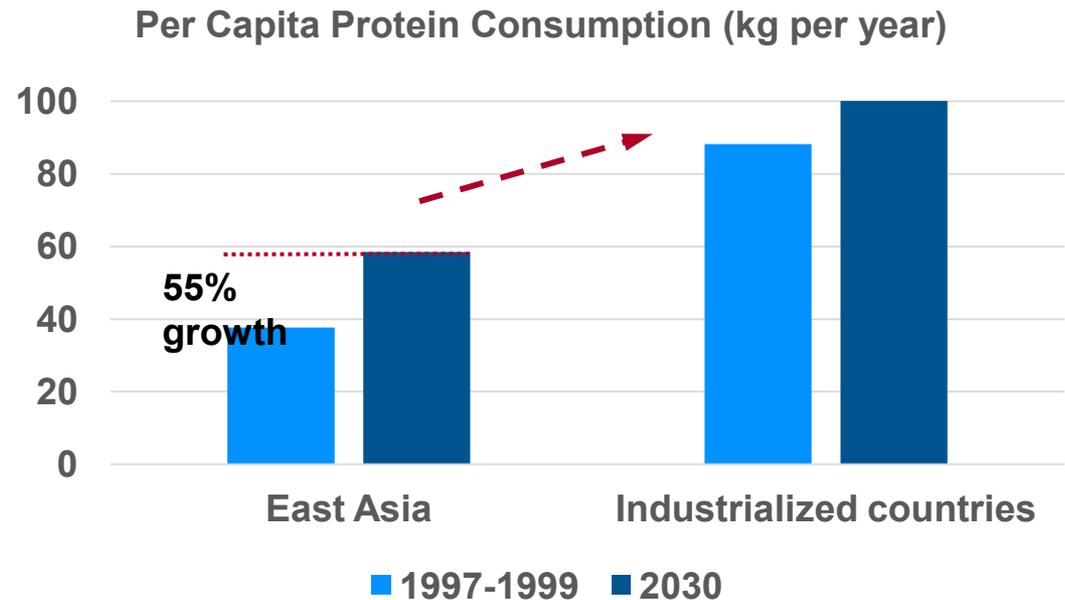
- Greg Page, CEO of Cargill

Source:

UN World Population Prospects: The 2012 Revision.

World agriculture: towards 2015/2030. Food and Agriculture Organization of the United Nations, 2002.

World agriculture: towards 2030/2050. Food and Agriculture Organization of the United Nations, 2012.



# Increased Protein Consumption is Currently Unsustainable

- More than two-thirds of all agricultural land is devoted to growing feed for livestock, while only 8 percent is used to grow food for direct human consumption.
- If the entire world population were to consume as much meat as the Western world does-176 pounds of meat per capita per year- the global land required would be two-thirds more than what is presently used.

## Calysta's single cell protein product provides

- comparable protein content to high-quality fish meal
- minimal impacts on land and water usage
- a source of protein orthogonal to the human food chain
- a safe, validated product already approved for sale



Source:

*UN Livestock, Environment, and Development (LEAD) Initiative, 2012.*

# What is FeedKind?

- High-protein feed produced biologically from methane
  - Bacteria (methanotrophs) metabolize methane as their sole source of carbon and energy, producing amino acids, proteins, and/or carbohydrates depending on process conditions
  - Current product is non-GMO
- Approved for use in the EU
  - >10 years of safety data in salmon farming
  - Safety studies completed in pigs, chickens, calves, rats, mink, and fox
- Product is analogous to yeast extract
  - No corn fiber residue: provides a concentrated protein product
- Supplied dry as powder or pellets; shelf-life >12 months at ambient temperature



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# Joint Development in Energy Ongoing...

**CALYSTA Energy™**



**Menlo Park, CA – June 16, 2014** – Calysta, Inc. ([www.calysta.com](http://www.calysta.com)) today announced it has successfully fermented methane into lactic acid, under a research collaboration with NatureWorks. Lactic acid is the building block for NatureWorks Ingeo™ lactide intermediates and polymers used in consumer and industrial products worldwide. The joint development program, started in June 2013 between Calysta and NatureWorks, is focused on creation of a commercially viable methane-to-lactic-acid process. The key aims are providing a structurally simplified, lower cost Ingeo production platform and diversifying NatureWorks' feedstock portfolio.

# With New Developments

**CALYSTA Energy™**



**DOE AWARDS \$2.5 MILLION TO NATUREWORKS TO TRANSFORM BIOGAS INTO THE LACTIC ACID BUILDING BLOCK FOR INGEO**

**MINNETONKA, Minn., October 30, 2014** -- The U.S. Energy Department's Office of Energy Efficiency and Renewable Energy, Bioenergy Technologies announced a grant of up to \$2.5 million to NatureWorks, one of the world's leading suppliers of bioplastics, in support of an ongoing program that aims to sequester and use methane, a potent greenhouse gas, as a feedstock for the company's Ingeo™ biopolymers and intermediates.

# Calysta Continues to Lead with Innovative Uses for Methane

- Calysta's progress in the last year has changed the face of the company
- Fully integrated lab-to-commercial platform
- Commercial plant siting is underway; construction to begin next year

**Building a sustainable platform to food, fuels, and chemicals from an abundant resource that represents a practical solution**



**CALYSTA**