



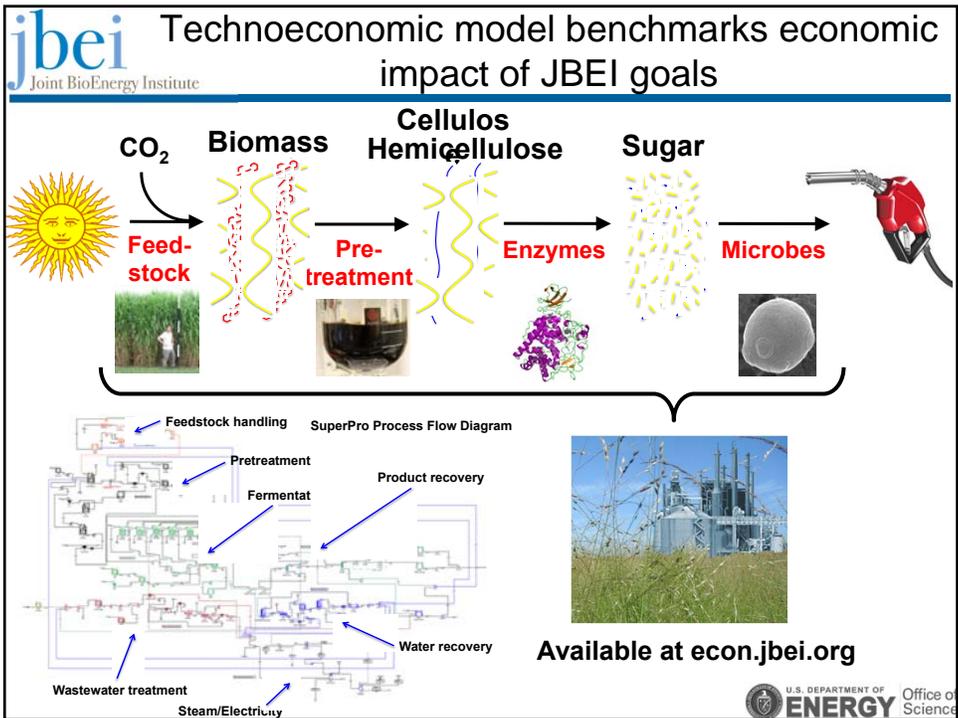
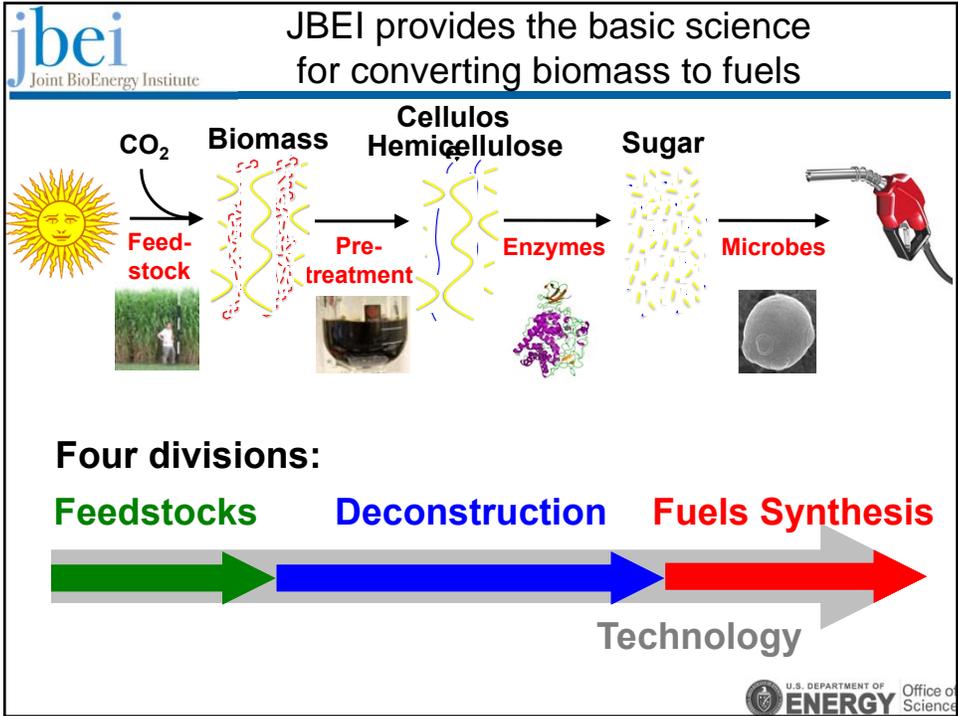
Use-inspired, team-based basic science

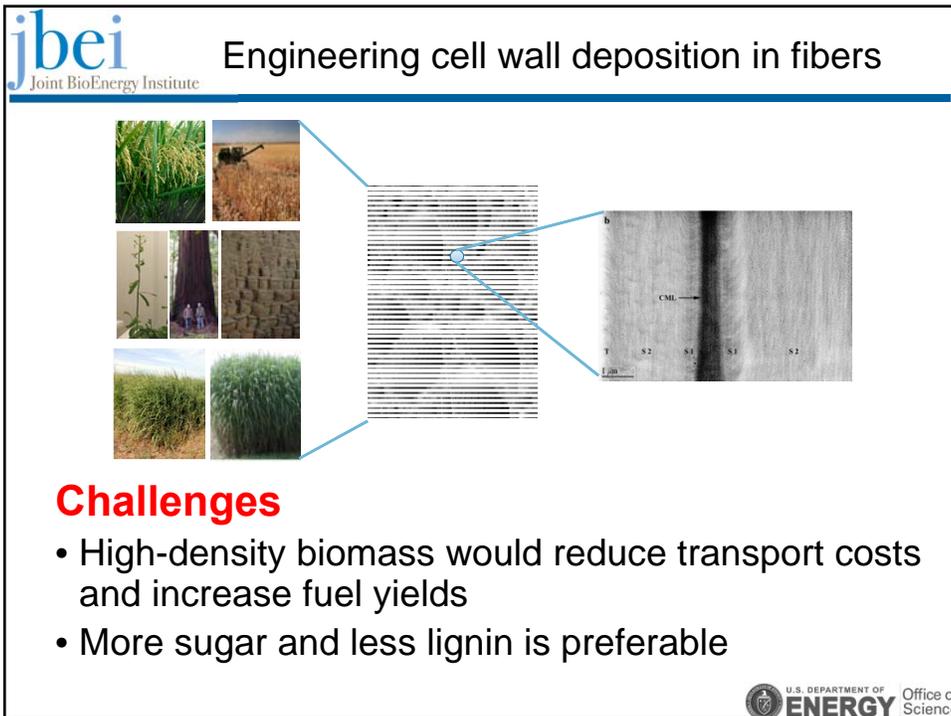
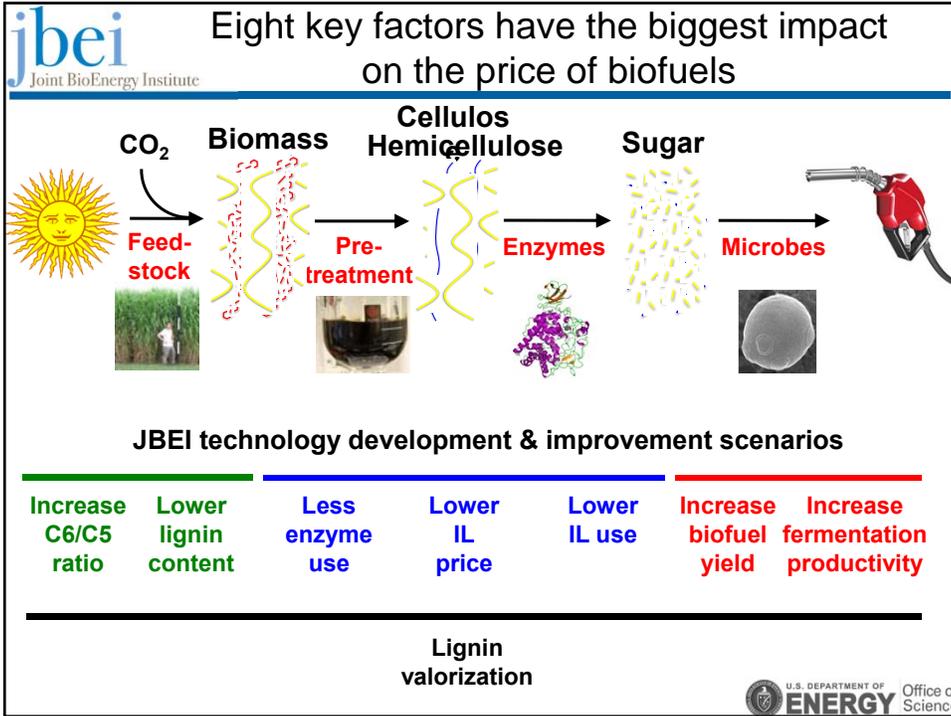
Jay Keasling, CEO

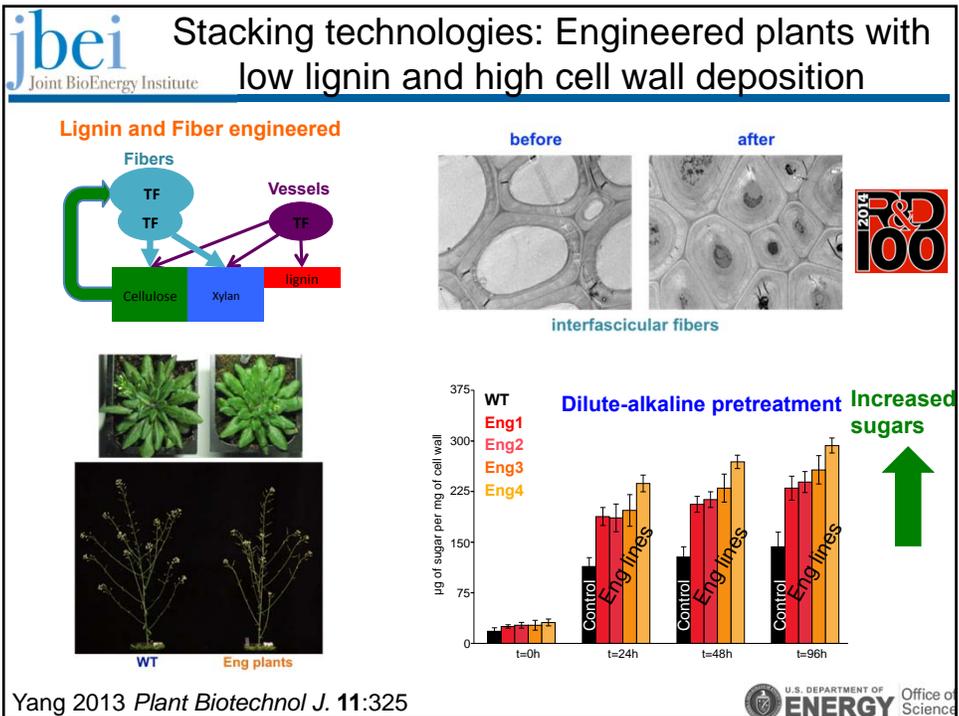
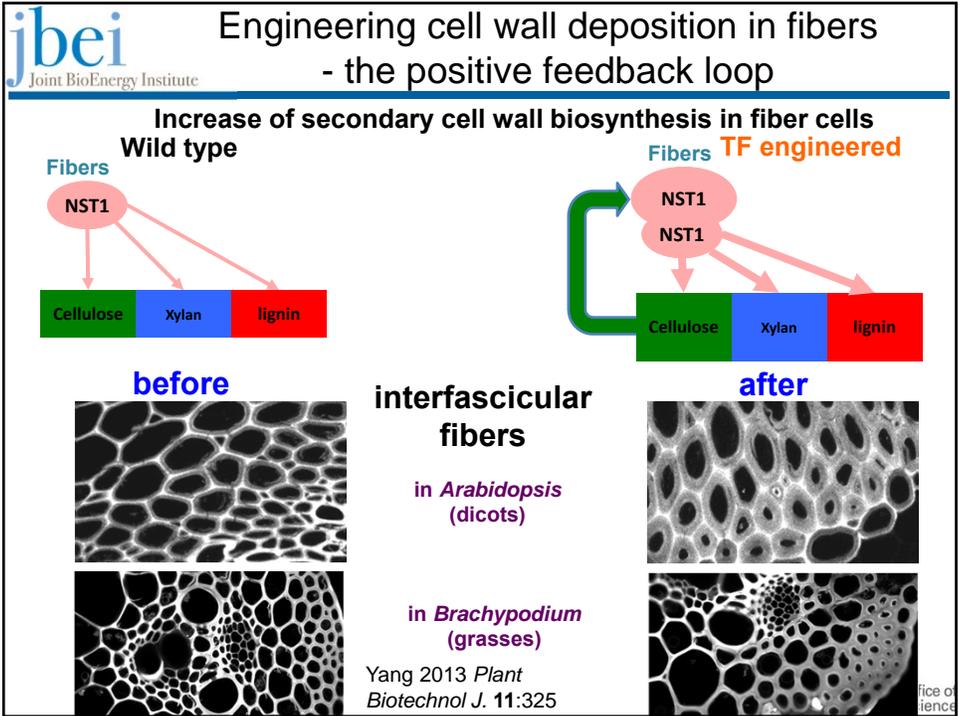


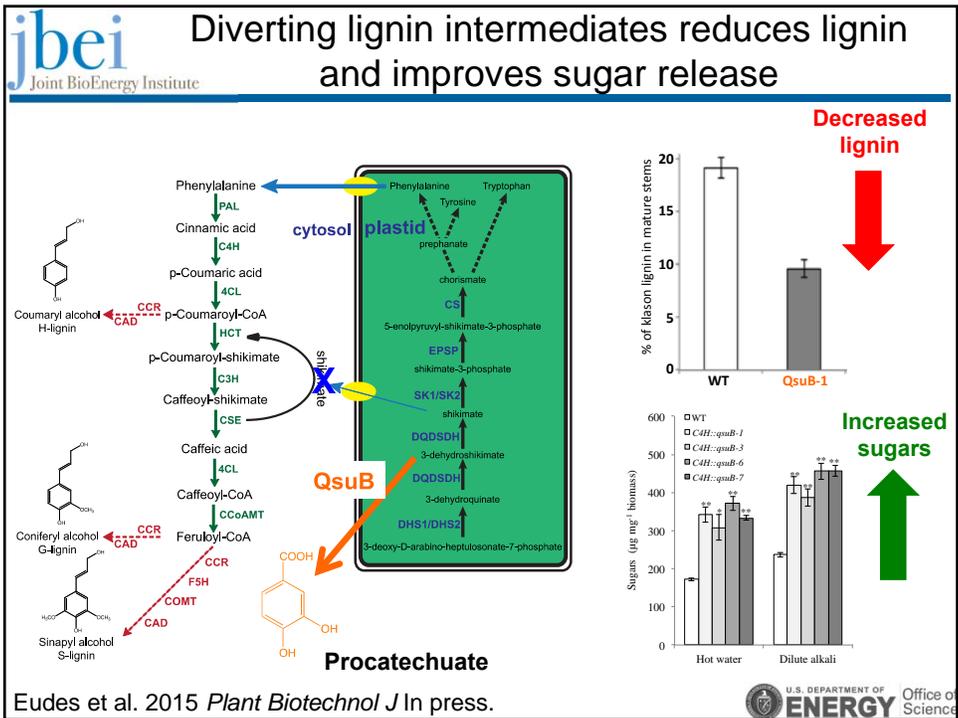
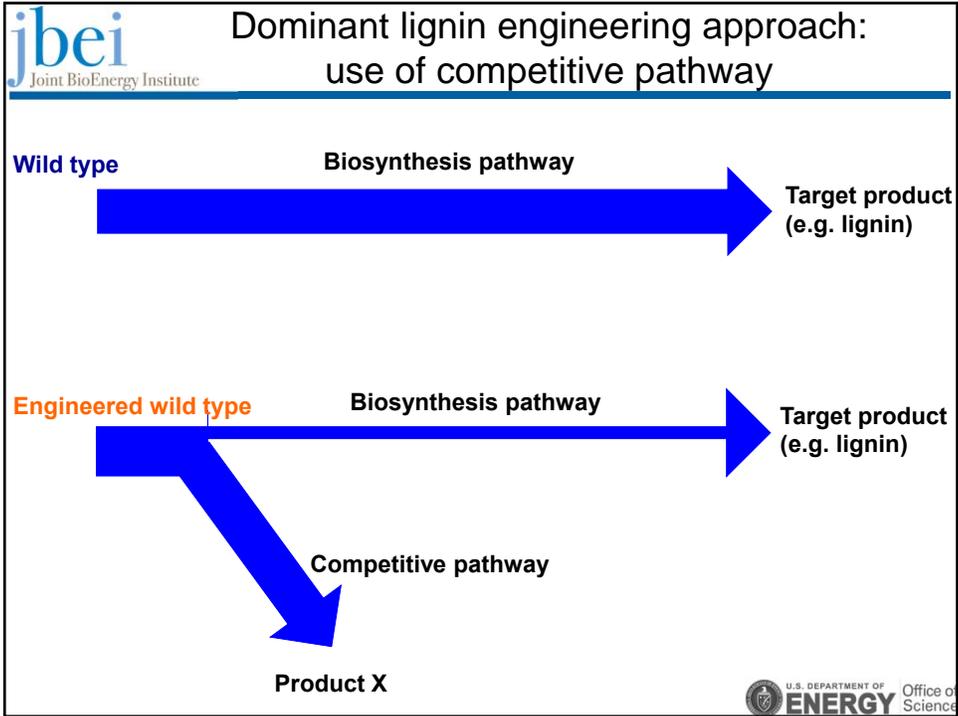
Joint BioEnergy Institute (JBEI)
Seven partners – One location



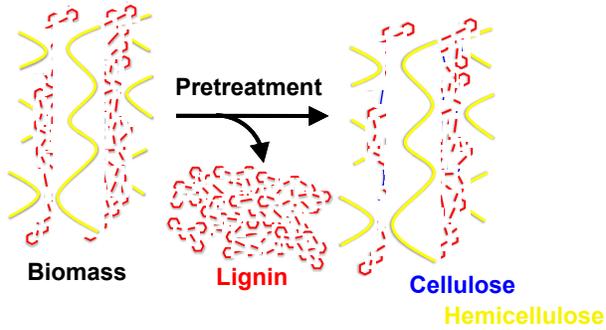








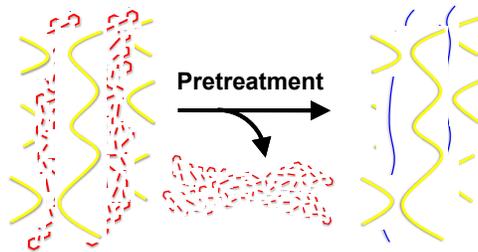
Some key challenges in converting lignocellulosic biomass to fuels



Challenges

- We need better pretreatment processes that yield cleaner cellulose/hemicellulose

Ionic liquids pretreatment produces clean cellulose/hemicellulose



Ionic liquids



Mix
Heat
Stir

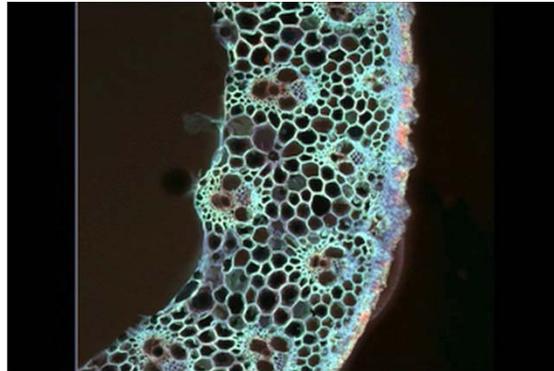


Add
Anti-solvent



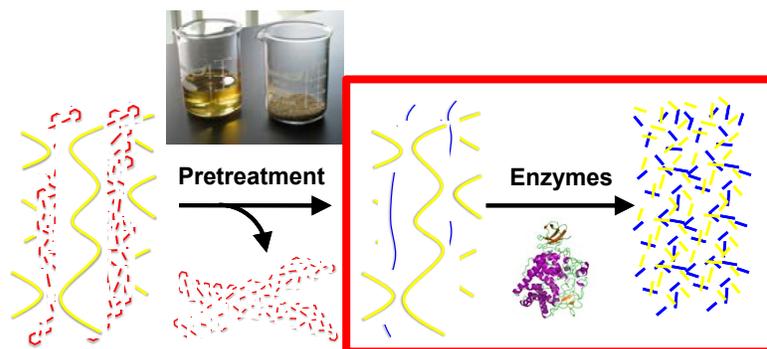
Biomass

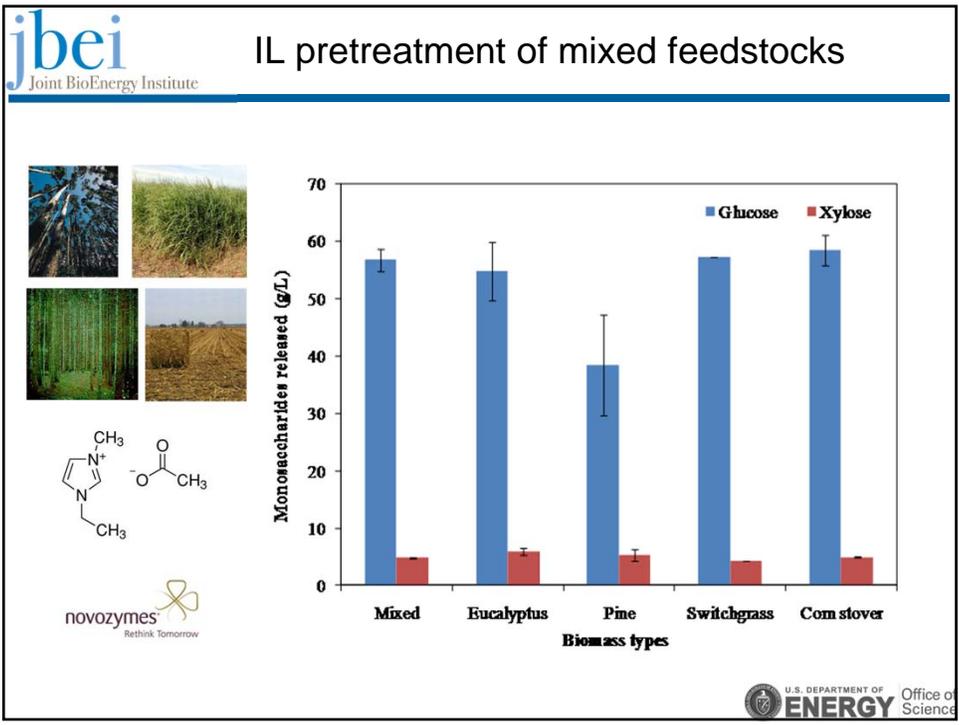
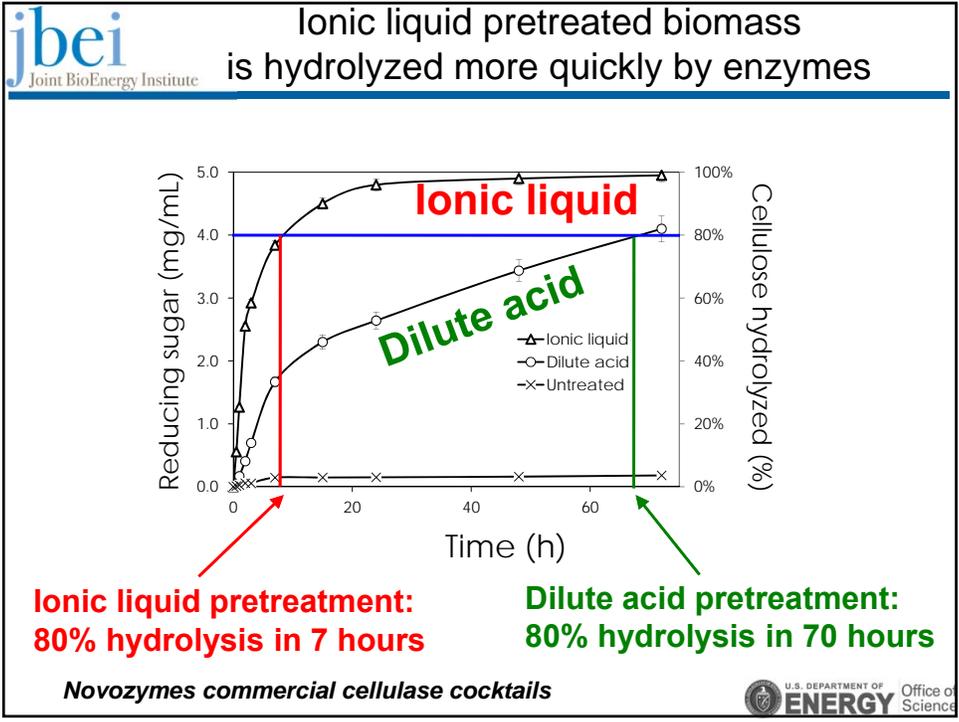
Switchgrass undergoing IL pretreatment

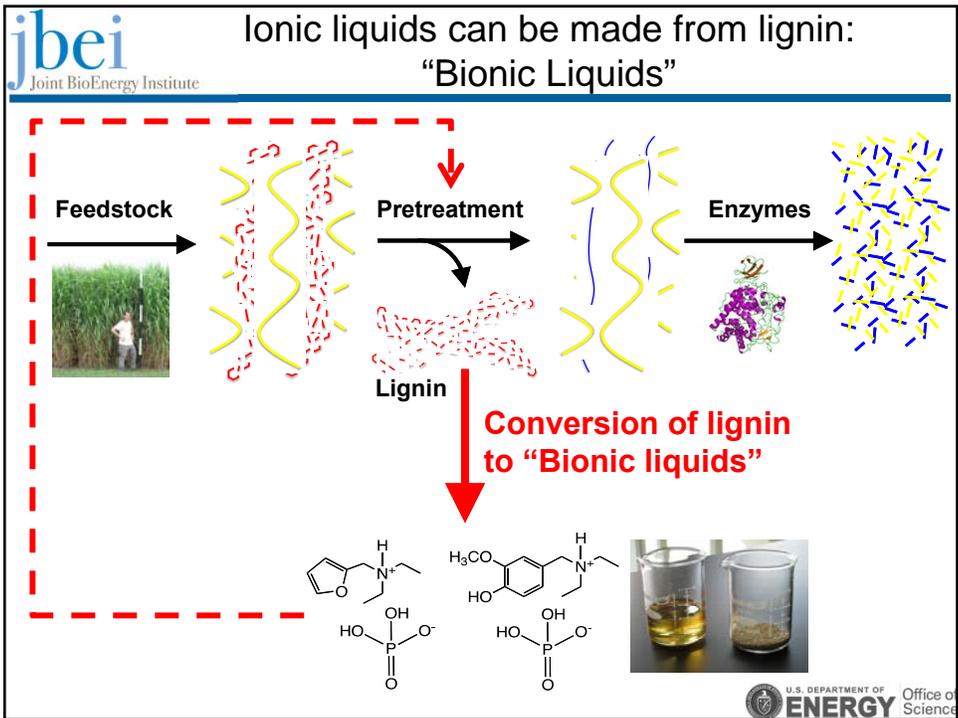
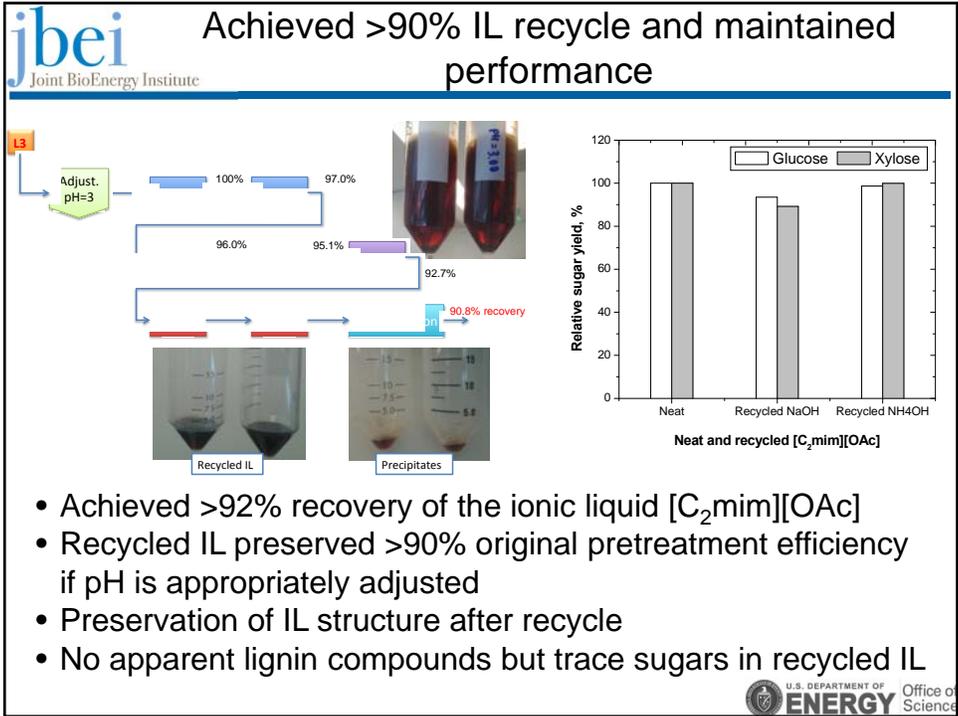


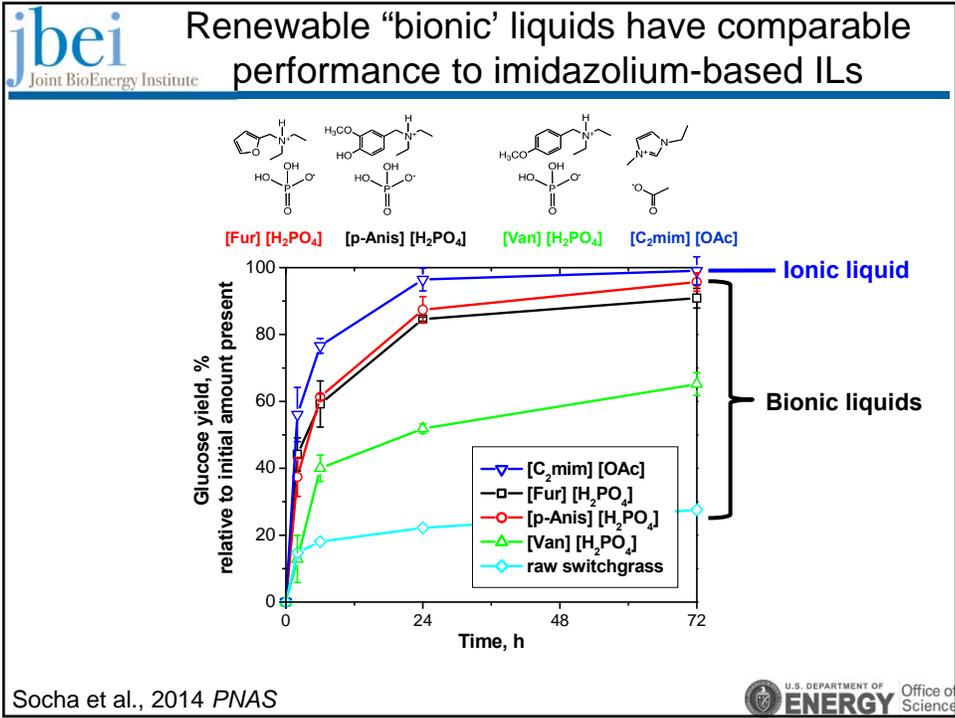
- [C₂mim][OAc], 120°C
- In situ studies using bright field microscopy
- Complementary Raman and fluorescence studies indicate that lignin is solvated first, then cellulose

Does pretreatment with ionic liquids improve cellulose hydrolysis?









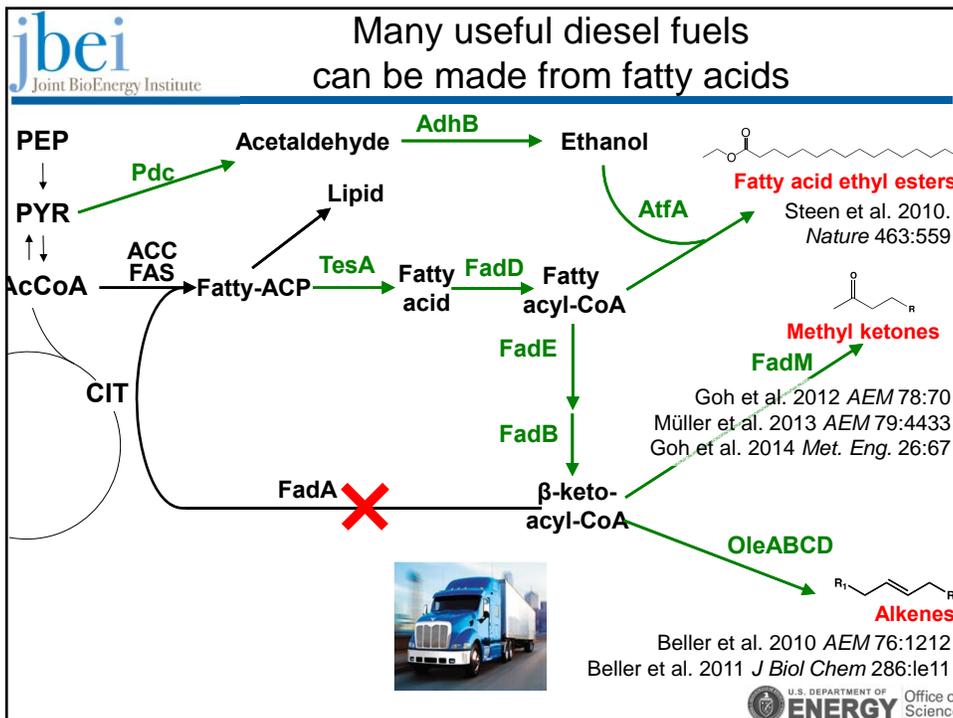
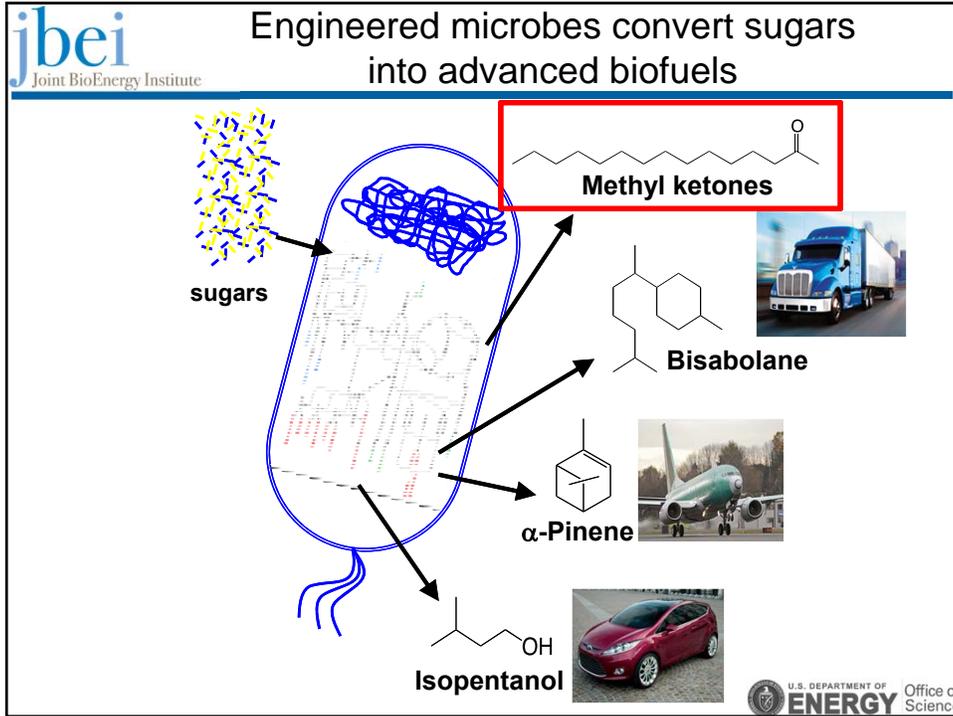
jbei Joint BioEnergy Institute

Some key challenges in converting lignocellulosic biomass to fuels

Challenges

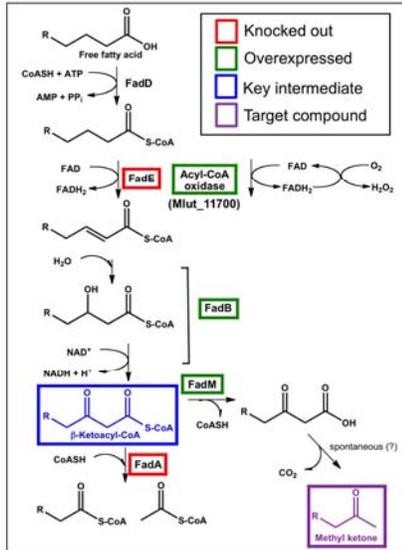
- Biofuels are needed for all kinds of engines, particularly diesel and jet engines
- Many fuel-producing organisms can only utilize a fraction of the sugars from biomass

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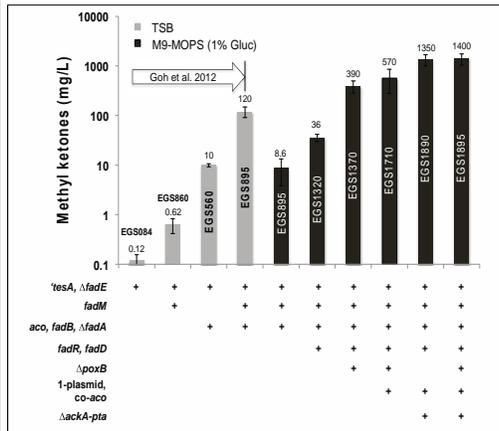


Diesel-range methyl ketones in *E. coli*

Re-engineering β -oxidation

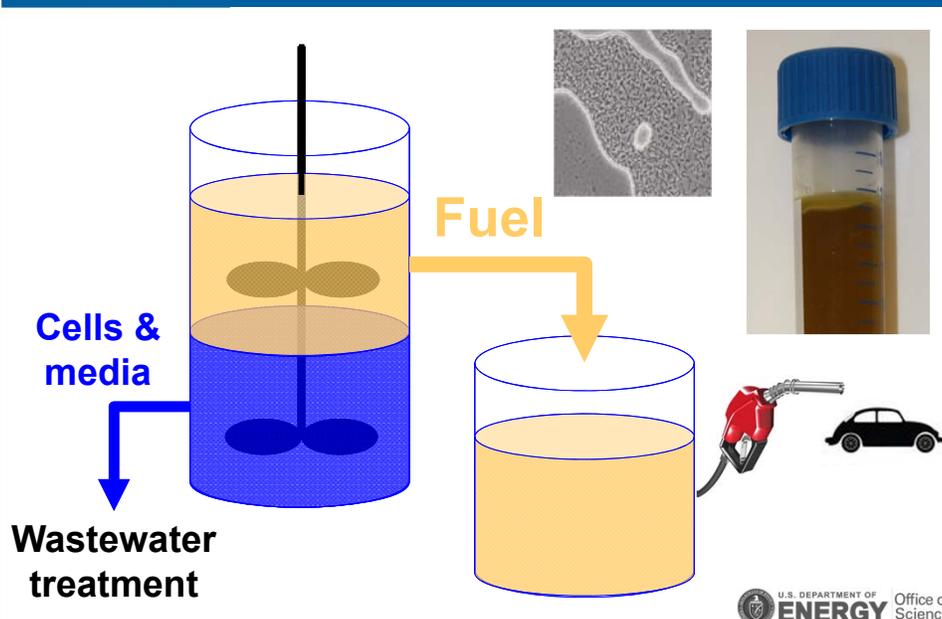


Titers exceeding 1.4 g/L (1% Glu, M9) 40% of maximum theoretical yield



Goh et al. 2014 *Metab. Eng.* 26:67

Phase separation allows simple purification of fuel



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Engineered microbes convert sugars into advanced biofuels

sugars

Methyl ketones

Bisabolane

α -Pinene

Isopentanol

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Improving isopentanol production using proteomics and metabolomics

Construct pathway
Quantify proteins

1

2

"top"

g isopentanol / g glucose

46% theoretical yield and 1.5 g/L tite

Highest reported yield (12%)

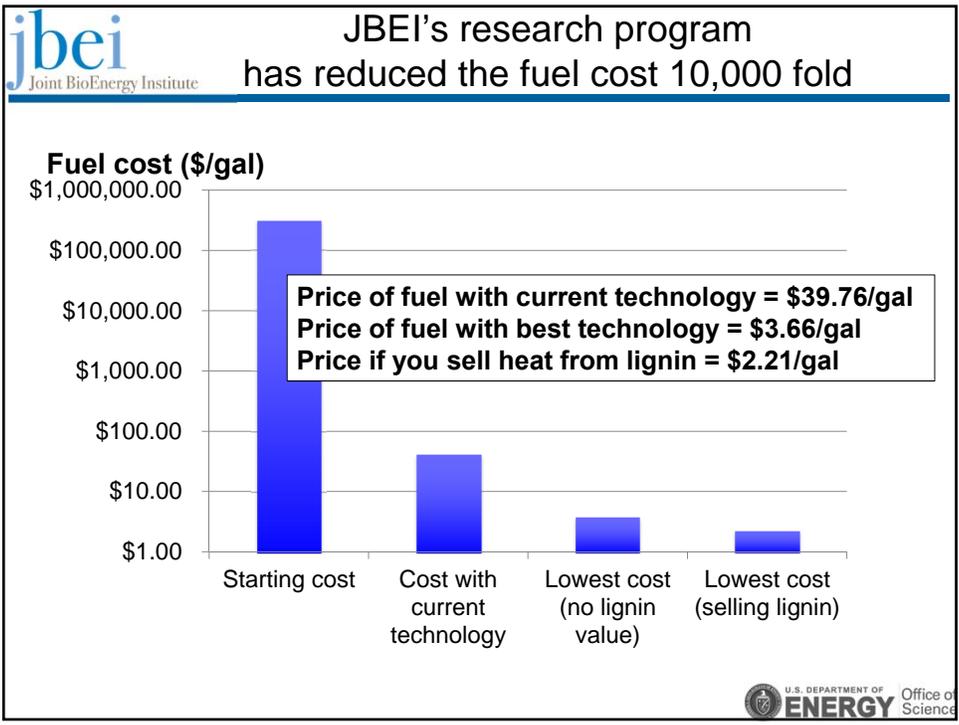
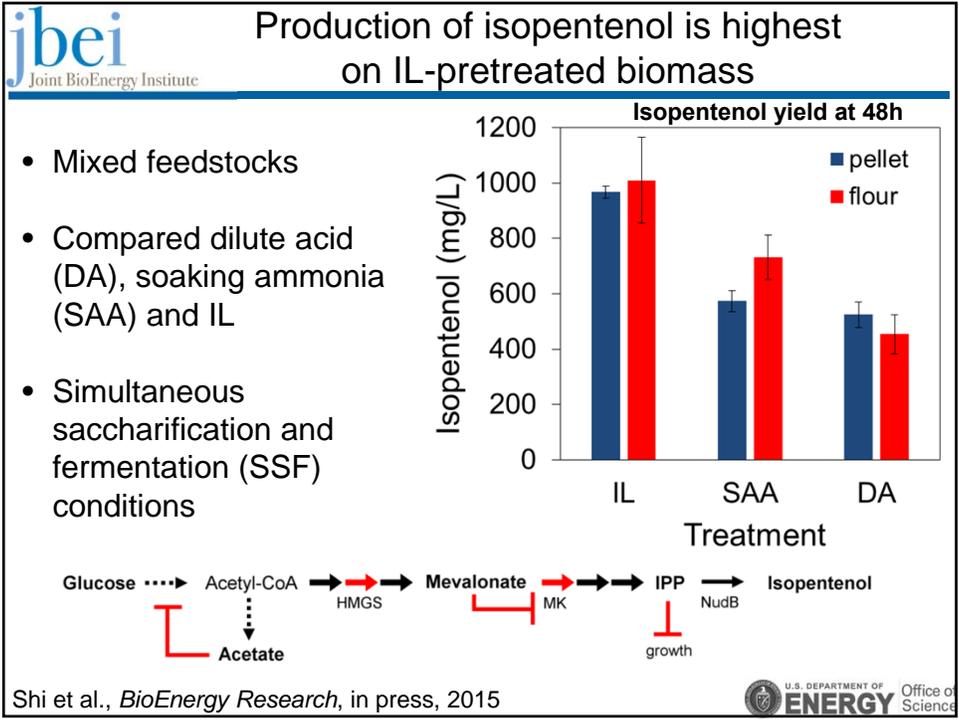
Chou and Keasling (2012)
Zheng et al. (2013)
1A
2A
2A-mk
3A
3A-mk
3A-mk-NudB
3A-NudB

Isopentanol (mg/L)
Acetate (mg/L)
Glucose (mg/L)

Strain

Chou & Keasling, 2012. *Appl. Env. Micro.* 78:7829
George et al. 2014 *Biotech Bioeng* 111:1648

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JBEI products are shared with the scientific community

- Data made available through JBEI-created databases
 - disseminated to external databases, including Kbase
- JBEI computational tools made available to the DOE community
- JBEI collaborates with Kbase to develop new tools for rapid synthetic biology
- JBEI research tools help advance other Genomic Science Programs:
 - Nano-initiator Mass Spectrometry (Northen) enables ENIGMA research

The diagram illustrates the flow of JBEI products. On the left, a box labeled 'Tools' contains icons for jbei, a monkey, j5, and JBEI-CC repository. Below it, a 'Data' box lists Genomes, Metagenomes, Omics, and Structure, with 'ELN EDD LIMS' below. A central box 'Grass Expression & Phylogenomics' includes MASCP, SUBA, and RiceNet, with 'Plant Proteomes' and 'Grass systems biology' below. An arrow points from this box to a 'Other GSP-related Resources' box containing 'img', 'img/m', 'phytozome', and 'MIG-RAST'. A large arrow points from the 'Grass Expression & Phylogenomics' box to a 'KBase' box labeled 'DOE Systems Biology Knowledgebase'. To the right of KBase are logos for BESC (BioEnergy Science Center) and GREAT LAKES BIOENERGY. At the bottom right is the U.S. DEPARTMENT OF ENERGY Office of Science logo.

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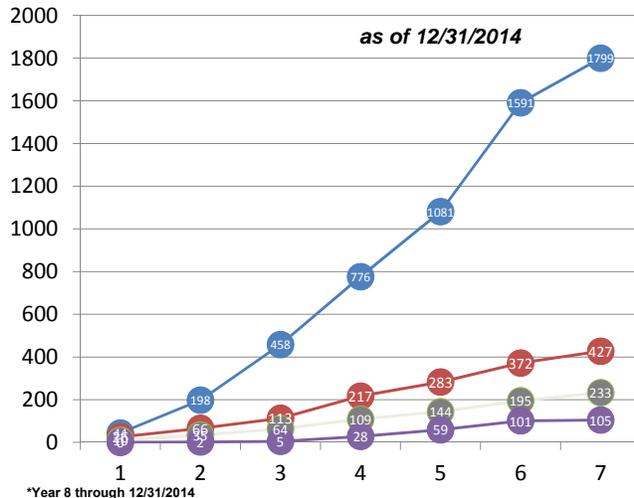
Thanks to ...

The JBEI Team

A large group photo of the JBEI team, consisting of many people of various ages and ethnicities, standing in front of a building. In the center, a group of people holds a white sign that says 'jbei Thank you Working Genomes Association'. Below the photo, the text 'BER for funding' is displayed. At the bottom right is the U.S. DEPARTMENT OF ENERGY Office of Science logo.

BER for funding

DOE Bioenergy Research Centers: Publications, Patents, Licenses



Total
Publications¹
1,799

Total
Invention Disclosures
427

Total
Patent Applications
233

Total
Licenses/Options²
105

Total Patents: 24

*Year 8 through 12/31/2014

¹ Represents publications "in print" and "accepted/in press"
² Represents patent applications licensed/options



Moving BRC advances to the marketplace

The grid includes logos for the following entities (among others): Pacific Ethanol, Inc., Dow, Ceres, Weyerhaeuser, POET, Monsanto, Scion, Roesein, Novozymes, Shell, Evolva, Cargill, Borregaard LignoTech, firstgreen, Lignol, GlucanBio, Boeing, Amyris, FuturaGene, DSM, LS9, Inc., GSF, ArborGen, CNH Industrial, Xylome, Iogen, FDC Enterprises, Aligna Technologies, Agricen Sciences, Renmatix, ASEC, Canada, Greenwood, Tesetagen, MillerCoors, Allopartis, GinkgoBioscience, PlantProbes, Nextval, Technology Holding, GE, Genomatica, ZeaChem, LYGOS, Syngenta, Opxbio, Soil Net, BP, Mendel Biotechnology, Opxbio, ExxonMobil, Decagon Devices, TBR, Verdezyne, Nidus, ADM, Johnson Controls, Ford, Codexis, Thermo Scientific, Oakbio, Elanco, Statoil, ADM, GM, Hyrax Energy, Caliper, DuPont, SugaNit, BASF, Mascoma, Storoensa, Afingen, Viridia, Semba Biosciences, Show Me Energy Cooperative, GreenEarth Institute, Dyadic, Edeniq, MBG, and Lignol.

