

Sugar Cane and Corn

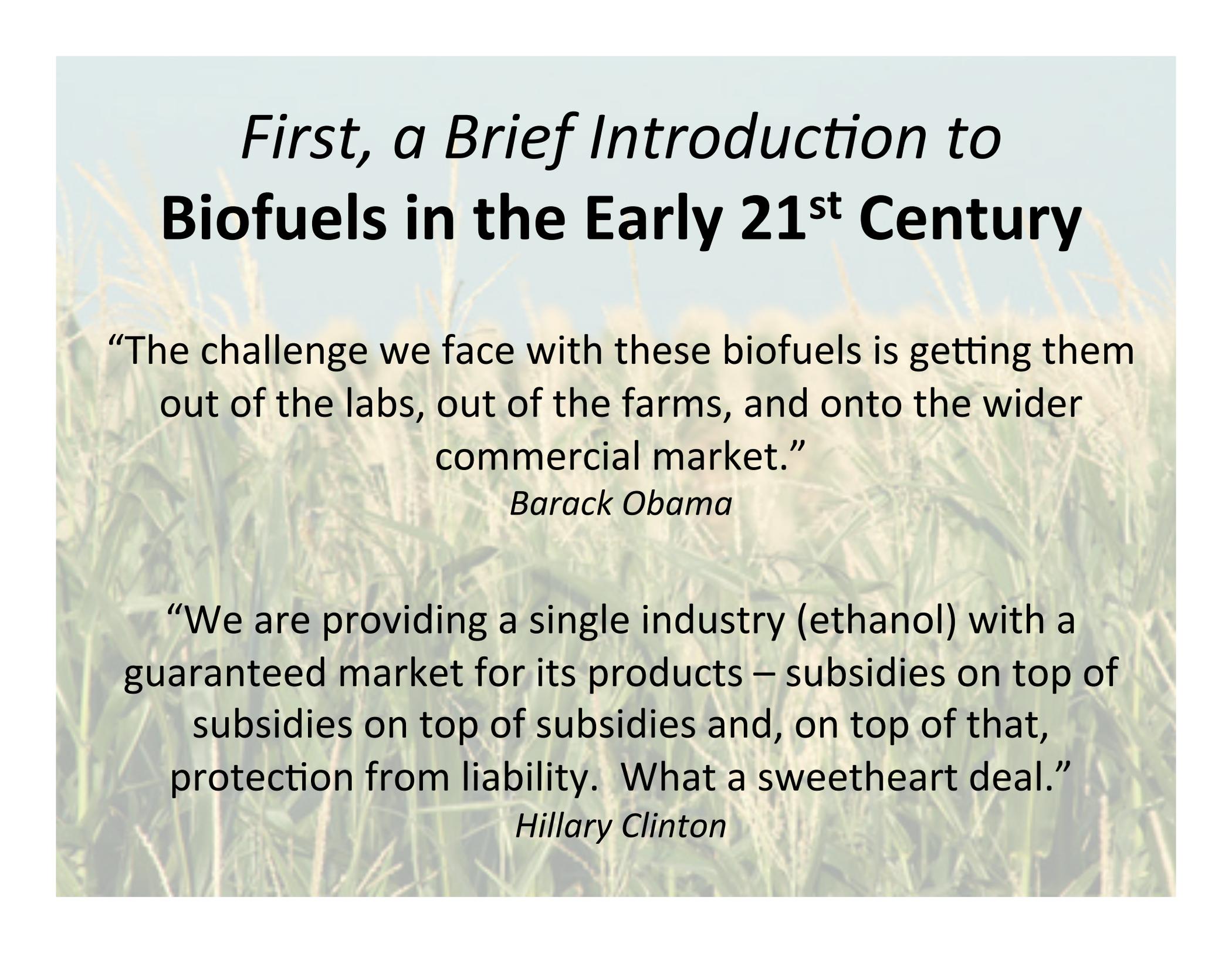
Biofuel-Based Study Abroad Programs in Brazil

Frontiers in Education 2010

Denise Wilson, Leah Freed, Jennifer Johnson
University of Washington, College of Engineering

Rebecca Bates, *Minnesota State University, Mankato*

Donna Frostholt, *Northwest Environmental Sciences*



First, a Brief Introduction to
Biofuels in the Early 21st Century

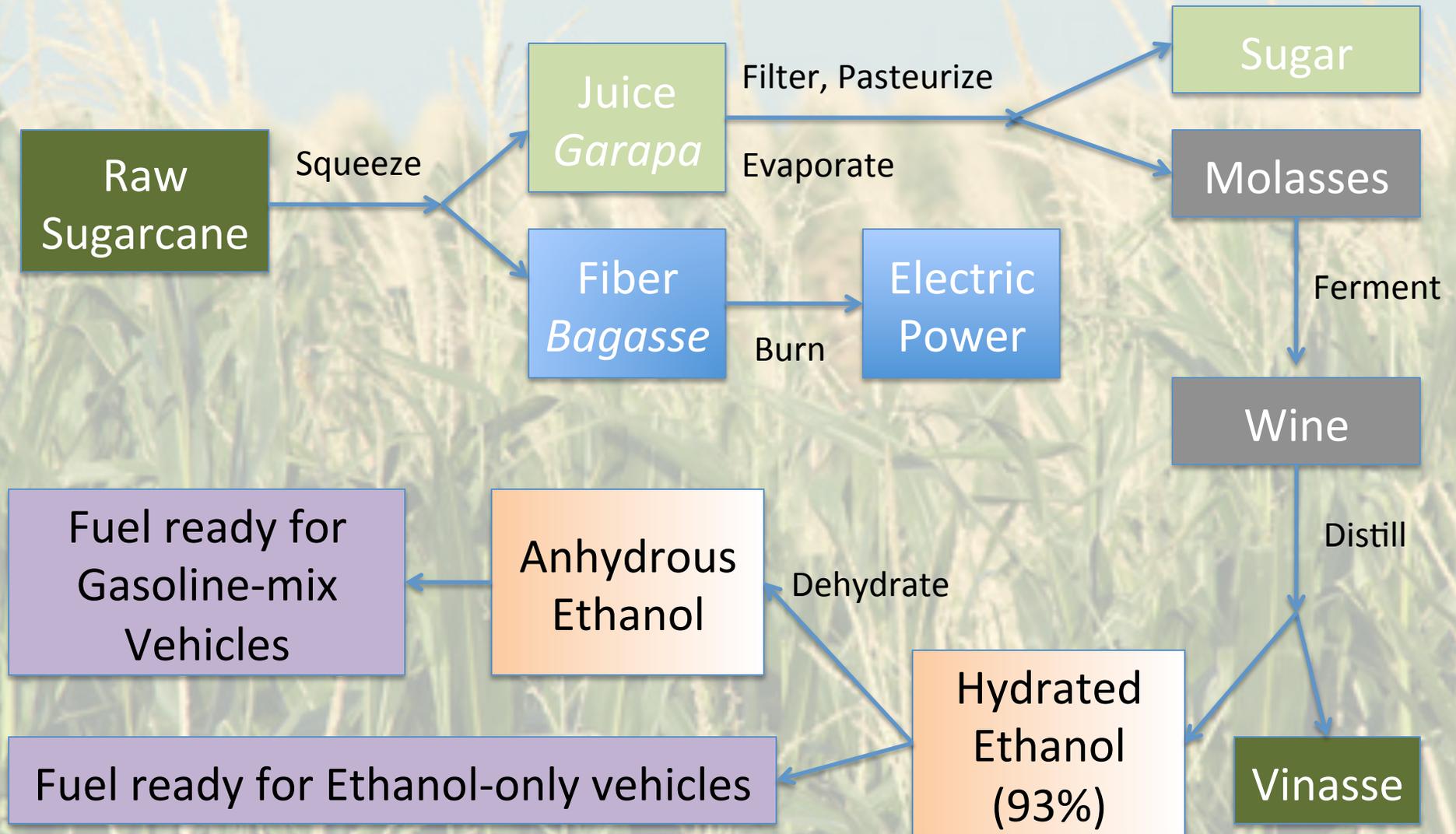
“The challenge we face with these biofuels is getting them out of the labs, out of the farms, and onto the wider commercial market.”

Barack Obama

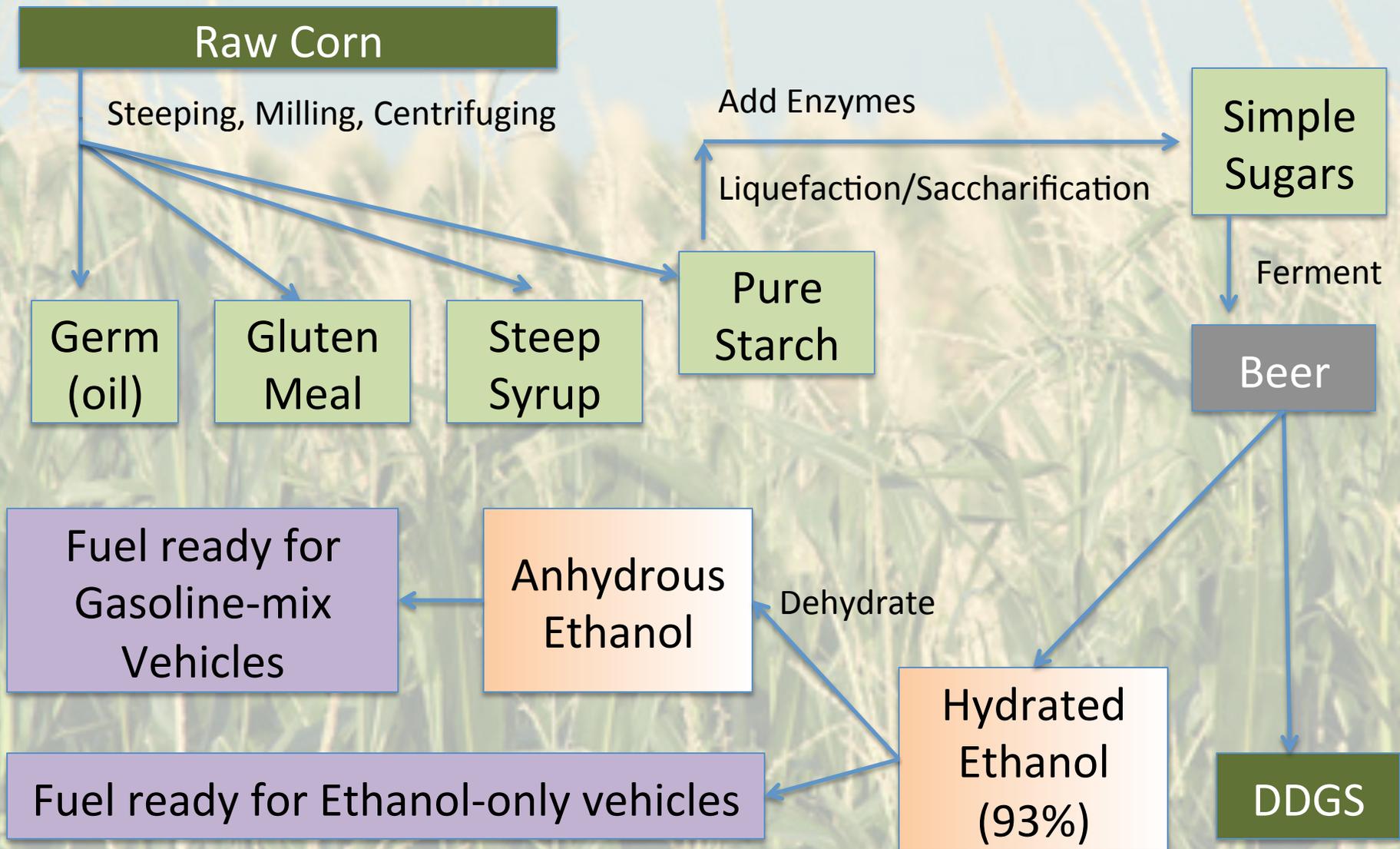
“We are providing a single industry (ethanol) with a guaranteed market for its products – subsidies on top of subsidies on top of subsidies and, on top of that, protection from liability. What a sweetheart deal.”

Hillary Clinton

Biofuels in the 21st Century: Producing Ethanol from Sugarcane



Biofuels in the 21st Century: **Producing Ethanol from Corn**



Biofuels in the 21st Century: Land, **Energy**, and Cost

	Sugarcane	Corn	Advantage
Transport	236 Mcal	322 Mcal	Sugarcane
Water	64 Mcal	15,000 L = 90 Mcal	Sugarcane
Stainless Steel	42 Mcal	3 kg = 165 Mcal	Sugarcane
Steel		4 kg = 92 Mcal	Sugarcane
Cement	14 Mcal	8 kg = 384 Mcal	Sugarcane
Steam		2,646 Mcal	Sugarcane
Electricity		392 kWh = 1,011 Mcal	Sugarcane
Ultra-purification		9 Mcal	Questionable
Sewage Effluent		29 kg = 96 Mcal	Questionable
Distribution		331 Mcal	Questionable
TOTAL	356 Mcal	4,824 Mcal	Sugarcane

Biofuels in the 21st Century:

In the United States:

Summary

**TOTAL:
270 Million
Hectares**

**Ethanol
10 Million
Hectares**

**3800 Liters of
Ethanol per
Hectare**

**10-30%
reduction in
GHG emissions**

In Brazil:

**TOTAL: 355
Million
Hectares**

**Ethanol
3.6 Million
Hectares**

**6800 Liters of Ethanol
per Hectare**

**86-90% reduction in
GHG emissions**

**Next –
Students in Brazil:
2009 Exploration Seminar
(June/July 2009)**

21 students -- 14 engineers
8 Civil/Environmental Eng
4 Chemical Eng
1 Industrial Eng; 1 Aero Eng

From the West
Week 1: The Pantanal
(Water Resources)

To South-Central
Week 2: Campinas
(Biofuel Resources)

To the East
Week 3: Piracicaba
(Service Learning)

**South-Central Brazil
*Exploration Seminar***

Food, Fuel, & Water

The Resource Triangle

Join us for an exciting immersion in the world of biofuels from environmental to engineering to public policy implications!



Earn EE, ENGR, CEE or Environmental Studies Credit (6) toward your undergraduate degree.

In this Exploration Seminar, we will traverse south-central Brazil to understand the transitions from water to fuel, from water to food, and from water, fuel, and food to culture, policy, and social fabric. We will start in the world's largest wetland, the Pantanal and then move southeast to Campinas, Piracicaba, and Sao Paulo to look at the production & use of food and biofuels alongside their impact on Brazilian culture, society, and economics. The use of land to produce sustainable energy (through biofuels) is substantially more varied and dependent on culture, climate, practice, and environment than fossil fuel usage. Creating a sustainable balance among food and fuel production and the use of water and other natural resources is an emerging and enormously complex problem that engineers, policy makers, and environmental scientists face in developing technology over the 21st century.

The BioFuels Puzzle

If you put a sugarcane and an ear of corn at the same table, what would they talk about? Would corn realize that it has a long way to go before it becomes the sugarcane of the United States? Would sugarcane gape in awe of the support and the fame that corn enjoys in the U.S. as the potential solution to relieving dependence on fossil fuels? Would corn look shyly away and confess to its inefficiency compared to sugarcane in producing ethanol? Or would they both just sit at the table and ferment, evolving into ethanol of their own free will... while we discuss their fate in this Exploration Seminar about biofuels and their impact on food and water resources? We invite you to find out, as we explore the fascinating world of biofuels in the midst of a successful biofuel economy.



Students in Brazil

(Starting) In the Pantanal: The World's Largest Freshwater Wetland

The Environmental Impact:

The critical nature of water & wetlands to food & fuel resources
contrast to

The Sociocultural Impact:

The invisible Pantanal in the eye of the urban Brazilian



Students in Brazil

(Moving on to the Core) In Campinas (UNICAMP):
The Political & Economic Commitment to Sugarcane

Why study biofuels in Brazil?

The contrast in political and economic viewpoints between the United States (a developed nation) with Brazil (a rapidly evolving, thriving developing nation) captures the importance of politics and culture in determining the advancement of technology



Students in Brazil

(Wrapping up) In Piracicaba:

Service Learning in Ordinary Brazilian Community

Service (building homes for those in need) to the suburban city of Piracicaba provides an opportunity to connect with the Brazilian people and to truly understand what it means to be, live, and work in urban Brazil.



And Now – Students Experiencing Brazil

Expressed through

Connections to Community:

Belonging (in the class)
Affiliation (to the home dept/college)
Psychological Sense of Community (PSC)

Strength of Self

Self-Efficacy
Locus of Control

Relationships

Faculty Concern for Students
Interactions with Faculty
Connections to Peer Group

Engagement:

Behavioral
Emotional
Institutional and Goal Commitment

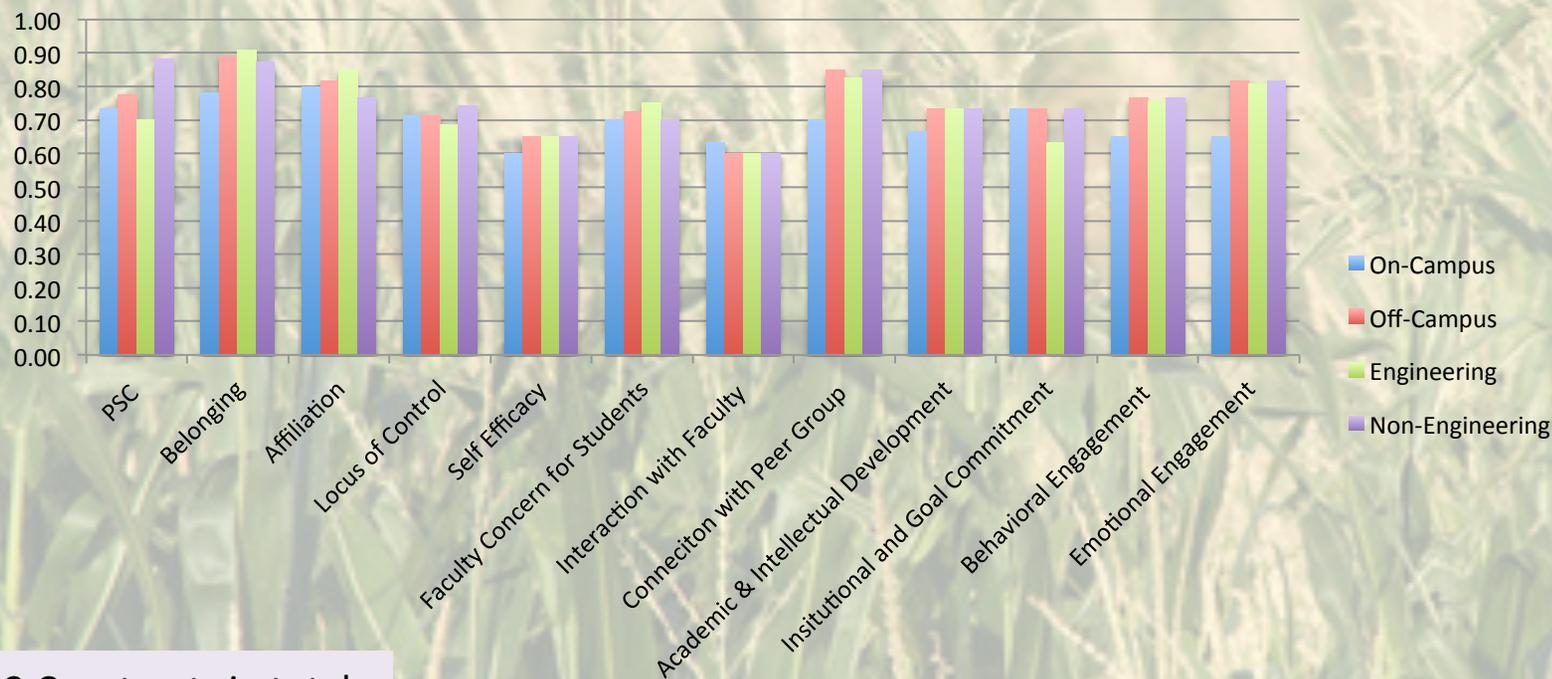
Study-Abroad is considered necessary to prepare American students to enter a global society. Yet, exposure by itself does not guarantee learning. How is the student experience changing as the academic experience shifts from on-campus to off-campus?

Students Experiencing Brazil: **Methods**

Survey: Students were given a survey at the end of each class (an on-campus Civil and Environmental Engineering class; the off-campus Brazil program) using 5-point Likert Scale items.

Written Work: Term Papers for Engineering students were compared to those for non-engineering programs in the Brazil Study Abroad Program.

On-Campus and Off-Campus Groups = All Engineering Students
Engineering and Non-Engineering Groups = All Brazil Study Abroad Students



All results are expressed as normalized median values, evaluated for significance using Mann-Whitney tests.

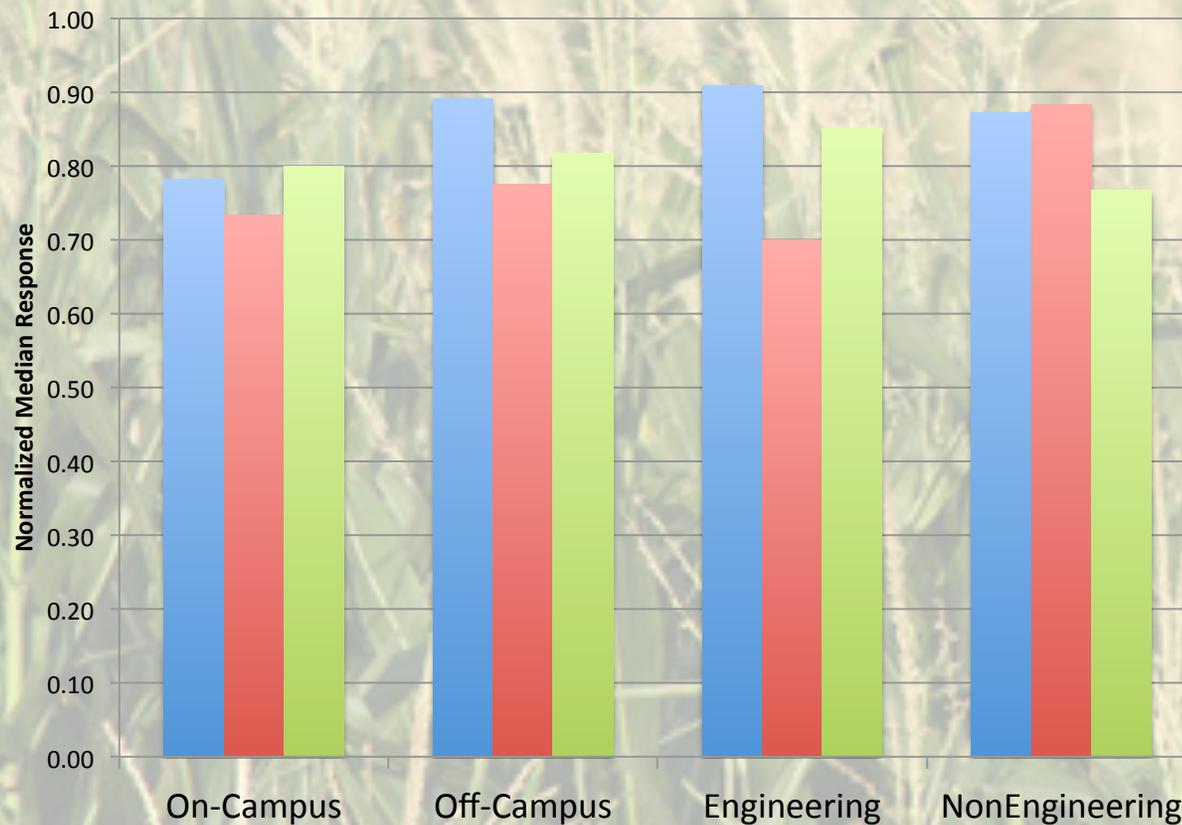
12 Constructs in total and written academic work were evaluated in this study.

Students Experiencing Brazil: **Connections to Community**

Belonging (in the class): is a fundamental human motivation and refers to close, local, and frequent relational connections with other people in a local community

Psychological Sense of Community (PSC): is the sense that a student is part of a readily available, mutually supportive network and shares common values at the university level.

Affiliation (to major): refers to well a student feels connected his major/home department.



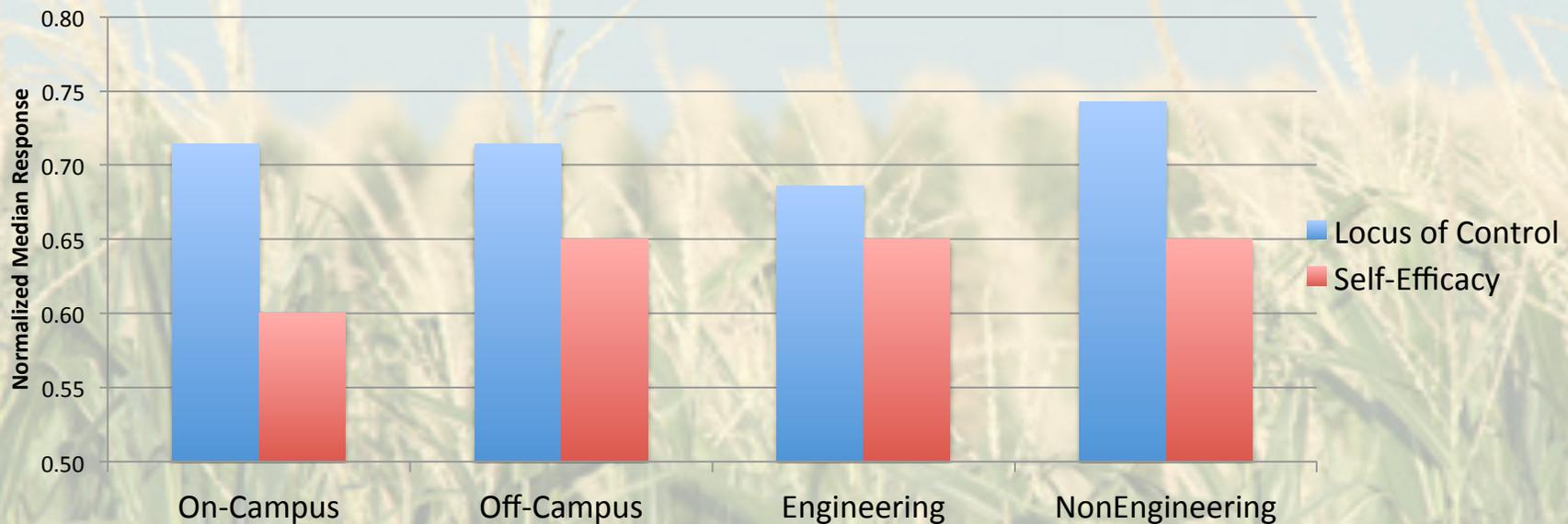
Students develop a stronger sense of belonging overseas, although their other connections to community remain unchanged.

Engineers have stronger connections to their major but weaker connections to the university as a whole.

Students Experiencing Brazil: **Strength of Self**

Self-Efficacy: reflects a student's assessment of her own competence as well as her confidence in her academic work

Locus of Control: how well a student relies on internal reinforcements (as opposed to external) of their beliefs.



While self-efficacy is fairly consistent across majors (CSET and non-technical) in study-abroad programs, it is lower among on-campus engineering students (compared to those engineering students who choose to study abroad).

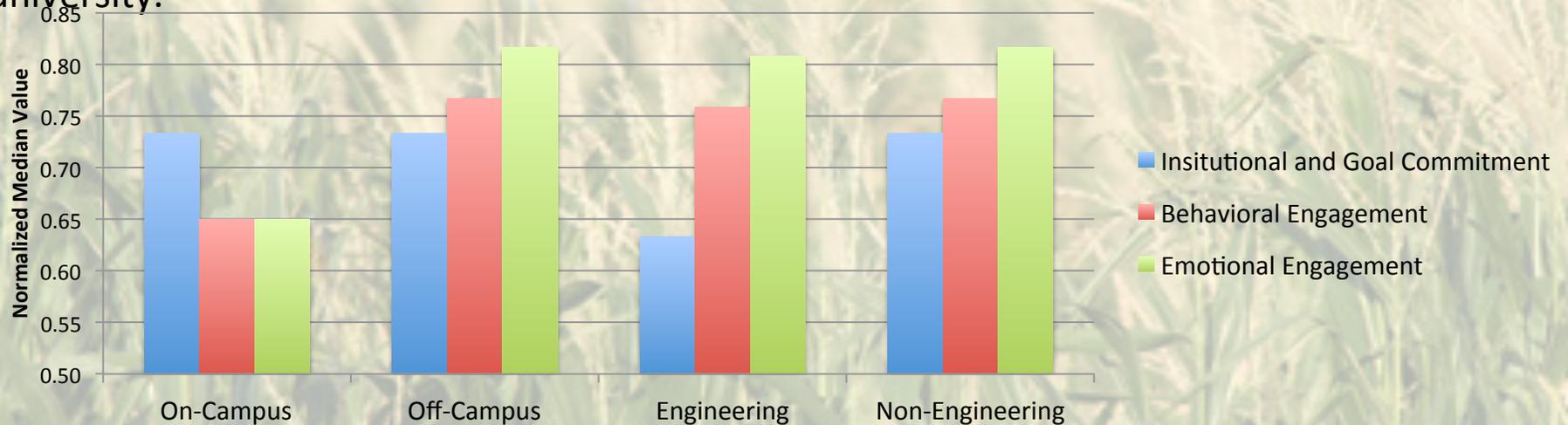
Non-Engineering students who study abroad rely far less on external reinforcement of their beliefs than engineering students.

Students Experiencing Brazil: Engagement

Emotional: reflects how much a student feels inclined to engage or is interested in a class or classes.

Behavioral: how well a student is actually actively participating in a class or classes.

Institutional and Goal Commitment: reflects how satisfied the student is in his choice of the home university. Also indicates how likely the student is to remain engaged at the university.



Engineers show substantial increases in engagement, especially emotional, in study-abroad programs (compared to on-campus classes)

Similar to PSC (connection to the university), engineers who study abroad show less commitment and loyalty to the university than non-engineers.

And Finally – Students Learning in Brazil *Expressed through* **Snapshots in Writing**

Which of these was written by an engineer? Which a non-engineer?

Because biofuels are so dependent on maximizing land use, they, by nature, require increasingly more fertilizer and pesticide as production continues to rise. Fertilizer and pesticide use adversely affect water quality, and have been found as pollutants in ground and surface water (Ongley, 1996).Thus, farmers growing crops for biofuel production need to pay attention to the impact increased production has on water quality, and have an ethical responsibility to ensure that undesirable environmental impacts are minimal by keeping the use of fertilizers and pesticides at a minimum.

This country alone consumed 17,479,000 barrels of finished petroleum products per day throughout 2008, and over 50% of this went to motor gasoline (EIA, 2009). Not only is this breathtaking rate of consumption dire to the environment, as 25 billion tons of carbon dioxide seep into the atmosphere on a global scale each year (Kessler, 2008); it also necessitates an alternate form of energy to match pace with the masses. Biofuels have recently mushroomed in public awareness as a solution for all of the above issues. ... While demand remains too high for ethanol products to independently satiate all US fuel needs, it is readily within the nation's capabilities to offer an ethanol blend derived from sugarbeets at every gas station.

And Finally – Students Learning in Brazil

Expressed through

Snapshots in Writing

Which of these was written by an on-campus engineer?

Off-campus?

There are three main issues that interfere with green technologies becoming the main infrastructure today. The first is the simple fact that the laws and regulations do not require it. There is no push from a builder's standpoint to use technologies other than their tried-and-true methods if they are not being forced or penalized for failing to use green technologies. This leads into the second point that without a market, craftsmen will not learn a new craft. Green technologies require special knowledge and qualification to implement and install, which most general contractors today do not have. ... The third issue is education. At this time most developers still do not have the knowledge and wherewithal to use green infrastructures because there is still the common misconception that it is cost-ineffective.

The impact of Waste Electronics Recycling on humans is real, and ... it can be seen that water contamination will directly affect humans through the food we eat. The article does not specifically say what health issues come from the polluted environment, but chemically contaminated food and water is not healthy for humans and the necessary quality of food resources that is needed is much lower. As it can be inferred, if the food humans consume is contaminated and harmed, the animals that are being eaten are also be affected by the pollution. The ecosystem and humans are directly affected by pollution from Waste Electronics Recycling.

Connecting it all Together

The 2009 Biofuels Exploration Seminar in Brazil

In the Context of

The Study Abroad Literature

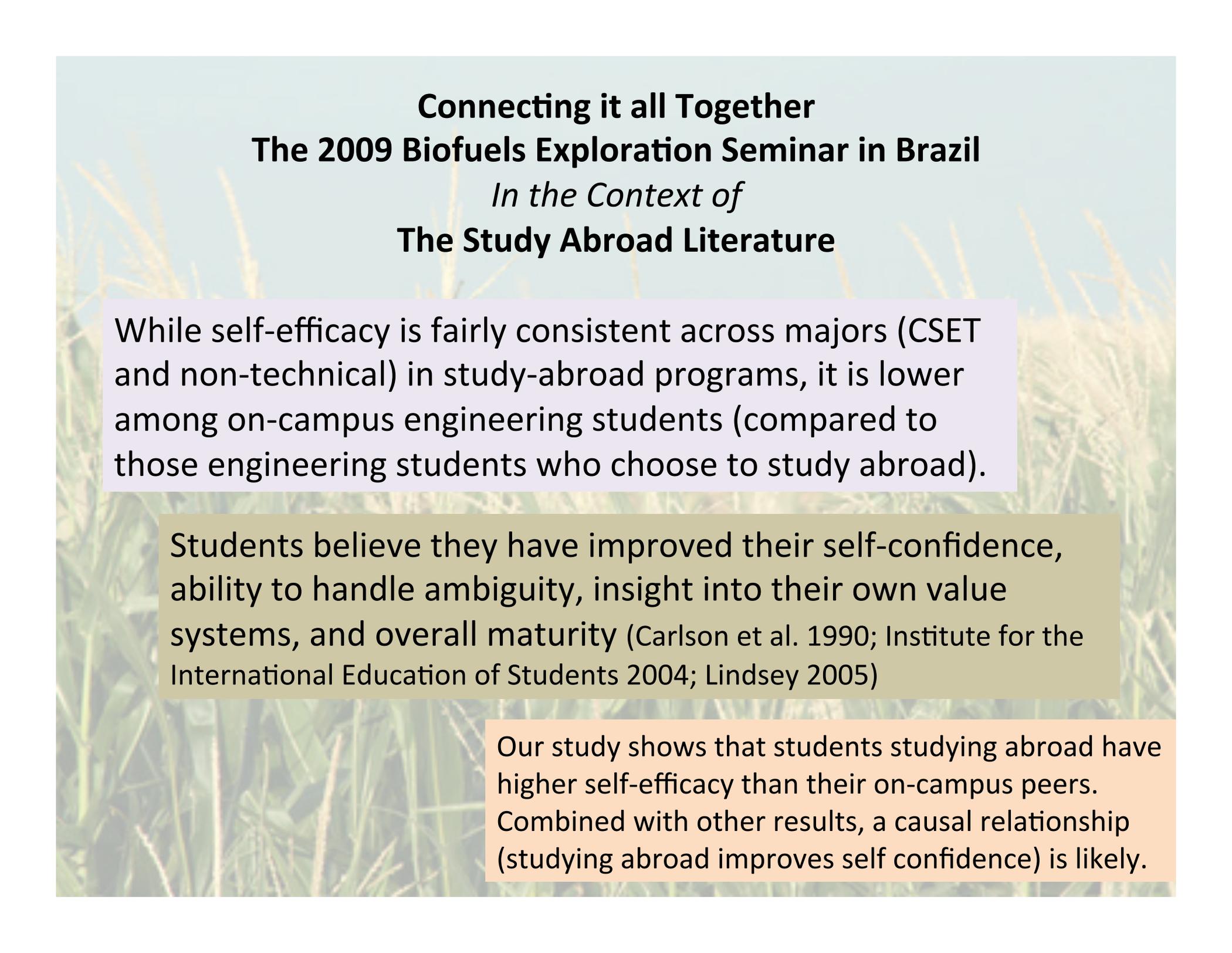
Students who have studied abroad develop:

- A deeper understanding and respect for global issues
(Carsello & Creaser 1976; Carlson et al. 1990; Douglas and Jones-Rikkens 2001)

Writing assignments show a deeper understanding and willingness to consider broader/global impacts.

Stronger intercultural communication skills (Anderson et al. 2006; Williams 2005)



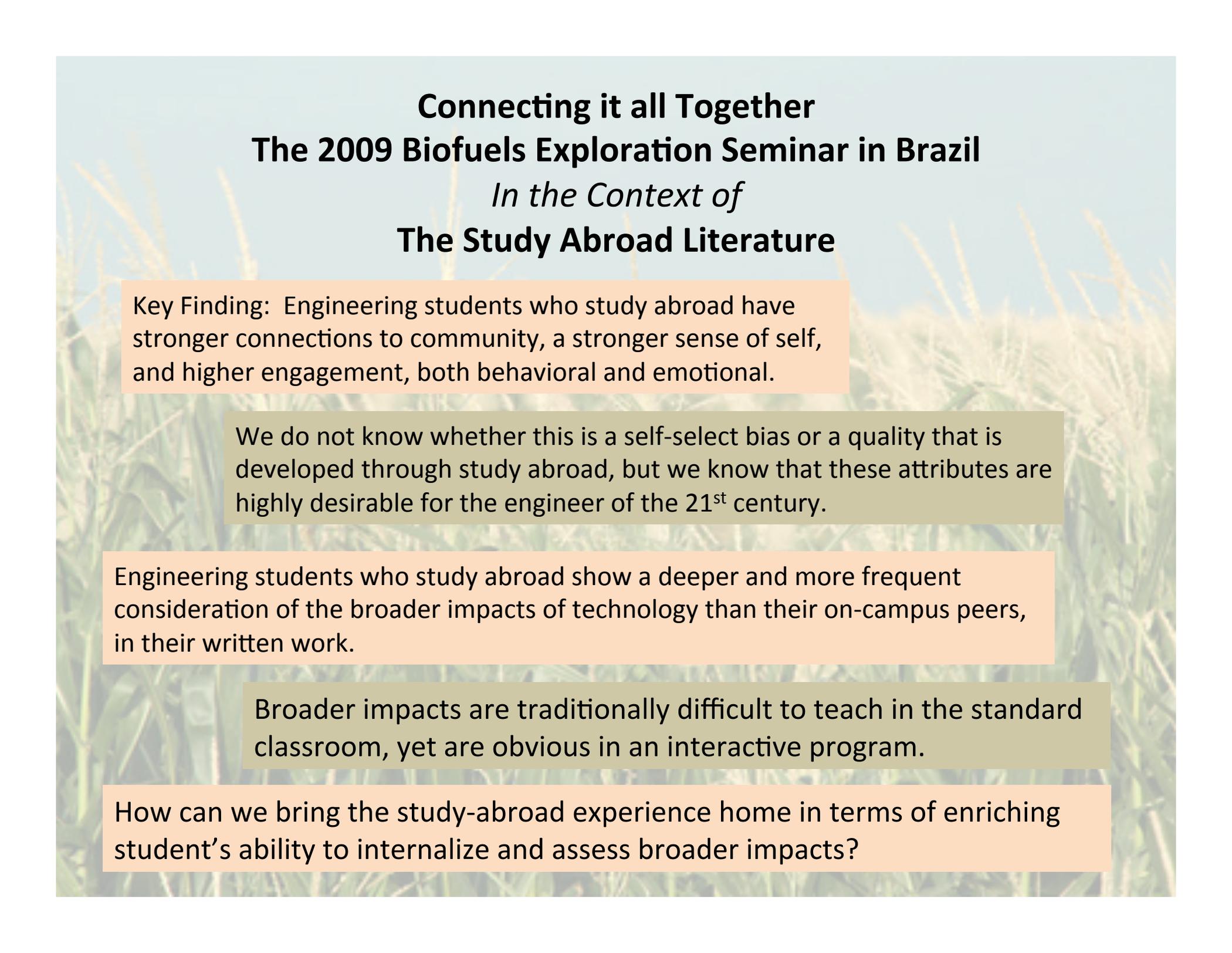


Connecting it all Together
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While self-efficacy is fairly consistent across majors (CSET and non-technical) in study-abroad programs, it is lower among on-campus engineering students (compared to those engineering students who choose to study abroad).

Students believe they have improved their self-confidence, ability to handle ambiguity, insight into their own value systems, and overall maturity (Carlson et al. 1990; Institute for the International Education of Students 2004; Lindsey 2005)

Our study shows that students studying abroad have higher self-efficacy than their on-campus peers. Combined with other results, a causal relationship (studying abroad improves self confidence) is likely.



Connecting it all Together

The 2009 Biofuels Exploration Seminar in Brazil

In the Context of

The Study Abroad Literature

Key Finding: Engineering students who study abroad have stronger connections to community, a stronger sense of self, and higher engagement, both behavioral and emotional.

We do not know whether this is a self-select bias or a quality that is developed through study abroad, but we know that these attributes are highly desirable for the engineer of the 21st century.

Engineering students who study abroad show a deeper and more frequent consideration of the broader impacts of technology than their on-campus peers, in their written work.

Broader impacts are traditionally difficult to teach in the standard classroom, yet are obvious in an interactive program.

How can we bring the study-abroad experience home in terms of enriching student's ability to internalize and assess broader impacts?

Questions?



Thank you!

