ASU LightWorks
ARIZONA STATE UNIVERSITY

Roundtable on Science and Technology for Sustainability

The National Academy of Sciences

asulightworks.com

Bill Brandt
ASU LightWorks
December 5, 2013

What happens if we don't solve global sustainability problems?

ASU quick facts

ASU is the largest university in the U.S. under a single administration with over 72,000 students

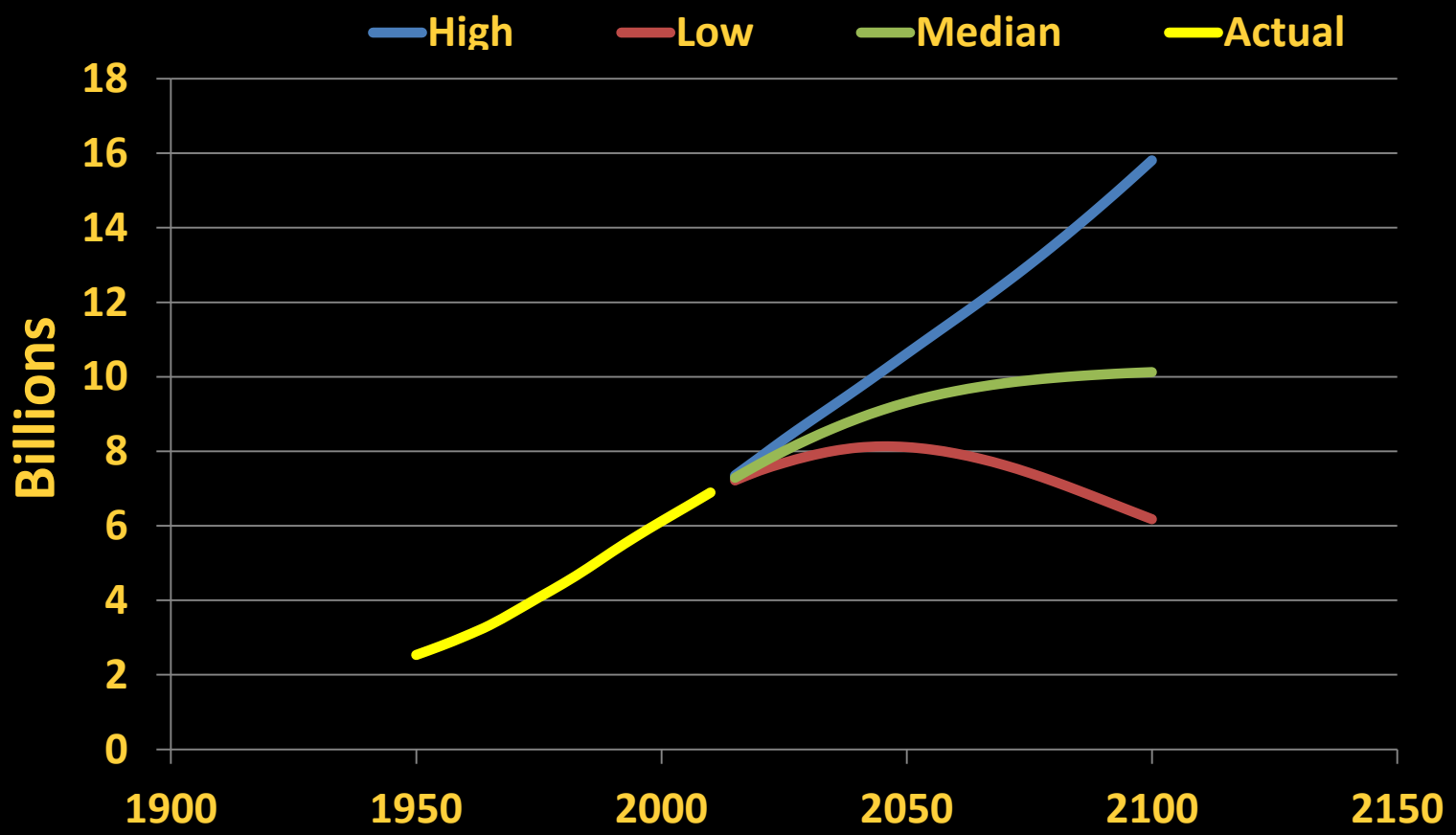
Conducted $386M in externally sponsored research in FY12

NSF ranks ASU in top-20 research universities w/o a medical school

Strong focus on “use-inspired” research

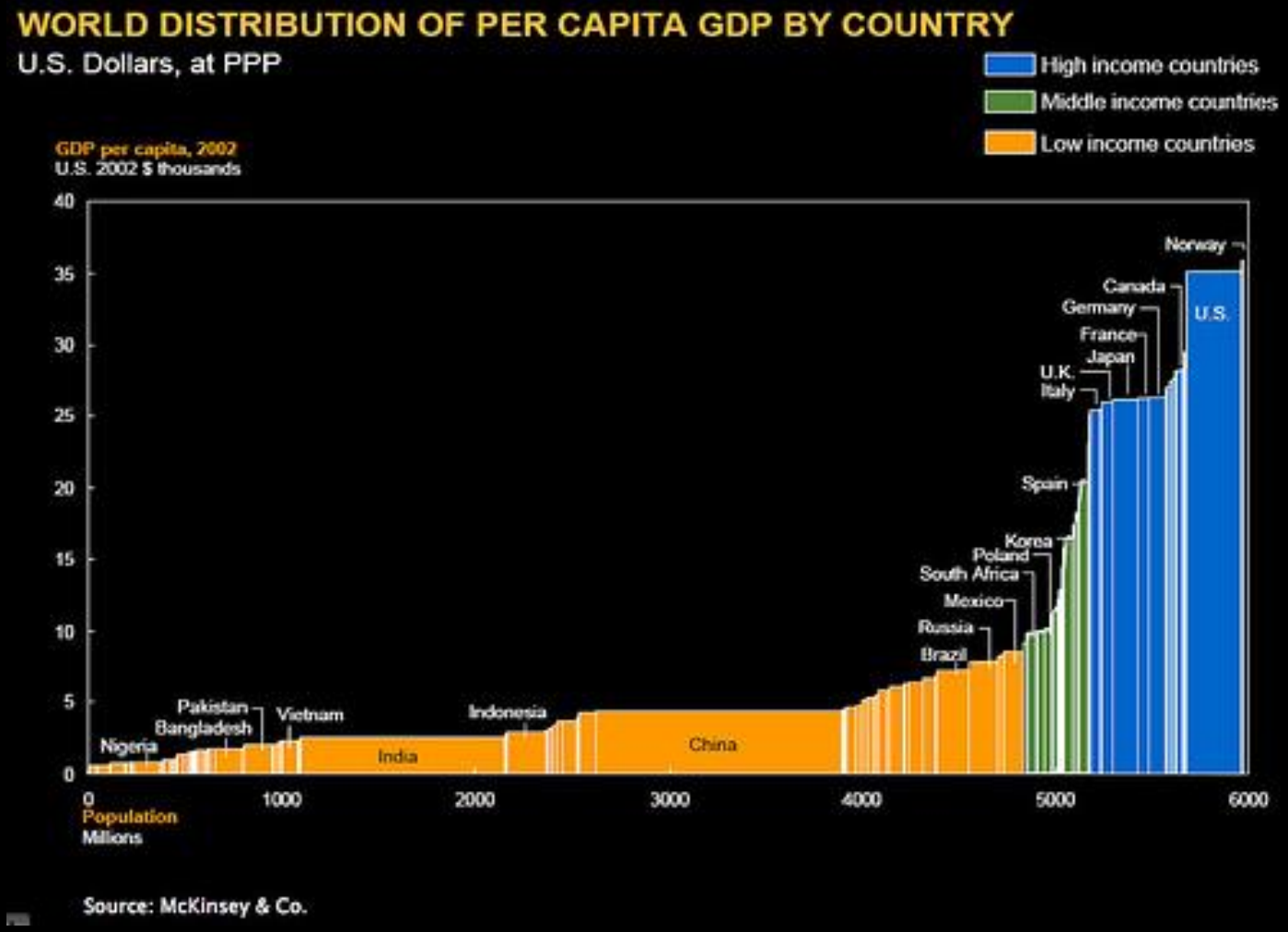
Global Institute of Sustainability

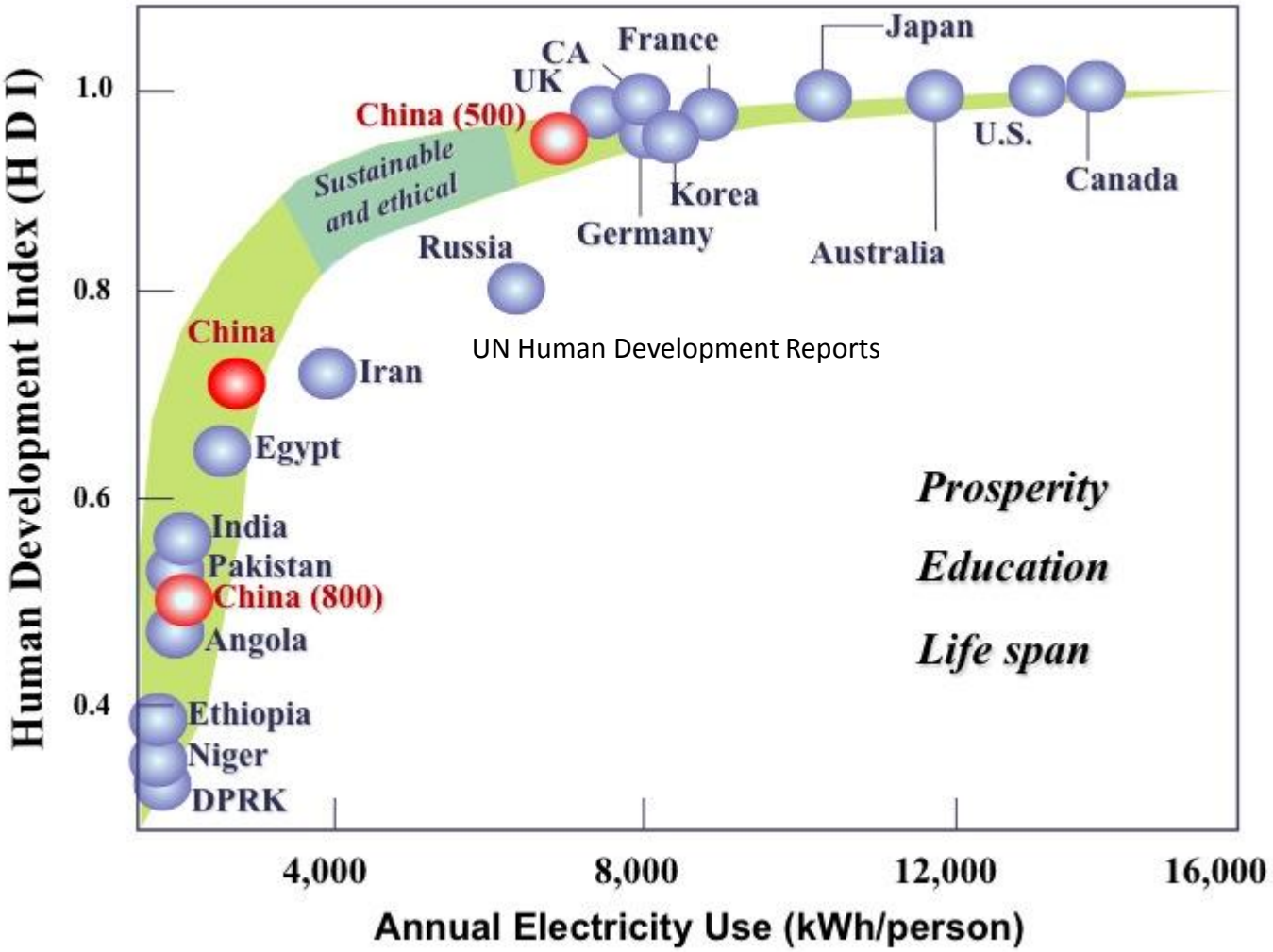
World Population



United Nations Department of Economic and Social Affairs

GDP per Capita





UN Human Development Reports

Wright and Conca, 2007

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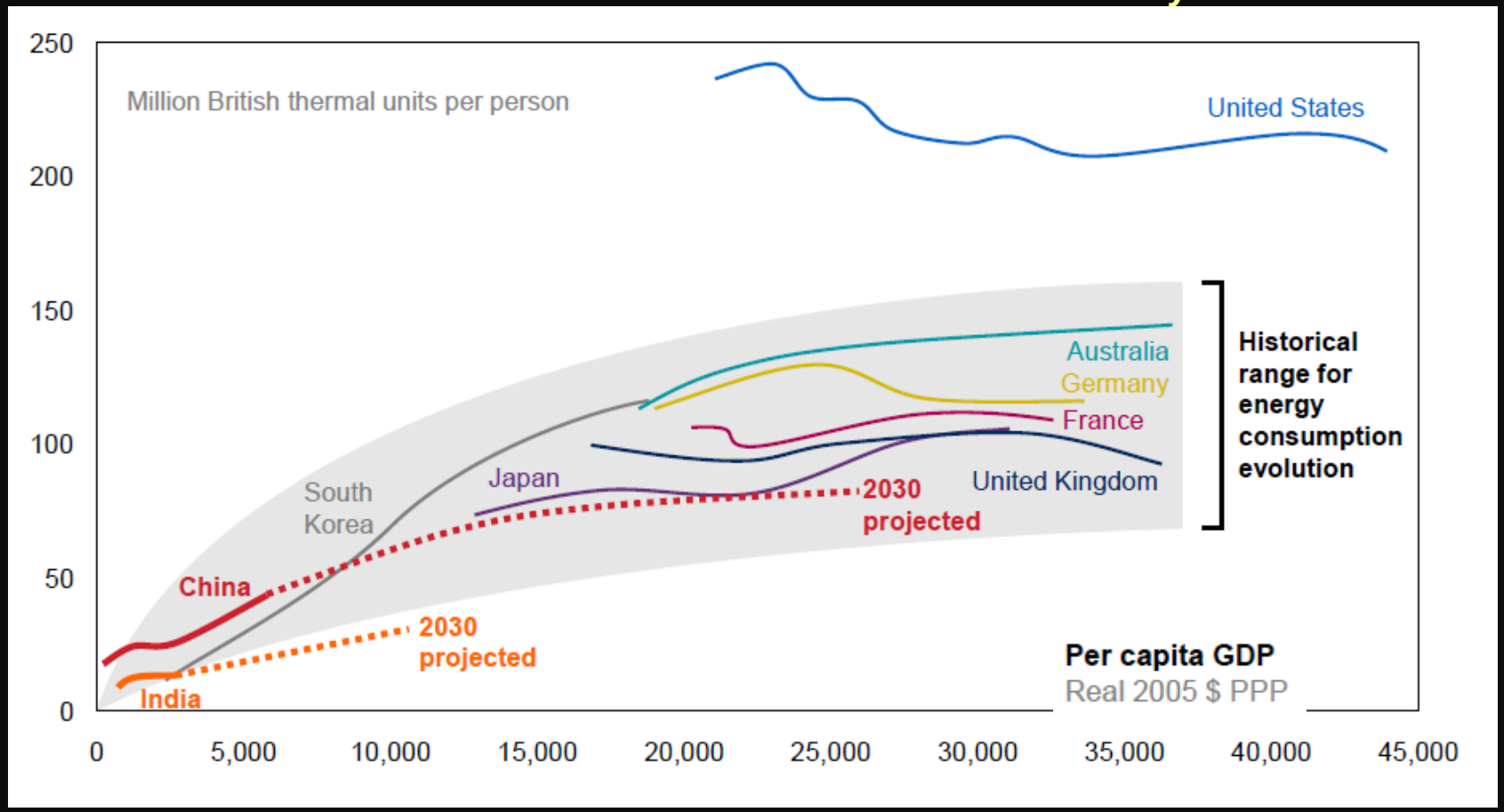
Energy and GDP

McKinsey Global Institute



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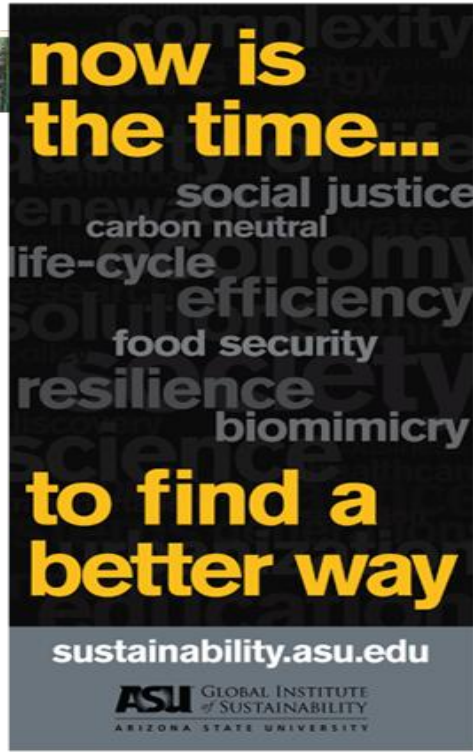
"The world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable -- environmentally, economically or socially."

IEA World Energy Outlook 2008



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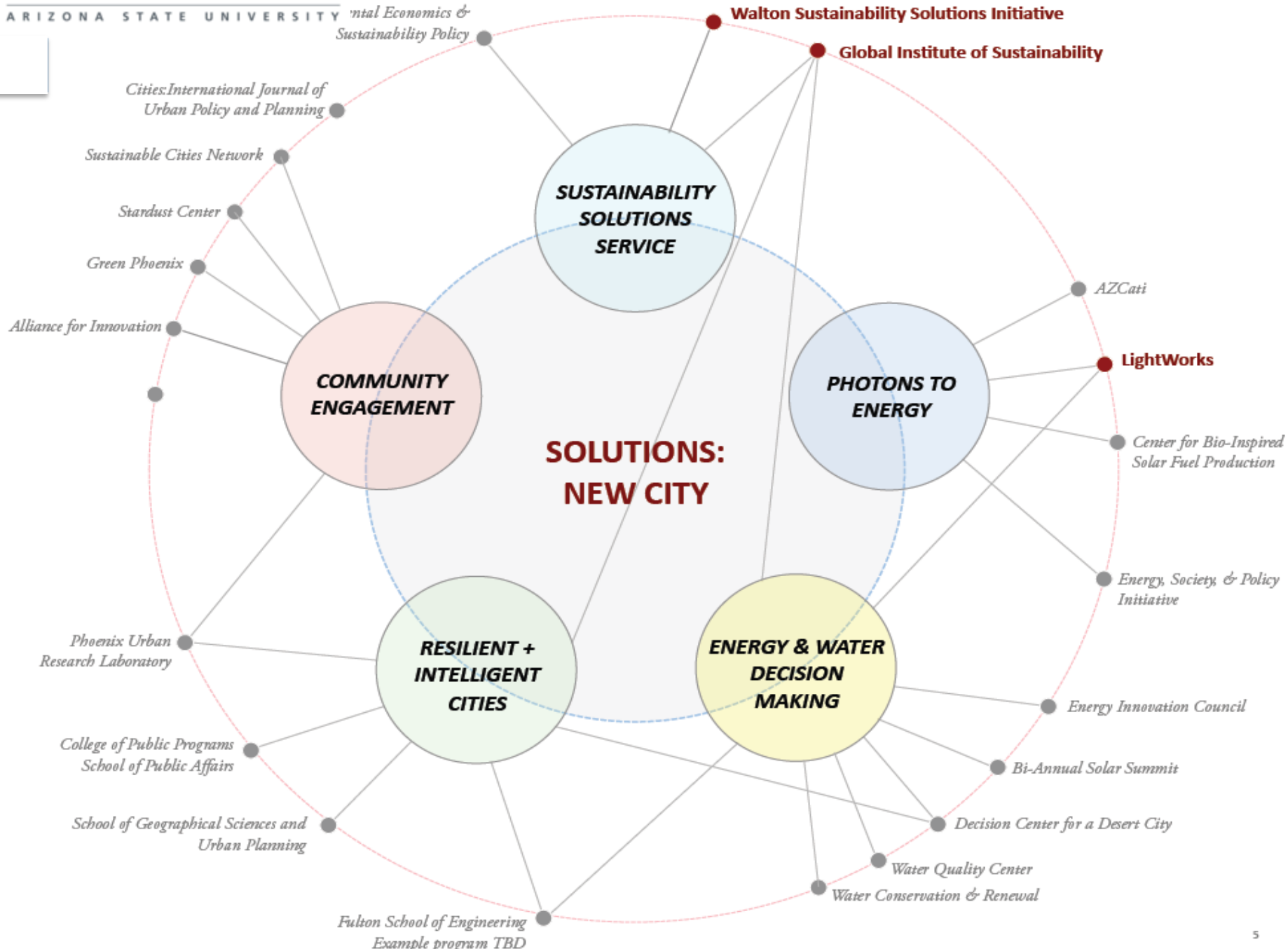

Next-Generation Sustainability Projects

Seed, nurture, and grow the sustainability science of tomorrow, using innovative approaches to problem-solving

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Why?

The world is faced with **“wicked problems”**—problems that resist solution and are “complex all the way down”

Traditional academic research alone may not be enough to address wicked problems

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At the core: solutions

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ASU LightWorks Vision

ASU will **inspire and develop** ways to revolutionize the use of energy and the large scale conversion of sunlight, carbon dioxide and water into useful products. We will support **creation of new industries** not just to power the world, but to empower it; not just to create wealth for a few, but to **enrich people's** lives everywhere; not just to light an energy revolution, but to enlighten communities across the globe; not just to achieve **energy security** but to secure **energy justice**.

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Communicating ?

It's time to move from

science to action

Given that our climate continually changes, we need to stimulate physical, policy, and behavioral transformation

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Water is liquid energy?

- The U.S. Geological Survey (USGS) reports that 53% of all fresh surface water withdrawn for human use in 2005 was used by power plants.
- In 2009 the water footprint of U.S. electricity was approximately 42 gallons per kilowatt hour (kWh) produced.
- Average U.S. household requires 39,829 gallons of water for electricity; five times more than direct residential water use.
- 13% of total electricity used to move, treat and heat water.

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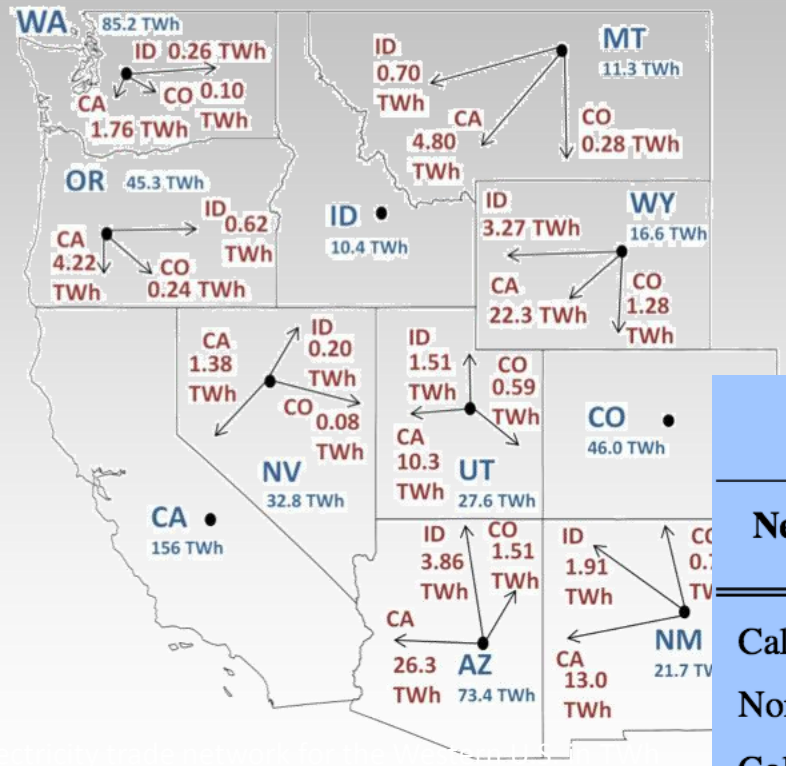
"Value Intensity" of Water



Electricity trade network for the Western U.S. in TWh

Embedded Resource Accounting identifies the value intensity of water embedded in electricity traded across the Western U.S.

TABLE 3
NET EXPORT OF EMBEDDED WATER IN ELECTRICITY

Net Export from Arizona to:	Martin and Ruddell (2012)	Scott and Pasqualetti (2010)
California	4,838 Mgal	7,984 Mgal
Northwest (Idaho)	709 Mgal	1,932 Mgal
Colorado	277 Mgal	-1,100 Mgal

Elizabeth Martin / Benjamin Ruddell

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Alternative Fuels

No shortage of fossil carbon

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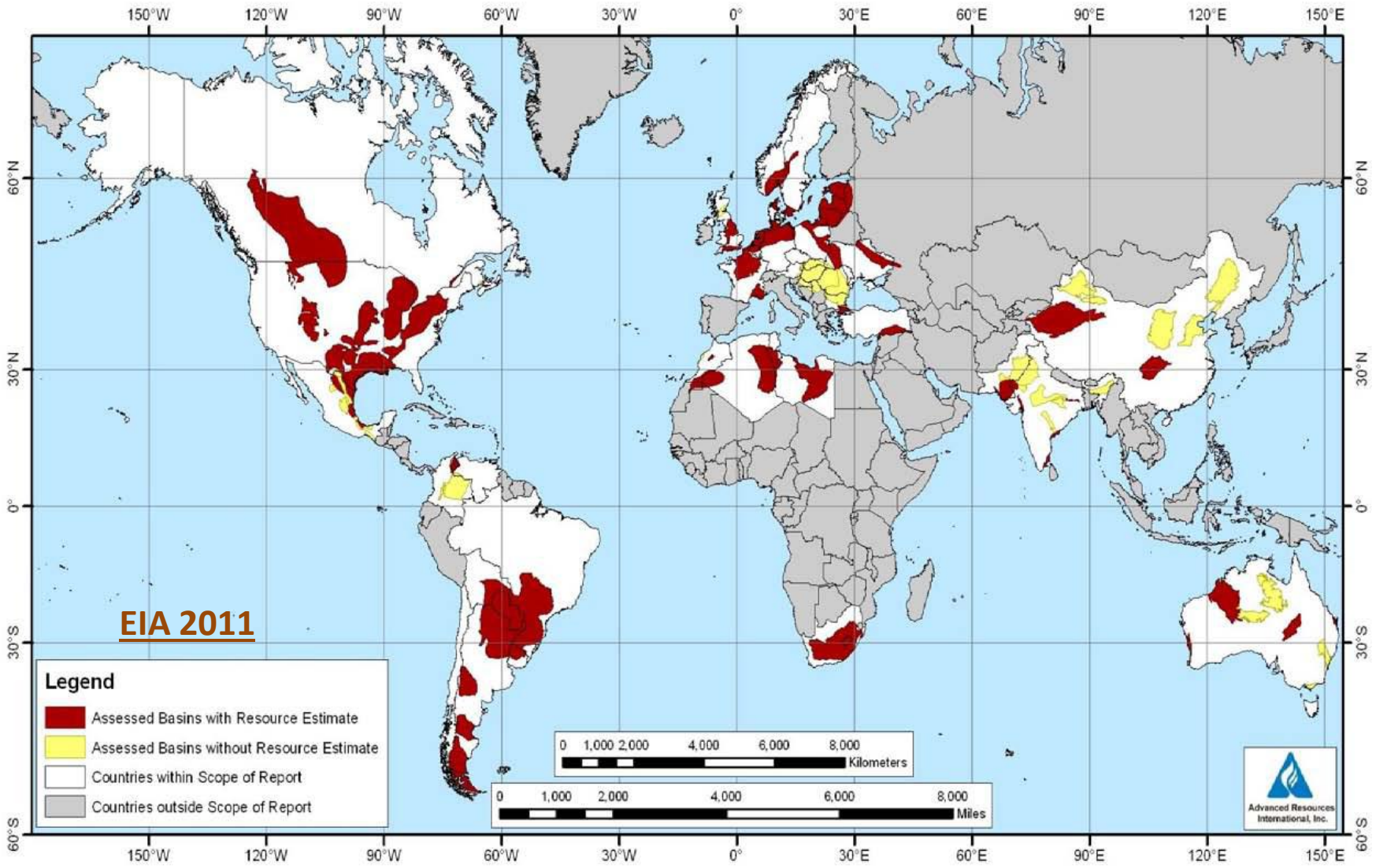
Shale Gas Reserves



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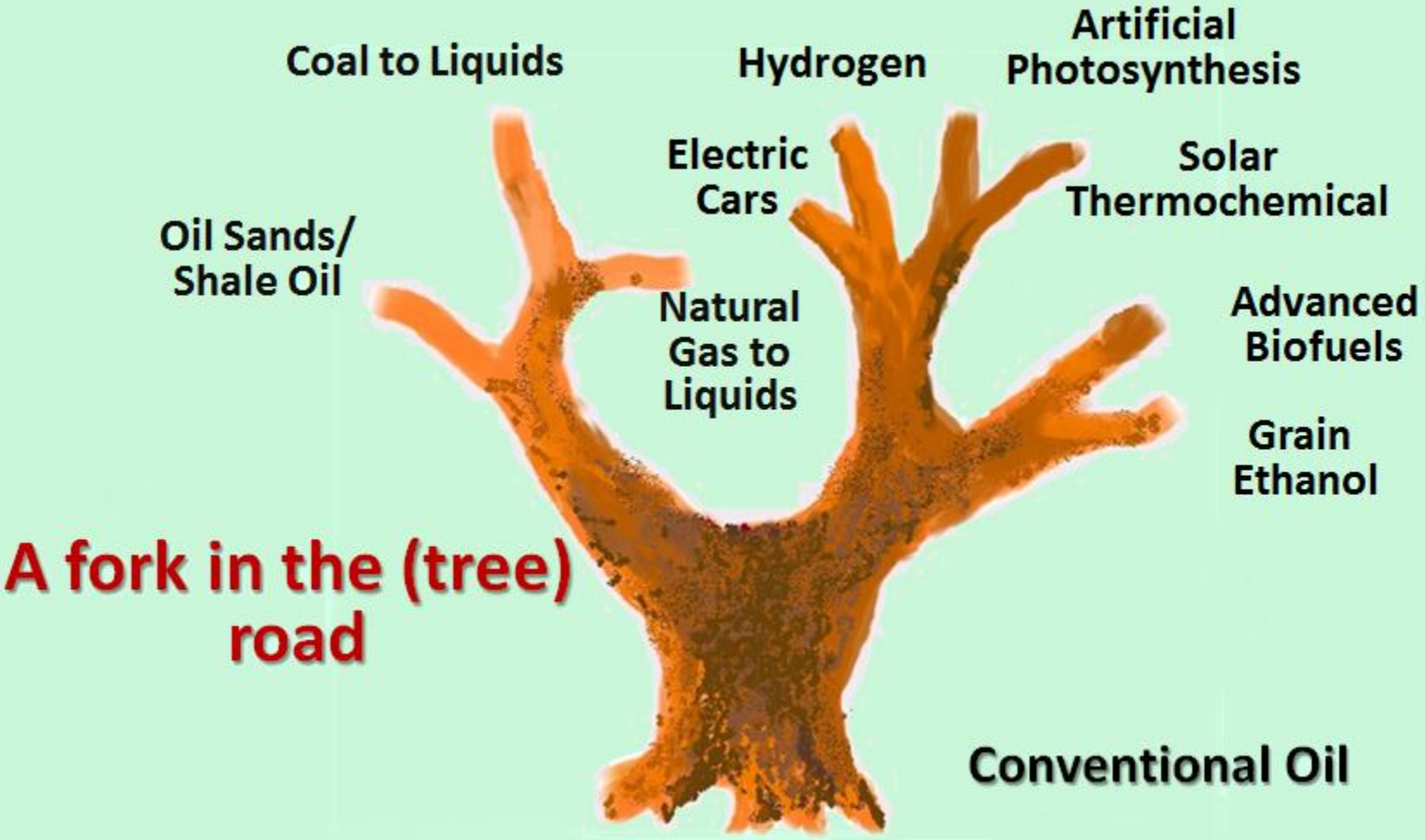
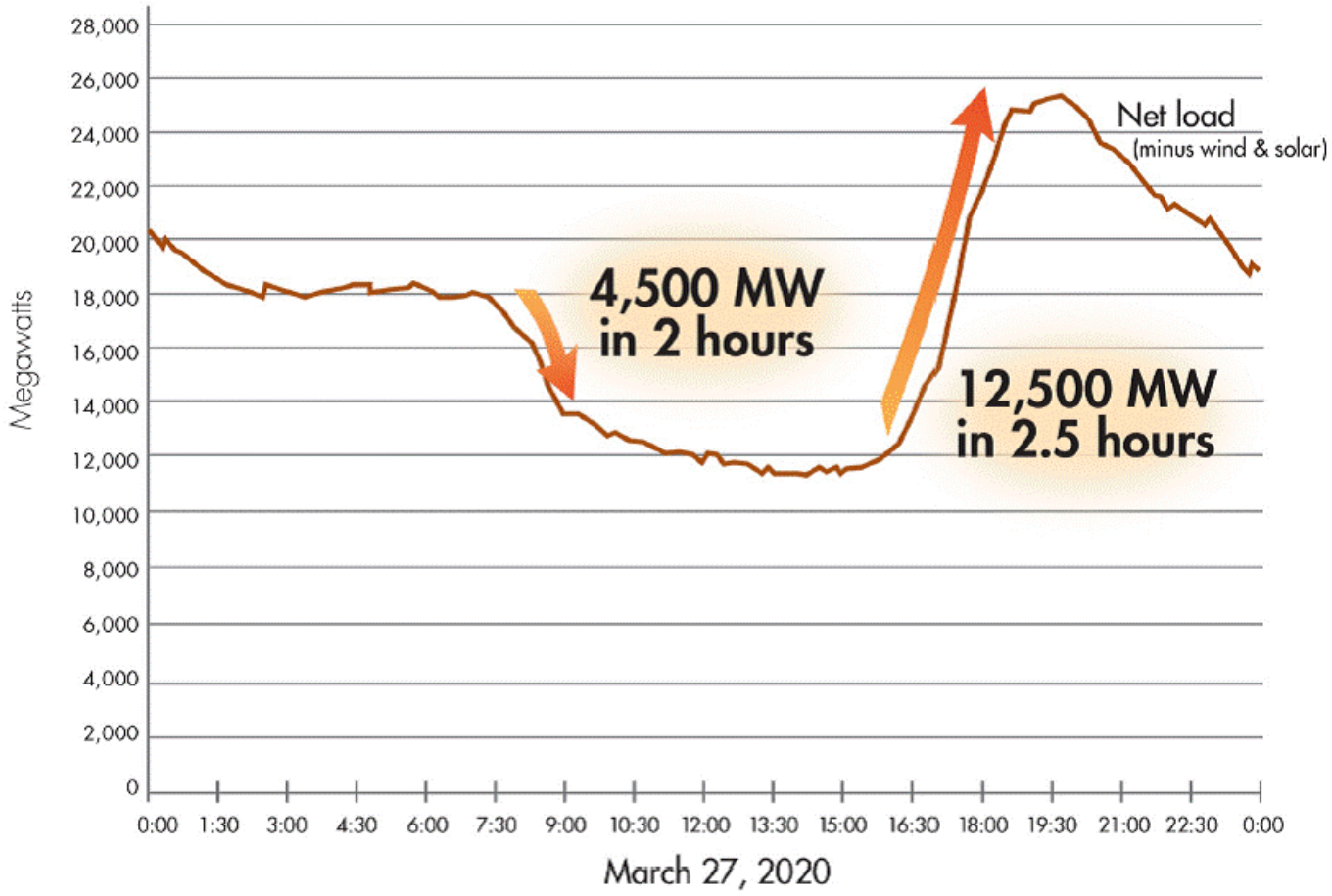
Choices to Be Made



The need for smart everything

CaISO "Duck" – an operators challenge



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ASU carbon neutral 2025

Energy (Primary Source)

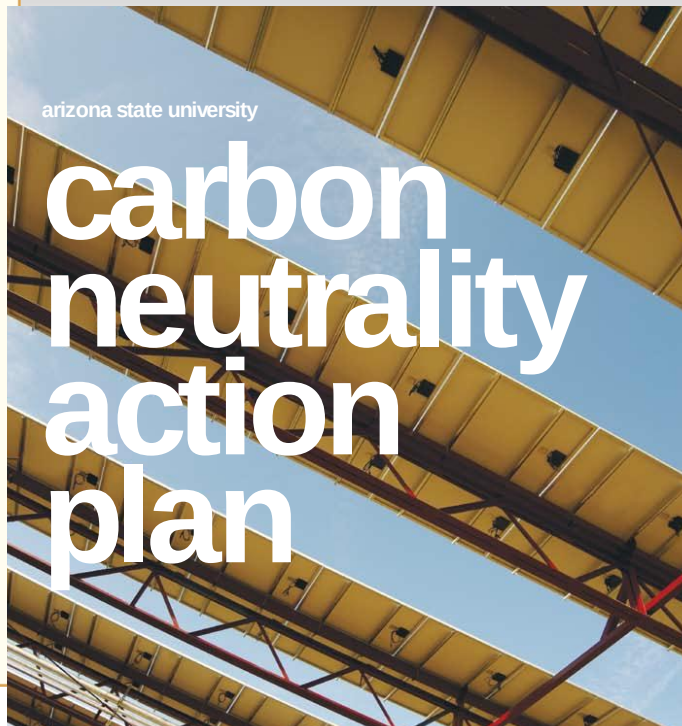
Purchased (all four campuses)
Current Sources: Coal Fired Plants, Hydro, Nuclear
Solution Strategy:
- Transition to On-site Renewable Energy Generation (Qualified Management Agreement or otherwise)
- Purchase Green energy generated by APS or SRP

Site Generated (Tempe Campus)
Co-Gen (Converts Natural Gas to 2 forms of energy)
Central Plant
Solution Strategy:
- Decommission Current Plants
- Identify alternative fuel source

-or-

- Capture and sequester emissions

Buildings/Infrastructure (all four campuses)
Solution Strategy:
- Energy Efficiency upgrades on all buildings, consideration in all purchases, performance criteria for all new builds and renovations
- Energy Conservation Education, Awareness, Engagement of the campus community
- Evaluate each campus as a system



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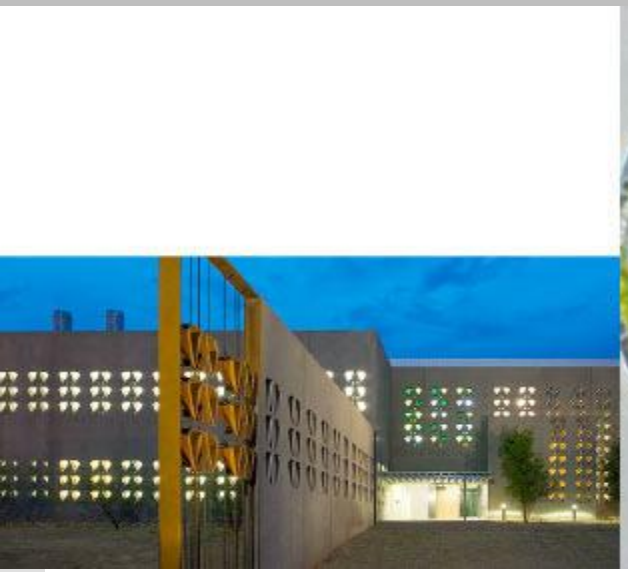
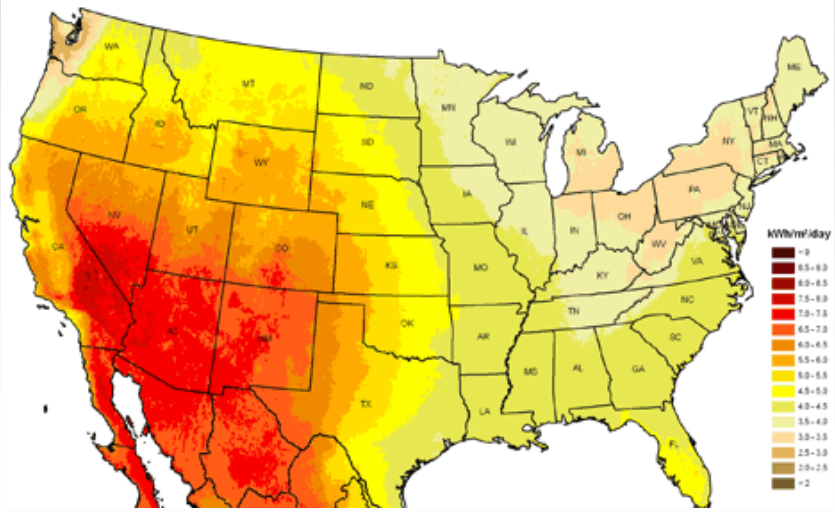
New high tech agriculture





Plenty of sunshine, but…

… less water.

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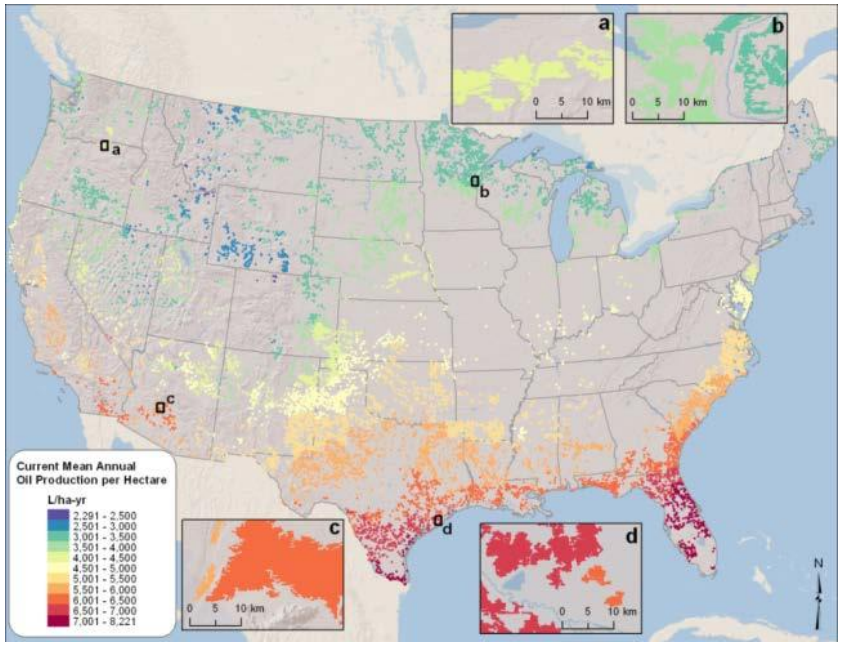
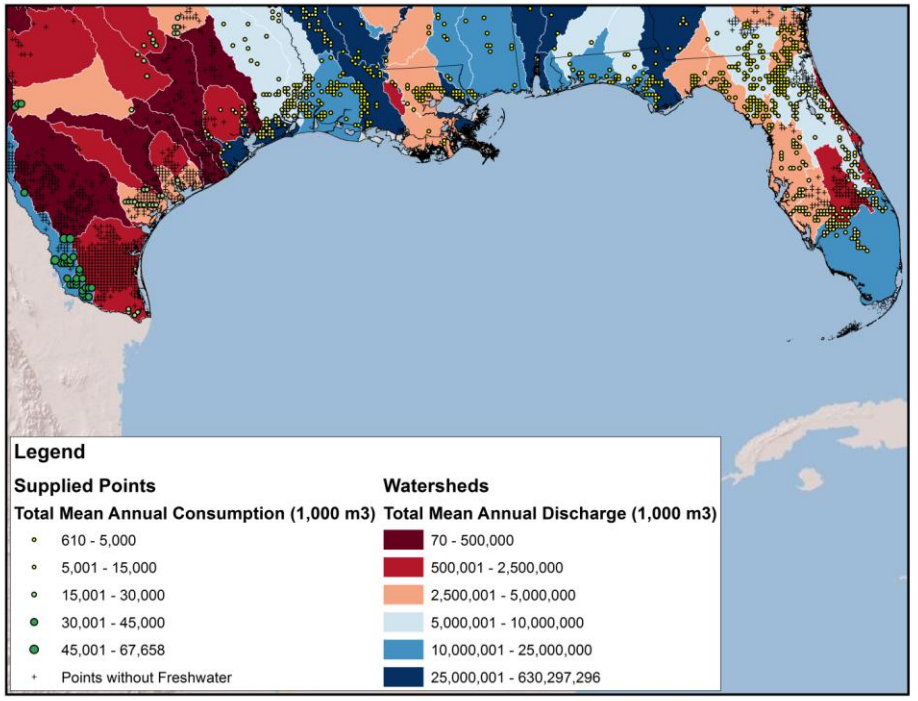
Water impact on algae agriculture

All Water option



Fresh water only



Davis, Fishman, Frank, Wigmosta – June 2012

ATP³ Algae Testbed

Public-Private Partnership

ATP³ Algae Testbed Public-Private Partnership

Our network is growing (11 partners, 6 testbed sites)

AzCATI Arizona Center for Algae Technology and Innovation

NREL National Renewable Energy Laboratory

Sandia National Laboratories

cellana algae-based products for a sustainable future

Cal Poly San Luis Obispo

Georgia Tech

UTEX The Culture Collection of Algae at The University of Texas at Austin

Valicor Renewables

Florida Algae, LLC

Commercial Algae Management, Inc.

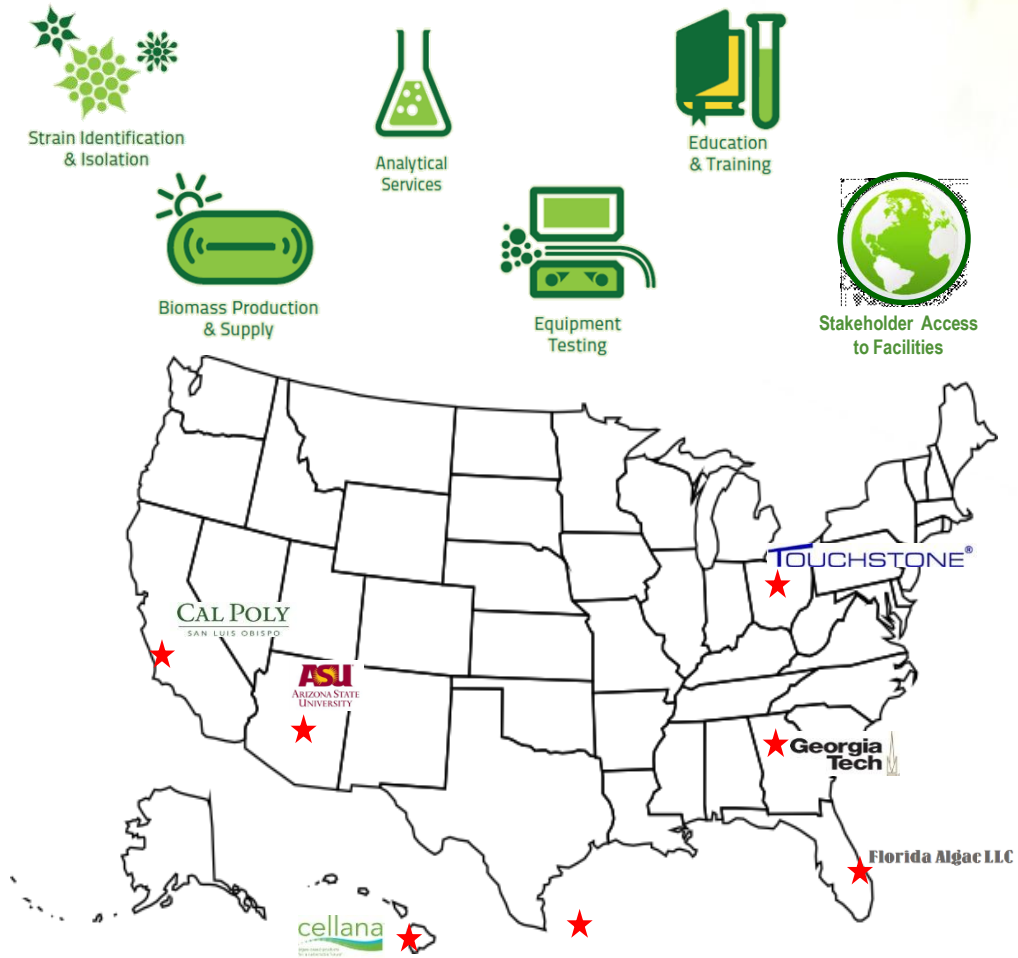
Touchstone®

ASU LightWorks

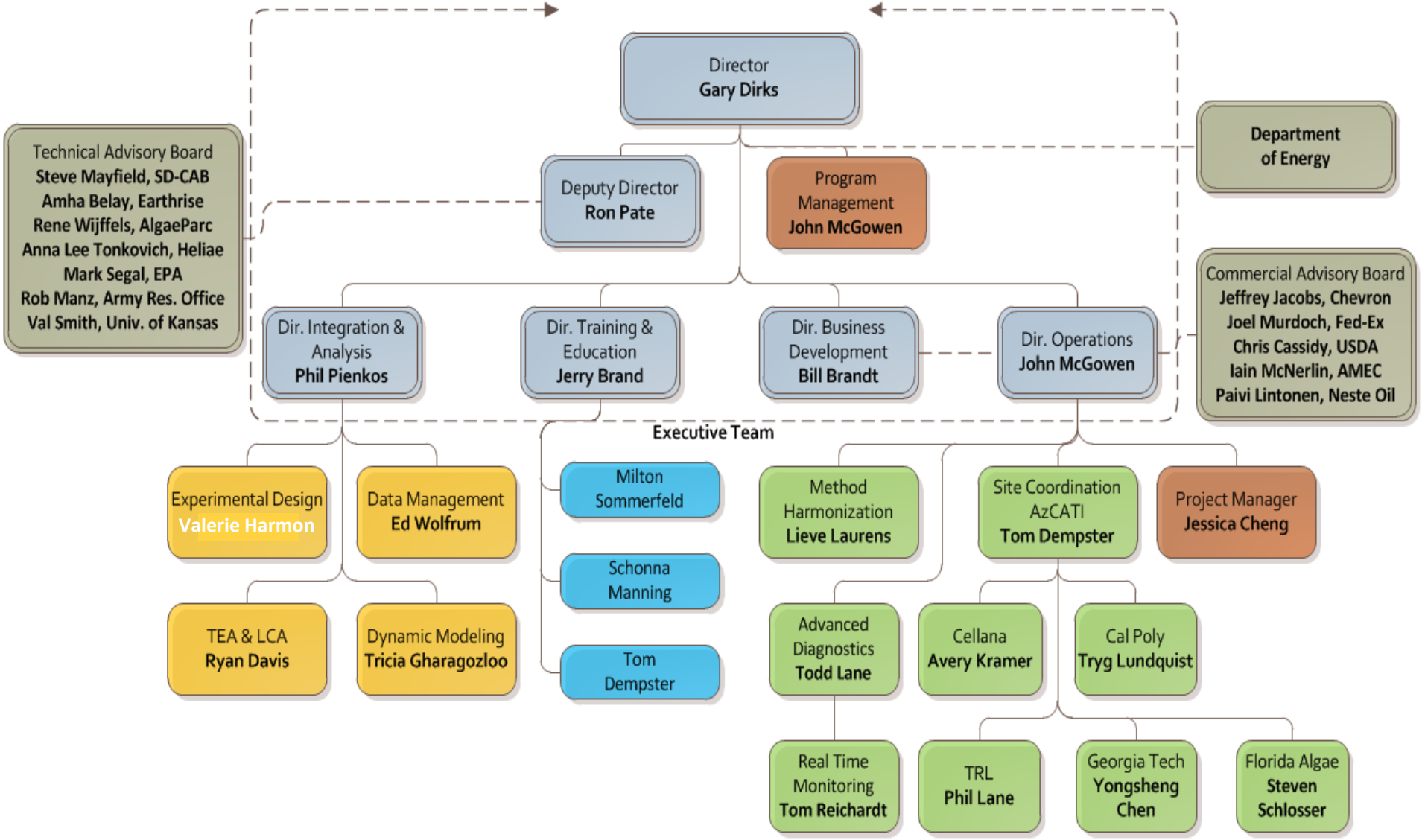
ASU Arizona State University

U.S. Department of Energy

Collaborative Open Testbeds



ATP³ Organization



Manage change

"If we don't change direction soon, we'll end up where we're heading"

IEA World Energy Outlook 2011