

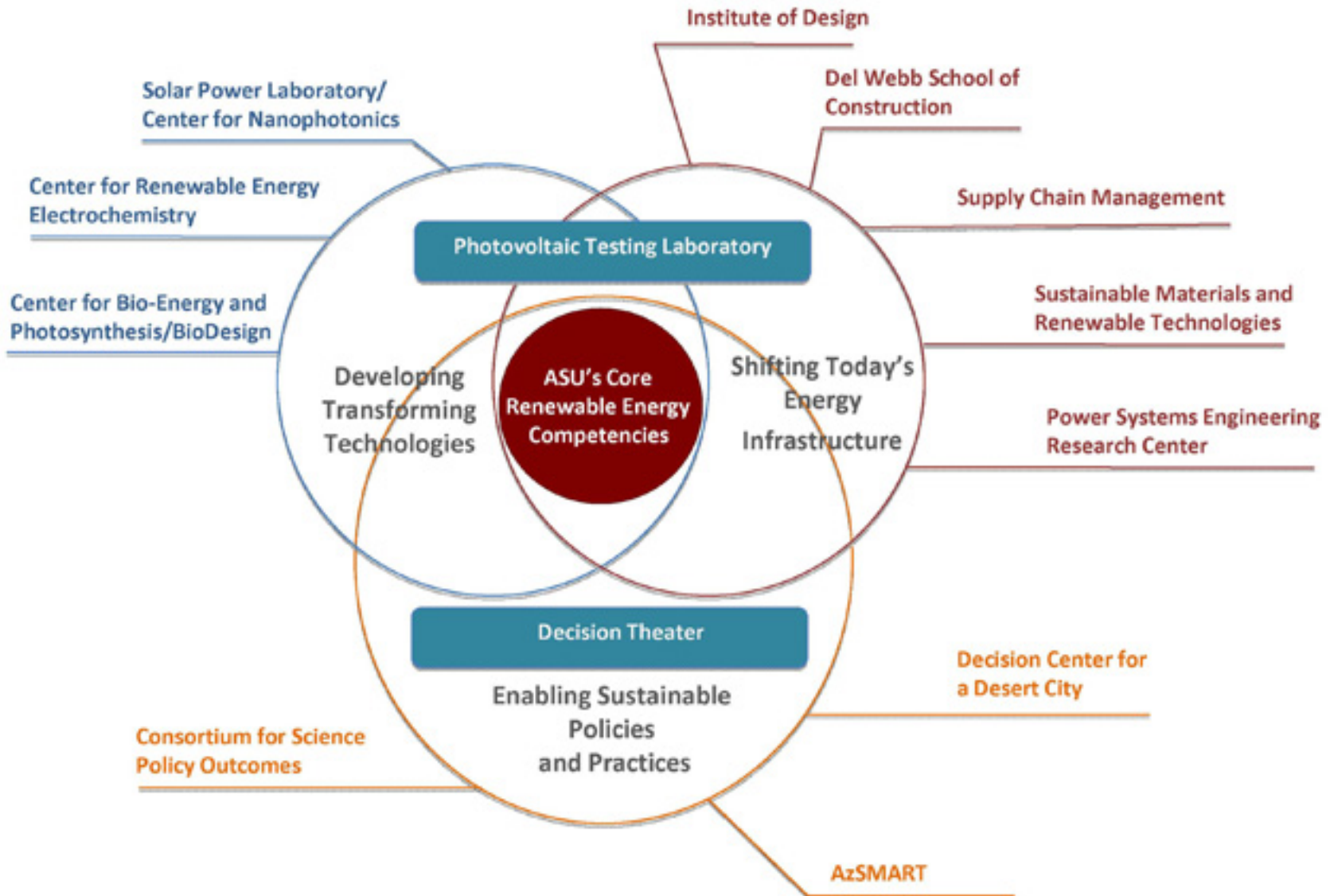
Discovery

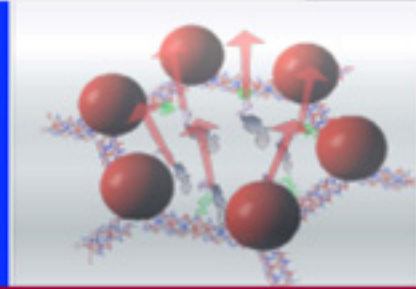
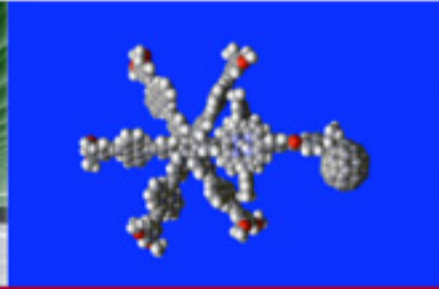
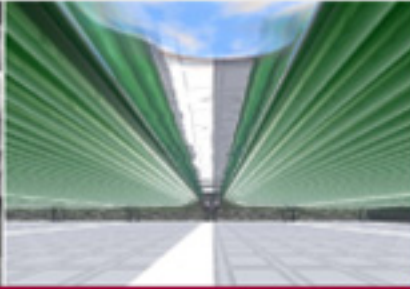
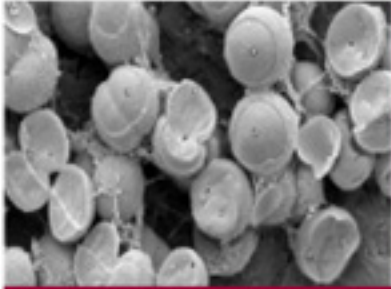
Excellence. Access. Impact.

Renewable Energy Summit February 11th, 2010

Stephen Goodnick

*Arizona Initiative for Renewable Energy
Arizona State University*





Biomass and Alternative Energy

Biometric Solar Systems



Sustainable Built Environment

Sustainable Policies and Practices



Reduced GHG and Carbon Footprint

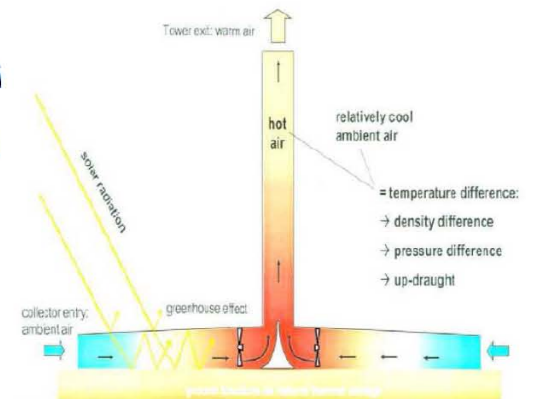
Photovoltaics

Intelligent Grid

Concentrating Solar Power (CSP)

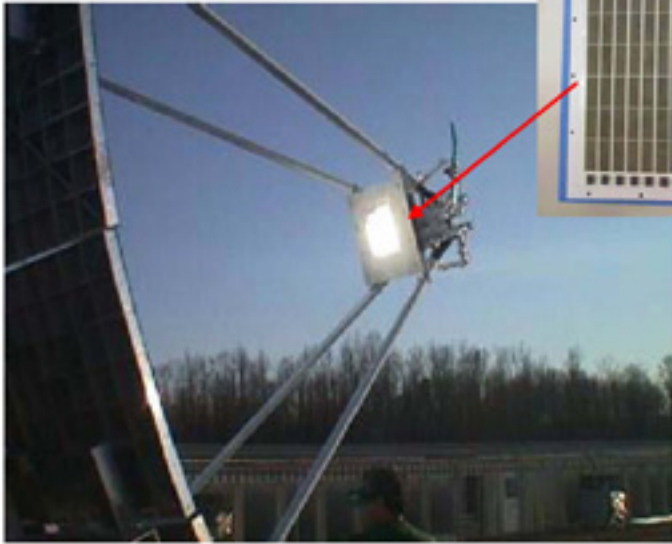


Figure 1: Above, power tower pilot project, pioneered in the U.S. (Barstow, CA) and (left) commercial unit under development by Abengoa called PS10, an 11 MW plant in Sevilla Spain (photo credit: Abengoa Solar). Bottom left, Stirling Dish/Engine, Center SEGS trough plants, Right, Compact Linear Fresnel Reflector.



Solar Tower (EnviroMission)

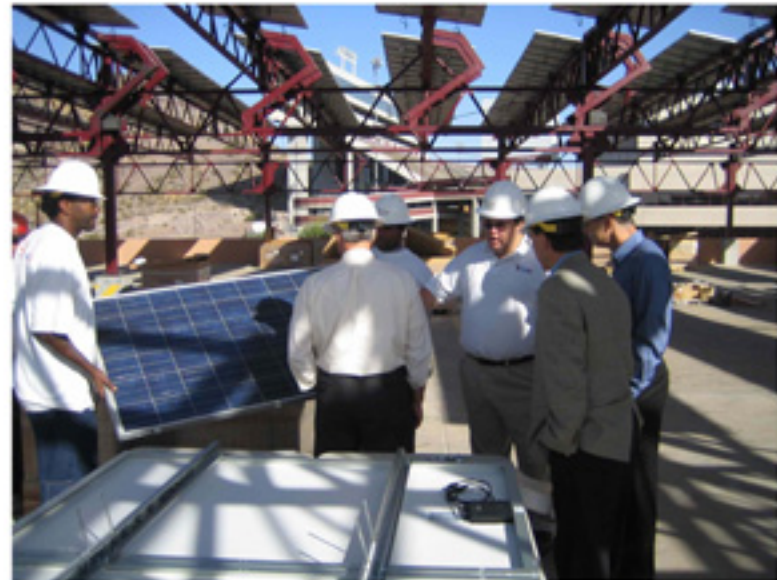
Photovoltaics (PV)



Concentrating Photovoltaic (CPV)



1 st Gen	Si, poly-Si
2 nd Gen	Thin Film
3 rd Gen	Multi-junction; nano-enhanced



ASU Campus Solarization



Flat panel photovoltaic (PV)

Nano-enabled 3G Solar Cells

R&D

Ensures technology ownership, enables DOE is the STEWARD

PV Module Production

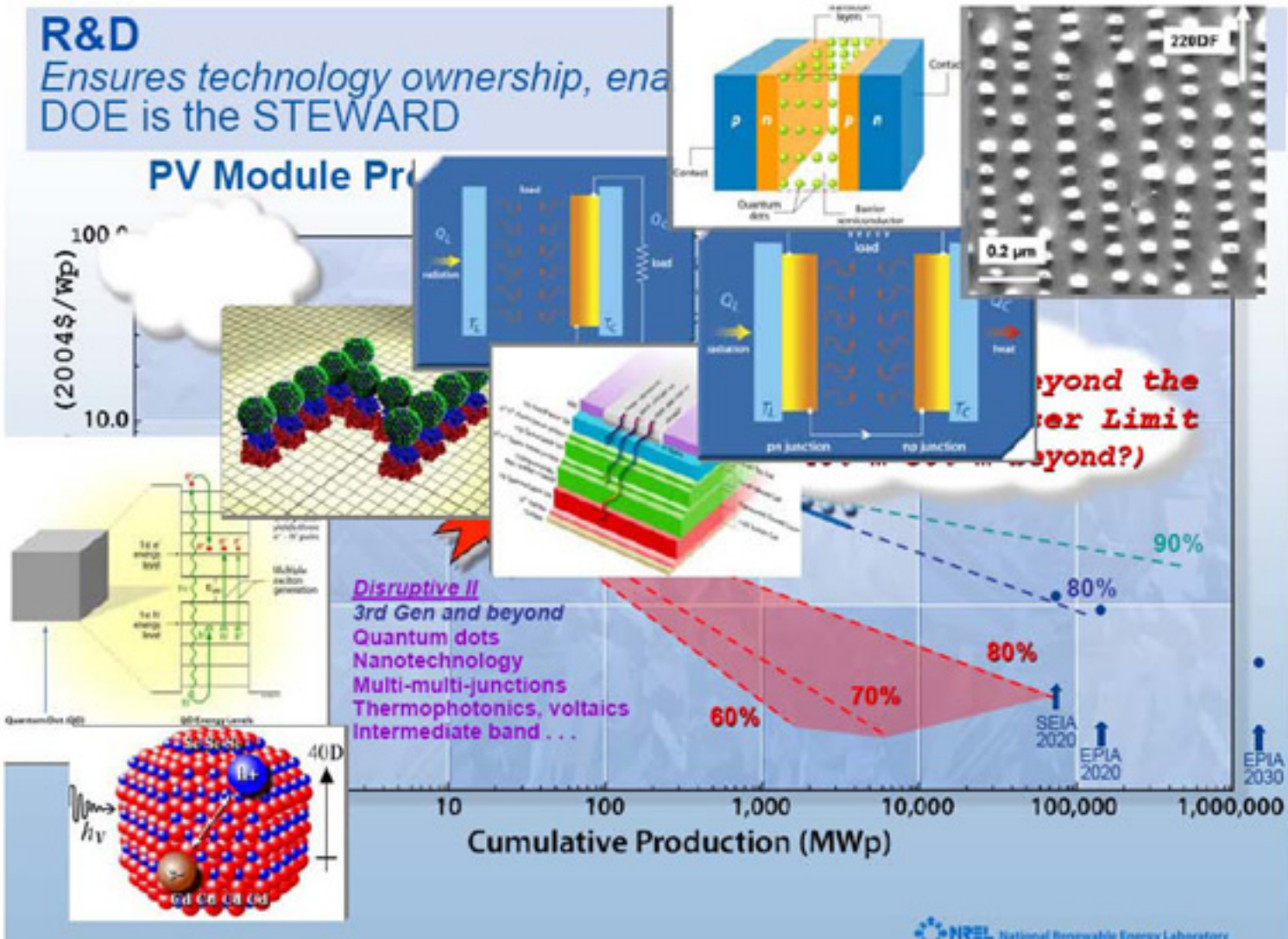


Table 2: Comparison of consumptive water use of various power plant technologies using various cooling methods

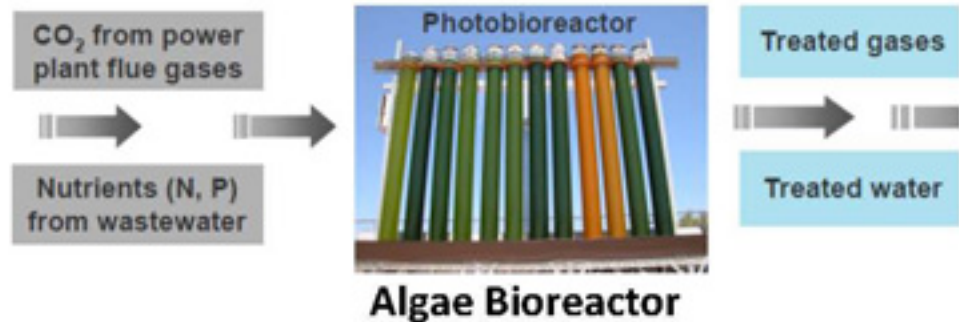
Technology	Cooling	Gallons MWhr	Perform. Penalty*	Cost Penalty**	Reference
Coal / Nuclear	Once-Through	23,000 – 27,000***			1, 3
	Recirculating	400 - 750			1, 3
	Air Cooling	50 - 65			1, 3
Natural Gas					
	Recirculating	200			4
Power Tower	Recirculating	500 - 750			(estm.)
	Combination Hybrid Parallel	90-250	1-3%	5%	10, 11
	Air Cooling	90	1.3%		9
Parabolic Trough	Recirculating	800			5
	Combination Hybrid Parallel	100-450	1-4%	8%	7, Appx. A
	Air Cooling	78	4.5-5%	2-9%	6, 9
Dish / Engine					
	Mirror Washing	20			5
Fresnel	Recirculating	1000			(estm.)

From “Concentrating Solar Power Commercial Application Study: Reducing Water Consumption of Concentrating Solar Power Electricity Generation” DoE Report 2007, http://www1.eere.energy.gov/solar/pdfs/csp_water_study.pdf

Microbial Biofuels

Photosynthetic Microbes vs. Plants

- superior energy conversion yield
- independent of arable land
- low water usage
- facile genetic engineering
- CO₂ from power plants can be used
- wide range of possible products/high purity
- rapid growth (short generation time)
- no limitation on seasonal growth
- efficient recycling of nutrients



Phase 1 (yrs 1-2)



Benchtop Photobioreactors



Rooftop Photobioreactors

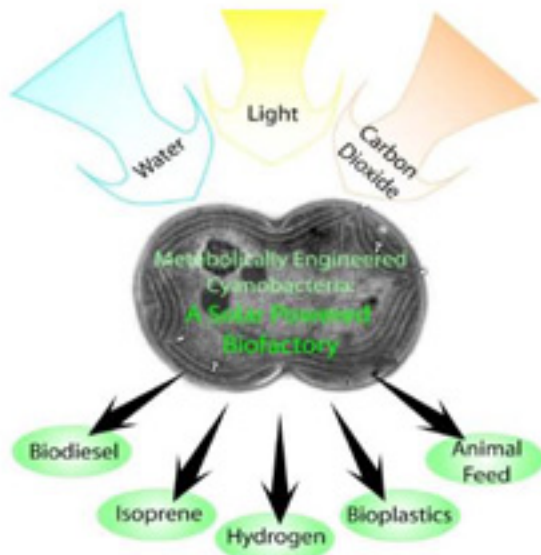
Phase 2 (yrs 3-5)



Notional Location to Depict Size

Phase 3 (yrs 5+)

Commercial scale deployment



Biofuels and Chemical Feedstocks from Cyanobacteria

Additional Information ASU Resources



Arizona State University

<http://www.asu.edu>

Office of Research and Economic Affairs

<http://asuresearch.asu.edu>

The Biodesign Institute

<http://www.biodesign.asu.edu>

ASU LightWorks

<http://asulightworks.com>

Arizona Initiative for Renewable Energy

<http://aire.asu.edu>

Global Institute of Sustainability

<http://sustainability.asu.edu>