



2011 World Materials Summit

Energy Fuels Panel

Chair	Russ Chianelli	UTEP
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James Brainard	NRL	
Jose Olivares	Los Alamos	
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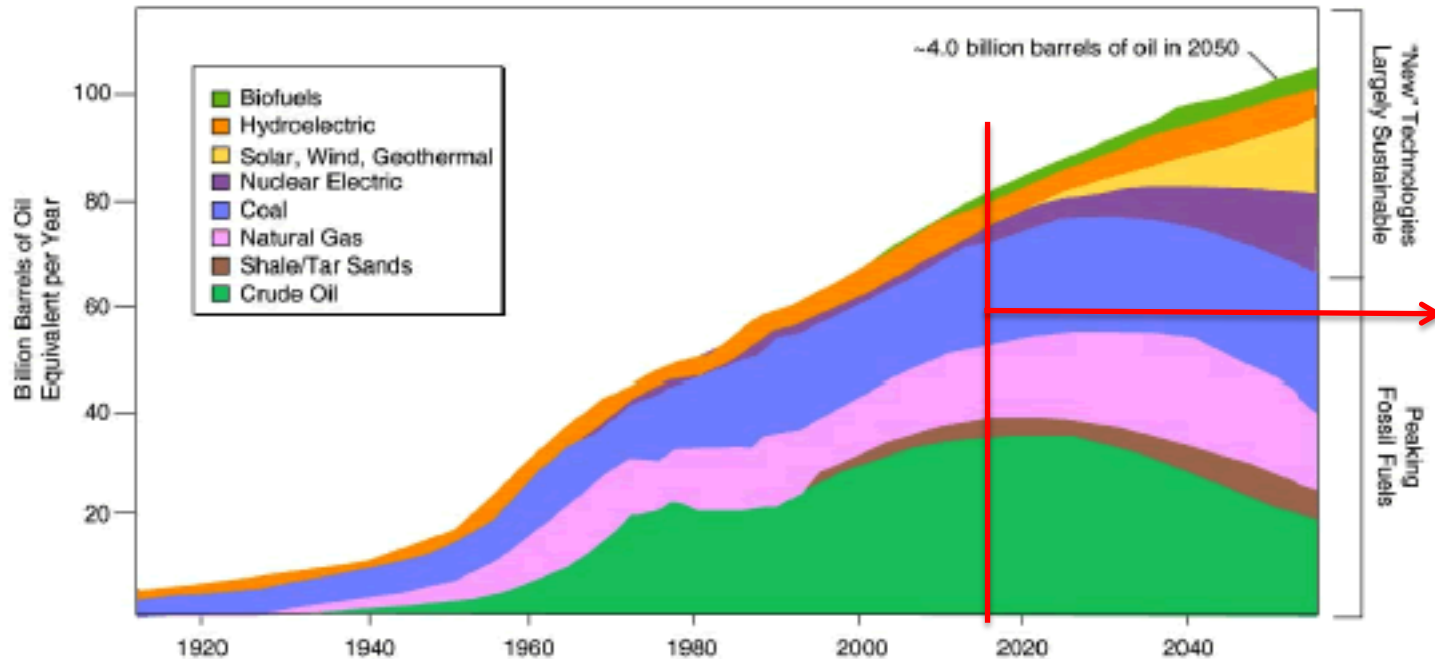
Major Technological and Research Opportunities

- Materials Science & Research **Basic** - Challenges
- Materials Science & Research **Applied** - Challenges
- Approaches to achieve future technologies – **Next Generation**
- **Green** Processes and **Green** Materials Approaches



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World Energy Demand—Long-Term Energy Sources

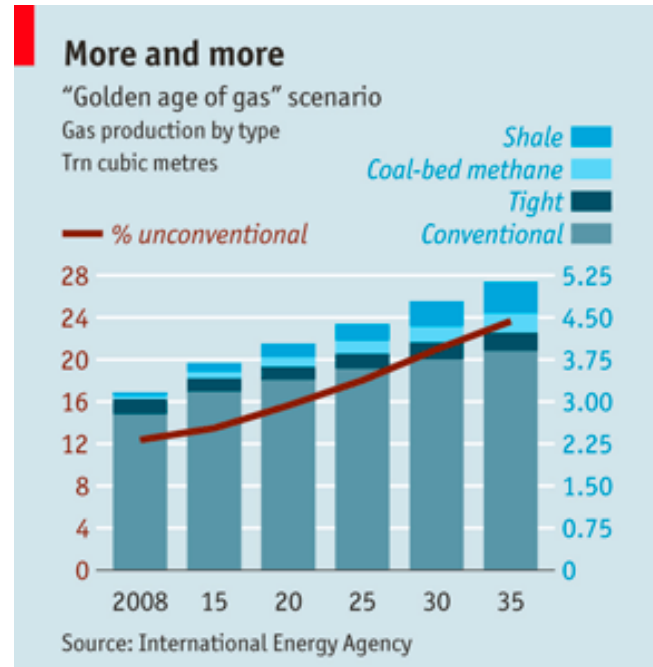


Sources: Lynn Orr, *Changing the World's Energy Systems*, Stanford University Global Climate & Energy Project (after John Edwards, American Association of Petroleum Geologists); SRI Consulting.

End of Oil 2006



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Areas of Study for Energy Fuels

Bio-Materials

Bio-Processing

Optimization of Bio-Fuels Production

Enzyme Catalysis

Catalysis

Photo-Catalysis

Carbon Capture

Materials for Safe Fossil Fuel Production



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Bio-Materials – Feedstocks for Bio-Fuels

Bio-Materials Structure

Lipids and Lignocelluloses

Bio-Materials Deconstruction

Bio-Processing

Metabolic Engineering

Bio-mimetic Systems and Materials

Synthetic Biology

Optimization of Bio-Fuels Production

Land, Soil, Water and Resource Use

Cultivation and Processing Materials



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Enzyme Catalysis

- **Cellulases/Lipase**
- **Enzyme Engineering**

Catalysis

- **Fundamental Understanding for Prediction of Catalytic Properties**
- **More Efficient Use of Fossil Fuels**
 - **Greener Processing**

Electro-Catalysis

- **Synthetic Fuels**

Photo-Catalysis

- **Artificial Photo-Synthesis**



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CO₂ Conversion

Catalysis

**Better Fischer Tropsch and Water Gas Shift
Processes**

Methane Reforming with CO₂

Electro-Catalysis

Synthetic Fuels

Photo-Catalysis

Artificial Photo-Synthesis

Materials for CO₂ Capture

Materials for Safe Fossil Fuel Production



Obstacles and Opportunities

- **Interdisciplinary Approach Required: Basic/Experimental/Application/Commercialization and Communication.**
- **New Funding Models Required for Interdisciplinary and Translational Approach to Research and Education. For example EU R&D through Innovation and NIH Translational Programs.**
- **Student Interdisciplinary/Transitional Teams need new funding mechanism.**
- **Reduce “Hype”: Effective science, technological, economic and energy balance evaluation.**
- **World implementation of Sustainable Energy for research and development. For example, “Scientists and Engineers without Borders”, Kenya and Nigeria and intergovernmental agency funding.**
- **International. *IP neutral*. Catalyst Testing Laboratories.**



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Energy Fuels for the Future

- Prepare *Now* through Research and Development for Transition to Bio-Fuels
- Discover Improved Catalysts for Energy Fuels
- Create Enhanced International Environment for Translational Energy Fuels Science