Academic and/or Company Research? …Or how should Universities take the lead with Energy Research?

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The Thematic Paradigm Shift @ Rice

- Nanotechnology
- Bio sciences/engineering
- Environmental
- Information Technology

- Energy
- Health
- Urban Sustainability

Rice
The Rice Energy Vision

“Building the bridge to a sustainable, affordable and secure energy future.”

The image of the “bridge” conveys that Rice is, building a bridge to the future working simultaneously from both sides of the bank.

Near-term need to maximize the availability and minimize the environmental impact derived from fossil fuels

Realize a future in which global energy demand is met by affordable energy from renewable and sustainable sources

Rice does not conduct research across the entire spectrum of existing and future energy technologies…

Research at Rice is applicable to critical areas…

Working from the “future bank,”
Nano-applications to Energy.
• Nano-photonics - solar power and low energy lighting
• Armchair quantum wire
• Fuel cells, and energy storage

Biomass to Energy and Chemicals.
• Biobutanol
• Glycerol fermentation
• Cellulosic biomass
• Computational analysis of bio-systems and genetic network design and life cycle analysis

Cutting-edge Science and Engineering Applied to Fossil Fuels.
• Seismic imaging techniques
• Unconventional oil and gas recovery
• Gas hydrates
• Nano-sensors

Cross-cutting research.
• Science and policy research conducted by the Rice Energy Program
• Inter-departmental research assessing the environmental consequences of energy choices
• Educational programs
The Distributed Storage-Generation Grid:
One World Energy Scheme for 2050

Single Walled Carbon Nanotube (SWNT) fibres are spun into quantum wires, to re-wire the grid.

Vast electrical power grid
- Continental scale
- Interconnect asynchronous "local" storage and generation sites
- System continually innovated by free enterprise

'Local'
- House, block, community, business, town, ...
- Local storage: batteries, flywheels, hydrogen fuel cells, supercapacitors, etc.
- Local optimization: days of storage capacity, quality of local power

Local generation
- Solar, geothermal, wind, etc.
- "Buy low, sell high" to electrical power grid

The Benefits of the Quantum Wire:
- Expected Features
  - 10x Copper Conductivity
  - 6x Lighter
  - Stronger Than Steel
  - Zero Thermal Expansion
- Key Grid Benefits
  - Reduced Power Loss
  - Low-to-No Sag
  - Lightweight
  - Higher Current-Carrying Capacity
- SWNT Technology Benefits
  - Type Specific
  - High Purity
  - Low Cost
  - Scalable Processing

The World of the Grid:
- Global grid
  - Robust
  - Massive primary power input to grid via HV DC lines.
  - New input from vast solar farms in deserts, wind, NIMBY nuclear, clean coal, stranded gas, wave, hydro, biomass, space-based solar... "Everybody Plays"
- Ethanol / Methanol / Hydrogen are transportation fuels
- Transition technology – Plug-in Hybrids

Rick Smalley's vision of a global energy network.
Commercialization of Nano Solutions

• Rice University spinout
• Energy-focused nanoproducts company
• Tight initial focus on developing and commercializing *OxProp* a “controlled buoyancy proppant” that is expected to *materially* enhance oil and gas recovery

*OxProp* Payback: 82 days
Customer IRR: 410%

- Improved reservoir permeability and flow rates
- Extended total reservoir recovery and well life
- Fracture design flexibility and control – stay “in zone”
- Environmental impact

![Diagram of *OxProp* properties and payback](image)

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**Optimal range**

- Spherelight
- Sintered bauxite
- “Lightweight” ceramic
- Resin-coated sand
- Sand

**Schematic of *OxProp***

- Reservoir expansion
- Horizontal wells
- Recoverable (5A) = 98 Tcf
- Reserves = 20 Tcf
- 2005 Production = 2.56 Bcfld
Integration of the Biofuels Industry

The Problem - The production of biodiesel in the US increased by 10-fold in the last two years. Each gallon of biodiesel inevitably generates 0.75 lb of glycerol.

The Rice solution - Anaerobic fermentation of glycerol - EtOH and H₂, succinic acid (raw material)
Stewardship and Social Impact

• Socially responsible business
  • Local negotiations and needs

• Public perceptions and policy

• Community involvement
  • Stewardship of resources
  • Community impacts

• Life cycle engineering
  • Environmental impact of CO₂
  • Bio fuels impact of production, distribution, etc.

• Rice strength in interdisciplinary systems
  • Economic policy, environmental impact, technology risk
  • Public policy relating to technology implementation
Why Research @ University?

Oil producers
Service companies
Downstream
Chemicals

Interdisciplinary and Integrated
Why Rice?

• The Rice Consortium Approach
  • Scale and complexity
  • Strengths of multiple centers & universities

• Why this is the Best Approach?
  • Synergistic expertise
  • Shared risk, shared load, and shared reward

• Why Rice is a Good Consortium Member - “No borders”
  • Collaboration is an intrinsic part of Rice University
  • Rice’s small size (low student to faculty ratio = 5-to-1)
  • Leverage our resources and deliver significant results

Consortium for Nanomaterials for Aerospace Commerce and Technology (CONTACT)

Gulf Coast Consortia (GCC) - Rice acts as a focus for competing medical institutions.

The China-US Center for Environmental Remediation and Sustainable Development
Future Energy Systems

How do we know the effects of new technology?
Who cares about energy usage?
I just want to go faster!

Future Car
“The Body” and “The Brain”