RENEWABLE AND NUCLEAR ENERGY-BASED MITIGATION OF CLIMATE CHANGE: SUBSTITUTION FOR FOSSIL FUEL USAGE

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POTENTIAL DOE NUCLEAR – RENEWABLE HYBRID MISSIONS

• Near-term mission (1): Integration of renewables and baseload generation into decreasing-carbon energy economy, the main emphasis of the current workshop, and a major US electricity priority

• Ultimate long-term mission (2): use of renewables and nuclear generation in replacement of global fossil fuel consumption, the dominant US and global energy priority needing a long-term development strategy
FOR MISSION 2 DOE LEADERSHIP IS NEEDED, FOR THE US AND GLOBALLY

• A New, Vital Mission – Climate Change Mitigation
  ■ Abundant, cheap fossil fuels will continue to drive climate change unless restrained and replaced in a practical fashion
  ■ Market intervention (e.g., carbon tax) and new, large-scale climate change-focused technologies are needed
  ■ The market is unlikely to provide them when needed, this is a governmental mission
  ■ Renewable and nuclear technologies can be primary response portfolio elements
  ■ Time is wasting
STRATEGIES FOR GLOBAL SCALE FOSSIL FUEL REPLACEMENT

- Needed Future Context for New Energy Economy:
  - Social consensus demanding replacement of fossil fuels
  - Imposition of heavy carbon tax or equivalent
  - Serious effort to promote maximal use of portfolio of non-emitting technologies, both in US and globally*
    - Renewables
    - Hydro
    - Geothermal
    - Nuclear
    - Synfuels production
  - Constrained competition among non-emitting technologies in a global marketplace

*Efficiency improvements and electrical grid renewal are also essential.
STRUCTURES FOR GLOBAL SCALE RENEWABLE AND NUCLEAR ENERGY-BASED FOSSIL FUEL DISPLACEMENT

- Required Scale? 5,000-10,000 GW
- Required Products? Electricity and Fossil Fuel Substitutes (Hydrogen-based)
- Required Deployments?
  - Renewables, globally
  - Nuclear
    - To industrialized world with fossil fuel replacements going to the rest of the world?
    - Or, Worldwide, with strict controls upon operations?
RENEWABLE AND NUCLEAR-BASED ENERGY ECONOMY STRUCTURE

Diagram:
- Labor
- Fossil Fuels
- Biomass
- Hydro
- Solar Electric
- Solar Heat
- Wind
- Nuclear
- Geothermal
- Fuel Feedstocks
- Heat
- Syn Fuels
- CO₂
- H₂
- H₂O
- Work
- Electricity
Important implications of mission 2 versus mission 1

• Design of social and market incentives trump technological innovations – but all are important

• Very large scale energy technologies are needed for:
  ■ Renewables (i.e., high temperature, dispatch-ability, biomass efficiency)
  ■ Nuclear, (i.e., high temperature and fuel efficiency, proliferation resistance)
  ■ Carbon capture and recycle, and synfuels production (energy storage becomes less important)

• Integrated global nuclear fuel cycle control becomes essential (for control of all fissile material, nuclear fuel efficiency and waste disposal)
Seek Answers in Designing Mitigation Strategy*:

- Focus upon identifying long lead-time development tasks and important uncertainties to guide use of resources (avoid near-term demonstration programs)
- Identify global performance priorities
- Identify attractive technological options and plan development strategies
- Avoid premature technological down-selections, technology lock-in

* Seeking good engineering answers, before ideology, politics and self-interest affect the results.