

PERSPECTIVES ON HELIUM-3 FUSION :
YEAR 2000

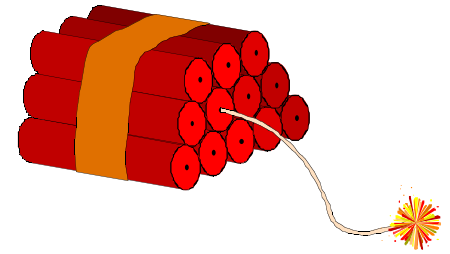
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Space Resources Utilization Roundtable

Colorado School of Mines, Golden CO, 27-29 October 1999

THE PROBLEM



- 10 -12 BILLION EARTHLINGS BY 2050
- >X8 INCREASE IN ENERGY DEMAND
 - **X2 TO STAY EVEN WITH 2000 DEMAND**
 - **X4 OR MORE TO MEET ASPIRATIONS AND SLOW POPULATION GROWTH**
 - **X? TO MITIGATE CLIMATE CHANGE**

IN THE BOX SOLUTIONS



- **FOSSIL FUELS**

- **ACE IN THE HOLE #1**

- **>X8 INCREASE OF UNKNOWN IMPACT**

- **FUTURE VALUE AS FEED STOCK**

- **SUPPLY VULNERABILITY/CONFLICT**

IN THE BOX SOLUTIONS

- **NUCLEAR FISSION**

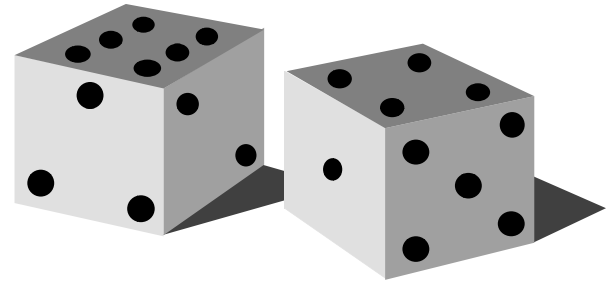
- **ACE IN THE HOLE #2**

- **POLITICALLY DIFFICULT**

- **LIMITED U.S. INFLUENCE**

- **WASTE DISPOSAL**

- **WEAPONS PROLIFERATION**



IN THE BOX SOLUTIONS

- **SOLAR (TERRESTRIAL)**
 - **REGIONAL ACE IN THE HOLE**
 - **LAND USE ISSUES**
 - **FULLY BURDENED COST ISSUES**
 - **NET ENVIRONMENTAL IMPACT**



OUT OF THE BOX SOLUTIONS

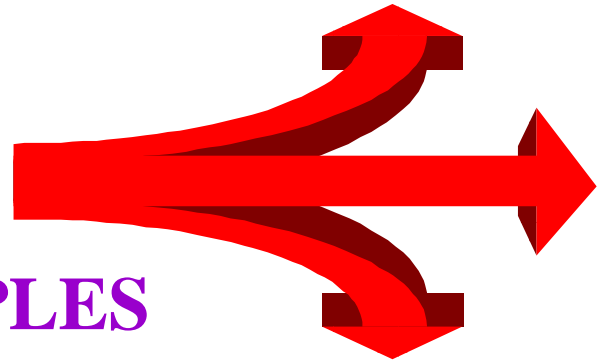


- **D/T FUSION**
 - **LARGE PLANT SIZE**
 - **PROTOTYPE DEMONSTRATION**
 - **MATERIALS ENGINEERING**
 - **WASTE DISPOSAL**
 - **RADIOACTIVE FUEL**
 - **CAPITAL COST**
 - **ACCESS TO CAPITAL MARKETS**

OUT OF THE BOX SOLUTIONS

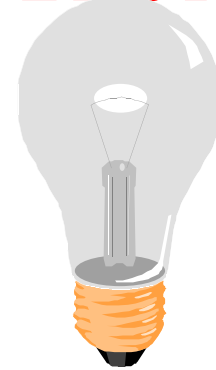
- **SOLAR (SPACE)**

- **NEEDS APPLES TO APPLES
COMPARISON WITH COMPETITORS**
- **PROTOTYPE DEMONSTRATION**
- **LAUNCH COSTS**
- **SPACE LAW ENVIRONMENT**
- **POWER BEAMING ISSUES**
- **ACCESS TO CAPITAL MARKETS**

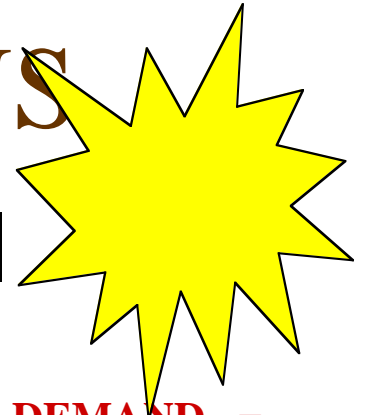
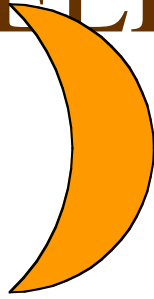


OUT OF THE BOX SOLUTIONS

- **LUNAR HELIUM-3 FUSION**
 - **NEEDS APPLES TO APPLES**
 - **COMPARISON WITH COMPETITORS**
 - **PROTOTYPE DEMONSTRATION**
 - **LAUNCH COSTS**
 - **SPACE LAW ENVIRONMENT**
 - **ACCESS TO CAPITAL MARKETS**
 - **NEAR-TERM APPLICATIONS**



HELIUM-3: STATUS



- **>10,000 TONNES IN UPPER 3M OF TRANQUILLITATIS**
- **POLES AND PROCELLARUM MAY PROVIDE ADDITIONAL EARLY POTENTIAL RESOURCE**
 - VERIFICATION REQUIRED
- **MINING, PROCESSING, AND REFINING CONCEPTUALLY STRAIGHT FORWARD**
 - MAXIMIZE AUTOMATION
- **LAUNCH COSTS \$1-2000/KG**
 - LONG-TERM PRODUCTION
 - MODERN TECHNOLOGY
 - CONCEPTS PROVEN
- **U.S. ANNUAL ELEC. DEMAND ~ = 30 TONNES HE-3/YR**
- **VALUE ~ = \$90 BILLION**
 - ADDITIONAL VALUE IN BY-PRODUCTS FOR USE IN SPACE
- **IEC FUSION TECHNOLOGY**
 - PROMISES LOW CAPITAL COSTS
 - NEAR-TERM APPLICATIONS
- **ACCESS TO CAPITAL MARKETS**
 - REQUIRES NEAR-TERM ROI