Aim High is a project with lofty goals.

Global warming is a serious threat to our civilization. Another serious threat -- world population growing to 9 billion people. Already competition for resources such as food and energy has depleted fisheries and led to wars.

This scatter plot relates income to birthrates. The data for 84 nations are taken from the CIA World Fact Book. To the right you see the low GDP per capita for countries with high numbers of children per woman.

Population scientists observe that birthrates less than about 2.3 children per woman are less than population replacement rates. To the left of this line are the US, OECD, and other nations with high incomes and low birthrates.

A prosperity level of about $7,500 per capita distinguishes those nations with stable population replacement. Prosperity enables women to reduce labors of subsistence living, freeing them for education, work, independence, and choices about reproduction.

This scatter plot from CIA data relates income to energy -- specifically electrical energy. Electrical energy is important for water, sanitation, food, heating, cooling, lighting, transportation, communications, manufacturing, and business. It takes about 2,000 kWh per year per capita, about 1/6th US usage, to achieve the $7,500 prosperity level that leads to stable population replacement.

Developing nations want energy to improve their prosperity.

DOE projects that they will burn coal and emit more CO2, making global warming worse.

Carbon taxes such as cap-and-trade are not accepted here in the US and certainly not in the developing nations, who will not forgo the advantage they perceive OECD nations had from burning fossil fuels. An alternative is to undercut coal power economics with nuclear energy cheaper than from coal.

In the Cold War Oak Ridge scientists conceived the molten salt reactor to be a compact, 200 MW heat source to power jet engines of bombers that could circle the Soviet Union without refueling. The first molten salt reactor proved the concept, and the "fireball" aircraft reactor was designed, but not built because ICBMs obsoleted bombers.

Alvin Weinberg foresaw today's energy and atmospheric CO2 crises. He directed Oak Ridge to design and test another successful molten salt reactor experiment. It was tested with U-233, intended to be made from thorium.

Nuclear fission of U-233 takes place in the central (yellow) core of a liquid fluoride thorium reactor. Some released neutrons continue the chain reaction, and some pass into the (green) thorium blanket surrounding the core, converting thorium to U-233. The uranium separator (on the left) sends thorium back to the blanket and U-233 to the core to replace that which was consumed. Fission product waste is similarly separated. Heat from the fissioning core is exchanged with a salt that heats a gas to run the turbine-generator.

Using thorium for fuel is one key concept. Another is the liquid

fuel form. Uranium and thorium are dissolved in molten salts of lithium and beryllium. The liquid's high heat capacity enables high temperatures, efficiency, and compactness. Chemical processing takes place in continuous streams.

The LFTR (liquid fluoride thorium reactor) is started up with a fissile material, but none is transferred in or out thereafter.

Thorium is inexhaustible, unlike uranium.

Once fission products decay, the long-lived radio-toxic actinide wastes from LFTR are orders of magnitude less than from today's power reactors.

LFTR may make energy cheaper than from coal at a capital cost near $2/watt. One indication is that five independent historical cost estimates center on $1.98/watt.

Another reason is that LFTR needs no costly 160-atmosphere pressure vessel and containment dome.

LFTR is small. The workman in the center of the AP-1000 is about the same size as the "fireball" molten salt reactor designed for flight.

Intrinsic safety reduces the need for costly defense in depth. There are no pressurized radioactive materials to contain. The fuel is already melted down. Loss of power drains fuel to safe dump tanks.

The high heat capacity of molten salt allows a compact core and high temperature.

The high temperature enables power conversion efficiencies up to 50%, halving today's water cooling needs or enabling dry air cooling.

Factory production cuts costs. Boeing aircraft produces similar cost units with similar concerns about materials, quality, and life safety. Factory produced LFTR reactors will benefit from the learning curve, expected to reduce costs 10% for every doubling of units produced.

I recommend a specific project to develop LFTR in 5 years, for $1 billion, as the Gen IV International Forum estimates suggest. Then provide the nuclear industry with the R&D knowledge and encourage factory production and competition.

What is the benefit of installing a 100 MW LFTR each day? If LFTRs replace coal power plants, 10 billion tons of worldwide CO2 emissions will be zeroed in 38 years.

A high temperature LFTR allows efficient dissociation of water to make hydrogen, which is a feedstock to synthesize fuels. We can recycle some carbon from coal plants to synthesize gasoline and diesel vehicle fuel substitutes, or make ammonia for non-carbon fuel or fertilizer.

Providing the developing nations with safe, affordable electric power can increase their prosperity to allow lifestyles that include lower birthrates, stabilizing world population.

But advanced nuclear fission R&D has dropped, and there is none for LFTR. Compared to $16 billion spent on liquid metal

fast breeder reactors, DOE will spend $103 million on the prolonged high temperature gas reactor development. The advanced fuel cycles budget has no money for closed fuel cycles nor for liquid fuels.

A specific LFTR project will have specific tangible results:
- cut 10 billion tons of CO2 emissions by 2058.
- avoid carbon taxes.
- improve developing world prosperity, and check population growth.
- avoid weapons proliferation by obviating the need for uranium enrichment plants.
- reduce radio-toxic waste; consume world fissile material stocks.
- use inexhaustible thorium fuel, available in all nations.

Thank you.