AN ENVIRONMENTALLY SOUND, ENERGY-RICH FUTURE

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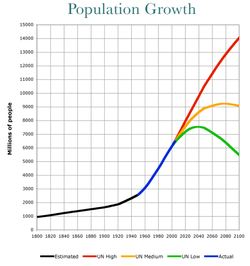
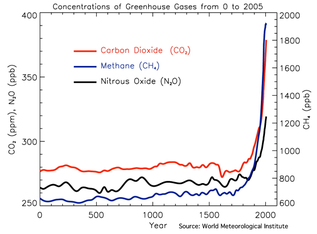
DAUNTING CHALLENGES

Population Growth





BURGEONING ENERGY DEMAND

- World population expected to increase by about 3 billion by 2050
- Water supply for 3 billion more people, exacerbated by shrinking glaciers, will require energy-intensive desalination and water transport on a staggering scale
- Demand for dramatically improved standard of living for billions who now live in relative energy poverty

U.S. residents use nearly 4.5 times as much energy per capita as the world average, and over 5 times as much electricity, yet the USA contains less than 5% of the world's population.

Predictions vary, but government energy agencies generally forecast a doubling of energy demand by about 2040 or 2050. Given the drivers listed above, and the very real possibility that demand will increase far faster than predicted in currently energy-poor nations (due to globalization, communications, etc), it would seem prudent to plan for a tripling of energy demand by mid-century.

Can we avoid energy and water wars in the coming decades?

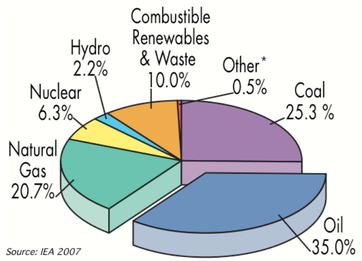
Can it be done in an environmentally sound way?

Can it be done at all?

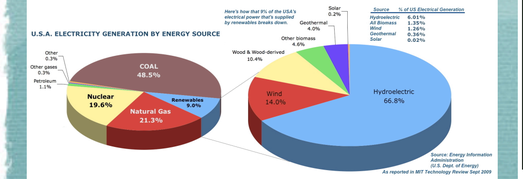
YES, YES, & YES! HERE'S HOW

HOW CAN WE ELIMINATE THE FOSSIL FUELS?

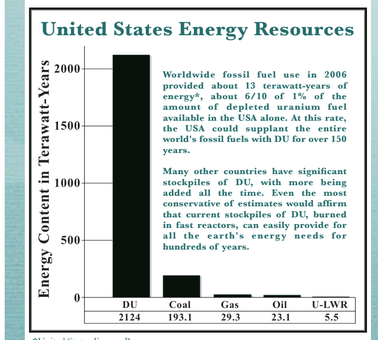
Total World Primary Energy Supply



*"Other" includes wind, solar, geothermal, heat, etc



United States Energy Resources

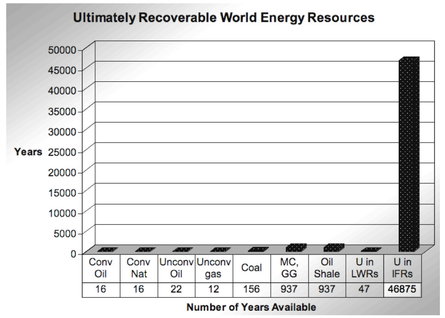


Worldwide fossil fuel use in 2006 provided about 13 terawatt-years of energy*, about 6/10 of 1% of the amount of depleted uranium fuel available in the USA alone. At this rate, the USA could supplant the entire world's fossil fuels with DU for over 150 years.

Many other countries have significant stockpiles of DU, with more being added all the time. Even the most conservative of estimates would affirm that current stockpiles of DU, burned in fast reactors, can easily provide for all the earth's energy needs for hundreds of years.

*United States Energy Resources
International Energy Agency, World Energy Outlook, 2006

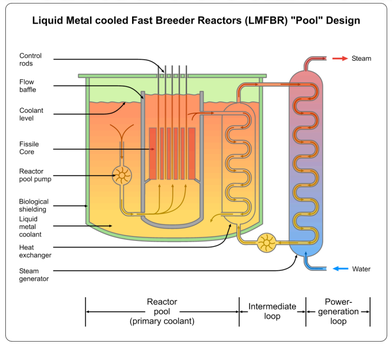
THOSE WHO SAY THERE'S NO SILVER BULLET ARE RIGHT. IT'S NOT SILVER. IT'S DEPLETED URANIUM.



Conv Oil	Conv Nat	Unconv Oil	Unconv gas	Coal	MC, GG	Oil Shale	U in LWRs	U in IFRs
16	16	22	12	156	937	937	47	46875

This graph shows how many years each type of fuel would last if we were to rely on it to supply all the world's energy needs by itself.
Unconventional Oil and Gas denote problematic and costly extraction methods.
MC & GG: Methane clathrates and Geopressure Gas, as yet undeveloped.
All of the above, even if feasible to extract, are still fossil fuels.
LWR: Light Water Reactors - most reactors in use today are LWRs.
Data from *Prescription for the Planet*

THE INTEGRAL FAST REACTOR (IFR)



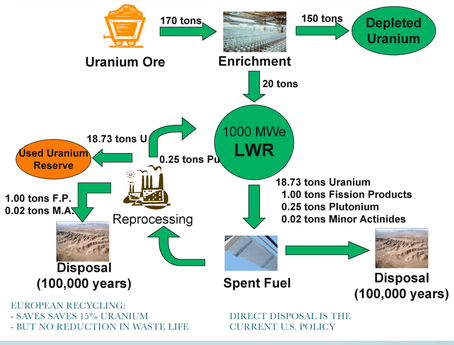
The IFR was developed at Argonne National Laboratory. IFRs can burn all the world's nuclear waste and nuclear weapons material as fuel, and once that's cleaned up they can burn depleted uranium.
We have enough depleted uranium already out of the ground to power the entire planet's total energy needs for almost a thousand years. Today it's considered a bothersome waste product.
IFRs can extract nearly 100% of the energy in uranium, compared to less than 1% in today's LWRs.

Think of it like this:
All of the energy a typical American will use in a normal lifetime:

- Electricity
- Heating and Cooling
- Transportation
- Energy invested in the production of food and other goods consumed during a lifetime

Can be derived from a piece of depleted uranium the size of half a ping-pong ball!

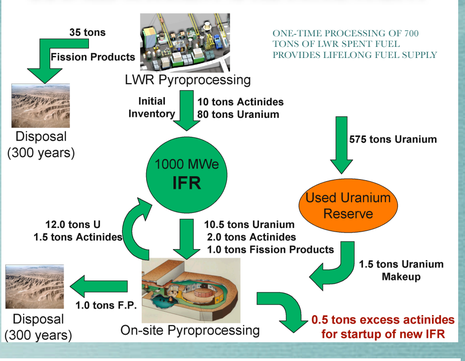
URANIUM UTILIZATION IS <1% IN CURRENT LWRs



EUROPEAN RECYCLING:
- SAVES SAVES 15% URANIUM
- BUT NO REDUCTION IN WASTE LIFE

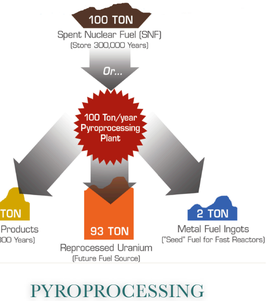
DIRECT DISPOSAL IS THE CURRENT U.S. POLICY

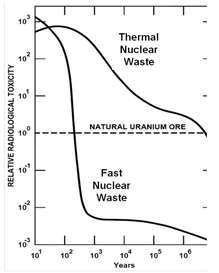
IFR IS SELF-SUFFICIENT AFTER INITIAL STARTUP



ONE-TIME PROCESSING OF 700 TONS OF LWR SPENT FUEL PROVIDES LIFELONG FUEL SUPPLY

ALL THE SPENT FUEL IN THE WORLD CAN BE RECYCLED INTO IFR FUEL





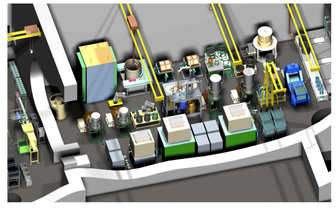
Fast (vs. Thermal) Nuclear provides
100X uranium energy extraction and 0.1% waste toxicity
[Chang, Advanced Nuclear System for the 21st Century, Workshop on Nuclear Cycle System for the 21st Century, 2002]
www.thesciencecouncil.com/Chang_WNCS02.pdf

The small amount of nuclear waste, comprised of fission products, will be immobilized for thousands of years yet its radiotoxicity will be far below that of natural uranium ore within a few hundred years, effectively solving the waste problem.

All the actinides (the elements with long half-lives that stay radioactive for thousands of years) will be transmuted into electricity and short-lived fission products.

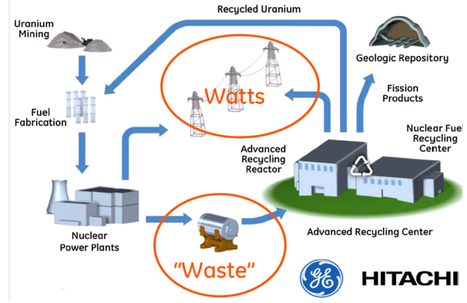
PYROPROCESSING

The combination of fast reactors and recycling their fuel is the key to an abundant energy future for the entire planet. The metal fuel developed for the IFR is highly proliferation resistant and yet is easily recycled. Because it uses a greatly simplified recycling system compared to reprocessing systems currently used (e.g. in France and Japan), the relatively small recycling centers will be located at each power plant. Like the reactors, the components will be modular, produced in factories and assembled on site.



A PRE-CONCEPTUAL DESIGN OF PILOT-SCALE (100 T/YR) PYROPROCESSING FACILITY FOR LWR SPENT FUEL

GE-Hitachi is prepared to build the first commercial-scale IFR (labeled "Advanced Recycling Center" in the diagram below) to lead the world into an era of unlimited clean energy. Efforts are underway to build the first PRISM (the reactor portion) and the first pyroprocessing facility. If the political will can be mustered, IFRs could quickly begin to turn the energy tide for the entire planet.



Waste to Watts
Loewen (GE-Hitachi Nuclear Energy), Is Nuclear Renewable?, AREDAY 2010.
www.thesciencecouncil.com/Loewen_AREDAY_2010.pdf