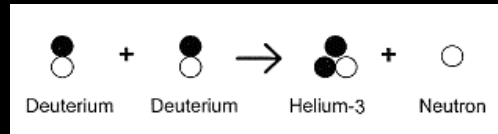


# Cold Fusion and It's Development into a New Science: LENR (Low-Energy Nuclear Reactions)

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Editor, *New Energy Times*  
Executive Director, New Energy Institute  
New Energy Movement Canada  
Simon Fraser University, Vancouver, CA, September 8, 2008

## Thermonuclear Fusion



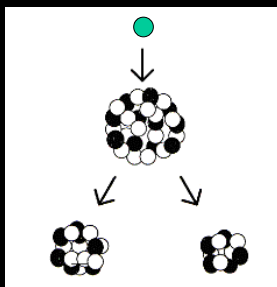
## Three Types of Nuclear Processes

1. Fission
2. Thermonuclear Fusion
3. LENR (Low-Energy Nuclear Reactions)

## Fundamental Energy Factors

1. Cost
2. Location
3. Size

## Nuclear Fission



## "Green" Energy



Micro-hydro

## "Green" Energy



## Energy Devices - Size Comparison (Real Applications)



Chemical



Nuclear Fission

## Energy Density – Raw Fuel (Real Applications)



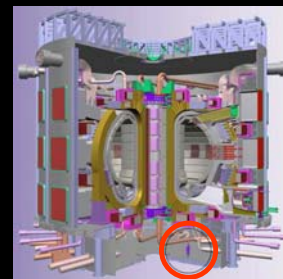
Chemical



Nuclear Fission

3.5 barrels of oil  
17,000 cubic feet of NG  
1,780 pounds of coal

## Energy Devices - Size Comparison (Science Research)



Thermonuclear Fusion

## Energy Density – Raw Fuel (Science Research)



Thermonuclear  
Fusion



LENRs  
Low-Energy  
Nuclear Reactions

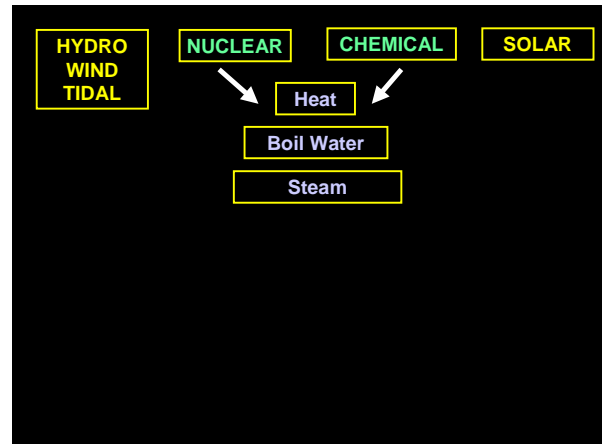
## Energy Devices - Size Comparison (Science Research)



LENR - Low-Energy Nuclear Reactions

## Two Energy Forms

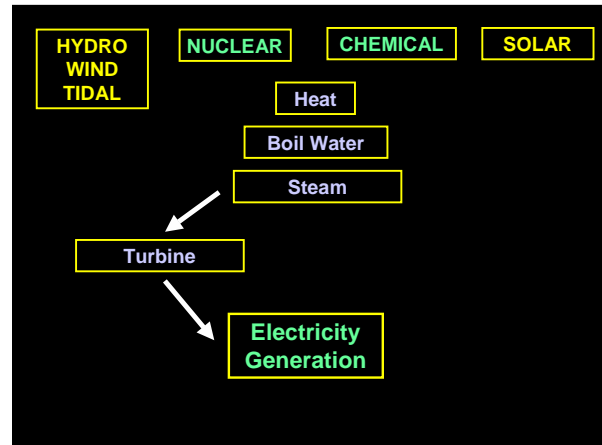
1. Liquid Fuels
2. Electricity



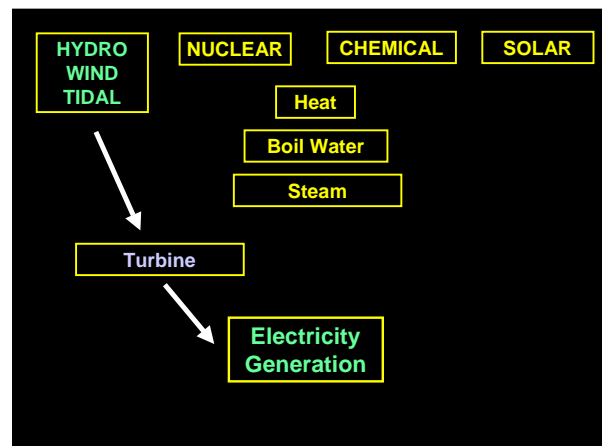
Liquid Fuels  
Petroleum - Ethanol

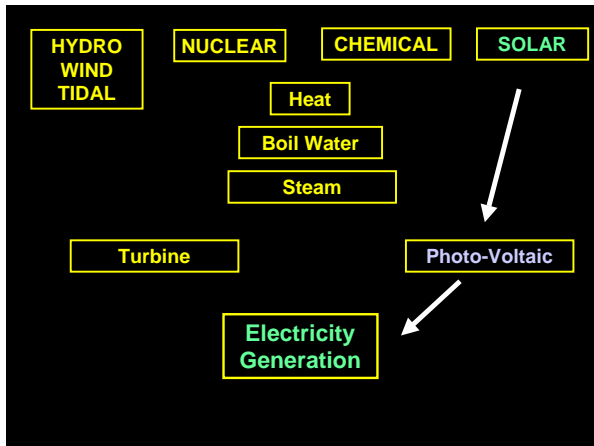
Primary Use:  
TRANSPORTATION

**WHY?**  
Dense, Portable, Independent

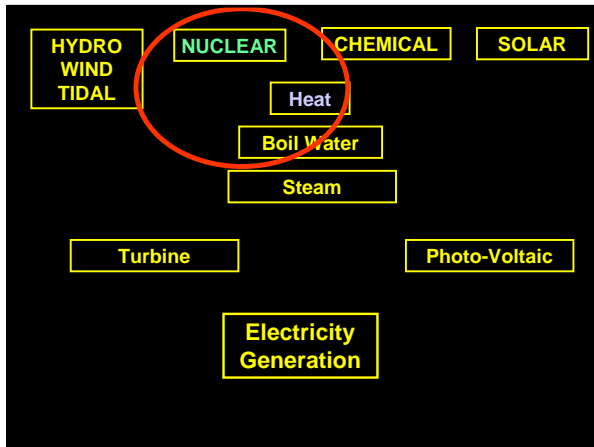


## Sources of Electricity






A New Source of Energy?  
 The cell produced unexplained heat  
 Milliwatts of electrical input  
 4 Watts heat output?



Surprise!  
 Excitement!


### Utah Fusion Announcement



Martin Fleischmann  
University of Southampton

University of Utah  
Press Conference  
March 23, 1989

"... established a  
sustained nuclear  
fusion reaction ..."



Stanley Pons  
University of Utah

### U.S. Nationwide Cover Stories

May 8, 1989





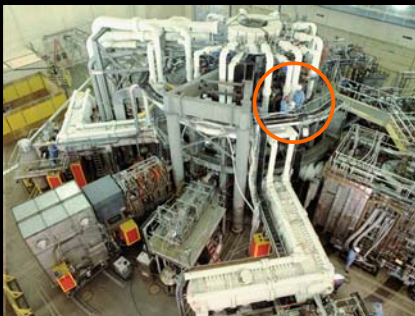


## What Was (and Still is) the Hope?

1. Energy from water
2. Virtually unlimited fuel
3. No dangerous radiation
4. Not harmful to environment

Hot Fusion  
\$20 Billion U.S.+  
57 Years +

## Princeton Plasma Physics Lab Tokamak Reactor Exterior



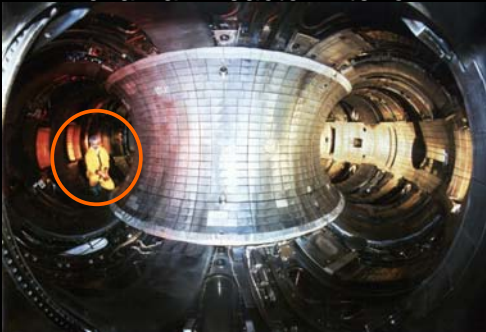
## Cold Fusion Is Announced



Martin Fleischmann  
University of Southampton

Stanley Pons  
University of Utah

## Princeton Plasma Physics Lab Tokamak Reactor Interior



**Failures to Replicate**

Frustration

Secrecy

**Fraud!**

**Mistake**

**Delusion**

Steven Koonin - Caltech/BP  
"Incompetence and delusions"



"Scientific Fiasco of the Century"

**Cold fusion**  
The scientific fiasco of the century  
John R. Huizenga

BAD SCIENCE

GARY TAUBES

PARK VOODOO SCIENCE The Road from Foolishness to Fraud OXFORD

Ronald R. Parker  
Director of MIT Hot Fusion  
"It's Fraud"

Interview with Nick Tate, Boston Herald, April 29, 1989



Nathan Lewis - Caltech  
"No Evidence" - Nothing There



Legitimate Science Questions...

It's not fusion as we currently know it...

Hey! Where's the Neutrons?



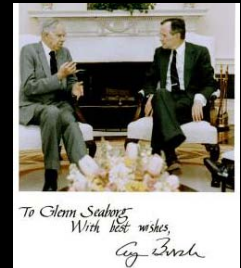
Six Months Earlier the  
President of the United States  
Was Told:

Cold fusion not real  
Have DoE perform investigation  
They will tell you it's not valid  
That will resolve the problem for you

Why Was Cold Fusion So  
Controversial?

Didn't look like thermonuclear fusion  
Apparent contradiction to laws of physics  
Threat to thermonuclear fusion funding  
Difficult science problem  
"End of Science" attitude

Glenn T. Seaborg, Adviser to the  
President of the United States



November 1989  
U.S. Department of Energy  
Cold Fusion Investigation

**Implications:**

Cold fusion not real  
Nothing to see, move along...  
We're not going to fund it

Nov. 2004 U.S. Dept. of Energy  
"Review of  
Low Energy Nuclear Reactions"

Was not a review  
Was pushed on DoE  
DoE deflected, did nothing  
Sparked interest from commercial  
sector

## 1989: Who Succeeded, and Why?

**Tadahiko Mizuno**  
Applied Physicist  
Hokkaido University

"...performed similar experiments  
for 20 years prior...."

...spent eight months preparing for  
my first cold fusion experiment.

(Nuclear Transmutation, pg 59)



## 1989: Who Succeeded, and Why?

**Robert Huggins,**  
Materials Scientist  
Stanford

"We had all kinds of  
background relevant to this  
stuff. We had our own  
palladium which had a lot of  
lithium in it."

(Private Communications, 4/6/2006)



## 1989: Who Succeeded, and Why?

**Edmund Storms, Radiochemist**  
Los Alamos National Lab. (ret.)

"I had worked with palladium  
previously..."

...I had to learn electrochemistry.

...I also had a great deal of luck.."

(Private Communications, 3/25/2006)



## 1989: Who Succeeded, and Why?

**Melvin Miles,**  
Electrochemist  
U.S. Navy, China Lake

...used Johnson-Matthey  
palladium... nearly every  
experiment worked.

...never worked with Wesco  
palladium..

(Private Communications, 4/16/2006 and Dec. 4, 2003)



## 1989: Who Succeeded, and Why?

**Michael McKubre,**  
Electrochemist  
SRI International

"...four experts already working  
with the Pd/D system..."

...spent three months planning  
and constructing ... and spent  
two further months performing  
it."

(Private Communications, 3/25/2006)



20 Years Later

All legitimate criticisms have been met

What has been learned?

What is known?

What goes in -

- Hydrogen or deuterium
- Palladium, nickel, titanium
- Lithium
- A few watts of energy  
(electrical or mechanical)

What *doesn't* come out -

- Greenhouse gases
- Strong prompt radiation
- Long-lived radioactive waste

What comes out -

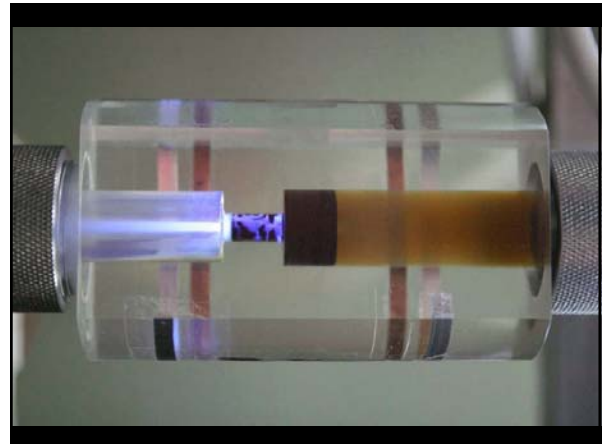
- Energy, in the form of heat
- Helium
- Transmuted Elements
- Tritium
- Neutrons (tiny amount)
- Other weird stuff



What is Excess Heat?

**More energy coming out of the experiment than can be explained by known science**





What's the Problem with LENR?  
(Strategic Problems)

- **Stigma: Publications, Funding**
- **Disbelief: "It's not nuclear"**
- **Belief: "It's fusion"**

More likely: Neutron catalyzed, weak interactions (14 MeV per 4He atom - Widom-Larsen)

Not as Simple as It Looks

- **Difficult to achieve conditions**
- **Difficult material preparation**
- **Difficult instrumentation**

What's the Problem with LENR?  
(Technical Problems)

- **Nature is being stubborn**
- **Research on a shoestring**
- **Competitiveness**

## LENR Uncertainties

- Will it be practical?
- When?
- Will it scale?
- At what cost?
- Will it replace liquid fuels?
- Will the knowledge die?
- Will it be used for destruction?

**New Energy Times Magazine**  
[www.newenergytimes.com](http://www.newenergytimes.com)

Phone: (310) 721-5919  
[steven1@newenergytimes.com](mailto:steven1@newenergytimes.com)

## Who will Seek the Answers?

- **YOU!**
- **Universities**  
(students and professors)
- **Commercial enterprise**

EXTRA SLIDES

Please Get Back to Me 😊

- Let me know what happens!
- Or doesn't happen!

**QUESTIONS?**

## Energy Density – Raw Fuel

(by Volume, Approx.)

Sources: Lattice Energy, Wikipedia, DoE EIA	Watt*hours/kg
Hydrogen	4,000
Wood	1,000
Ethanol	6,000
Gasoline	12,000
Coal	23,000
LENR	(theoretical) 57,000,000
Nuclear Fission	2,000,000,000
Nuclear Fusion	(theoretical) 3,000,000,000