

# LENR

## Low Energy Nuclear Reactions

### aka

# COLD FUSION

Introducing the Energy Catalyzer (E-Cat)  
Futuristic Technology For The 21<sup>st</sup> Century

By Roger Green - [www.Ecat.tech](http://www.Ecat.tech)

In conjunction with

A Rossi - Leonardo Corp



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# What is LENR and E CAT?

- LENR: Low Energy Nuclear Reaction aka COLD FUSION
- E CAT Uses small amounts of Ni and H<sub>2</sub> (milligrams, with catalysts)
- Low cost, simple and sustainable way to produce large amounts of heat, steam and convert to power.
- Eliminates hydrocarbons - no emissions or waste.
- Extremely high energy density: 2000X diesel fuel.
- Modular, scalable and easily mass produced.
- Unlimited applications - industrial, power stations, third world communities
- Considered the “**Holy Grail**” of the energy world!

# What is LENR and E CAT?

- No production of radioactive waste, and generated weak gamma rays can easily be shielded.
- Generates a large amount of heat energy when small amounts of hydrogen, special nickel powder and an undisclosed material are combined (catalyst-with-frequencies)
- About 1 percent of the annual world nickel production is sufficient to provide the energy needs of mankind.

# LENR Theory

- The theory states that once some energy is added to surfaces loaded with protons, if the surface morphology enables high localized potential gradients, then heavy electrons (muons) leading to ultra low energy (cold) neutrons will form that never leave the surface.
- The neutrons set up isotope cascades which result in beta decay and gamma emission. This results in interactions with heavy electrons which convert the gamma into heat.

# What is E CAT?

- The first-generation 1 MW power plants “WARM CATS”
  - generate heat energy in form of hot water with a temperature up to 120 °C. They are appropriate for industrial heating and cooling applications.
- The “HOT ECAT”, generates heat energy in form of hot water with a temperature above 700 °C .
  - It is appropriate for electrical generation
  - Its COP is 6 or higher

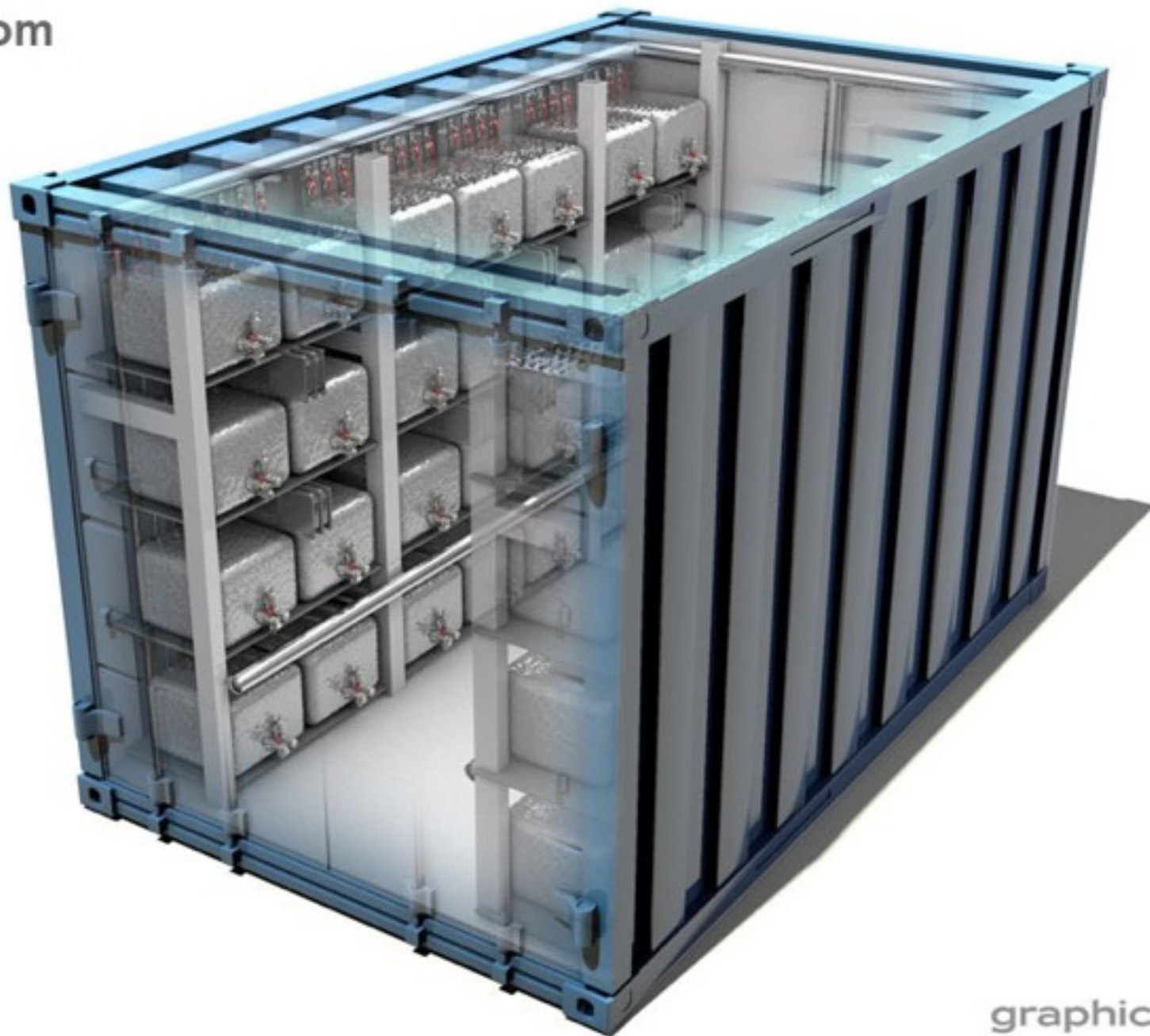
# COP 6.0 (Coefficient of Performance)

## What Does it Mean?

- The COP represents the net useful energy output, over and above the energy input
- 1000 kwh (1 MWH) divided by 6= 167 Kw.
- If used as a heater only, the net COP remains 6.
- If the heat is used to run a turbine, then:
  - If the turbine is conventional, the efficiency is approx 40%. If it is a Tesla turbine, then it is 60-80%.
  - If the turbine is coupled to a conventional alternator, that efficiency is approx. 80-90%.
  - Conventional turbine with alternator is 32% (0.4 x 0.8).
- To obtain 167 KWH for the loopback, we must consume 521 KWH, leaving the NET COP 1.92 using conventional turbine / generator

# Generation of Electricity with E-cats

- On-site Power Generation
- Small, Distributed Power Generation Systems
- 1 MW scalable Ecat Units
- Large Power Stations: replace fossil fuel (retrofitting?)
- Emerging Tesla Turbine possible increase in efficiency
- Siemens SST-700 turbine, uses steam at up to 585 °C

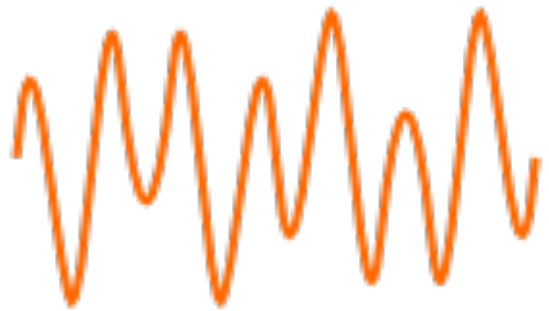






Nickel Powder  
(micron sized grains)

# LENR Reaction



Catalyst frequency

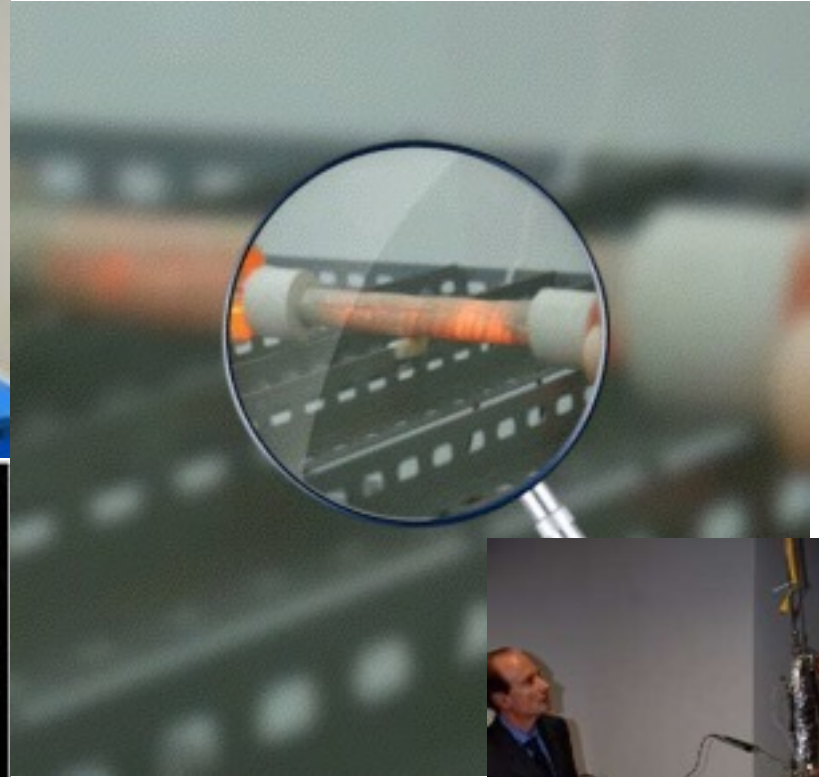


Hydrogen

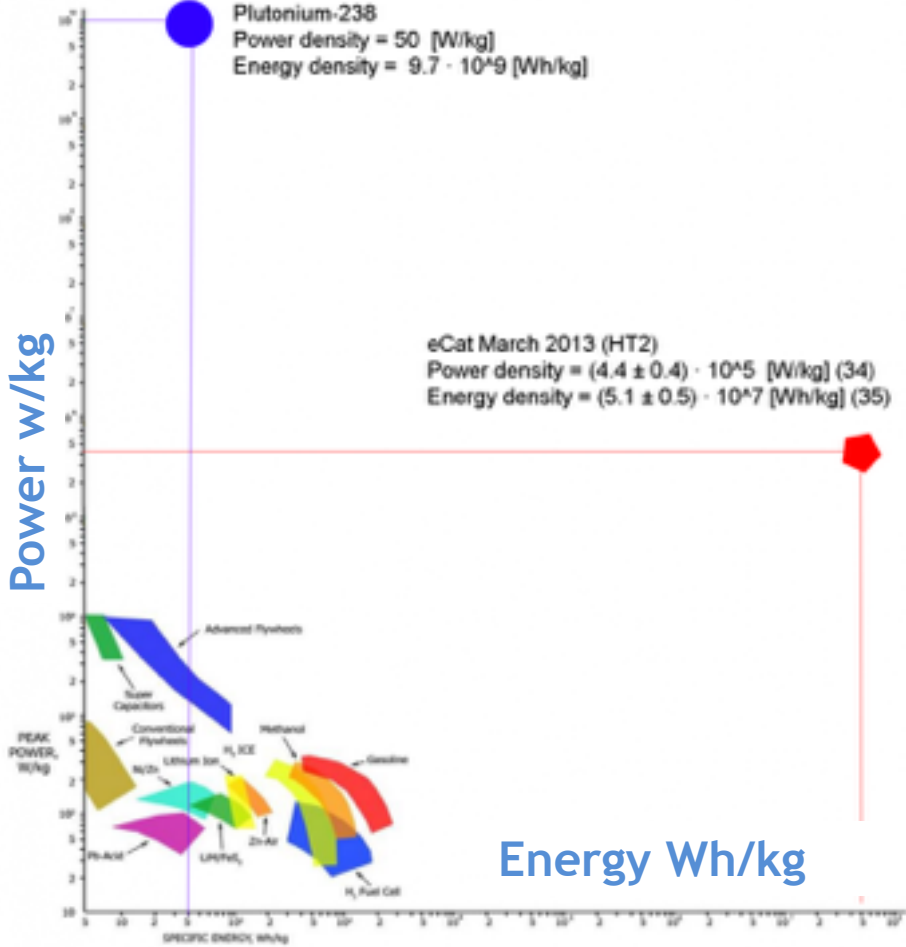


Heat

Third party independent report released Oct 2014  
Reactor ran for 32 days non stop and reached-1400 C-  
Overseen by four 4 top scientist-the report was downloaded by approx 200,000  
people



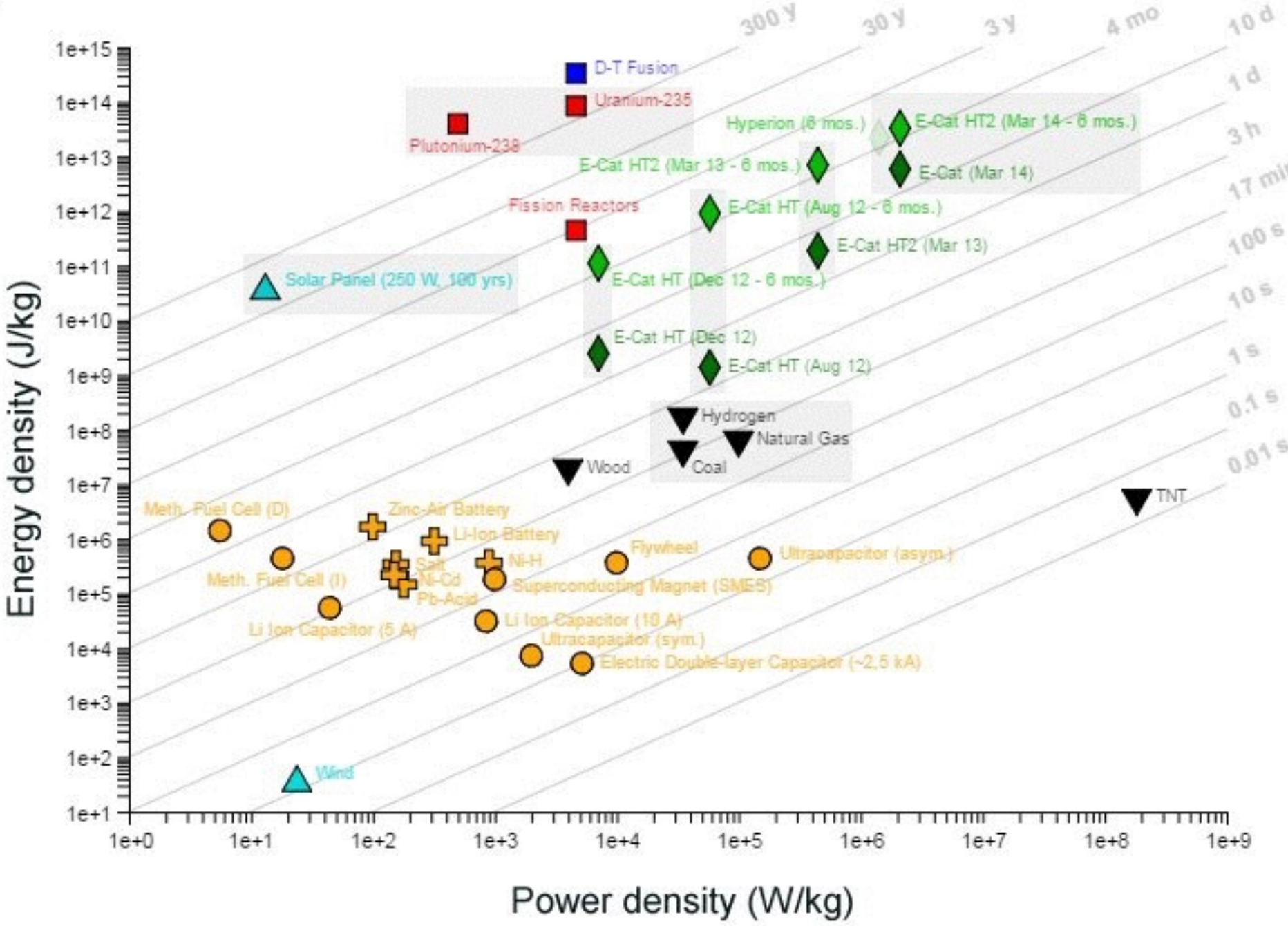
# Energy Density Comparisons



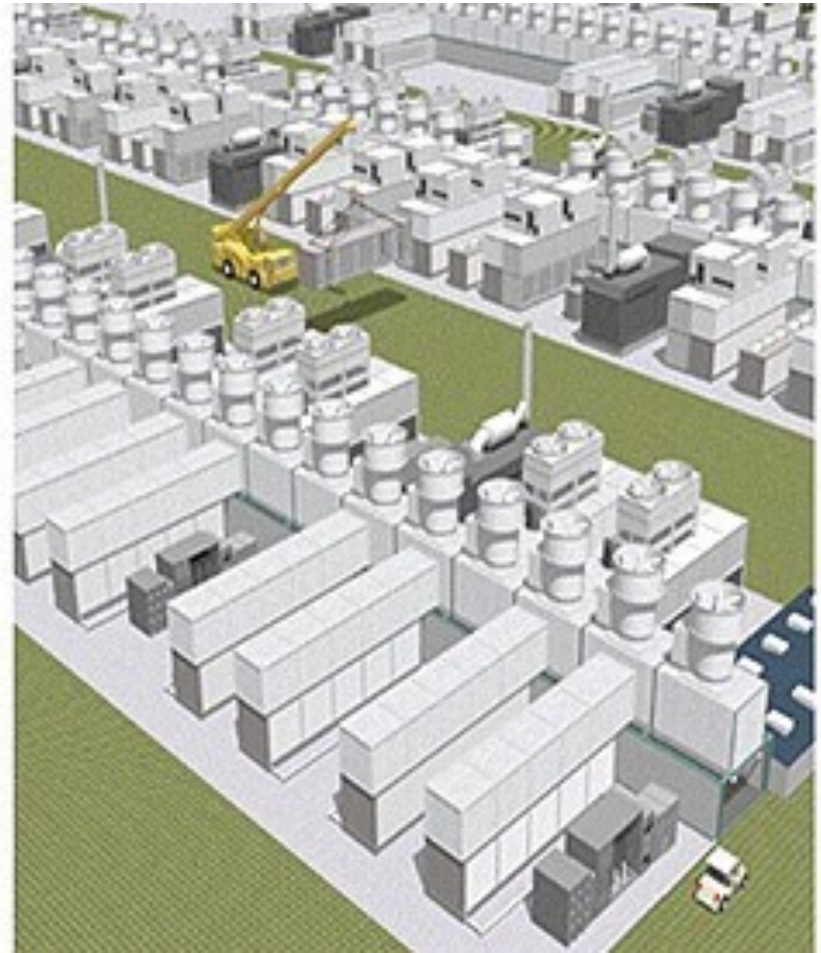
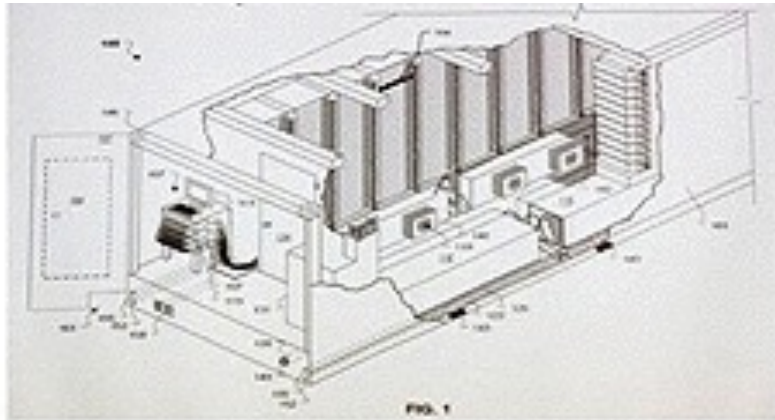
"Indication of anomalous heat energy production in a reactor device containing hydrogen loaded nickel powder", Levi et al. <http://arxiv.org/ftp/arxiv/papers/1305/1305.3913.pdf>

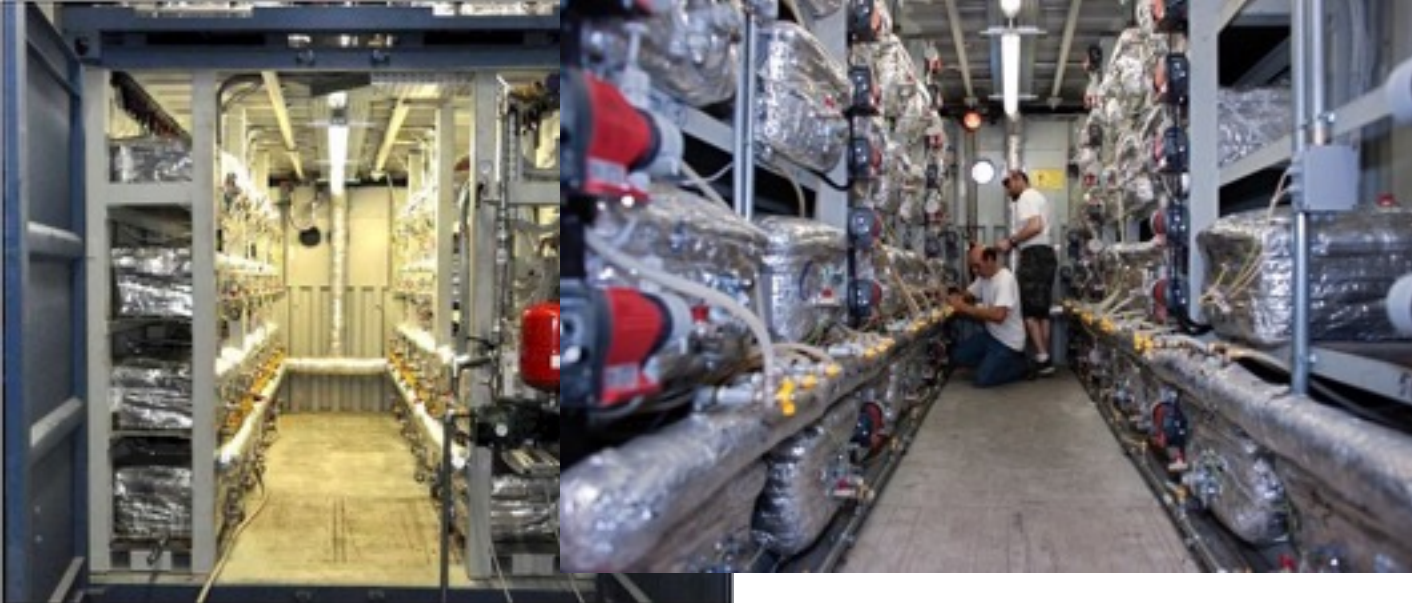
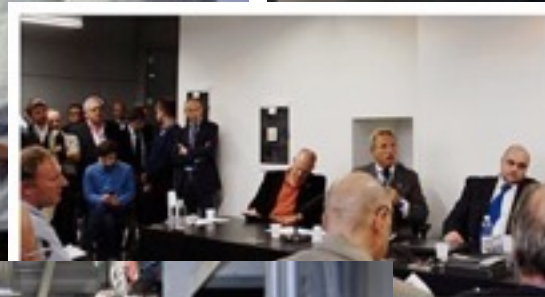
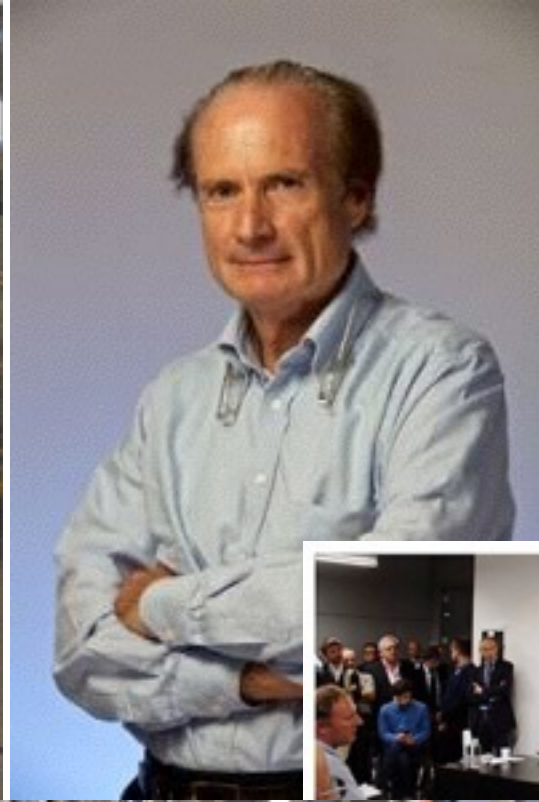
Fig 9 expanded to show the Ragone plot of Pu-238 and the eCat test, March 2013.

By Alan Fletcher [www.inconfidence.com](http://www.inconfidence.com), based on: Ahmed F. Ghoniem, "Needs, resources and climate change: clean and efficient conversion technologies", Progress in Energy and Combustion Science 37 (2011), 15-51, fig. 38. Version 130520\_ragone\_02



# Ecat Power Stations







Ni+H



1 Barrel of Ni-H fuel  
=  
1 Supertanker of oil



ECAT.com - LENR Energy

# Stand-alone System



**Stromgenerator**



**E-Cat 1/N**



**E-Cat N/N**



**Turbine**



**Wechselstromgenerator**



**Stromnetz**



**The Energy Density in an ECAT is 2 million higher by volume than oil.**



**1 liter of ECAT fuel = 100 tank trucks.**



## “WARM\_ECAT” -1MW Technical Data

All data provided below may be subject to change due to the ECATs’ development. Technical specifications will be continuously be updated when changes are made.

	Steam Production	Hot Water Production
Thermal Output Power	1 MW	1 MW
Electrical Input Power Peak	200 kW	200 kW
Electrical input Power Average	167 kW	167 kW
COP	6	6
Output Power Ranges	20 kW-1 MW	20 kW-1 MW
Modules	104	104
Power per Module	10kW	10kW
Water Pump brand	Various	Various
Water Pump Pressure	4 Bar	4 Bar
Water Pump Capacity	1500 kg/hr	9000 kg/hr
Water Pump Ranges	300-1500 kg/hr	1000-9000 kg/hr
Water Input Temperature	4-85 C	4-85 C
Water Output Temperature	100-120 C	50-99 C
Control Box Brand & Software	National Instruments	National Instruments
Fuel Cost	\$1/MWhr	\$1/MWhr
Recharge Cost	Included in O&M	Included in O&M
Recharge Frequency	2/year	2/year
Warranty	2 years	2 years
Estimated Lifespan	30 years	30 years
Price	USD\$1.5M	USD\$1.5M
Dimension	2.4×2.6×8m (approx)	2.4×2.6×8m (approx)

# LENR Competitive Advantage

- Self Running Sustained output - 1-20 MW
- Safe - Simple - Low cost - Easy to operate.
- Long life -Easy to integrate and maintain.
- Parity with Coal Generation with NO Emissions!
- Runs off grid in any location!
- Huge savings over natural gas and oil!
- Projected Power Cost: 2-4 cents per KWH.
- Projected Heat Cost: 0.3-1.0 cents per KWHT.

# Economics - Market Size

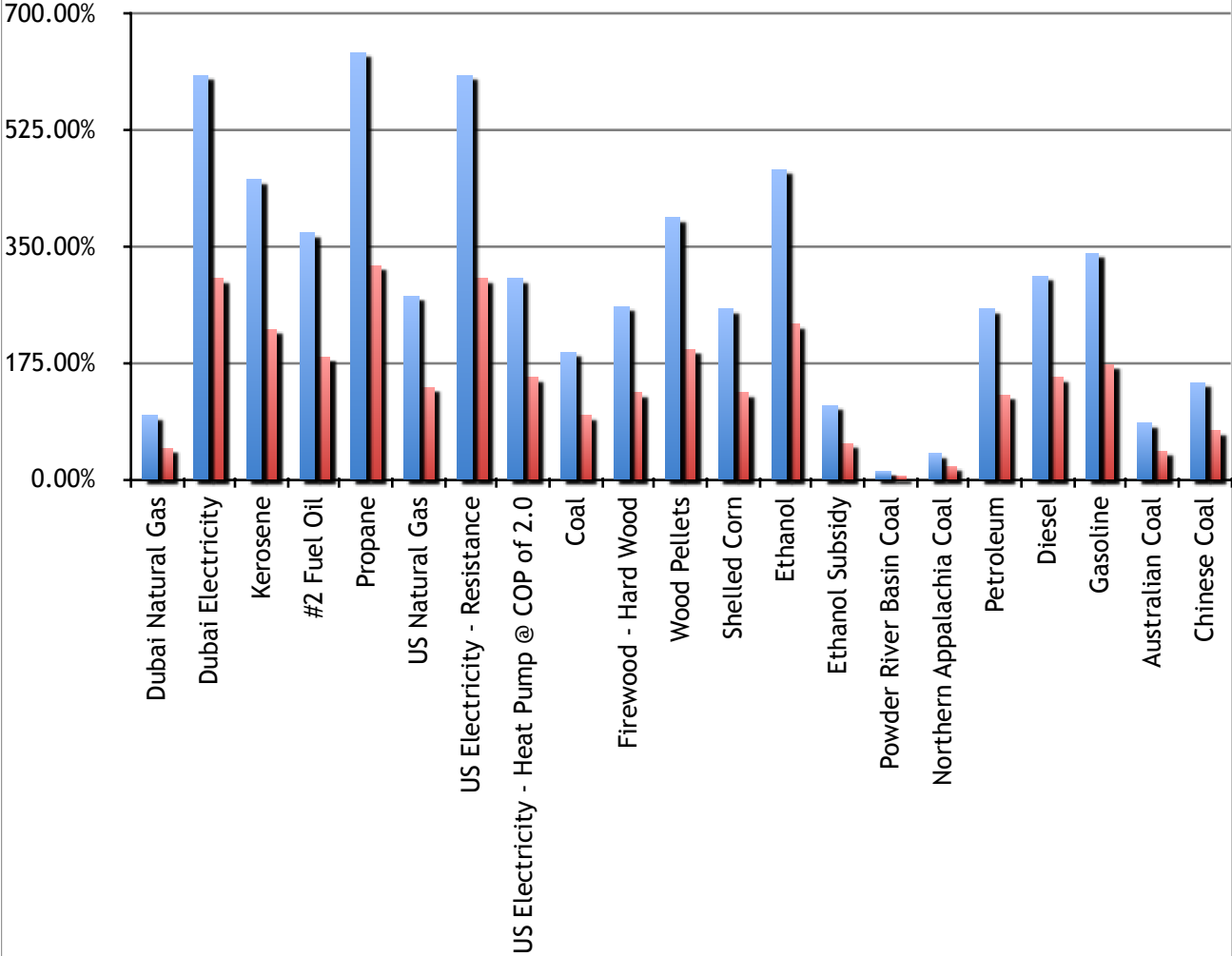
- Total world energy market is \$5 trillion annual
- Target addressable LENR markets are enormous!
- Markets like desalination range from \$200-500 Billion
- World market of distributed energy supply projected to be \$155B by 2030
- LENR system cost: very competitive with current technologies. Rapid ROI and savings.
- Birth of new trillion dollar growth industry & many jobs!

# Possible Future Developments

- Use high efficiency power conversion: Tesla turbine & alternator or quantum well device.
- Tesla turbine with alternator has a net efficiency of 64%. This means a loop back of 261 KWH, and a net COP of 3.84.
- However, if the unit runs in self-sustain mode, then there is no loopback, and conventional turbines and alternators can be used.

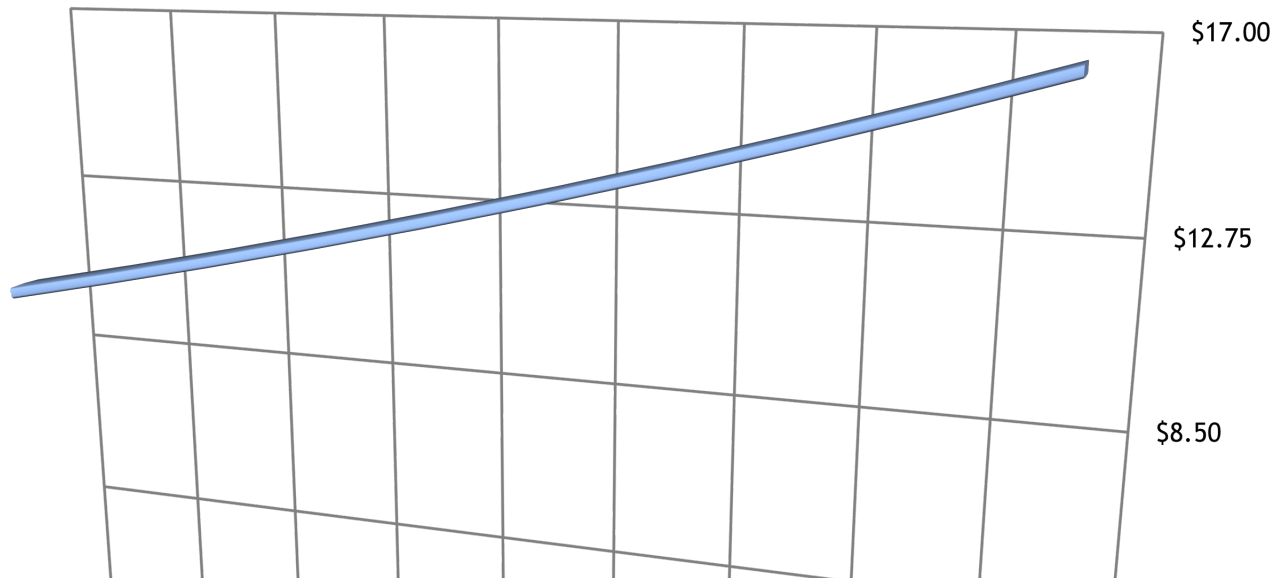
# Economics Cont.

6.0 vs. 12.0  
COP E-Cat



# Economics Cont.

— Coal    E-Cat



**Chart above show coal as our strongest competitor**

*As E-Cat technology decreases over time and coal prices will increase, the projected cross-over point is 3-4 years. We did not calculate the carbon CO2 emission taxes and associated health costs and environmental impact of fossil non-renewable coal. Nor did we calculate the carbon foot print credits and government subsidies for the E-Cat green technology benefits for the customer (also if customer replaces coal, they get rebates / subsidies etc)*

# Economics Cont.

## 1 MW industrial unit:

### Cost Estimates of Rossi E-Cat

Type of Nickel:	IP Process
Number of Cells per Installation for 1 MW:	106
Nickel consumed per MW/h (Grams):	0.50
Cost of Nickel per gram:	\$0.80
Cost per MW/hr:	\$36.34
Cost per KW/hr:	\$0.036
Cost per day:	\$872.23
Cost per year:	\$318,580.50

Note: Costs above are for heat Generation ONLY!

### Possible Conversions; heat to electricity assumptions:

Cost of power generation KW/hr. @ 33% Eff.	
For conventional turbine power plant:	\$0.108
Cost of power generation KW/hr. @ 10% Eff.	
For thermoelectric power conversion:	\$0.363
Replacement cost per unit:	\$10.00
Total cost of 106 units:	\$1,060.00
Recharge Frequency 2/. Yr.:	\$2,120.00
Total Cost over 20-year period:	\$42,400.00

### OPERATIONAL & MAINTENANCE COST E-CAT TECHNOLOGY



Description - material	Unit Rate - USD		Required for per MWh Heat output		Cost per day (24Hrs) of MW Heat output	Cost per year (8766Hrs) of MW Heat output	Remarks
Electricity Input COP 6:1	\$0.11	Per KW	3.33		\$440.00	\$160,710.00	This is based on cheap Dubai Tariff, with a COP of 6.
Water Calculations Sydney Water Price	\$0.03	Per Liter	5.2	liter	\$0.16	\$1,367.00	Cost per Year @ Standard Boiler leakage Rates NOT an e-cat expense
Operation & Maintenance per Published Specs	\$0.50	Per MWh	\$0.50	USD	\$12.00	\$4,383.00	Per Published Specs.
Recharge Cost	\$10.00	Per module	0.24	USD	\$5.80	\$2,120.00	Per Published Specs.
Hydrogen	5	Liters				\$1.00	Very small amount- not even in the equation
Actual Variable Cost						\$160,580.50	
Capital Cost	1.5	Million			\$418.68	\$150,003.00	Amortized at 1MW per hour for 8766 hours per year for 10 years.
Variable & Amortized Capital Cost for 10 year operation	1.5	Million			\$872.23	\$318,580.50	Actual per day cost including amortization
Variable & Amortized Capital Cost over 20 years Operation	1.5	Million			\$436.11	\$159,290.25	Actual Per day cost including Amortization



# Economics Cont.

	<b>E-Cat Cost Comparison</b>				
	<b>E-Cat</b>	<b>Dubai Electricity</b>	<b>Kerosene</b>	<b>#2 Fuel Oil</b>	<b>Propane</b>
<b>Price Per Million BTUs</b>	<b>\$10.65</b>	\$32.24	\$23.97	\$19.73	\$34.04
<b>Price Per Megawatt Hr.</b>	<b>\$36.35</b>	\$110.04	\$81.81	\$67.34	\$116.18
<b>Cost Per Day</b>	<b>\$872.36</b>	\$2,640.84	\$1,963.43	\$1,616.12	\$2,788.28
<b>Cost Per Month</b>	<b>\$26,170.88</b>	\$79,225.29	\$58,902.92	\$48,483.71	\$83,648.53
<b>Cost Per Year</b>	<b>\$318,630.51</b>	\$964,567.86	\$717,143.04	\$590,289.20	\$1,018,420.91
<b>Cost For 10 Yrs Op.</b>	<b>\$3,186,305.13</b>	\$9,645,678.62	\$7,171,430.41	\$5,902,892.03	\$10,184,209.06
<b>Cost For 20 Yrs Op.</b>	<b>\$6,372,610.25</b>	\$19,291,357.24	\$14,342,860.83	\$11,805,784.07	\$20,368,418.13

Ratio of Electricity input cost vs. Net Cost:	3.979513836					
				<b>% of E-Cat</b>	<b>% of E-Cat</b>	<b>Cost Per Day 1HW Plant</b>
<b>Cost Comparisons:</b>	<b>Cost</b>	<b>BTU</b>	<b>Per KW</b>	<b>COP 6.0</b>	<b>COP 12.0</b>	
Dubai Natural Gas	\$5.00	1000000	\$0.0171	46.96%	93.91%	\$206.61
Dubai Electricity	\$0.11		\$0.1100	302.67%	605.35%	\$1,331.77
Kerosene	\$23.97	1000000	\$0.0818	225.11%	450.21%	\$990.47
#2 Fuel Oil	\$19.73	1000000	\$0.0673	185.29%	370.57%	\$815.26
Propane	\$34.04	1000000	\$0.1162	319.67%	639.35%	\$1,406.57
US Natural Gas	\$14.71	1000000	\$0.0502	138.14%	276.29%	\$607.83
US Electricity - Resistance	\$32.24	1000000	\$0.1100	302.77%	605.54%	\$1,332.19
US Electricity - Heat Pump @ COP of 2.0	\$16.12	1000000	\$0.0550	151.39%	302.77%	\$666.10
Coal	\$10.18	1000000	\$0.0347	95.60%	191.20%	\$420.65
Firewood - Hard Wood	\$13.89	1000000	\$0.0474	130.44%	260.89%	\$573.95
Wood Pellets	\$20.96	1000000	\$0.0715	196.84%	393.68%	\$866.09
Shelled Corn	\$13.66	1000000	\$0.0466	128.28%	256.57%	\$564.45
Ethanol	\$24.74	1000000	\$0.0844	232.34%	464.67%	\$1,022.28
Ethanol Subsidy	\$5.92	1000000	\$0.0202	55.60%	111.19%	\$244.62
Powder River Basin Coal	\$0.56	1000000	\$0.0019	5.26%	10.52%	\$23.14
Northern Appalachia Coal	\$2.08	1000000	\$0.0071	19.53%	39.07%	\$85.95
Petroleum	\$13.56	1000000	\$0.0463	127.34%	254.69%	\$560.31
Diesel	\$16.21	1000000	\$0.0553	152.23%	304.46%	\$669.81
Gasoline	\$18.16	1000000	\$0.0620	176.54%	341.09%	\$750.39
Australian Coal	\$4.45	1000000	\$0.0152	41.79%	83.58%	\$183.88
Chinese Coal	\$7.82	1000000	\$0.0267	73.44%	146.88%	\$323.13

# Economics Cont.

	US Natural Gas	US Electricity - Resistance	US Electricity - Heat Pump @ COP 2.0	Firewood - Hard Wood	Wood Pellets	Ethanol
Price Per Million BTUs	\$14.71	\$32.24	\$16.12	\$13.89	\$20.96	\$24.74
Price Per Megawatt Hr.	\$50.21	\$110.04	\$55.02	\$47.41	\$71.54	\$84.44
Cost Per Day	\$1,204.93	\$2,640.84	\$1,320.42	\$1,137.76	\$1,716.88	\$2,026.50
Cost Per Month	\$36,147.77	\$79,225.29	\$39,612.64	\$34,132.73	\$51,506.27	\$60,795.09
Cost Per Year	\$440,099.05	\$954,567.86	\$482,283.93	\$415,565.99	\$627,088.78	\$740,180.18
Cost For 10 Yrs Op.	\$4,400,990.46	\$9,545,678.62	\$4,822,839.31	\$4,155,659.93	\$6,270,887.84	\$7,401,801.77
Cost For 20 Yrs Op.	\$8,801,980.92	\$19,291,357.24	\$9,645,678.62	\$8,311,319.85	\$12,541,775.67	\$14,803,603.54

# Andrea Rossi-Roger Green



# Who we are

**Director:** *Andrea Rossi*

- Inventor of the E-Cat, and strong proponent of renewable energy
- He has been active for many decades in various renewable energy systems.
- CEO of Leonardo Corporation - USA

**Director:** *Roger G. Green*

- Mr. Roger Green, a New Zealander, is an international businessman based in New York and Sydney Australia and has been active in the promotion of the E cat Technology worldwide. His company Eco Global Fuels holds several E cat licenses in the South East Asia , including a JV partnership with E cat Africa, Ecat India and a JV partnership with E cat Japan
- He has been active for over 25 years in environmental, eco-design and emerging green energy initiatives around the world. He is the founder and director of the Breakthru-Technologies Company, which has sponsored several international conferences and is financing many innovative inventions, including R & D utilizing the E cat technology for desalination, electrical generation and transportation.
- **Ecat Africa Limited is registered in Seychelles**
- **Ecat India [www.EcatSouthAsia.com](http://www.EcatSouthAsia.com)**
- **Ecat Japan is registered in Singapore**
- **Ecat Spain is registered in Madras, Spain**
- **Ecat license for Korea and South East Asia**
- **Ecat Agent for Australia, Indonesia and New Zealand**

• **Roger Green contact: [ecoglobalfuels@gmail.com](mailto:ecoglobalfuels@gmail.com)**

# More about Roger Green

- Early seed investor
- South East Asia including Korea
- Partners with Japan license (majority-Green)
- Partners with Melbourne Banker Roy Wise-Indian-Subcontinent (South Asia)
- Partners in African continent
- Partners in Spain and Portugal
- [www.Ecat.tech](http://www.Ecat.tech)

# Conclusions

- E-Cat is economically viable over the long run.
- It is a “green” technology that improves the environment, as opposed to coal.
- Zero carbon footprint in operation
- Can be used for process heating, with the potential to be a viable replacement for coal & oil.
- Reserves of nickel are well known, and most are not in conflict areas, as opposed to uranium.
- Is intrinsically safe, and any internal runaway reactions are self-extinguishing—far more safe than conventional fission plants such as Fukushima.

# NEXT\_STEP

- FIND STRATEGIC PARTNERS
- BUILD ECAT\_POWER PLANTS
- NO RISK INVOLVED
- DEMO-1MW unit in 6-8 months
- Producing statistics and performance data
- Begin with min. investment of 1 MW HOT - bolted onto turbine and generator
- 1.5 M plus turbine and generator (3-4 M)
- Start in secure locations
- Import 1MW to secure local safety certificates

# NEXT\_STEP

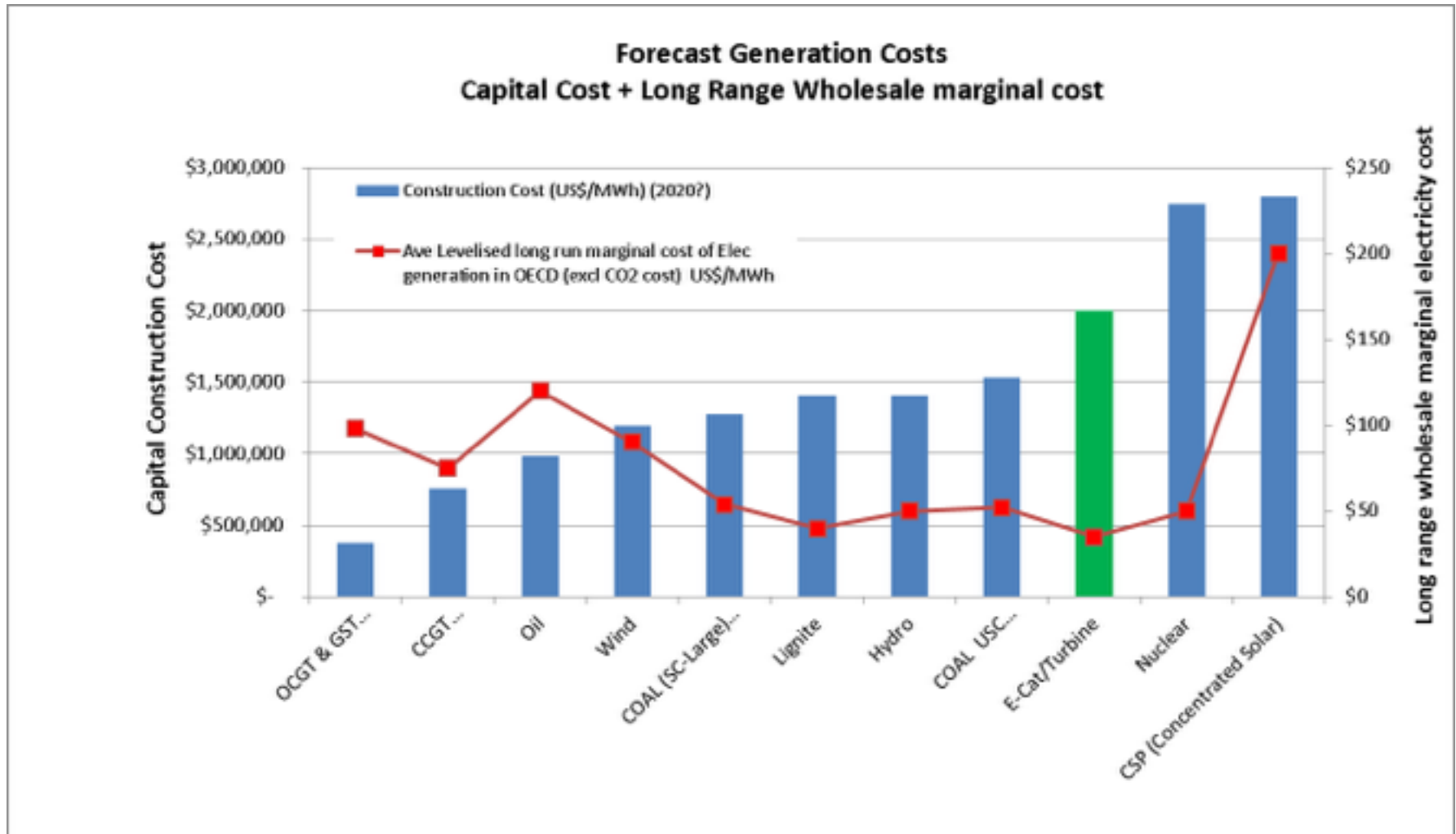
- Begin negotiations now-strategic partners
- Sign contracts after complete validations of working 1MW prototype
- Huge growth potential for original strategic partner (first options to increase value)
- Min. infrastructure required



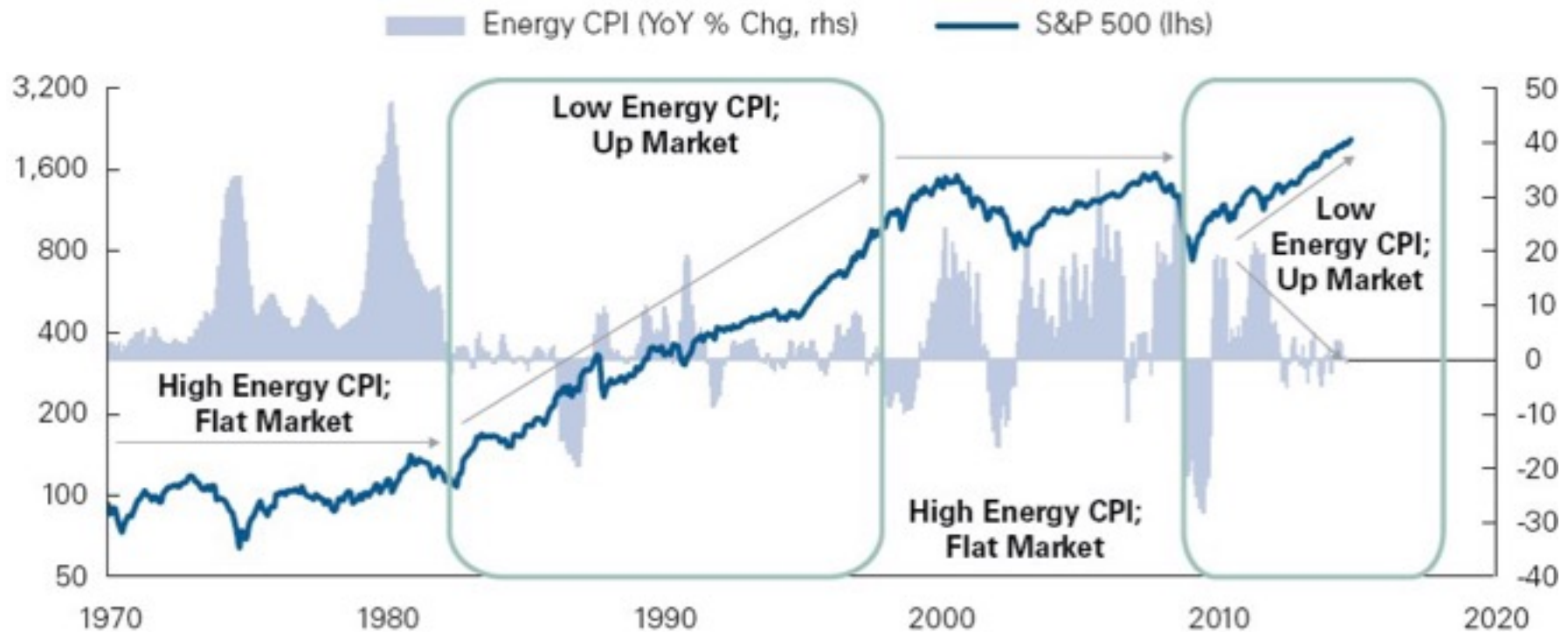
# So what is the State of the Nation?

- Wind farms and Solar are capital intensive, but relatively easy to do, and reliable to run with lower operating costs. Input energy is virtually free (wind/sun)
  - Total cost per MW is Medium and getting cheaper
- Hydrocarbon sources are reliable, solid suppliers. Politically jaundiced.
  - Low cost of inputs, moderate capital cost, large outputs, but also high maintenance costs. Source fuel is good for long term supply.
  - Total cost per MW is low

# Cost compared to Existing Technologies

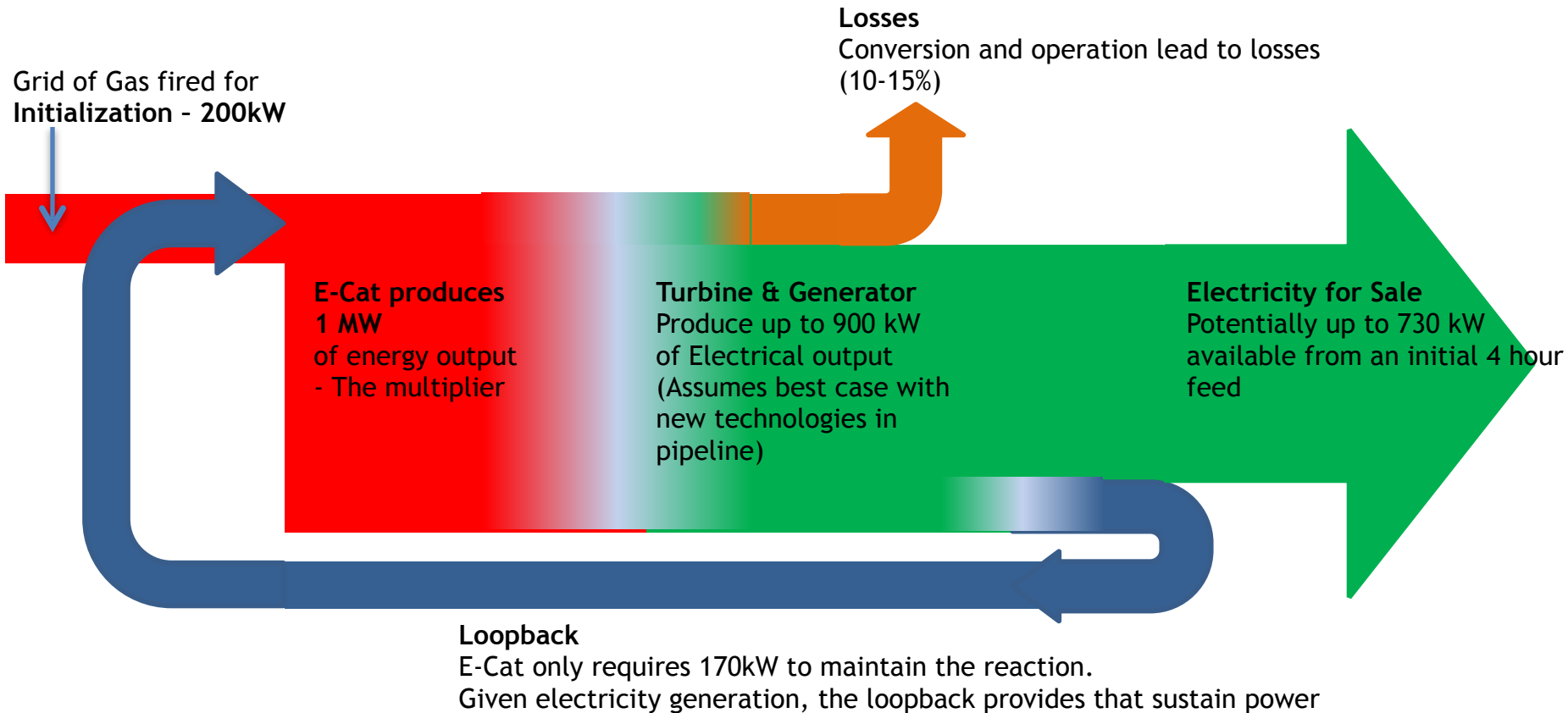


# Market - Energy demand expected to increase

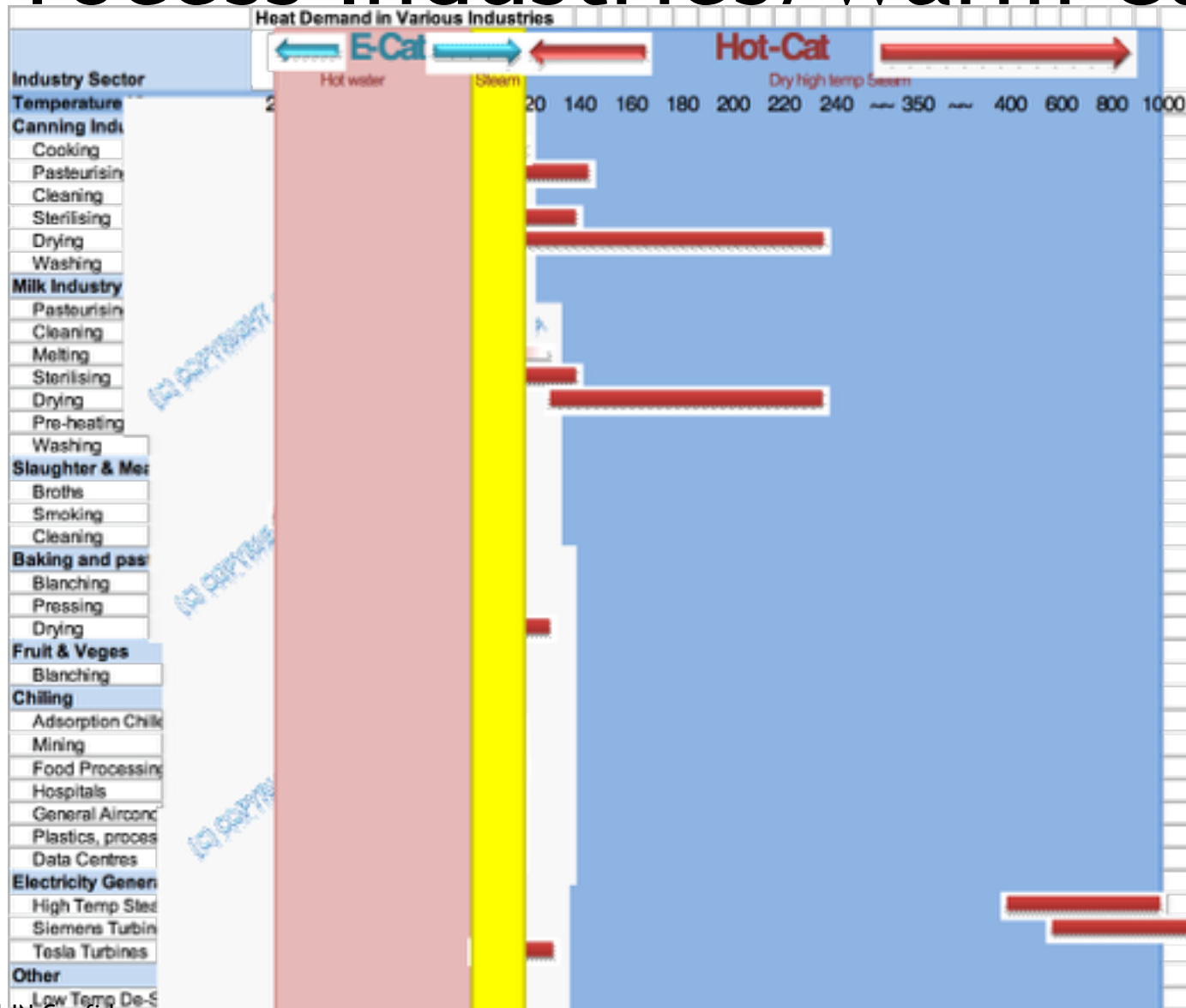


Source: Cornerstone Macro, Portfolio Strategy, data through November 28, 2014

# Overall Energy Balance



# Process Industries/warm Cat



# Contact

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