

LENR Market Development

Technology of the (near)Future ?

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LENR Technology overview

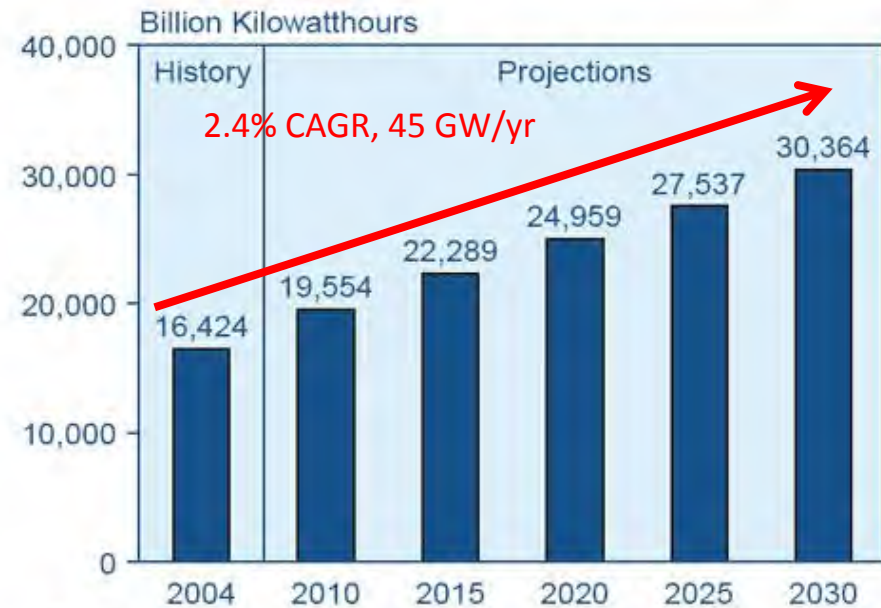
- Sporadic development since Pons & Fleishman's famous Cold Fusion announcement in 1989
- Replication/Scale limited – Many reports of excess heat; several groups planning to market LENR systems in 2013
- Many scientists & efforts – recent progress – great hope
- Promising efforts of Rossi, Defkalion, Piantelli, others
- R&D rekindled, but still mostly small level efforts
- Increasing interest and growing media attention
- Huge anticipation and potential partners & customers
- New formal efforts by U-Missouri + energy co's, others

New Sustainable Energy Discovery ?

- Simple Low Energy Nuclear Reaction – **LENR system**
- Uses minute amounts of Ni & H₂, (some with catalysts)
- Low cost, simple, sustainable way to produce unlimited Heat, Steam, and (ultimately) power !
- Eliminates Hydrocarbons – No emissions or waste
- Safe - No radioactive materials or waste
- Extremely high energy density: **2000X diesel fuel**
- Modular, Scalable and easily mass produced
- 1000's of applications, industrial, military, home, +
- Considered the **'Holy Grail' of the Energy world ?**

Global Energy Demand Rising

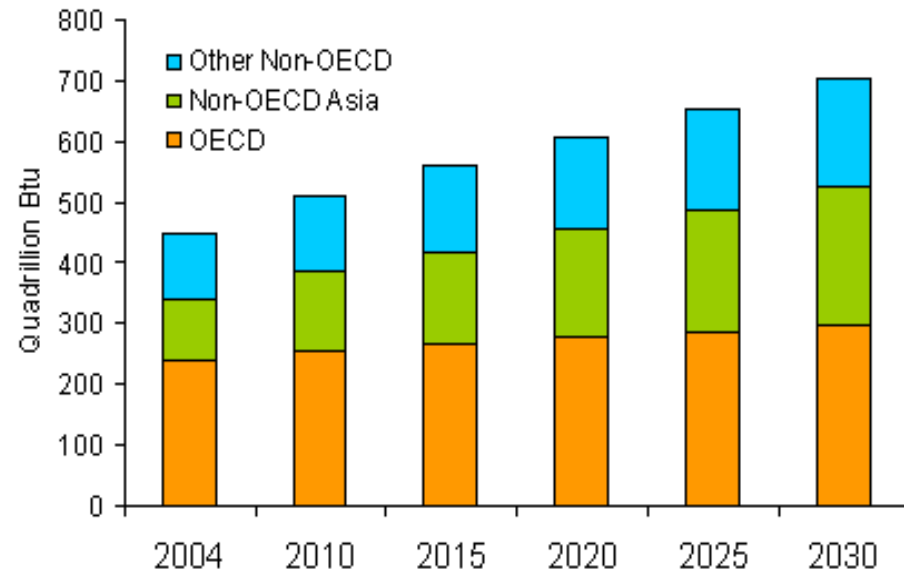
Figure 60. World Electric Power Generation, 2004-2030



Sources: **2004:** Energy Information Administration (EIA), *International Energy Annual 2004* (May-July 2006), web site www.eia.doe.gov/iea. **Projections:** EIA, *System for the Analysis of Global Energy Markets* (2007).

Electricity Generated

Figure 1. World Marketed Energy Consumption by Region



Source: EIA, IEO2007

All Energy (Quadrillion BTU's)

LENR Market Development

Players and Products

Primary LENR Applications

Technology readiness

Market readiness

Competition + other O/U techs.

Barriers to Market Entry

Early Market options

Economics – Market Size

Product development

Est. (Likely) Dev. Timeline

LENR Market Development (cont).

Intellectual Property

Compliance & Certification

Installation– Operation

Support and Service

Recharging – Refuel kits

Commercialization Options

Biz. Model – OEM Integration

Market Dev. Strategy – 3 Phases

How will LENR Market Evolve ?

Fast Tracking options - issues

Crystal Ball – Forecast

Summary

Key Players & products

- **Leonardo Corp.** - Andrea Rossi – E-Cat (several versions)
- **Defkalion** – Hyperion OEM – new product coming
- **Brillouin** – Godes - Hot Tube Boiler
- **Black Light Power** –Mills - Catalyst Induced **Hydrino** Transition
- **Nichenergy** (Piantelli) – Ni-H **technology** vs. product ?
- **Energetics** – new focus - moving to US ?
- **Other** – Coalescence - Nanor - AUS tech. – Japan, others ?

Rossi's 'E-Cat' Product family

- **Small E-cats** – 5-10KW – low temp. \$500-700 boiler -home use
Claims 1M pre-orders – (5-10,000 per day !) from Blogsite
He may try to sell thru national outlets like **Home Depot**

- **Large commercial systems** – 1MW - \$1.5M
8 x20 ft. container w/controls & reactors
50-100 E-cat low temp. modules in parallel
Many claims (1-2 sold ?) but limited test data



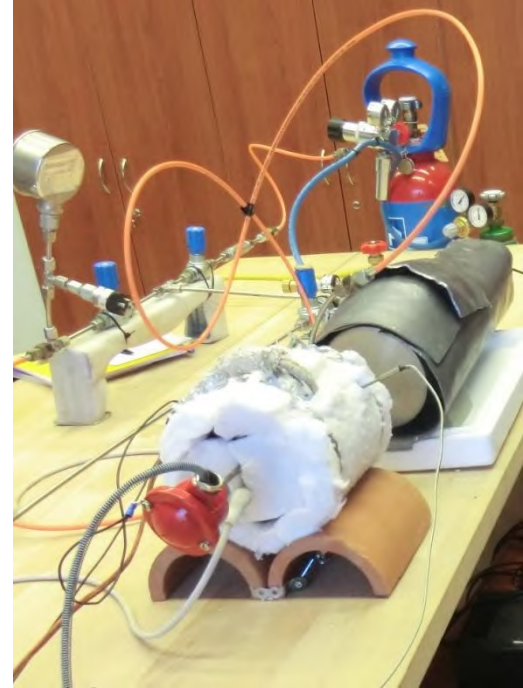
- **New 600C system** – 'Hot Cat' – not official yet
New design – 10KW High Temp - 600C Wall Temp
Claims continuous run of 40 days ~ 20 units **COP = 6**
Uses Ni, + H₂ pellets Easier to control & refuel
Continuous Input Energy needed + RF energy used
Will provide data in ~ 30 days ? **Many promises:**



"When I say above 600 Celsius I mean exactly this: the temperature of the wall is well above, as you will see from report we will publish Soon (matter of weeks)".

Defkalion Green Technologies

- **Hyperion** product – OEM market focus
- Simpler design – 5 Reactors (vs. 9, orig)
- Focus on comm'l market (vs. residential)
- Basic Ni + H₂, with plasma discharge
- 5-25KW vs. 5-45 KW – wide temp. coolant
- New reactor and 'trigger' system
- Self start – COP >10 – High Temp. operation
- New lab and team – Pilot plant in Xanthi
- 19 OEM's in 15 countries – paying 40M Euro each
- International network of business, scientific & political partners
- **Hyperion Launch scheduled for August** – possibly in US



Primary LENR Applications

- **Produce Hot Water** – Domestic, Industrial, Hotels +
- **Produce STEAM** –industry, pulp/paper, cloth, food/bev.
- **Process heat** – Industrial, Refining, Metal treating, etc.
Fertilizer, materials processing, plastics, bricks, clay, etc.
- **Building heat** – Commercial, Industrial, Residential, Farms
- **Farming, Cooking /Food prep. – Huge apps, human/animal food+**
- **Sterilization/Pasteurizing** – Food, Milk, Beer, Beverages, drugs
- **Water Desalination/Purification** – large/small systems
- **Power Production** – AC Power generation + CoGen
- **Propulsion** – Ships, Trains, Trucks, mining, aviation
- **Military and Space apps.** - many defense and space uses
ideal for mobile use – eliminates refueling issues

Technology Readiness

- Is LENR a proven concept ?
- Do we understand how it works ?
- What do we know /need to learn ?
- How to Control, and Start/Stop it
- Safety and Certification issues
- Where to apply first – early market rqmts. ?
- More testing is Critical
- **\$\$ Funding needed !**

Market Readiness

- Market Awareness – LENR still ‘unknown’
- Disruptive nature – could pose ‘pushback’
- Need to Identify and educate customers
- Many simple apps – Hot H₂O – process Heat +
- Turn-key ‘drop-in’ or integrated into systems ?
- How to prepare and ‘educate’ the market?
- Lots of ‘market development’ work to do

Competition

- Many forms, besides other LENR players
- Several LENR concepts, approaches: Ni-H, Pd-D +
- Too early to estimate – mostly pioneers today
No real products available (yet) to buy/test
- Big players (Fortune 500) still in Stealth mode
- Asia poised to copy and mass produce
- Distribution channels may be ‘key’
- **Huge market – many apps** – early market entry and acceptance primary concerns at this time

LENR Competitive Advantage

- Self Running Sustained output – 1-20MW
- Safe – Simple – **Low cost** – Easy to operate
- Long life – Easy to Integrate & Maintain
- Parity w/Coal-Power with **NO Fuel/Emissions**
- Run's 'off grid' in any location !
- Huge Savings Over Natural Gas & Oil
- Projected Power Cost: 1-2 cents/kWh
- Projected Heat Cost: 0.3-1.0 cents/kWhT



Barriers to market entry

Key barriers - some very challenging

- Many markets – varied requirements
- Sufficient testing and failure mode ID
- **Compliance and certification – BIG issue**
- Must have Distribution channels in place
- User acceptance – critical to success
- Resistance of Fossil Energy suppliers + utilities
- Cost to build tooling and factories
- Creating market awareness & visibility

Early Market Options

- Sell Direct to end user - Rossi's approach: large MW size and small E-cat units ? (1 MW & 10 kW)
- Sell home E-cat systems thru outlets like Home Depot
- Develop and market '**basic reactor core**' for integrators to design into their products
- Large OEM partners – i.e. Defkalion – 19 OEMs will build factories and sell Hyperion products in 15 key countries
- Vertical Market focus – Multinationals like GE, Siemens +
- Develop IP portfolio and license – Nichenergy/Piantelli, Celani, Miley, Widom-Larsen, Ahern, Mizuno, others

Economics – market size

- Total World Energy market is \$5T annual
- Target addressable LENR markets are HUGE !
- Markets like Desalination = \$200-500B
- Steam market also huge, + powerplants
- LENR System cost - very competitive with current techs. Quick payback and savings
- Birth of **New \$T Growth industry** - many jobs!

Product Development Cycle

- Proof of Concept model - Feasibility
- Lab Prototype
- Product Design – Spec's, plan, resources, \$\$
- Engineering Prototype
- Field Testing – Beta version
- Certification + Pilot Production + Financing
- **Market launch**
- Full Production - scale up

Est. (Likely) Product Dev. Timeline

- Proof of Concept – 2012-13
- Lab Prototypes – 2012-14
- Product Design – 2013-14
- Engineering Prototypes – 2013-15
- Field Tests – Beta version - late 2013-15
- Certification – mid 2013 – 2015
- Pilot Production – 2014 on
- Full (Real) **Market launch** – 2013 ? on
- Full Production – 2014 on

Intellectual Property - potential issues

- Limited solid IP – mostly Piantelli & few others
- US Patent office rejection (P/M devices)
- Rossi problems – rejected by EUR PTO + USPO?
- Defkalion – Limited protection – 6 new filings
- New Patent Filings – many and varied
- Widom and Larsen patents – Theory only
- Many new inventors - NASA – others
- **US Patent Office must revisit the P/M issue!**

Compliance & Certification

- Many levels, based on app's and country
- ASME, ASHRAE, UL, CSA, TUV, CE, EU, other
- Boiler tests and standards – ASME +
- Fire rating - Factory Mutual tests/rating
- Possible other govt. agency regs.
- State and local permitting – Fire marshal
- Safety, product liability and Insurance issues
- Standardization will be needed
- New Open Source LENR Project[®] group:
Gary Wright <http://opensourcelenr.com/>

Installation and Operation

Typical process

- Obtain site approval and permits
- Final approval for installation & drawings
- Identify approved licensed contractors
- Contract for Installation (and insurance)
- Schedule & perform inspections
- Perform acceptance testing
- Train customer/operator

Support and Service

Several options

- Factory direct
- OEM supplier provides
- Third party Service
- Installers
- Dedicated field service teams
- Warranty service

Recharging - refuel kits

Several methods:

- Included in Service contract
- Based on usage level
- User installable kit
- Field service agent
- 'Swap out' the reactor core
- Disposable, like toner

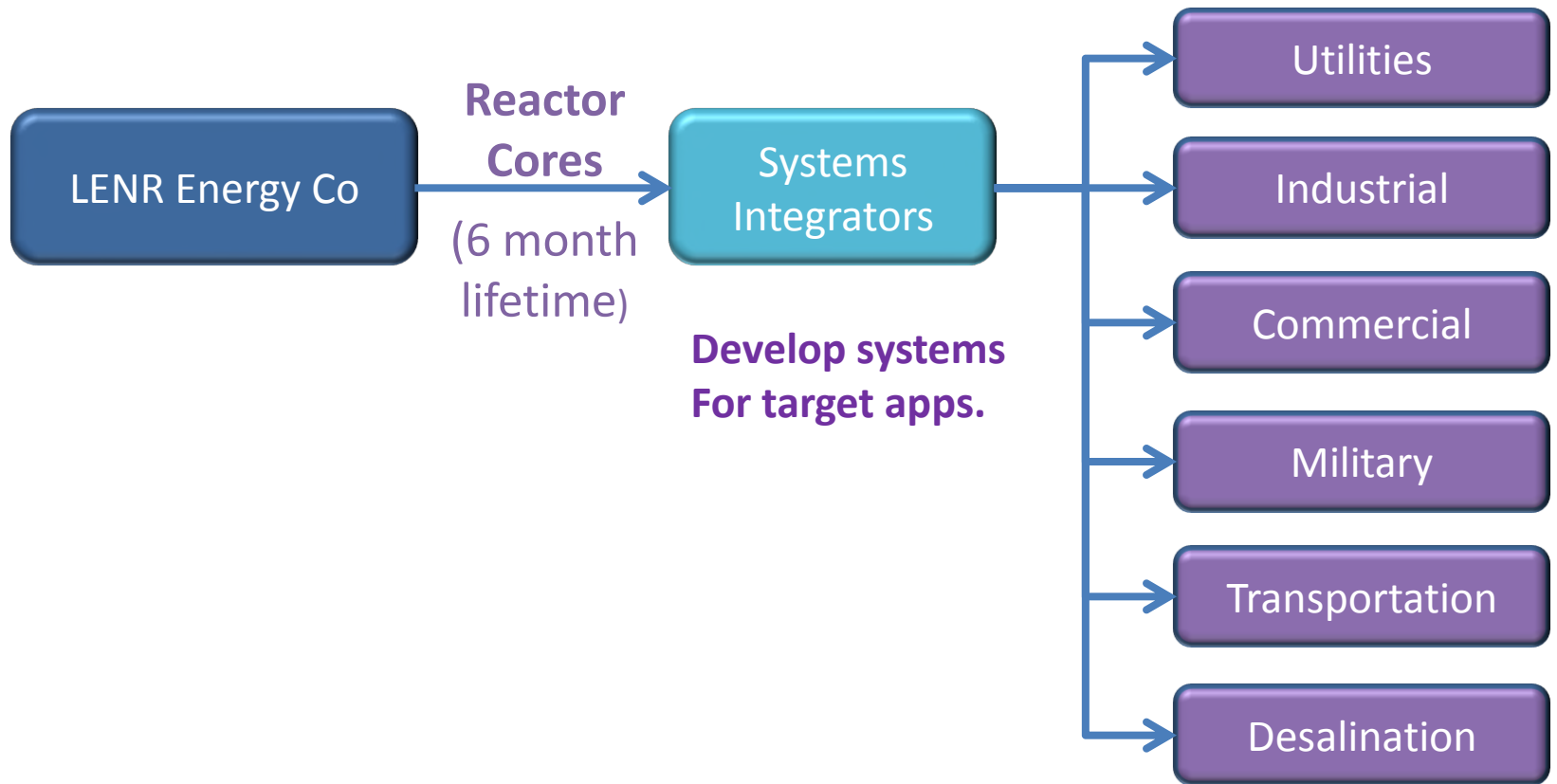
Options for commercialization

- Traditional IP Develop/licensing to select groups
- Develop and produce Core Technology module with market/app. specific licenses to select licensees
- Open source with control over proprietary reactant /media - ('razor blades')
- **Create R&D consortium** to further develop and commercialize on 'Fast Track' basis

Why is LENR so important ?

- Create new opportunity for **Fossil-free Energy**
- Huge impact on our economy and **job creation**
- Address **climate change** and carbon emissions
- Bring **low cost energy** to third world countries
- Initiate a whole **new field of research** and development of new products/systems
- Enable **New Aviation and Space initiatives**
- Revitalize **Research @ NASA** & national labs
- Create New companies and **Jobs**
- **Restore US Technology Leadership**

Primary Business Model

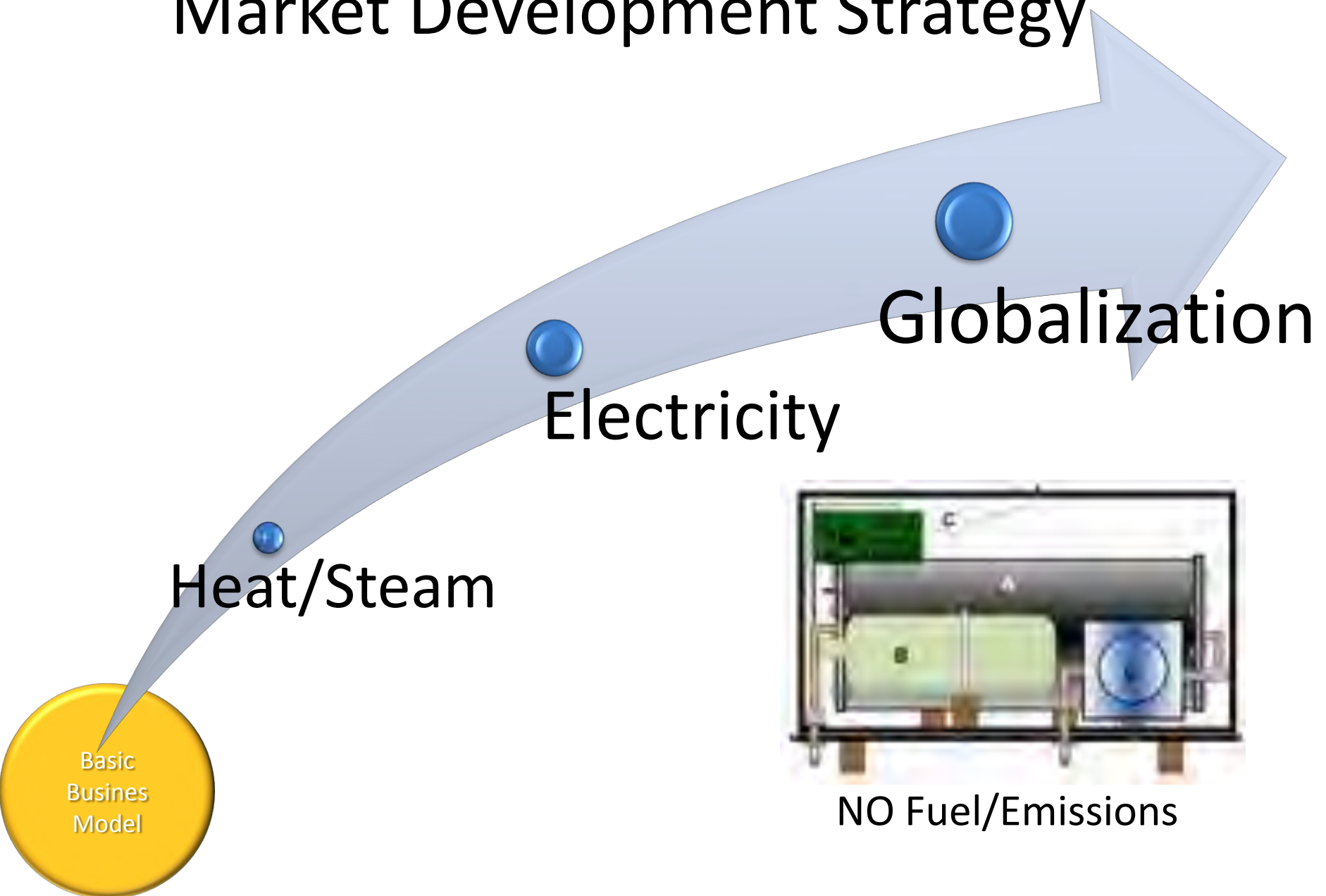


OEM Technology integration

Multiple approaches

- License factories (DGT) with country licenses
- Large corporate partners and JV's
- Private label products, existing distribution
- Subsystem integration - Longer dev. cycle
- Products focused on specific markets, like desalination and water purification

Market Development Strategy



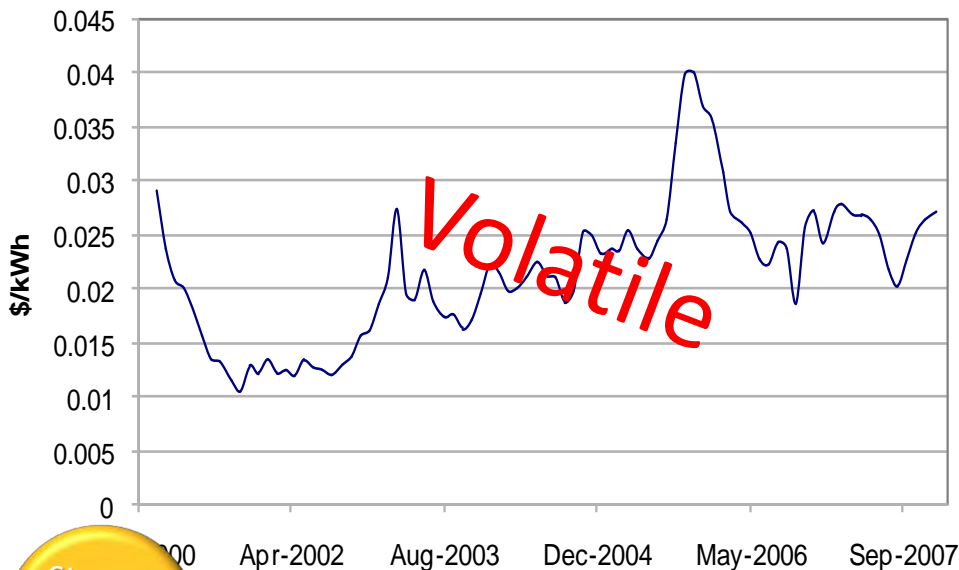
NO Fuel/Emissions

Phase I - Thermal Energy Production

Problems with Conventional Energy Sources

Fuel & Operating Prices are rising and volatile
Intolerable environmental impact and fuel issues
Political dependence and risk

Industrial Natural Gas Price



LENR Opportunity

Energy Sustainability
Stable, Competitive Pricing
Early Mover with Partners
Low Cost-Easy to integrate
Safe- Long Life, **No Emissions**

Strong
Business
Model

Sample early market application: Replace Existing Oil and NG boilers

Typical Fuelled boiler



New LENR Fuelless Boiler



SAFE, Simple, CLEAN Power - No Fossil Fuel or Emissions
Heat or steam plants can be located anywhere !

Phase II: Electricity production

Make Heat & Electricity – CHP systems

Huge Market - 15 TW – world power mkt.

Many Distributed and remote power markets

Potential Transportation, Military, Aviation, Space use

Low cost LENR Electric power systems

Key Advantage over other sources of electricity - improved efficiency at low-med. temps & **low operating cost**

Zero Fossil fuel – Zero Emissions – Low operating expense

Explore novel uses of ‘heat engines’, and drop-in apps.

● **NO CO2** - Becoming big climate change issue

Phase III - Scale-up – Global Ind. Growth

- LENR Tech. versatile-scalable to multi-MW levels
- Many large markets based on product size - specs
- **Agriculture** – impacts all phases + Irrigation
- Power, Water & Heat/cooking for third world !
- **Desalination and Water Purification – HUGE impact**
- Small Power plants < 100 MW – convert Coal fired powerplants - easy target in US/China (60% Market)
- **Isolated islands - Indonesia, Philippines, many others**
- Trains, Ships & Ocean liners - future targets

How will LENR market evolve ?

- Early demo's with **third party validation** – Key
- More Papers published + solid media coverage
- New Patent filings (PTO and US)
- Research 'kits' made available – new variants
- New inventions – new apps and systems
- Initial 'trial' products tested 'behind fence'
- Early customer field tests – pos. user feedback
- **LENR goes VIRAL** - New market players & mfgs.
- Large Corporate players enter market
- New Apps & uses across planet – **Energy Revolution!**

Can we 'FAST TRACK' Dev. process ?

Many possibilities – many challenges

- Large Govt. backed program – too complex, slow
- Large corp. program - GE/Siemens/ABB - slow
- Partnership of leading players (w/funding) - good
- UN or EU backed program – too slow/difficult
- **Open Source** – make tech. available worldwide
- Large VC/investor backed effort – could work
- **International Energy Consortium** – strong potential

‘Fast Tracking’ Issues - Risks

- Convincing Licensees & Partners to adopt
- Market prep. and introduction/timing
- Customer & Market acceptance critical
- Ramp-up issues, as new tech. takes hold
- Regulatory and permitting issues remain
- Push-back from existing tech's being displaced
- ‘Innovators Dilemma’ - Market dynamics

Other related technologies

- **Sterling Engines** – to efficiently convert heat to rotary motion (and electricity)
- **Thermal-electric solid-state devices** – low efficiency but new conversion tech. under development
- **High efficiency Turbines** – many new tech's.
- **New Heat transfer methods** and devices
- **Advanced materials** – nano structured materials like Graphene and new CNT's

Crystal Ball – ‘What’s coming’ ?

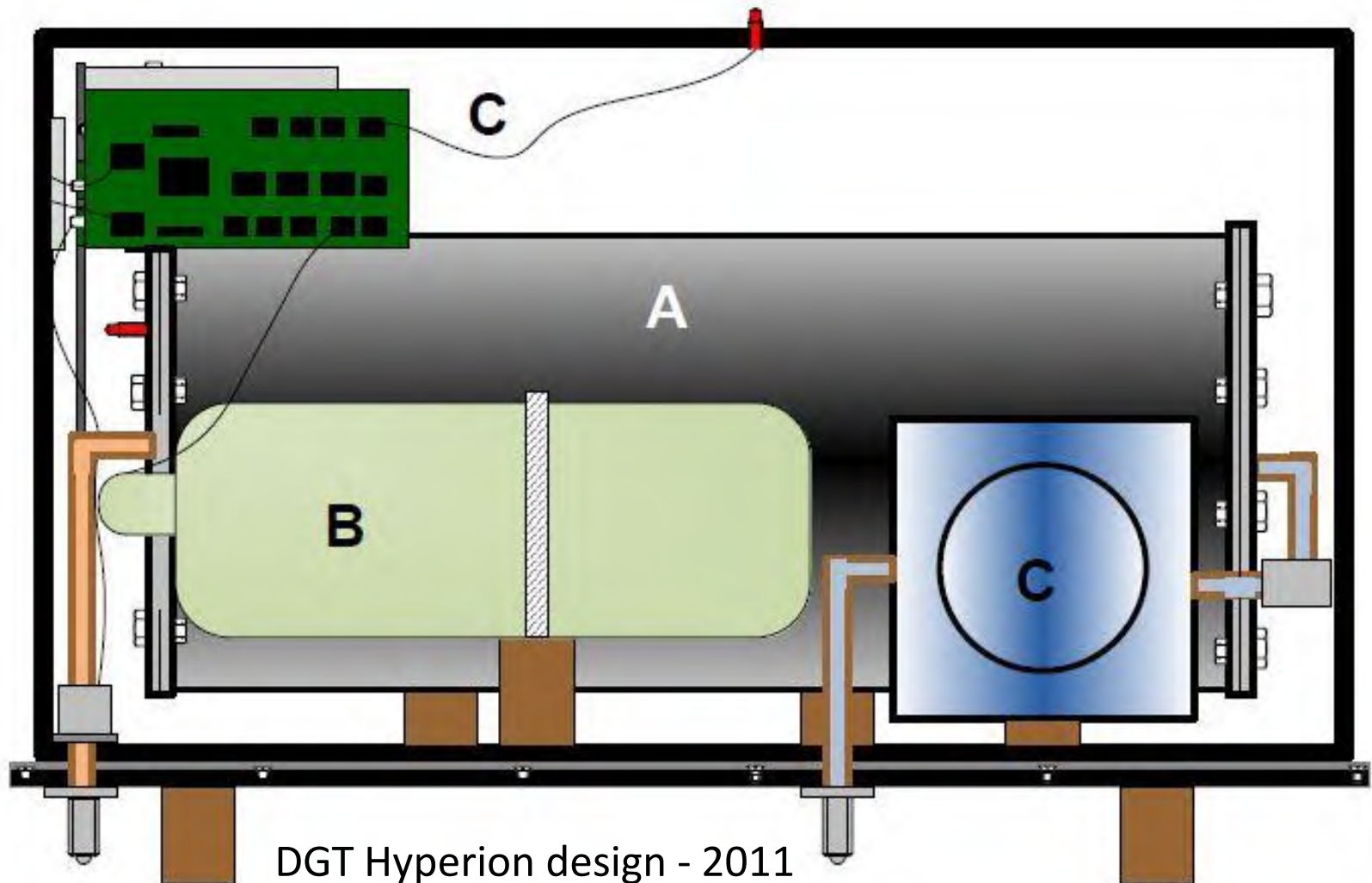
- Many **New LENR methods** and devices, and other reactants like Tungsten, Zirconium, Ti, Carbon, etc.
- Re-emergence of **Cavitation & Sono-Lum.** – new designs
- **New Energy Storage Systems** – undersea + phase change energy capture + **New Batteries/Ultracaps** - Nuclear, **Li-Air**, new Vanadium Redox, Ni-metal, liquid metal, etc.
- Advanced materials like Graphene, Piezo, and CNT's
- **New Energy Conversion & Thermo-Electric devices, systems,** and energy efficiency refocus – **No need for incentives** or carbon tax
- Rapid development of African & **Third World** markets
- New mobile applications – **Heat & Power Anywhere !**

Gradual shift in world fossil fuel dependence !

Summary

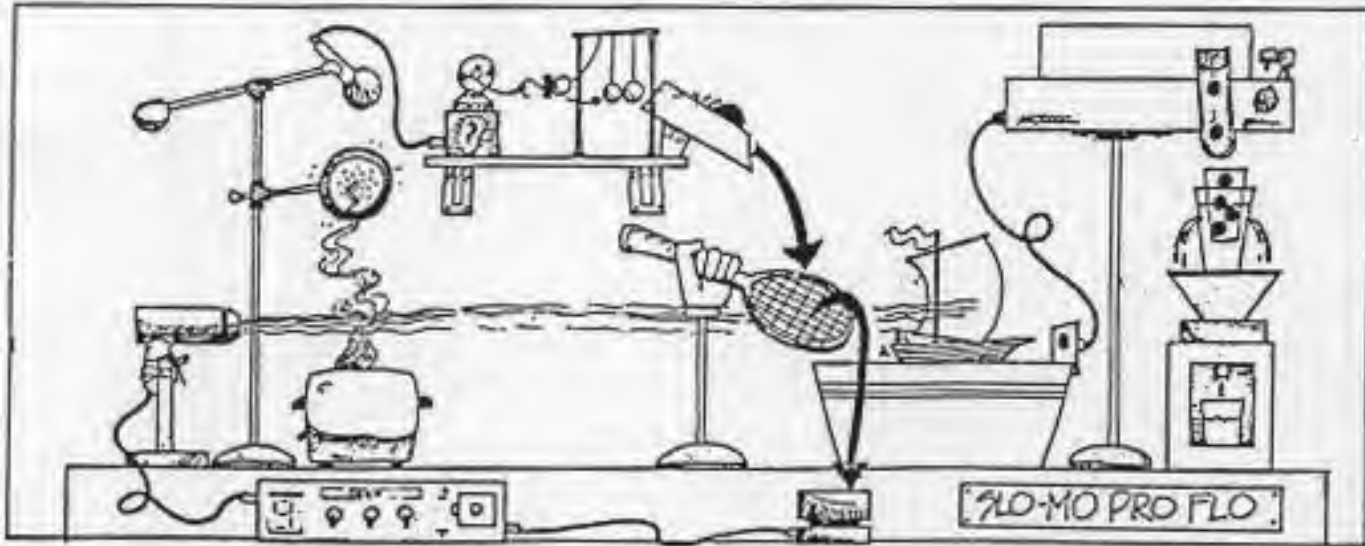
- LENR offers great potential, but lots of further development, testing, and IP work remains
- Too much early 'Hype' and confusion - people misled by promises of Rossi/others, & lack of verified test data
- **Need solid Understanding of LENR phenomena + process**
- Address Issues of reliability, durability, safety, service
- Major market development and 'mainstream'
media coverage & **industry acceptance needed**
- Market is poised – Technology & products unclear
- Many new Inventors, Developers & Marketing partners
- **Future promising, Game Changing** – could go 'Viral' !

The 'Technology of the Future' is (nearly) Here !



Thank You

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Newest E-Cat home energy system

LENR/CF inventors

Andrea Rossi – **E-Cat II** - Leonardo Corp – Bologna, Italy

Francesco Piantelli – **Nichenergy** – Sienna, Italy

Francesco Celani - Italy

Defkalion Green Technology – **Hyperion** - Athens, Greece

George Miley – Univ. Illinois - Newco

Peter Haglestein – MIT (plus Mitch Schwartz, B. Ahern, etc)

Brillouin Energy – Bob Godes – **Quantum Fusion Reactor**, CA

Black Light Power – Randy Mills – Hydrinos - Princeton

Widom-Larsen – (Theory only)

Australian R&D – New tech – Very promising – new elements

Energetics – Israel & Missouri - ?? – Co. moving to US ?

Rob Duncan's team – U. Missouri - \$5.5M funding – new labs

Govt. – NRL, SPAWAR, Los Alamos, **NASA**, DARPA, DOE ++

Indiv. inventors – CA, OR, WA, MA, France, Russia, Japan, India

World Coal Powerplant use

Country	2008 Coal Power Prod.	% of World Total
• China	2,733,000 GWh	33.1%
• U.S.A.	2,133,000 GWh	25.8%
• India	569,000 GWh	6.9%
• Germany	291,000 GWh	3.5%
• Japan	288,000 GWh	3.5%
• S. Africa	241,000 GWh	2.9%
• Australia	198,000 GWh	2.4%
• Russia	197,000 GWh	2.4%
• Korea	192,000 GWh	2.3%
• Poland	143,000 GWh	1.7%
• All Others	1,278,000 GWh	15.6%
World Total	8,263,000 GWh	100%