

GE Hitachi Nuclear Energy

The Nuclear Energy Option

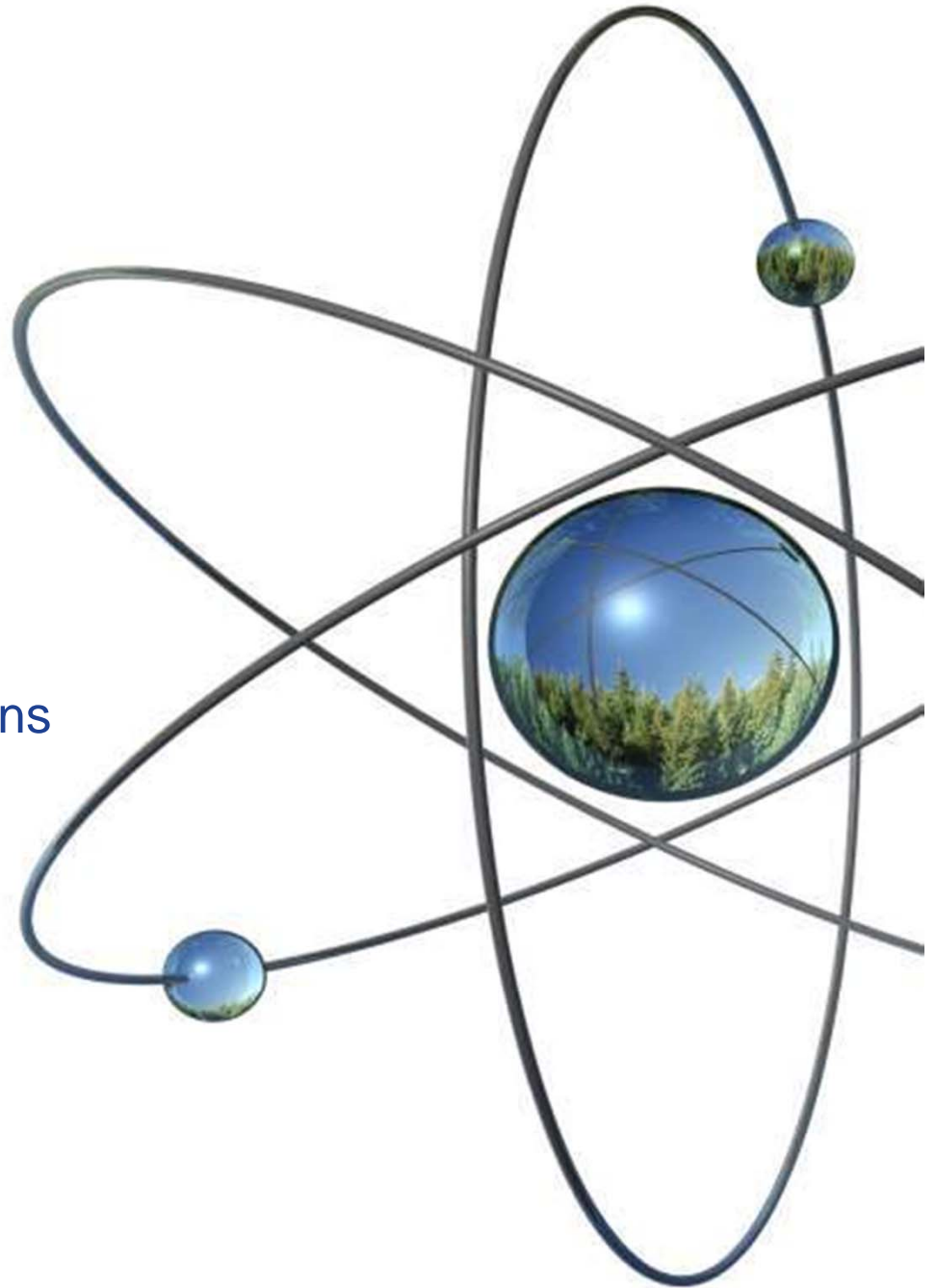
Craig Ihrke

Vice President, Commercial Operations

March 3, 2011



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Why nuclear?

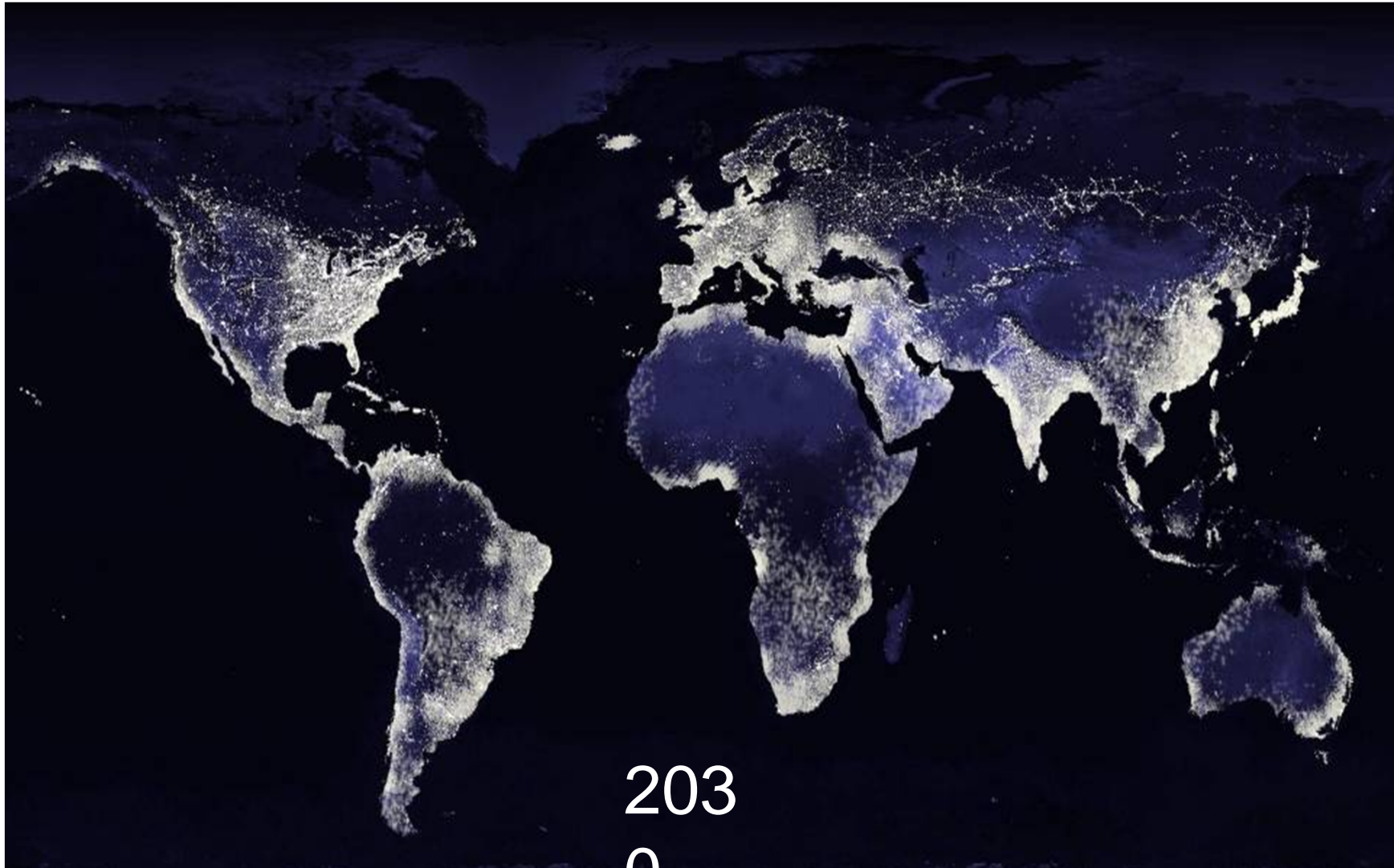
... consider the energy
demand landscape

Demand – 2007



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Demand – 2030



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Global trends ...

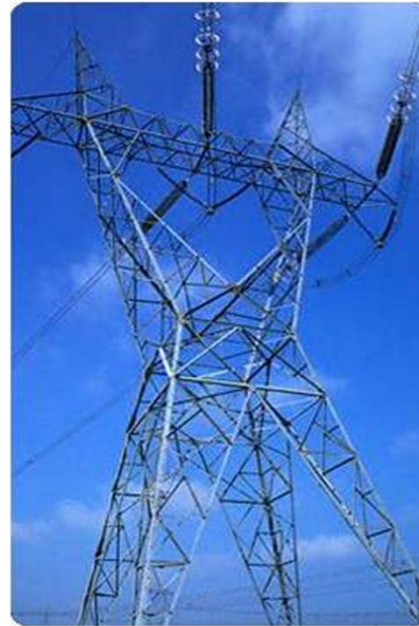
Population



Lifestyle



Energy Security



Environment

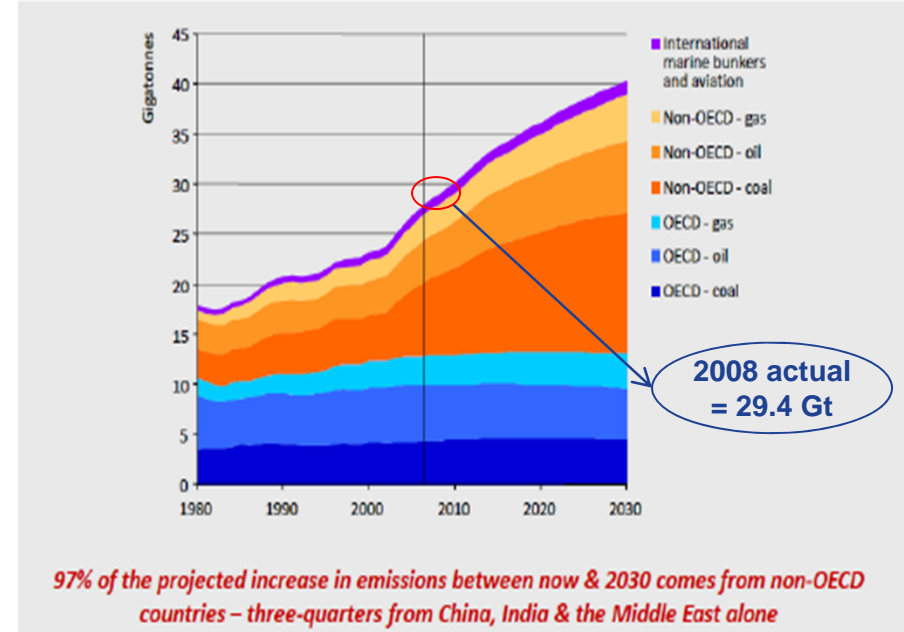
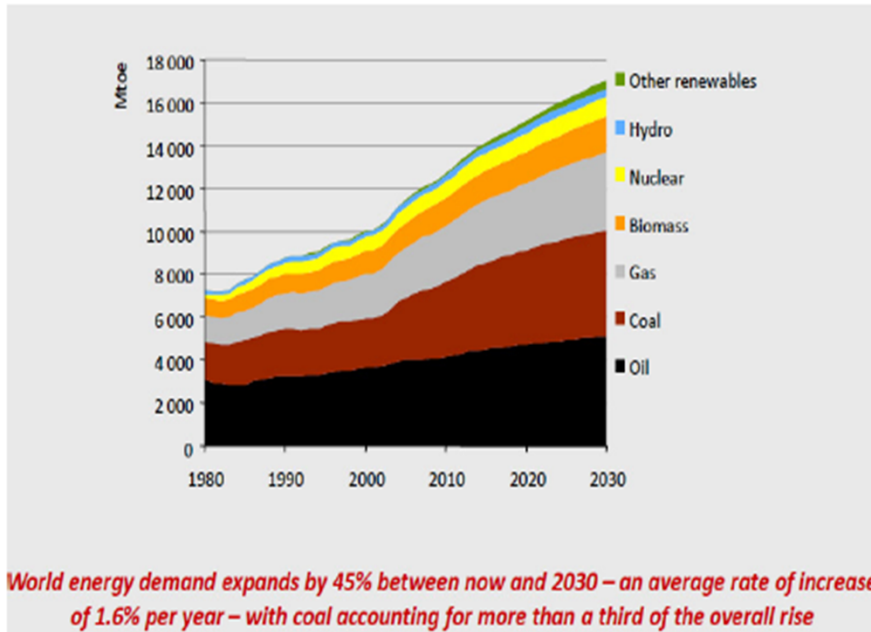


... create **big** challenges



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Energy demand and resulting



Global energy demand

CO₂ emissions

Current energy mix is not environmentally sustainable



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Source: International Energy Agency, World Energy Outlook 2008

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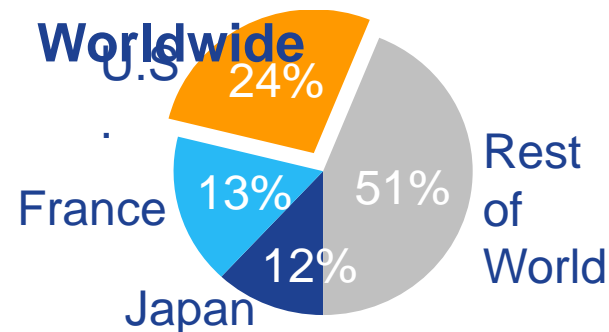
Nuclear – a necessary energy source

- ~14% of the world's electricity is generated by nuclear
- One nuclear plant is capable of generating about as much electricity as is consumed by one million U.S. households each year
- Provides stable-cost, base load power

Today

- 441 reactors in 29 countries
- 375 GW of nuclear generation worldwide
- 104 reactors in U.S.

Nuclear Plants Worldwide



Nuclear energy generation has no CO2 emissions!



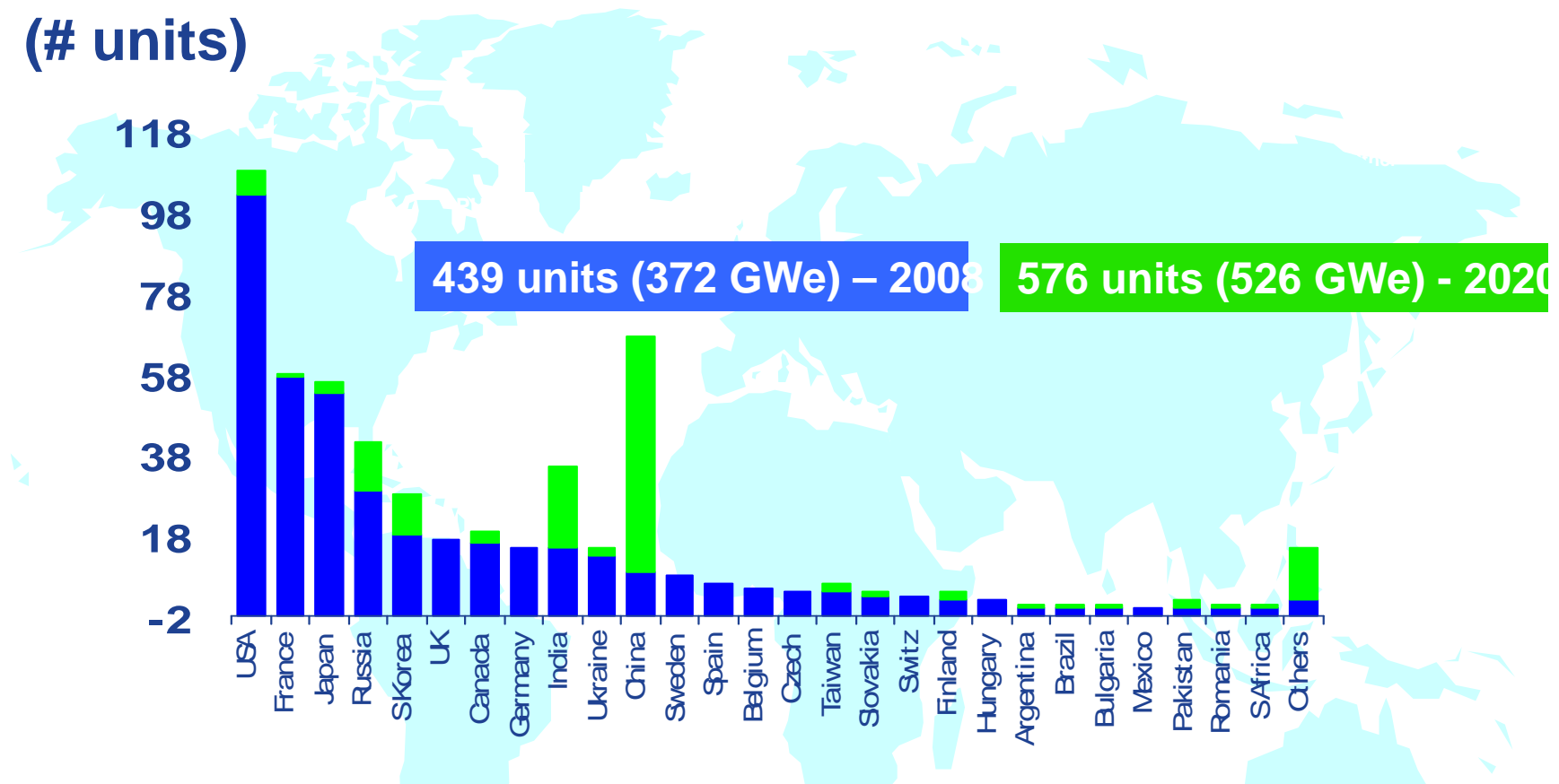
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Source: International Atomic Energy Agency, International Status and Prospects of Nuclear Power, 2 September 2010; WNA Optimized Capacity: Global Trends and Issues

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Nuclear worldwide – trends 2008-2020

(# units)



emerging countries ↑
60 nuclear units = 58 GWe under construction today



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Sources: UxC "Nuclear Power Outlook, Q3 2009";
 International Atomic Energy Agency, "International Status and
 Prospects of Nuclear Power, 2 September 2010"

Nuclear “barriers”

“Barriers” to nuclear energy

- Lack of supportive national policies



- Higher upfront capital costs



- Used nuclear fuel



- Public concerns about nuclear safety



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Overcoming the “barriers”

National policy

Top Ten Nuclear Countries

Rank	Country	# of Units	MWe net
1	United States	104	100,367
2	France	59	63,363
3	Japan	55	47,587
4	Russia	31	21,743
5	Germany	17	20,379
6	South Korea	20	17,500
7	Ukraine	15	13,195
8	Canada	18	12,652
9	United Kingdom	19	10,230
10	Sweden	10	9,037

National sponsorship
+ favorable legislation =
nuclear growth and success!

Top Ten Nuclear Countries

Rank	Country	# of Units	MWe net
1	United States	110	111,425
2	China	69	70,216
3	France	60	68,140
4	Japan	58	53,827
5	Russia	43	32,854
6	South Korea	30	29,380
7	Germany	17	20,379
8	India	37	18,362
9	Canada	21	15,237
10	Ukraine	17	15,095

Top Ten Nuclear Countries

Rank	Country	# of Units	MWe net
1	China	129	133,216
2	United States	120	126,567
3	France	63	76,480
4	Japan	69*	56,945
5	Russia	49	40,933
6	South Korea	36	38,187
7	India	50	35,786
8	Canada	20	17,860
9	Ukraine	19	17,535
10	United Kingdom	13	14,656



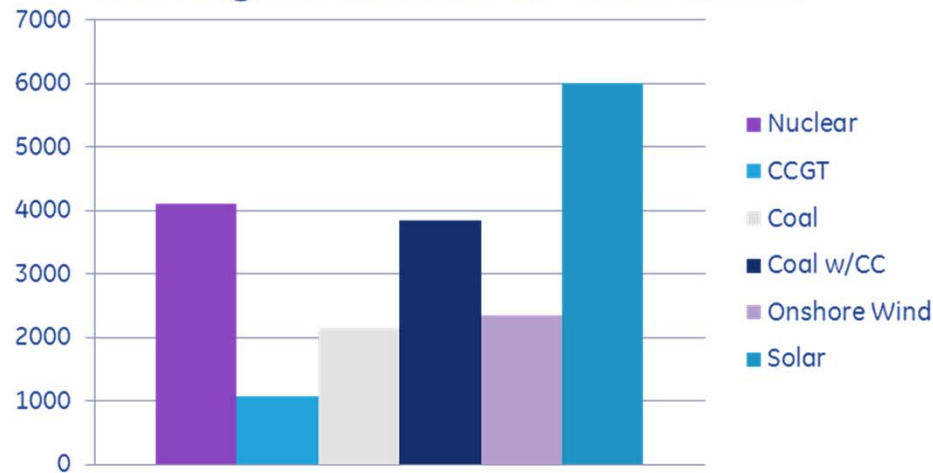
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Source: UxC Nuclear Power Outlook Q2-2010

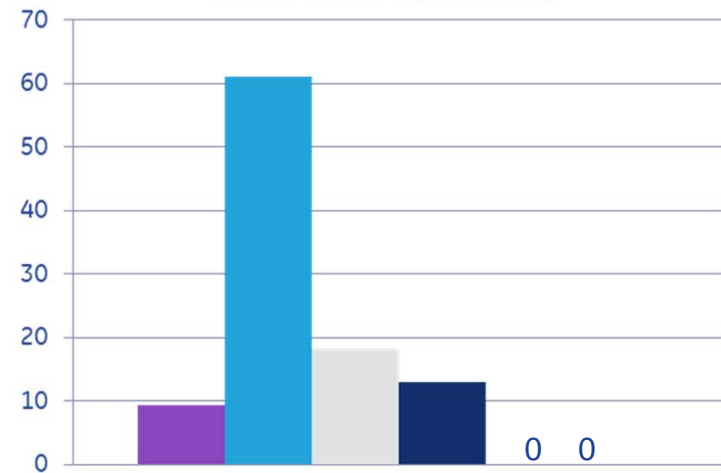
*includes recent Japan gov't announcement of 14 additional NPP by 2030

Costs

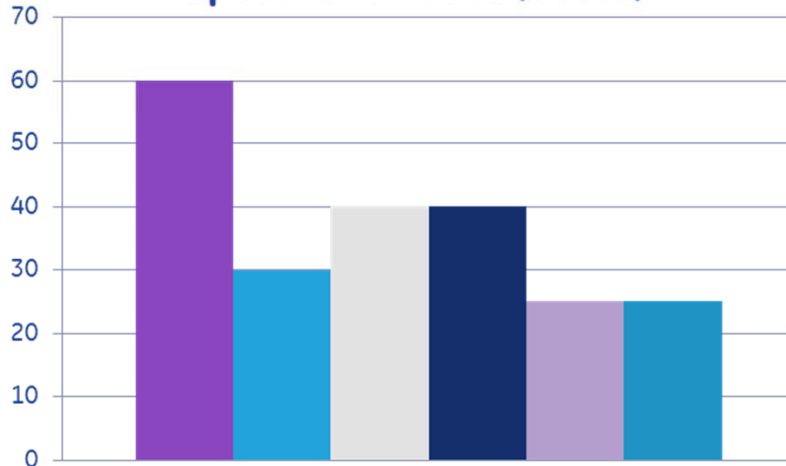
Overnight Construction Costs (\$/kW)



Fuel Cost (\$/MWh)



Expected Lifetime (Years)



**Nuclear capital costs
offset by longer lifetime
and lower fuel costs**



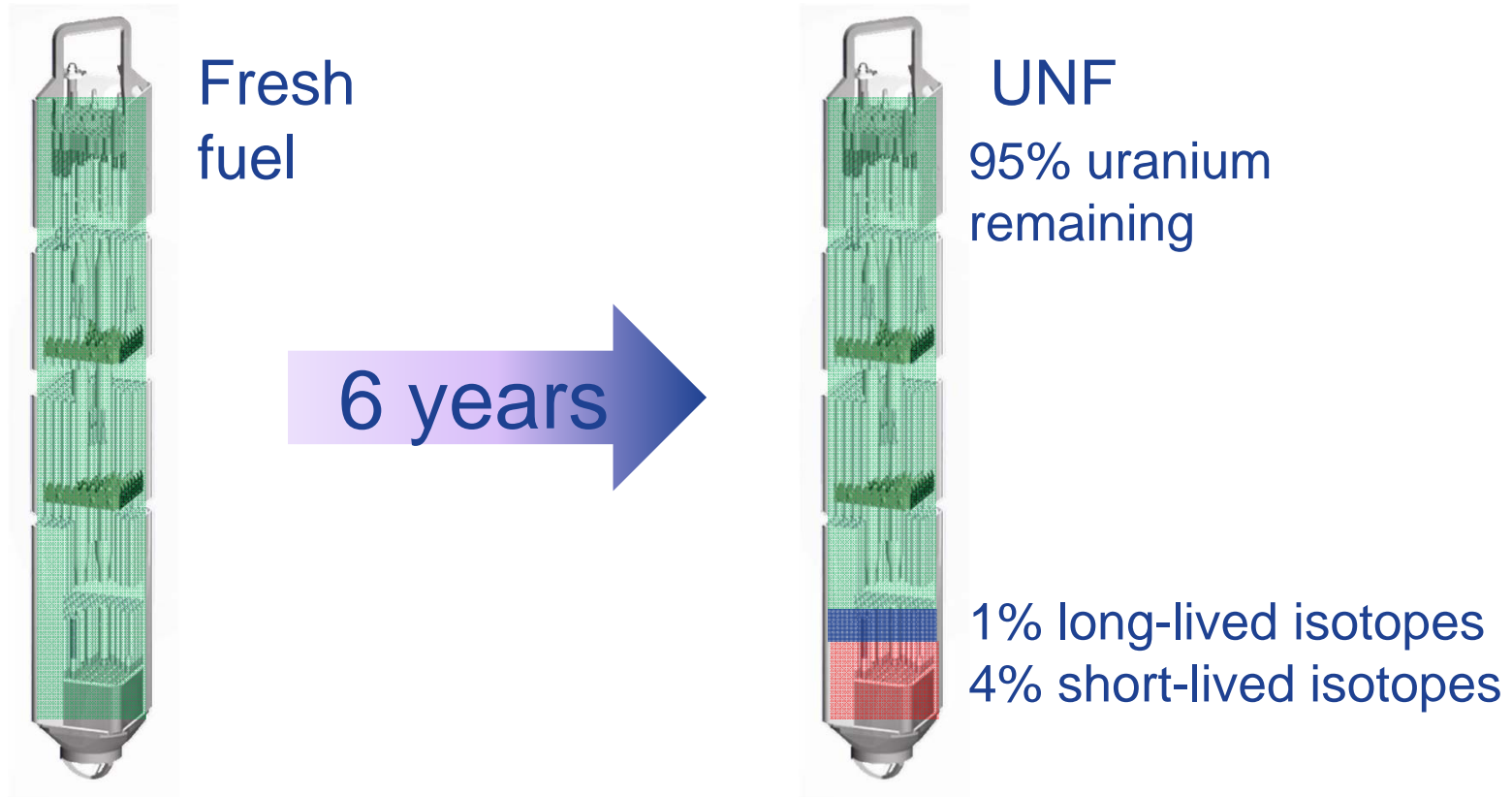
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Source: International Energy Agency / Nuclear Energy Agency "Projected Costs of Generating Electricity: 2010 Edition"

Used nuclear fuel (UNF)

management

- A new nuclear reactor fuel bundle produces electricity for 4-6 years
- At the end of this period, only **~5%** of the potential energy in nuclear fuel has been harnessed



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What to do about used nuclear fuel ... “the 3 R’s”

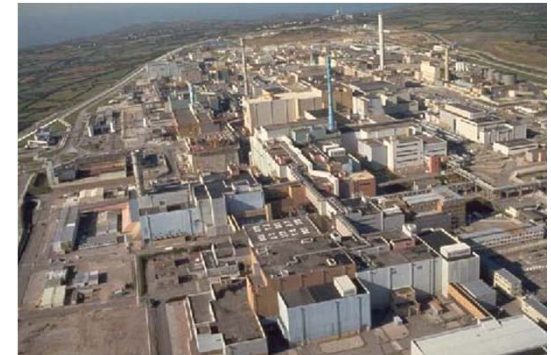
Repository

- Reclaims none of the remaining energy
- Politically difficult siting decisions
- Wasted uranium resource



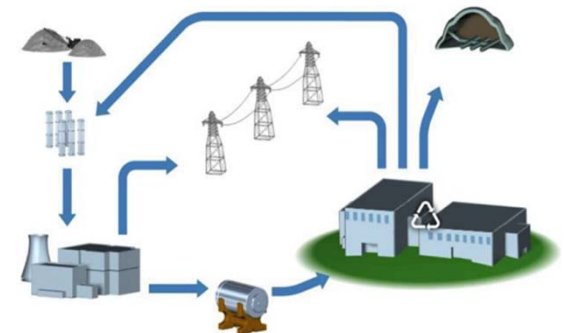
Reprocessing

- Only reclaims <10% of total energy
- Separates plutonium (proliferation concern)
- High level waste remains



Recycling

- Reclaims >90% of total energy
- No proliferation issues
- Dramatically shortens end repository lifetime

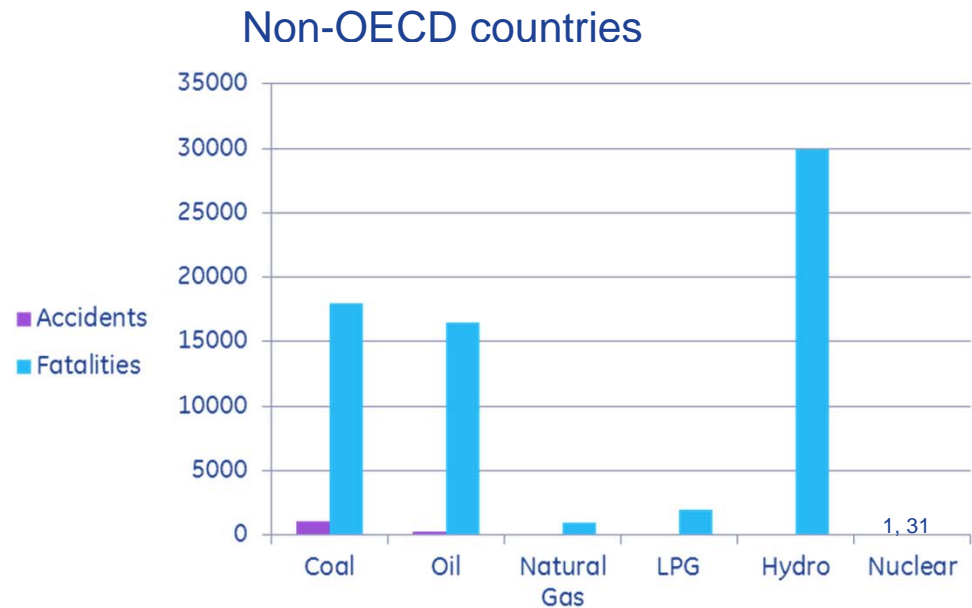
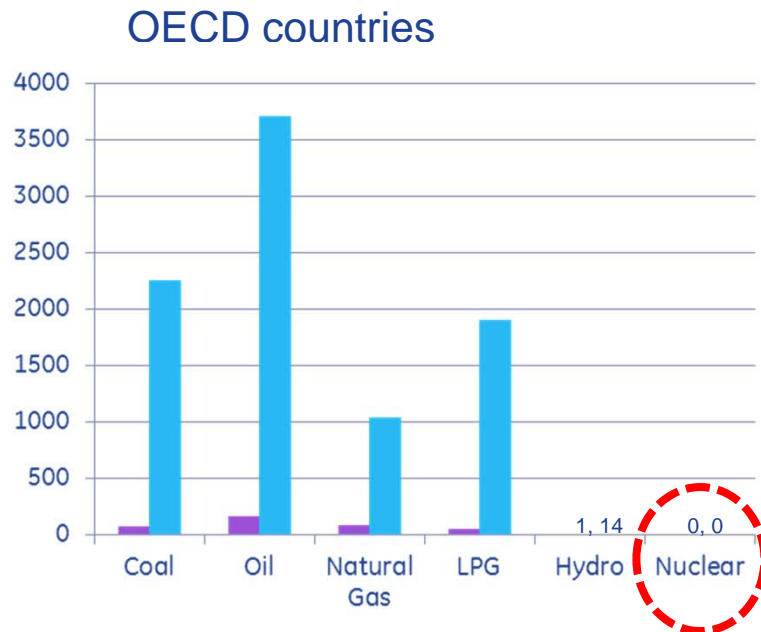


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Public concerns about nuclear safety

> 2500 people killed every year in energy-related accidents

Summary of severe accidents by energy industry
(1969-2000)



Nuclear energy is safe energy!



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Sources: Nuclear Energy Agency, Organization for Economic Cooperation and Development, 2010; Nuclear Energy Institute

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GE Hitachi Nuclear Energy Portfolio

Making history together

1950s

GE

First test reactor:
Vallecitos, CA



1960s

First Commercial
Plants: Dresden 1,
KRB, Tsuruga



1970s

Higher Power
Levels: Peach
Bottom 2, Tokai 2



1980s

Standard Designs:
Grand Gulf,
Fukushima Daiichi 6



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First Experimental
Reactor: JRR-3

First Test Reactor:
JPDR

Hitachi completes first
Japanese Commercial
Reactor: Shimane 1

Two BWR5s begin
operation:
Fukushima Daini
units 2 & 4



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Making history together

1990s

2000s

GE

Advanced
Designs: ABWR,
SBWR, Prism



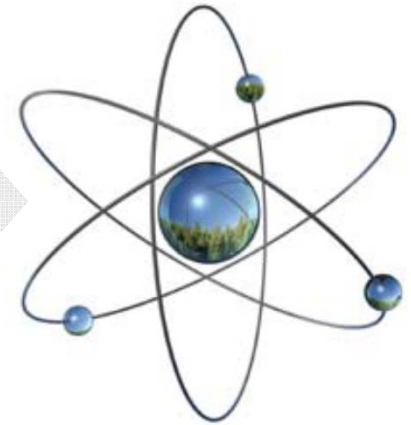
Global Nuclear
Fuel *



Laser
Enrichment



2007
GE & Hitachi
form
global nuclear
alliance



Hitachi

First ABWRs
constructed:
Kashiwazaki-
Kariwa units 6 & 7

Multiple ABWRs in
parallel construction



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The GE Hitachi business

Nuclear Power Plants



- Generation III Advanced Boiling Water Reactor (ABWR)
- Generation III+ Economically Simplified Boiling Water Reactor (ESBWR)
- Power Reactor Innovative Small Modular (PRISM)

Nuclear Services



- Reactors & balance of plant
- Life extension
- Power uprates
- Performance services
- Outages and inspections

Fuel Cycle



- Boiling water reactor & mixed oxide fuels
- Candu reactor fuel & handling equipment
- Fuel engineering services
- Nuclear isotopes
- Used nuclear fuel recycling
- Enrichment of natural uranium



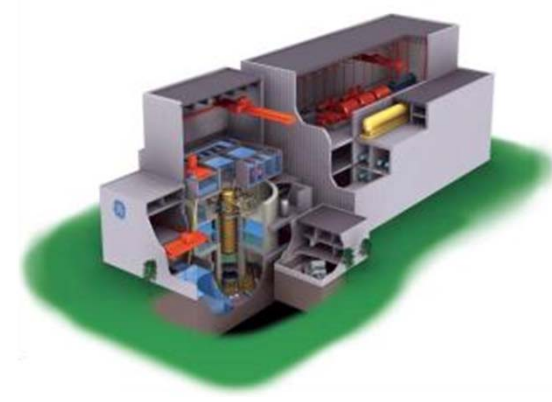
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New units product line

ABWR



ESBWR



A global presence ...

- Experience ... cost & schedule confidence
- Safety ... active system is desired
- Design ... latest Gen III+
- Value ... passive safety & lower costs

Licensing status ...

- Original design cert valid to 6/2012
- Renewal application by 11/2010
- 4 in operation with 4 under construction
- NRC design cert expected Sept 2011
- U.S. and Europe applications pending

GE ecomagination products to meet customer needs



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Uninterrupted construction

**Hokuriku Electric Power Co.
Shika NPS**



**Tokyo Electric Power Co.
Kashiwazaki-Kariwa NPS**



**Tohoku Electric Power Co.
Onagawa NPS**



**The Chugoku Electric Power Co.
Shimane NPS**



**Tokyo Electric Power Co.
Fukushima Daiichi NPS**



**Tokyo Electric Power Co.
Fukushima Daini NPS**



**The Japan Atomic Power CO.
Tsuruga PS**



**Chubu Electric Power Co.
Hamaoka NPS**

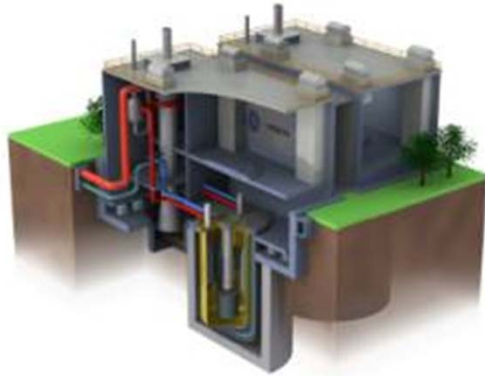


**The Japan Atomic Power Co.
Tokai Daini PS**



Used nuclear fuel solution

Advanced Recycling Center



What it is ...

- Electrometallurgical separations ... small electric current in a salt bath
- 3 streams: ~4% fission ... ~1% actinides ... ~95% uranium
- Liquid sodium cooled reactor (PRISM) ... scalable modular 311 MWe blocks

Alternatives

	<u>Recycling</u>	<u>Reprocessing</u>
Uses up spent fuel	✓	
Non-proliferation	✓	
Storage req's	500 yrs	10,000+ yrs
Generates electricity	✓	✓

What is delivered ...

- Non-proliferation ... no plutonium separation
- Environmentally responsible ... dry process
- Clean energy ... 400MM tons of carbon emissions avoided per year (per ARC)
- Spent fuel ... recycles 90%+ of nuclear materials ... reduces storage needs



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Questions?