
AREVA

Nuclear Energy And Sustainable Development: Assuring A Solid Foundation

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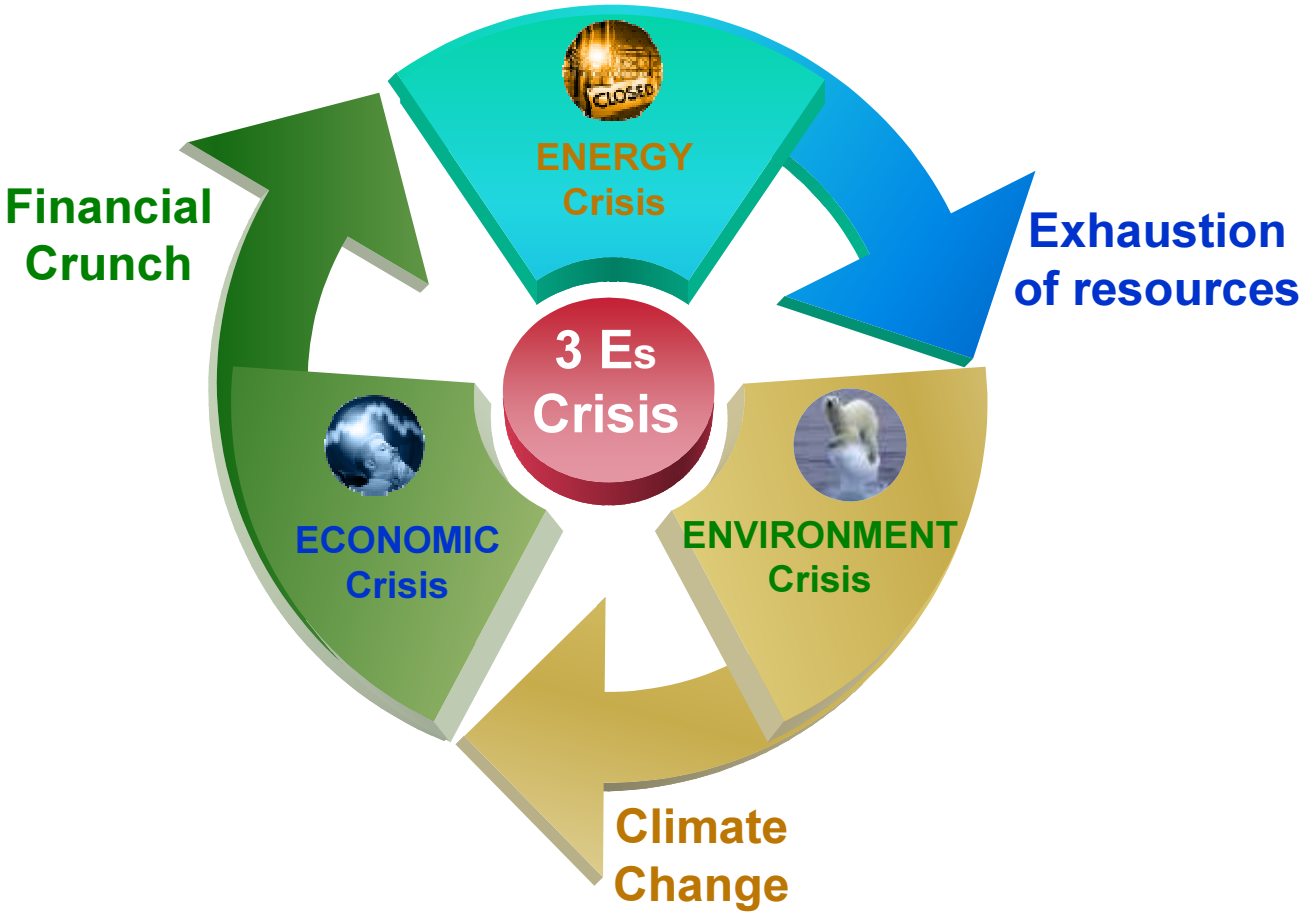
AREVA NC

URAM Vienna – June 2009

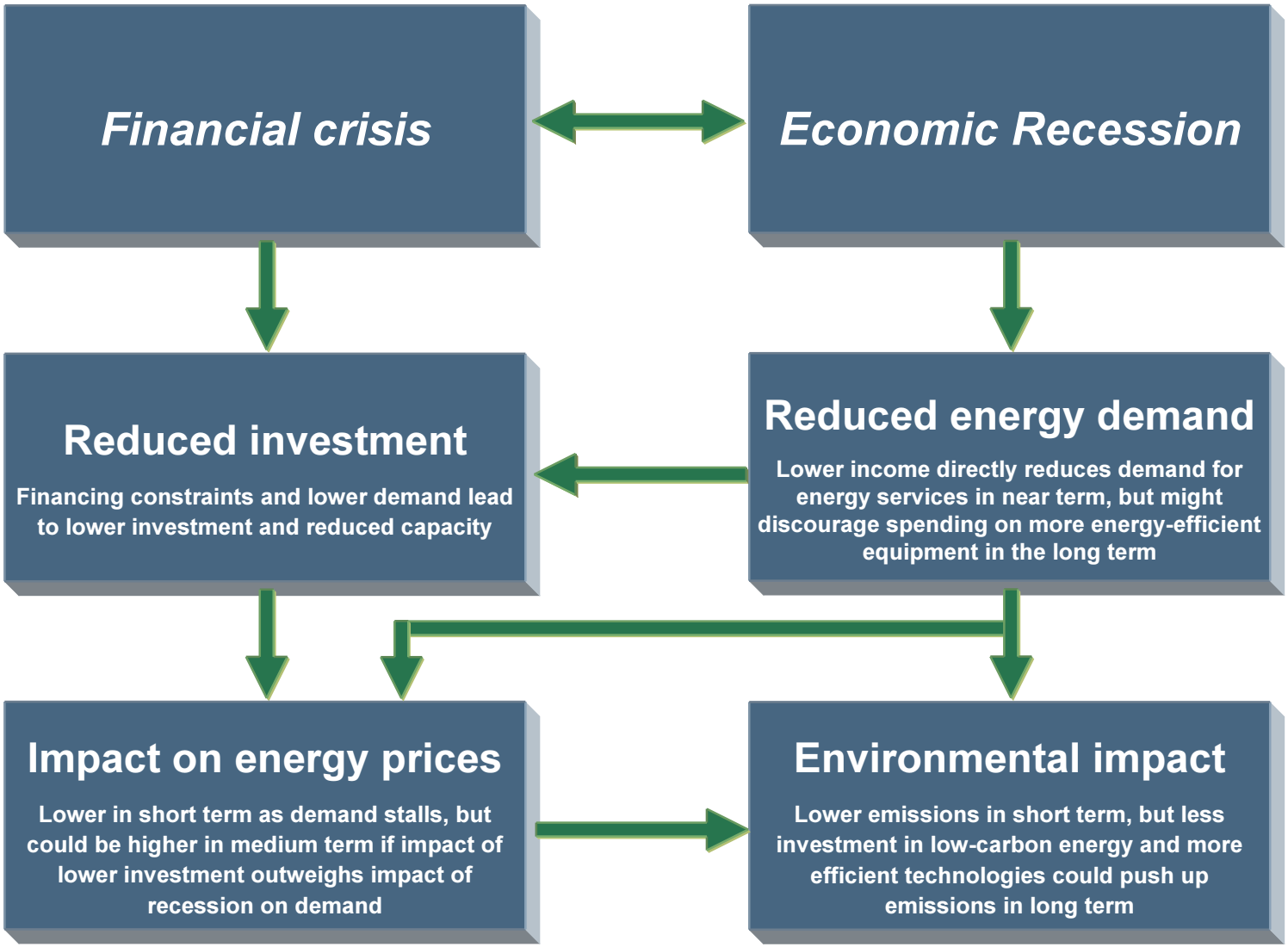
3Es Crisis

The Financial crisis has triggered a multidimensional global challenge



3Es Crisis

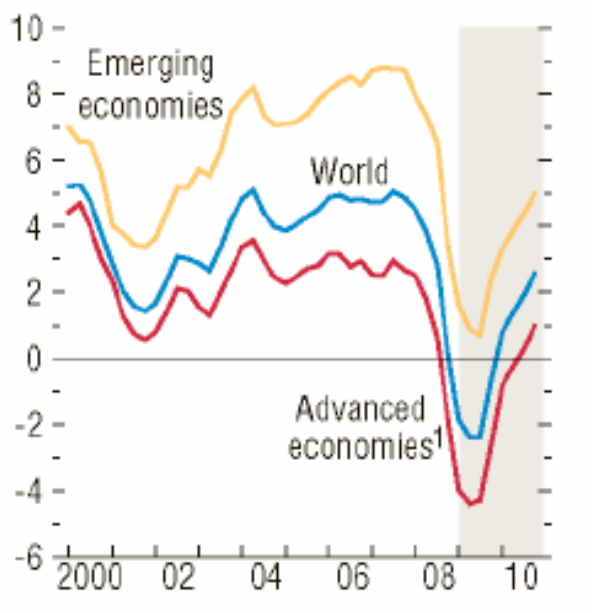
The impact of the financial and economic crises on energy security and the environment



Economic Crisis

All economic sectors are affected by the worsening business climate

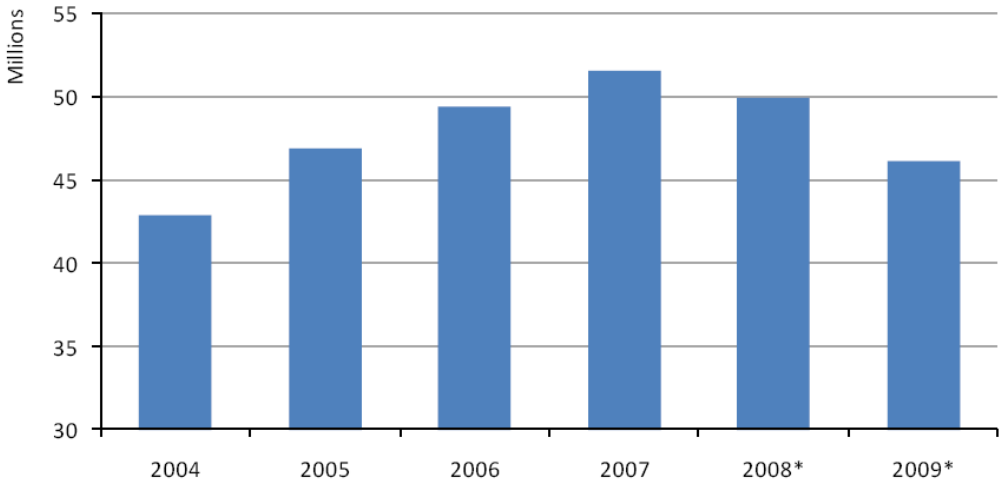
Global Outlook



Real GDP; percent change from a year earlier

Source: World Economic Outlook database

Example : Worldwide new car sales



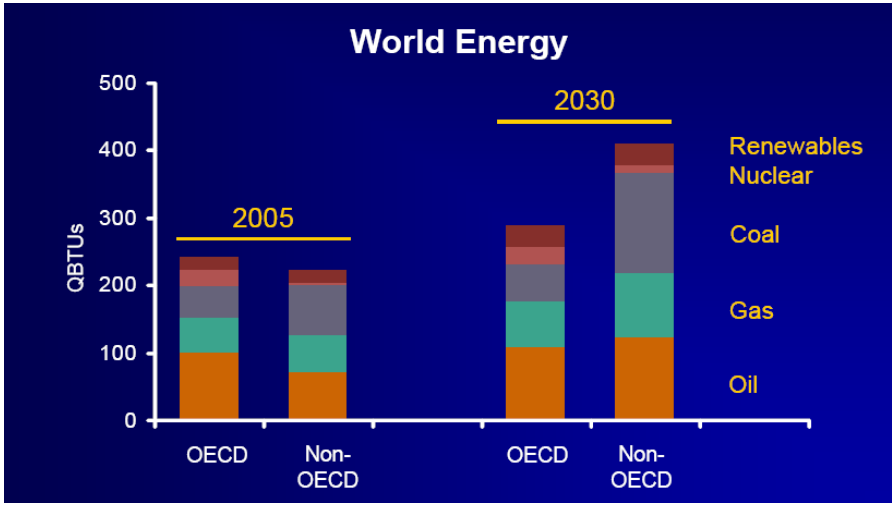
** IEA estimate (partial for 2008)*

Sources: IEA databases and analysis; IHS Global Insights database

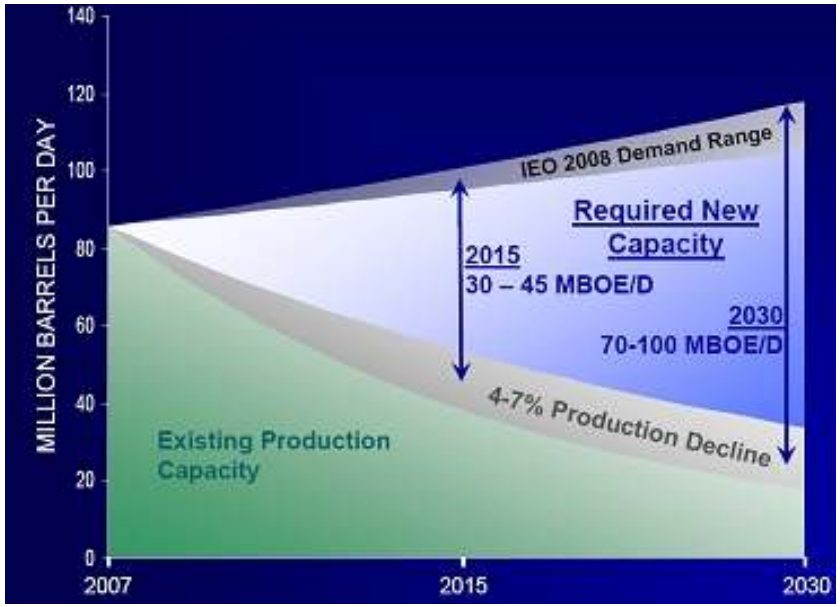
Energy Crisis

Increasing gap between energy demand and available resources

Growing demand…



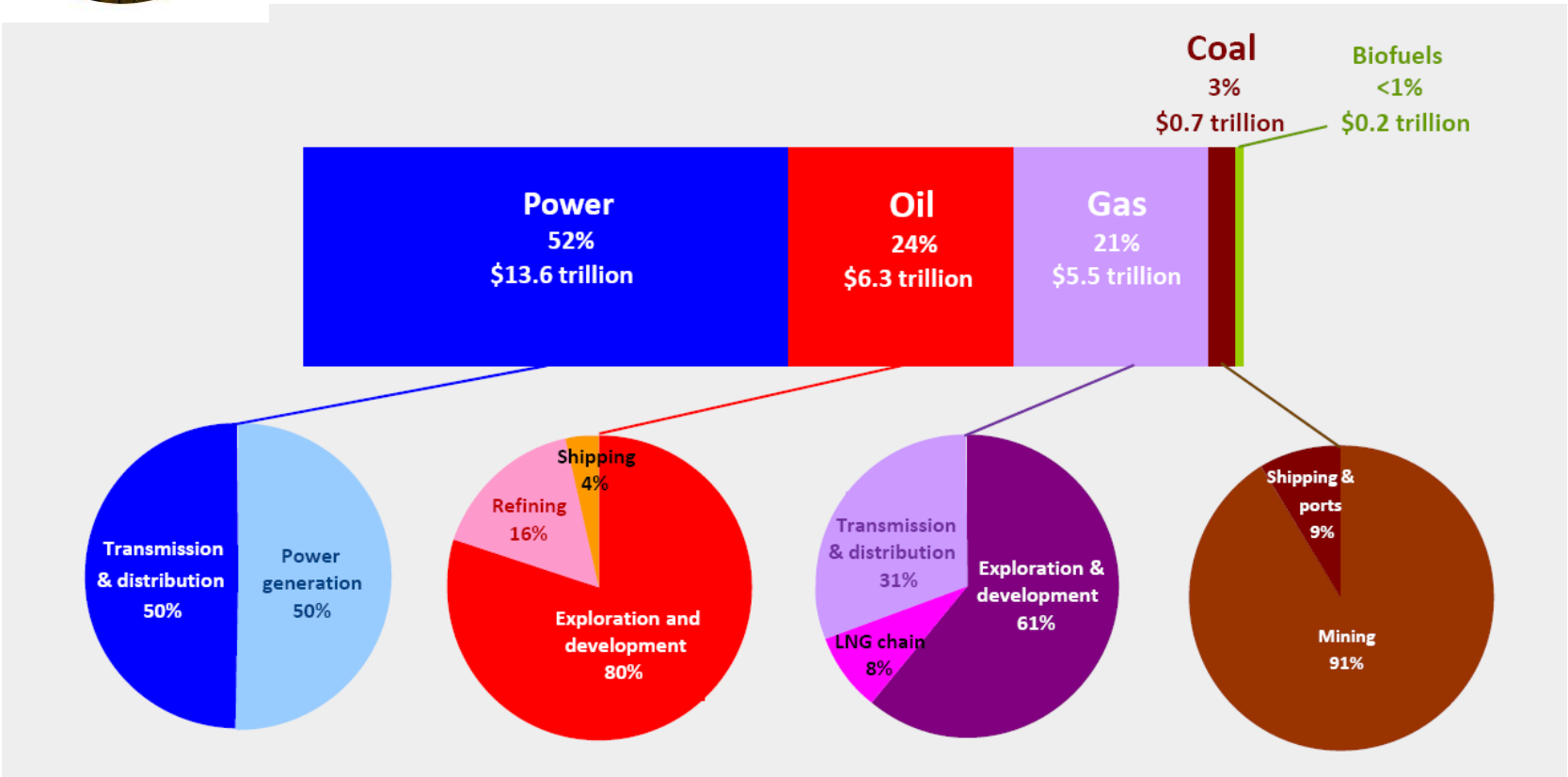
…but fewer available resources



Energy Crisis

Despite the crisis, huge investments are needed in the Energy Sector

2007 -2030 investments estimates for Energy Sector



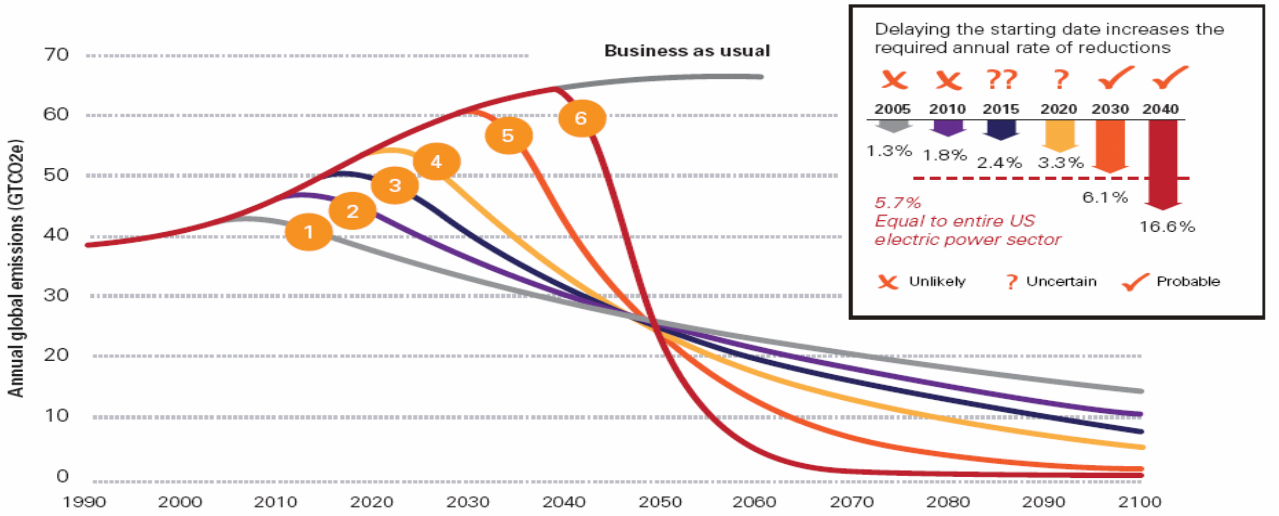
Source : International Energy Agency, World Energy Outlook, 11/12/2008

Until 2030, ~$600B per year will have to be invested in the Power Sector

Environmental Crisis

The urgent need to act against global warming is now widely accepted

- **Scientifics highlight the fact that the longer we wait, the harder it will be.**



Source: EDF MAGICC climate model 2008, Environmental Defense Fund report

« Climate Change and our dependence on foreign oil, if left unaddressed, will continue to weaken our economy and threaten our national security »

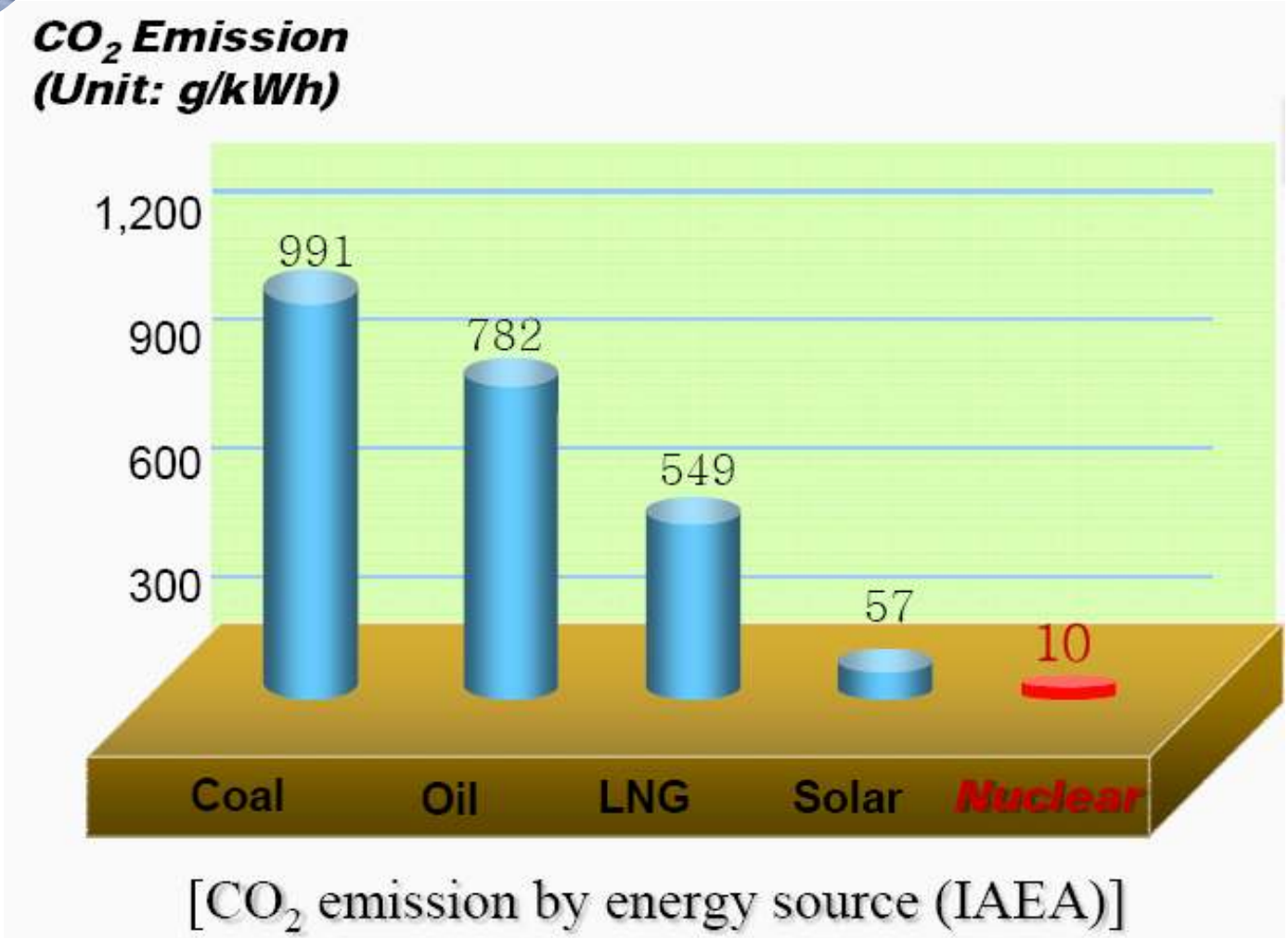
Barack Obama (Bipartisan Governors Global Climate Summit de Los Angeles, 11/28/2008)

« We have to be able to convince President Obama that the pledges he has made on the environment are great news... but he must go further and perhaps even draw inspiration from what the Europeans are doing »

Nicolas Sarkozy (Visit to Urmatt sawmill in Eastern France, 05/19/2009)

Environmental Crisis

Reducing greenhouse gas emissions (1/2)



[CO_2 emission by energy source (IAEA)]

Environmental Crisis

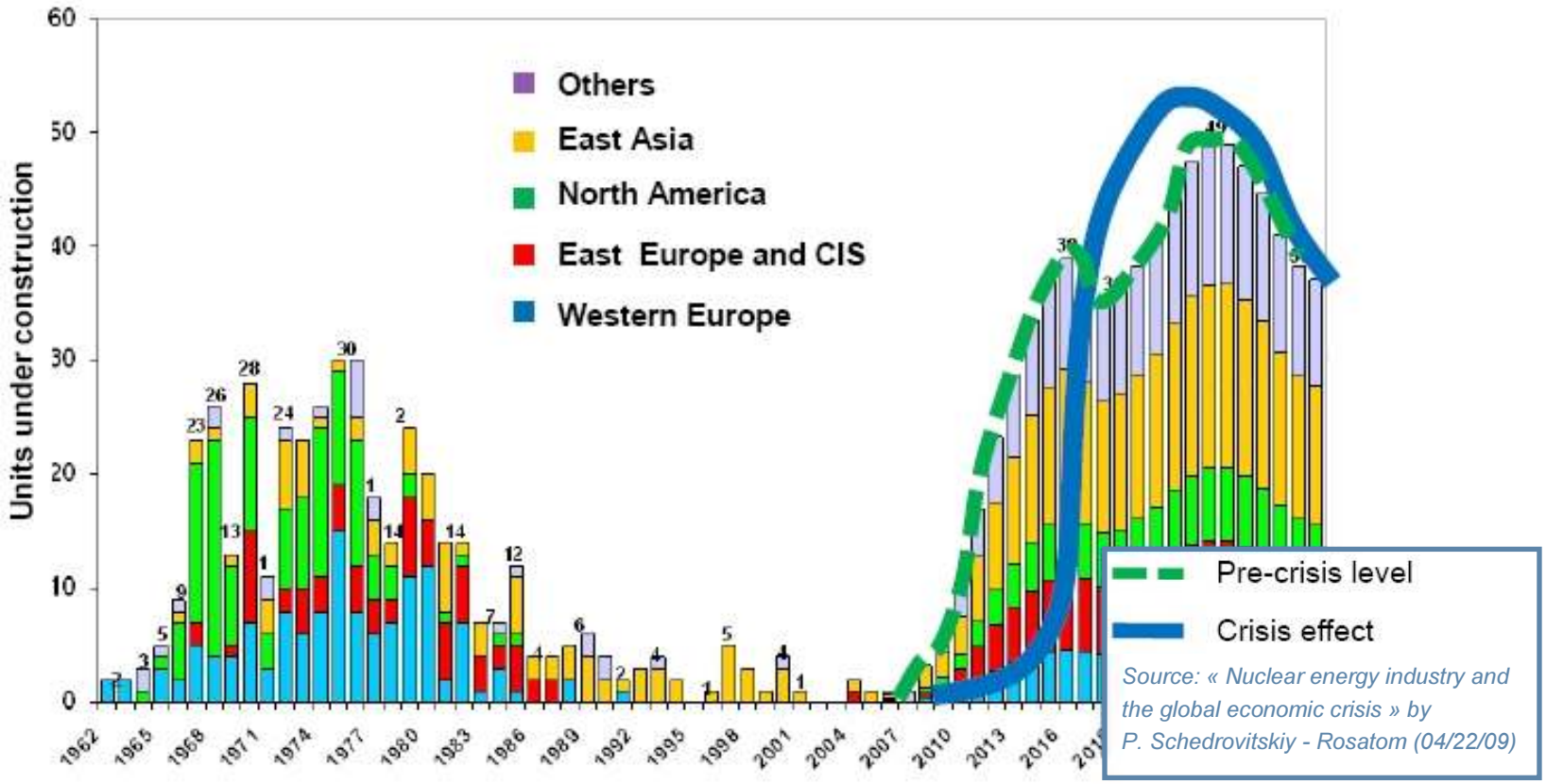
Reducing greenhouse gas emissions (2/2)

Technology	Actions that provide 1 Gt/yr of Carbon Mitigation
Coal-fired power plants	Build 1,000 "zero-emission" 500 MW power plants
Geologic sequestration	3,700 sequestration sites the size of Norway's Sleipner
Nuclear	Build 500 new nuclear plants, each 1 GW in size
Efficiency	Deploy 1 billion new cars at 40 mpg vs. 20 mpg
Wind energy	Install 650,000 wind turbines
Solar photovoltaics	Install 6 Million acres of photovoltaics
Biofuels for transport	Convert an area 20 times that of Iowa to new biomass
CO_2 storage in forests	Convert to new forest a barren area 9 times that of the state of Washington

Nuclear Renaissance

Limited impact of the crisis (1/3)

Correction of the global NPP construction forecast till 2030

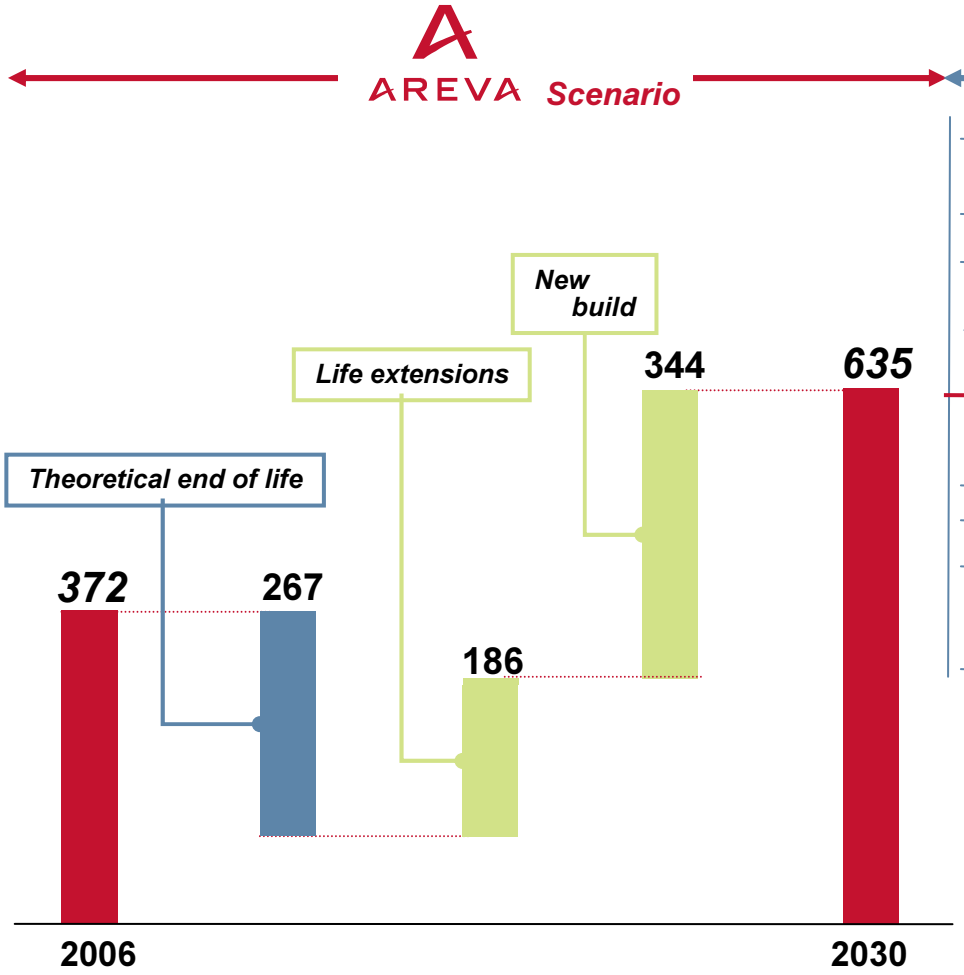


- **Although some projects may be deferred or called into question, global demand for clean energy is growing and worldwide increase in nuclear generation is inevitable.**

Nuclear Renaissance

Limited impact of the crisis (2/3)

AREVA nuclear projection is in line with international institutions forecasts



International institutions

- *824*: WEO[1]- 2008- 450 ppm Policy Scenario
- *748*: IAEA - 2008 – High Estimate
- *731*: WNA[2] - 2007- High Estimate
- *684*: WEO- 2008- 550 ppm Policy Scenario

AREVA's projection

- *529*: WNA - 2007 - Reference
- *498*: DOE[3] EIA[4] - 2008 Reference Case
- *473*: IAEA - 2008 – Low Estimate
- *433*: WEO - 2008 – Reference Scenario

GWe net installed

Nuclear Renaissance

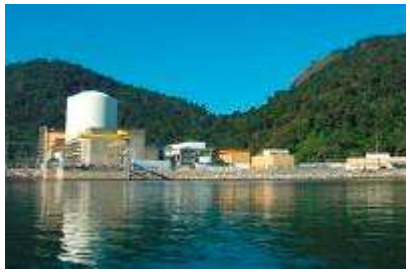
Limited impact of the crisis (3/3)

- **Many other scenarios are more ambitious :**
  - **Post-2030 scenarios mainly depend on energy growth & carbon-tax assumptions**
  - **Countries are willing to build up anticipated stockpiles to face their significant future needs (China, India, UAE…)**

China to set even higher nuclear targets

The current slowdown might result in a boost for Chinese nuclear energy. Ambitious targets could be raised further, while current build rates appear to make the new goals achievable.

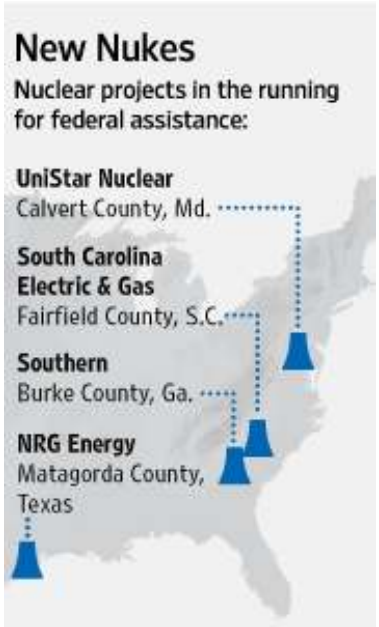
(WNN, 06/01/09)



Angra 1: Restarting

Brazil: Four more nuclear plants by 2030 ?

(Agencia Brasil, 06/11/09)



U.S. Chooses Four Utilities To Revive Nuclear Industry

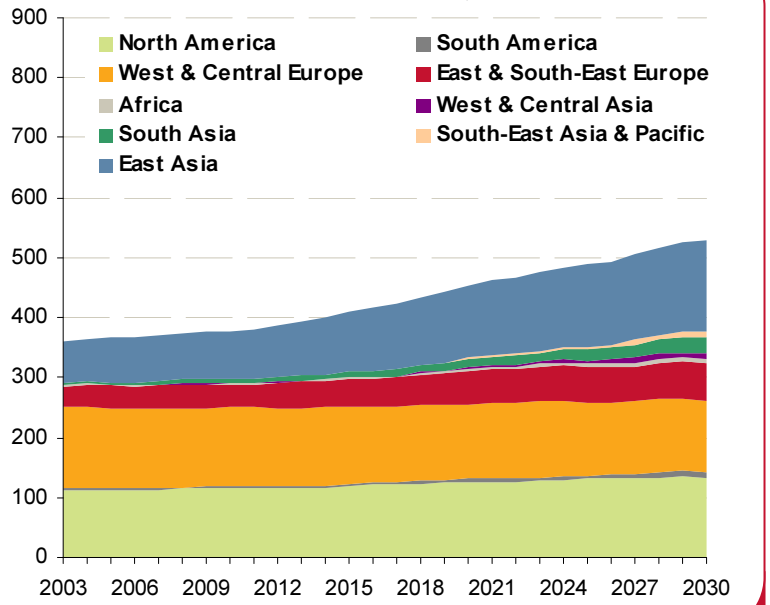
Four power companies are expected to split $18.5 billion in federal financing to build the next generation of nuclear reactors

(The Wall Street Journal, 06/17/09)

Developing the requisite supporting infrastructure

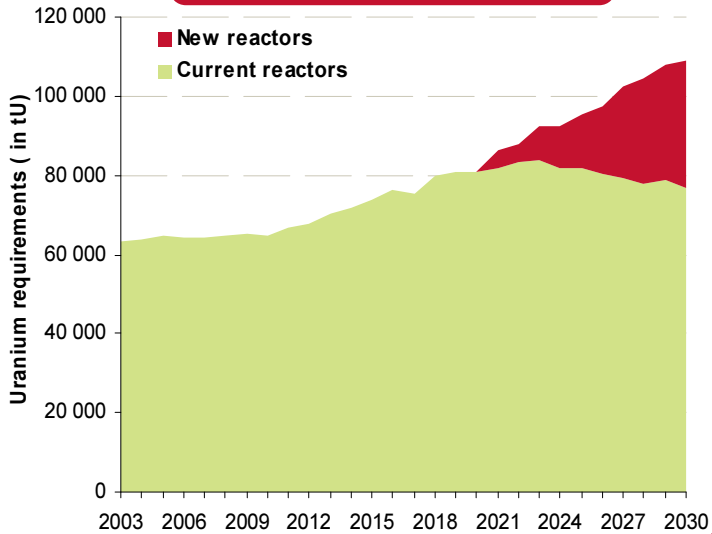
Uranium demand

Nuclear generating capacity by region,
Reference scenario, GWe



Source: WNA 2007, reference scenario

+170%
in U requirements



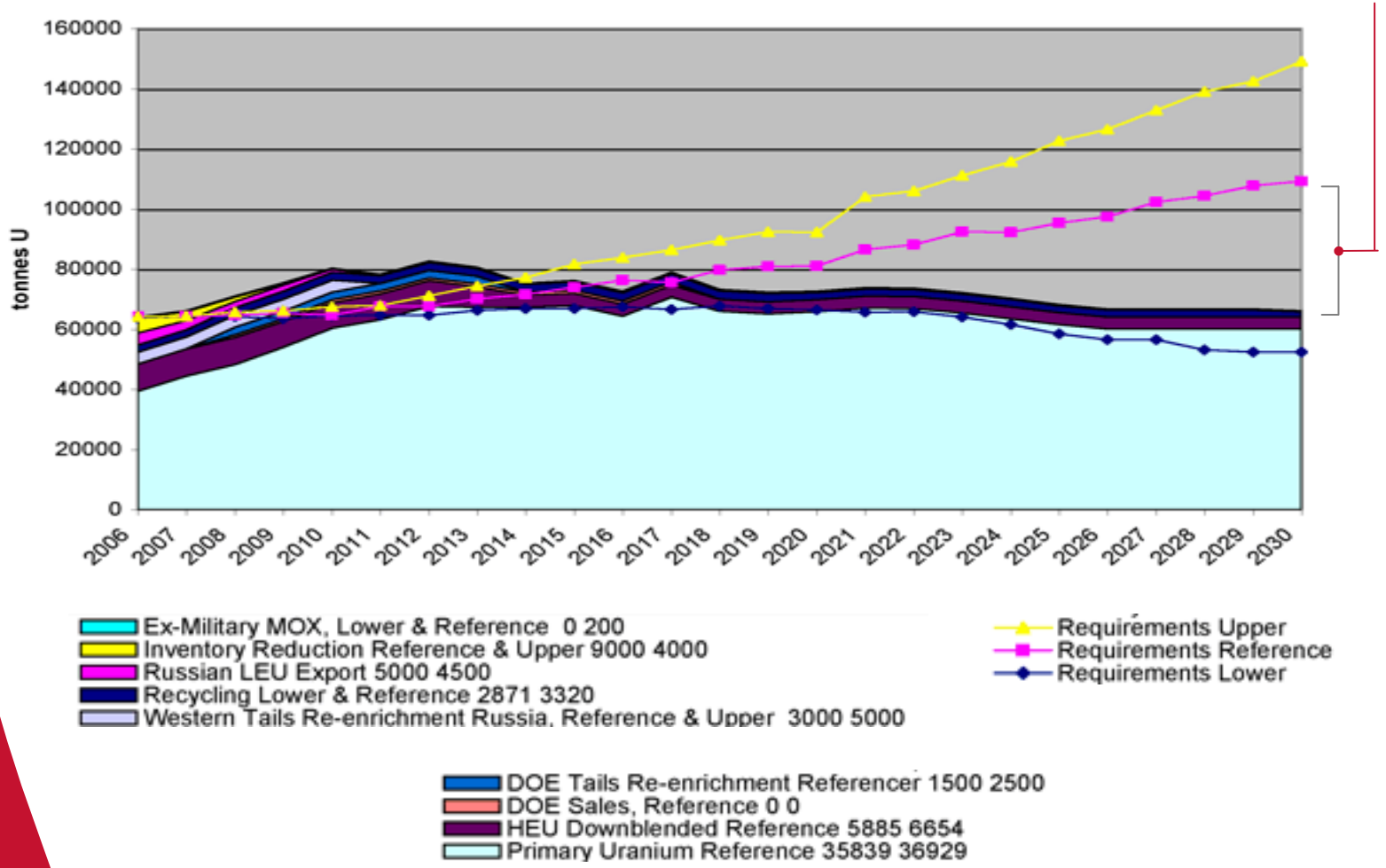
Assumption: tails assay @0.23

Developing the requisite supporting infrastructure

Strong increase of production is required to meet new demand in the next 20 years

World reference supply & demand

~45 KT in 2030

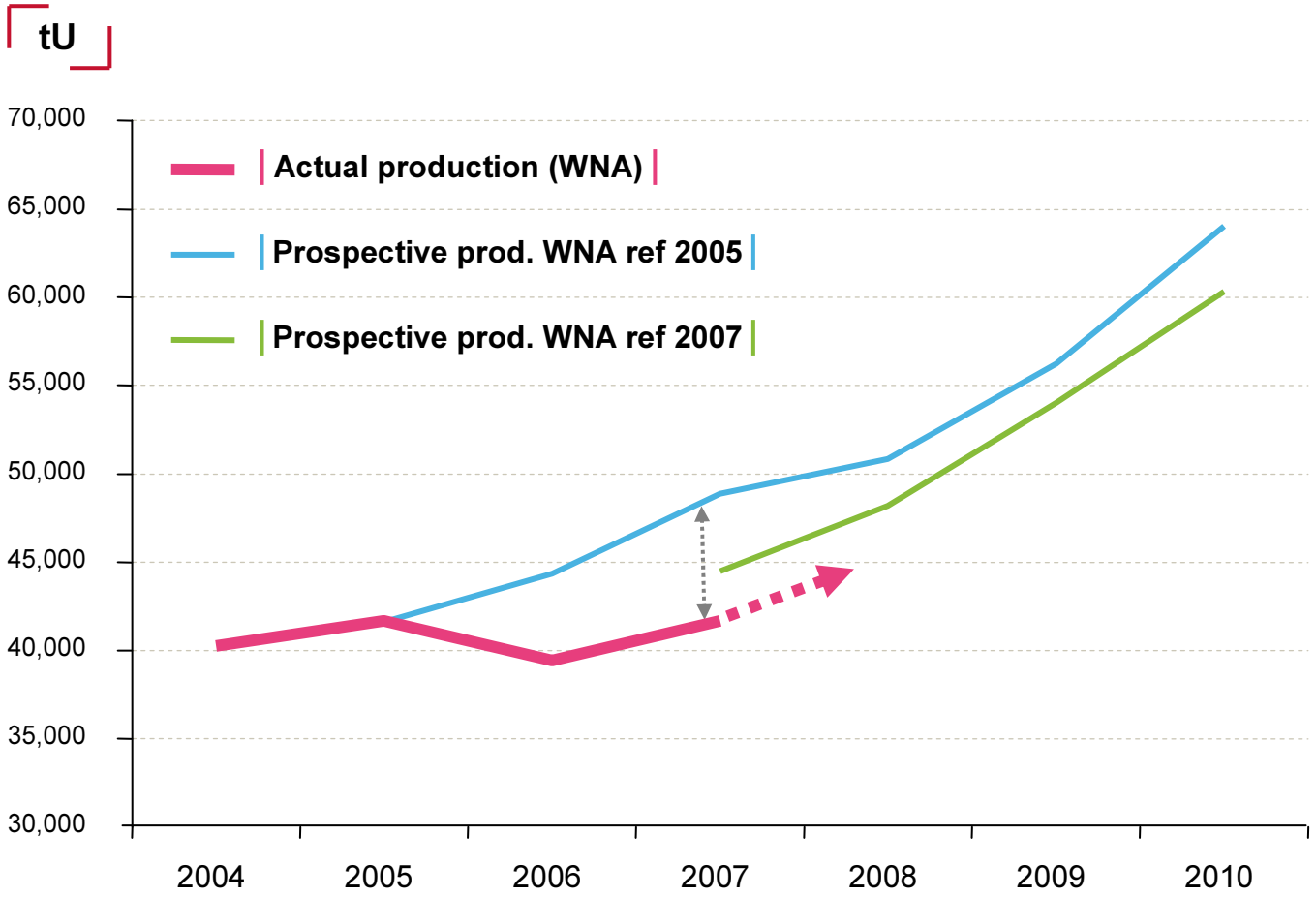


Source: WNA 2007

Developing the requisite supporting infrastructure

Uranium production forecast & reality

- **Even for the short term, forecasts of new production ramp up have proven too optimistic**

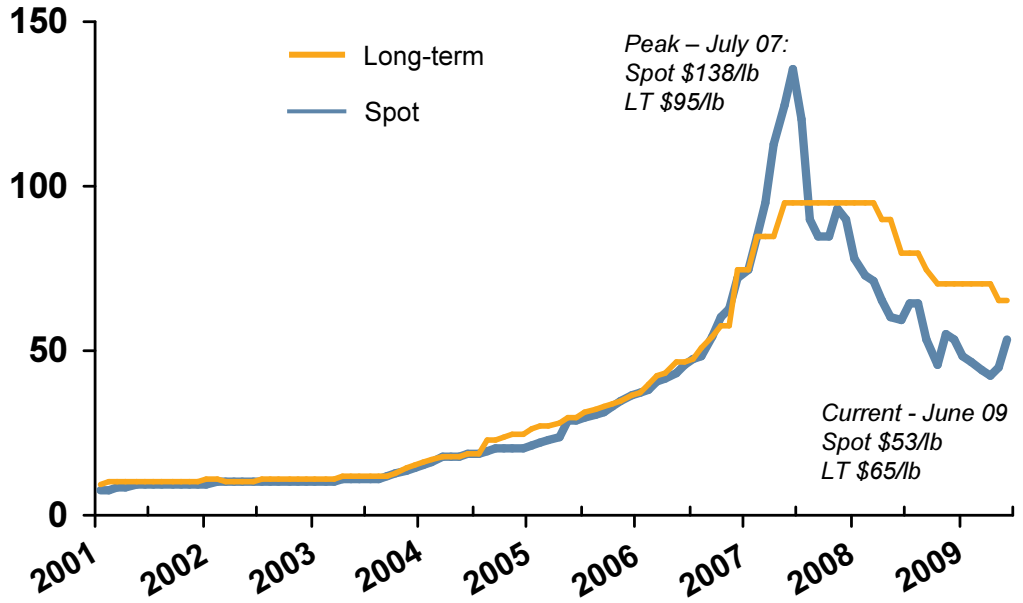


Developing the requisite supporting infrastructure

Market evolution

Market trend

LT & spot Ux prices, 2001- 2009



- **Solid fundamentals:**
  - **utilities want to secure supplies and future expansion of nuclear fleet**
- **Price drops in 2008**
  - **Spot: average of $62/lb in 2008 vs. $99/lb in 2007, currently at $53/lb**

    Volatility due primarily to investment fund sales
  - **Long-term: average of $83/lb in 2008 vs. $91/lb in 2007**

    Prices stable for the past 5 months between $65/lb and $70/lb

Developing the requisite supporting infrastructure

Sustainability of supply depends on a market that supports continued investments

Development delays / cancellations

Project	Start Date	Capacity (tU)
Dominion	2007	1,460
Hobson/La Palangana	2009	385
Midwest	2011	3,300
McClean Lake (Caribou deposit)	2009	?
Tony M	2007	?
Vasquez	2004	300
Kingsville Dome/Rosita	2006	300
J-Bird	2008	?
Rim, Topaz and Sunday mines	2006	?

But this situation seems to change…

Utilities want to secure supplies and future expansion of nuclear fleet

Uranium Mining Challenges

Mining economics: bottlenecks…

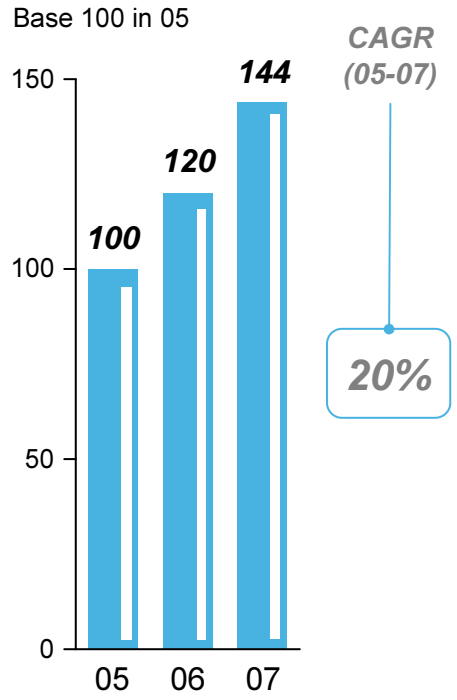
- **Boom in mining activities generates bottlenecks**
  - ***Exploration*: drilling services**
  - ***Project Management*: Milling engineering & construction contractors, Project management resources**
  - ***Infrastructures*: Water, Energy, Logistics and transport services, Life camp**
  - ***HR*: geologists, lobbyists, trained operators,plant engineers, middle and top management etc.**
  - ***Operating purchasing*: Dumpers, Tires, Crushers/Grinders, Transformers, Chemicals, Wheel loaders, Backhoes/shovels, Conveyors/Stackers, Cranes**

Uranium Mining Challenges

…Leading to inflation on direct costs

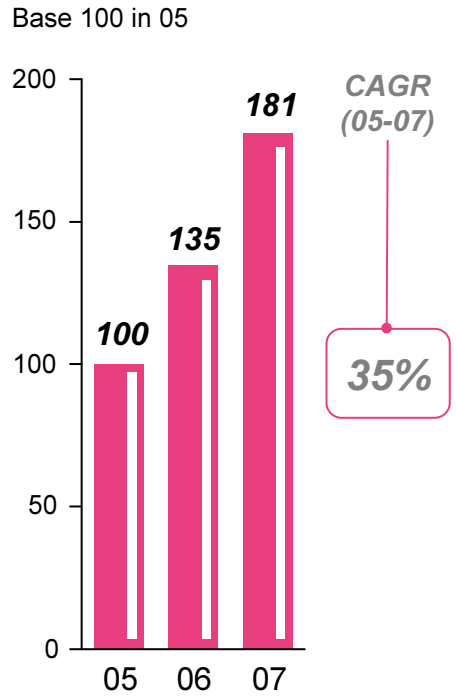
Employee average salary

▶ ***Personal costs per employee ($/FTE)***



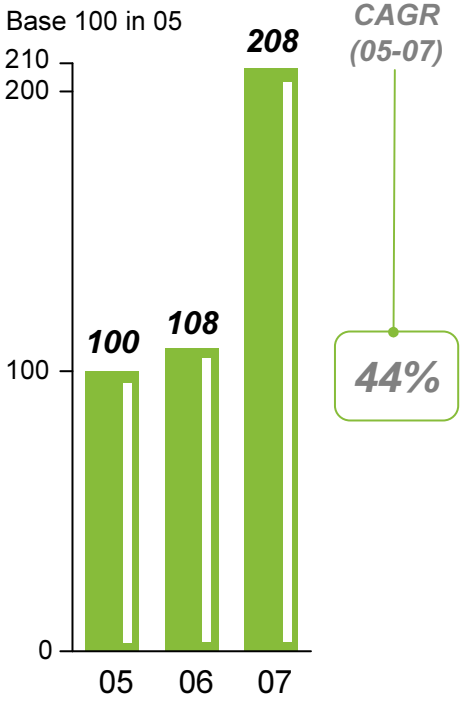
Mining equipment average costs

▶ ***Unit tire cost ($/tire)***



Sulphur reagent costs

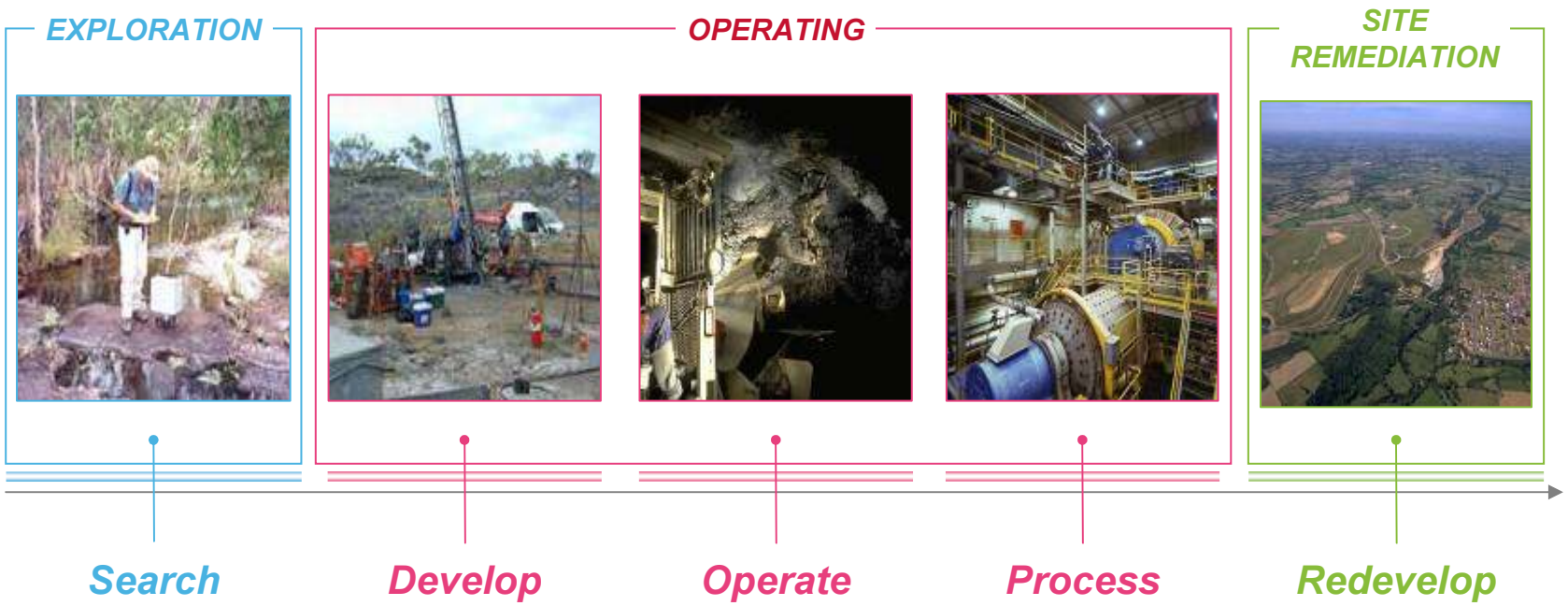
▶ ***Sulphur unit price* ($/T)***



Note: FOB VANCOUVER*
Source: Suppliers quotations, Market indicators

Uranium Mining Challenges

Indirect costs are also significant in the mining life cycle



- Exploration costs
- Development costs:
  - scoping study, pre-feasibility and feasibility, impact assessment, drilling & resource estimations
- Amortization, overheads, taxes, royalties, social and environmental costs
- Remediation costs

And it takes time to mine out uranium

TIME IS RUNNING

- Starting from green field it usually takes around 10 years to identify and characterize a uranium deposit

- It usually takes another 5 years to develop a deposit, get the necessary licenses and produce the first tons of concentrates

Uranium Mining Challenges

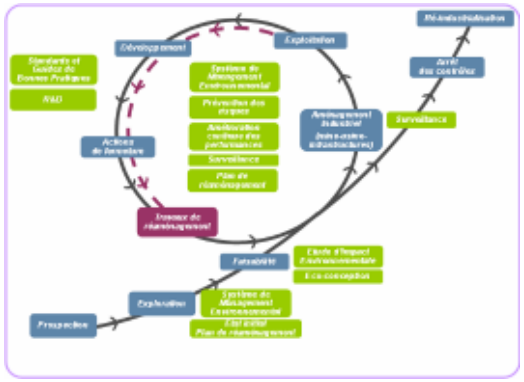
Future mines will be more difficult and expensive to exploit

- **Costs of production of new mines (post 2015) will be much higher due to increase in:**
  - **Technical complexity: new mines will be deeper and will require new technologies (e.g. freezing techniques in Canada); ore will be more difficult to process**
  - **Social and environmental responsibility**
  - **Royalties required by countries**
- **New mines will be in more remote location as most accessible ores have already been found**
  - **Infrastructure issues**
  - **Utility supply issues**
- **Geopolitical risks are increasing linked to the geographical diversification**

Uranium Mining Challenges

Environmental management

- Beyond production, acting as a environmentally responsible actor is key to long term security of supply
- Environmental management is an integrated approach throughout the mine lifecycle



- AREVA has good records in environmental issues
  - ISO 14001 certification or Environmental Management System on all its mining sites
  - Precautionary & preventive measures at every step of operation so as to prevent risk and mitigate impact on environment

- Remediation and supervising of sites at their end of life is critical

▶Bellezane (France) site before remediation

▶Cluff Lake (Canada) site before remediation

▶Bellezane site after remediation

▶Cluff lake site after remediation

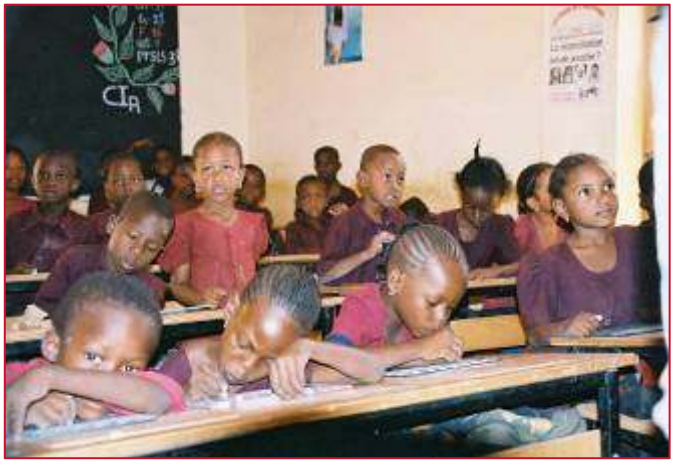
9 sites **closed in 15 years on** ***3 continents***
Total investments: > ***300 M€***
5 years **on average**
Environmental control: ***10 years***

Uranium Mining Challenges

Territorial Integration

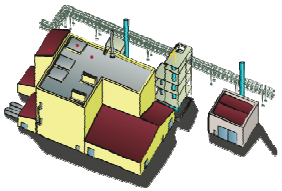
Canada

Australia



Niger

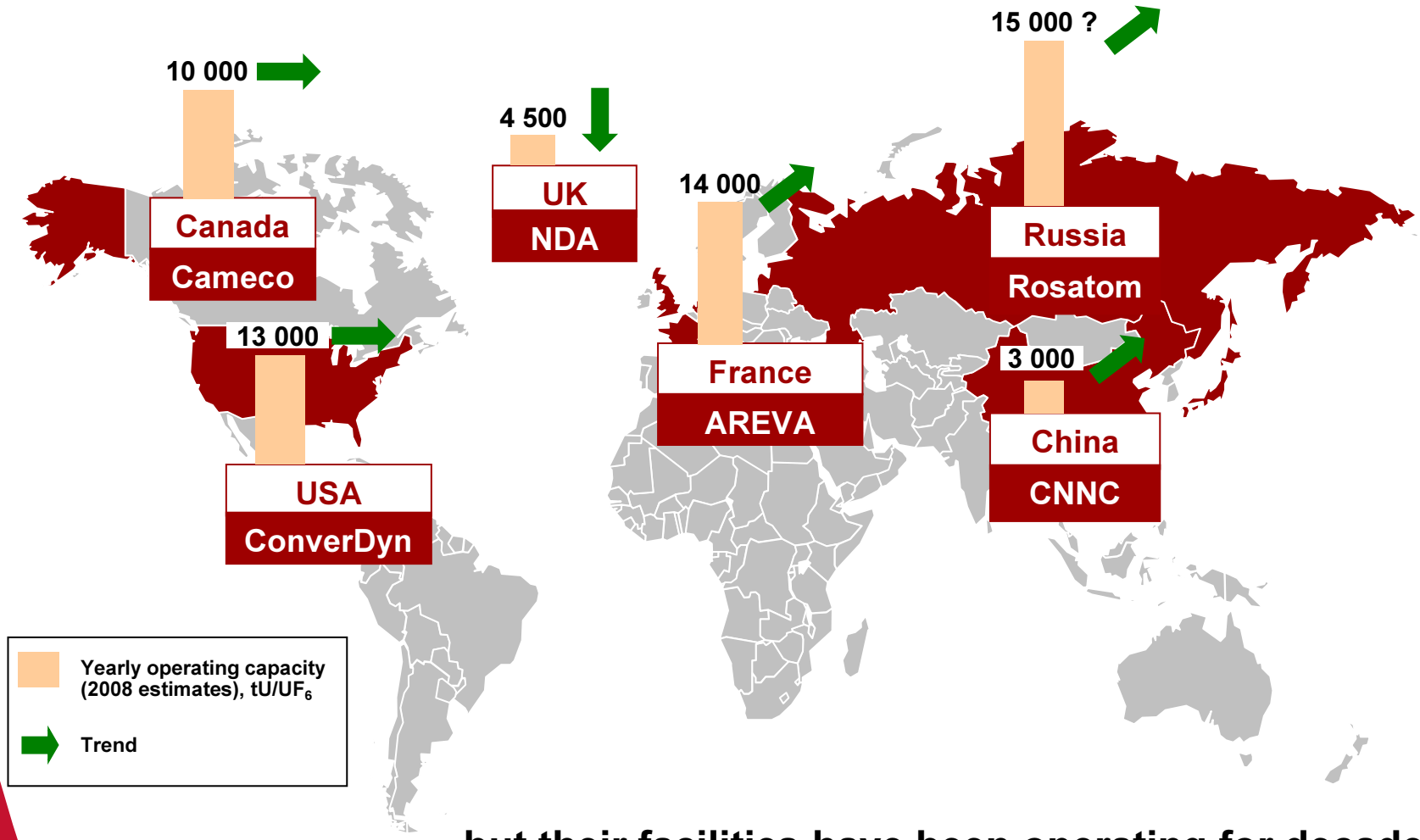
THE RENAISSANCE : MEETING OTHER INFRASTRUCTURE CHALLENGES



Developing the requisite supporting infrastructure

Conversion Overview

90% of capacity and production comes from 4 converters…



…but their facilities have been operating for decades

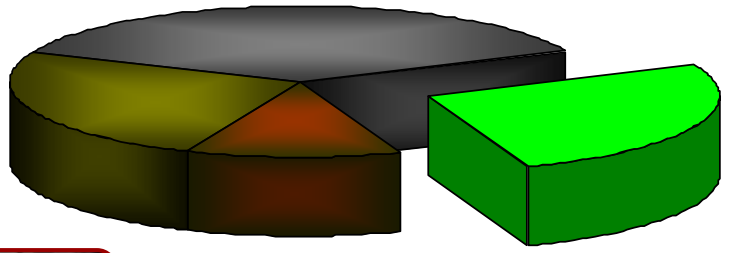
- **Increasing maintenance costs**
- **Issues of availability**

Current World Enrichment Capacity 2008

Nameplate total 60 MSWU/y

Operable total 53 MSWU/y

Old Centrif.
37%



GDP
operable
25%

GDP
extra marginal
12%

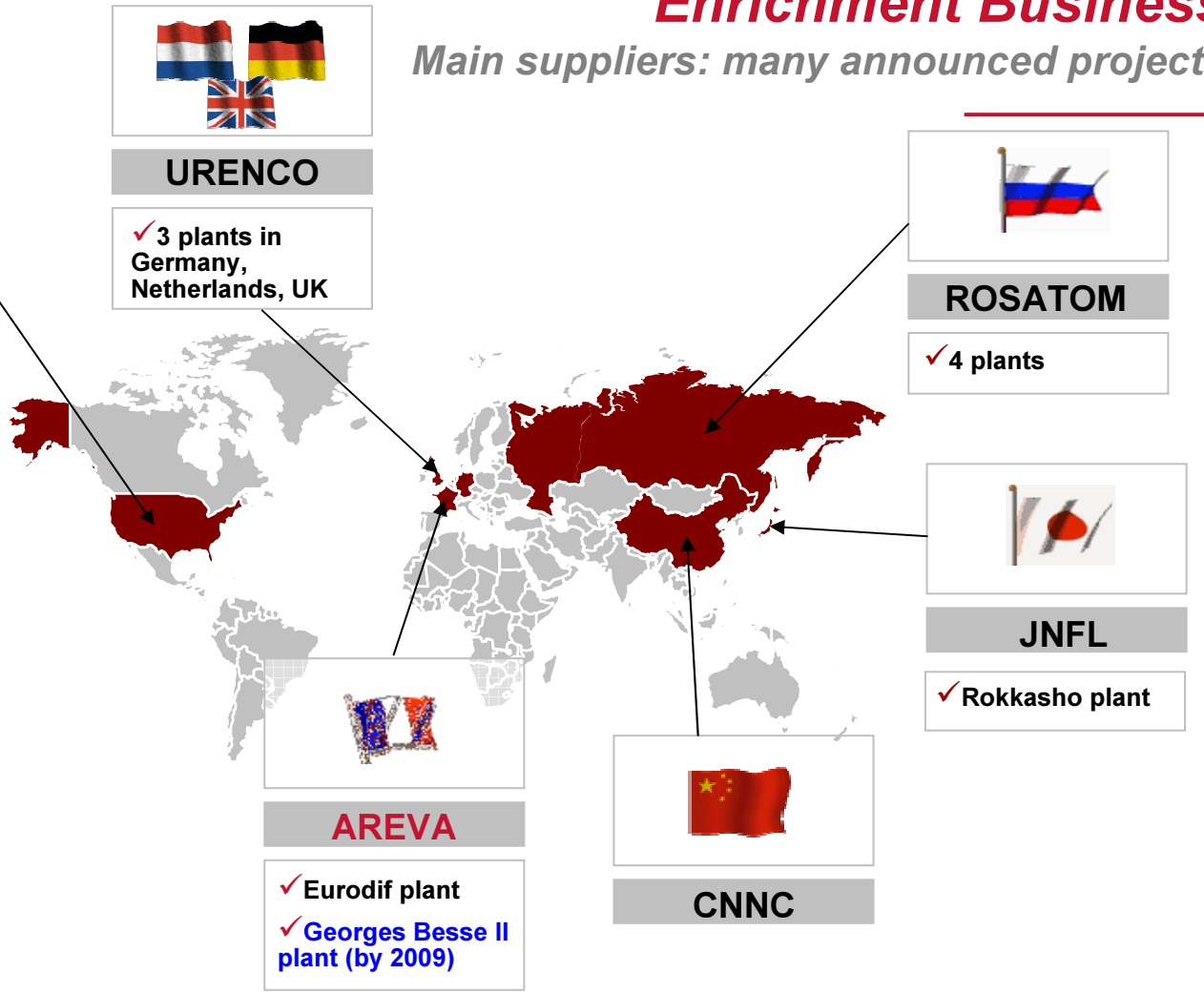
Recent Centrif.
(TC12, TC21…)
26%
16 MSWU/y

Recent v.s. Old
74% are old

Sources: WNA 2007 updated, IBR reports, Cies Annual Reports

Enrichment Business

Main suppliers: many announced projects



- Supply from new projects – volume and timing are very uncertain
- Most are on existing "UF6 sites" except NEF & EREF
- New AREVA and URENCO facilities are based upon fully demonstrated centrifuge technology

Conclusion

- Sustaining fuel supply in a growing market requires the readiness of all Front-End processes: Uranium mining, Conversion, Enrichment and Fuel fabrication.
- With rising market demands, additional projects are needed to secure supply.
- Investment in these projects insures fuel supply and market stability.

A SOLID FOUNDATION