



Mining: resources, needs, process

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SFEN, Atoms for the future, Nov. 10, 2011

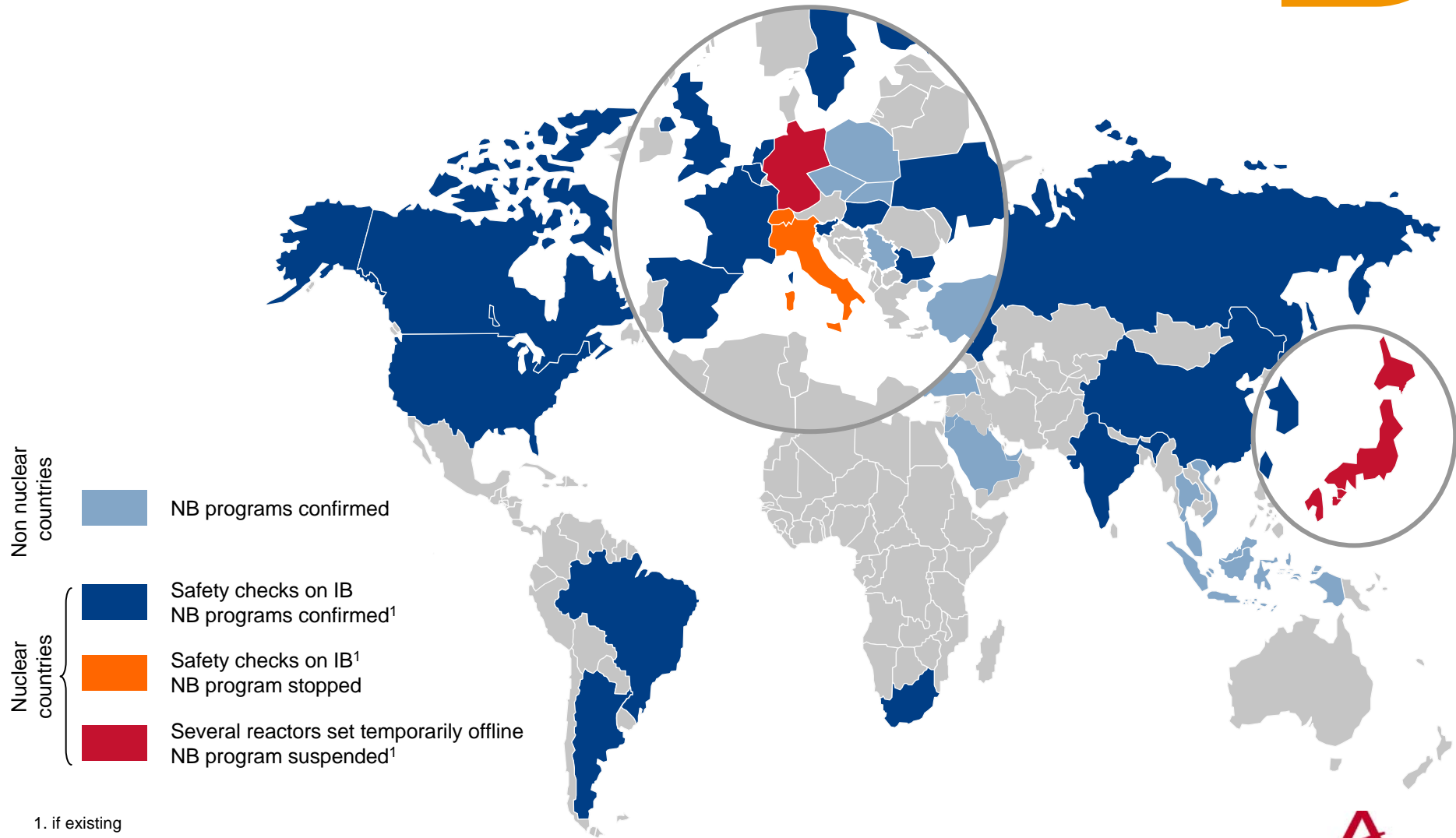
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- ▶ **Uranium mining status post Fukushima**
- ▶ **Market: Resources & key players**
- ▶ **Economical, political & technical challenges**
- ▶ **AREVA mining activities: key leverage**

Nuclear energy

Rational reactions post Fukushima

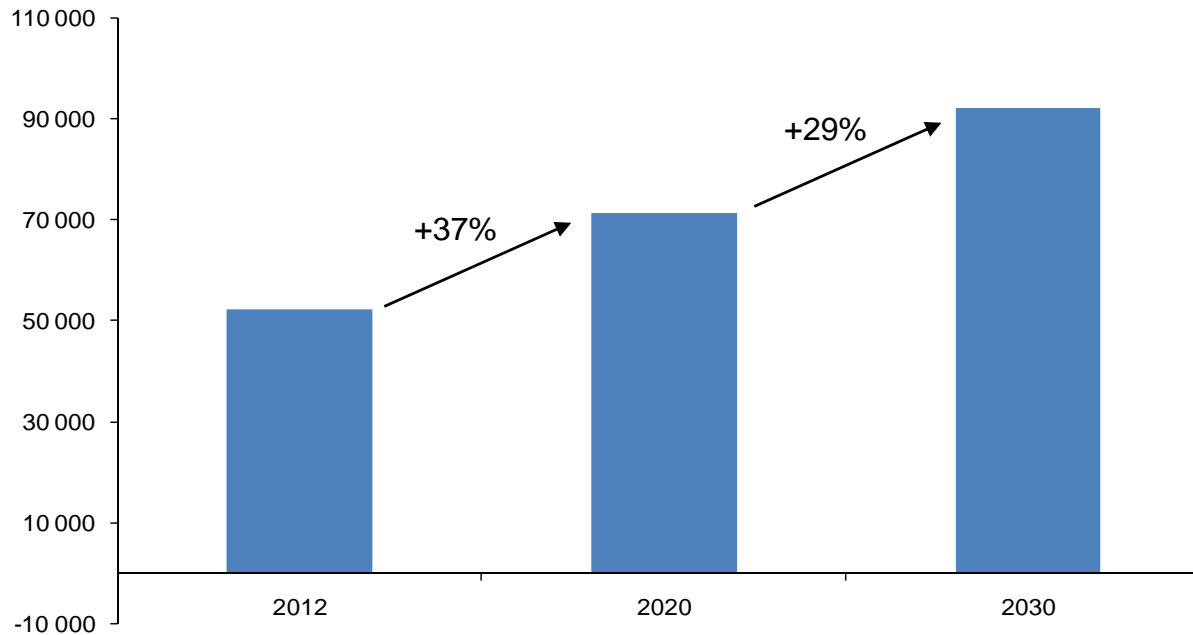


Despite Fukushima, rising demand will require bringing new mines into production

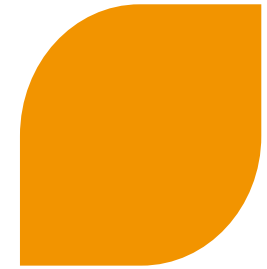


Production required to meet net demand - Kt U, WNA 2011 report -

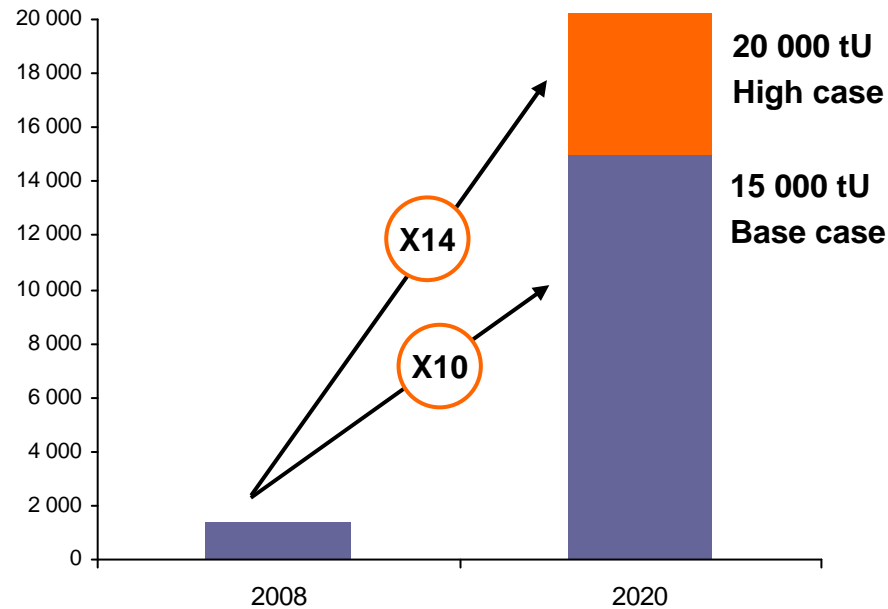
World prospective production, reference scenario (tU)



China's ramp up is largely ahead of the world nuclear renaissance and supported by an aggressive supply strategy



China uranium requirements, tU



- ▶ China's nuclear capacity is expected to ramp up from 8.6 GW in 2010 to ~75-110 GW
- ▶ China will need 100-120ktU for the decade including strategic inventory build up

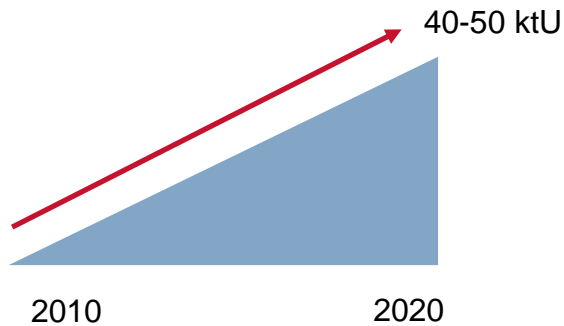
China supply strategy

- ▶ Opportunistic spot purchase to build up strategic inventory
- ▶ Started record long term contracting (AREVA, KAP, Cameco)
- ▶ Fukushima impact expected to be limited by 2020

Strategic stockpiles and financial players will add up to uranium requirements



- ▶ China will constitute 40-50 ktU of stockpile, 2-3 years of forward consumption corresponding to what other major consumption centers hold



- ▶ Financial players like banks, funds, ETF have entered the market since 2007

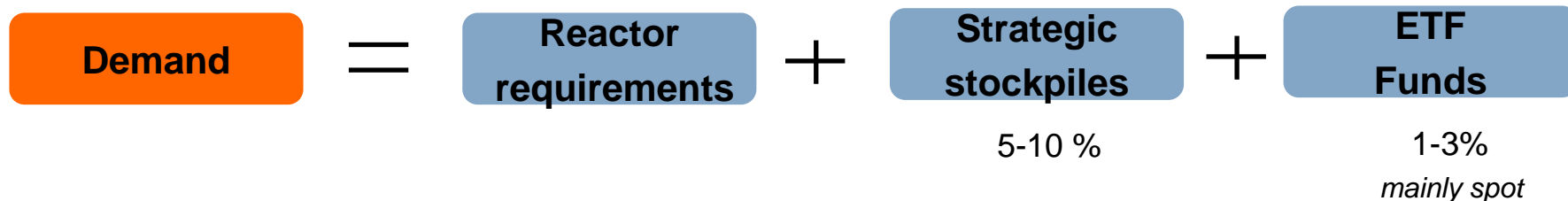
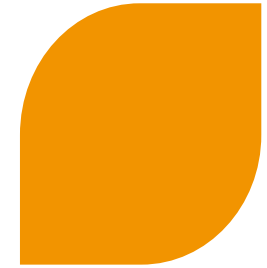


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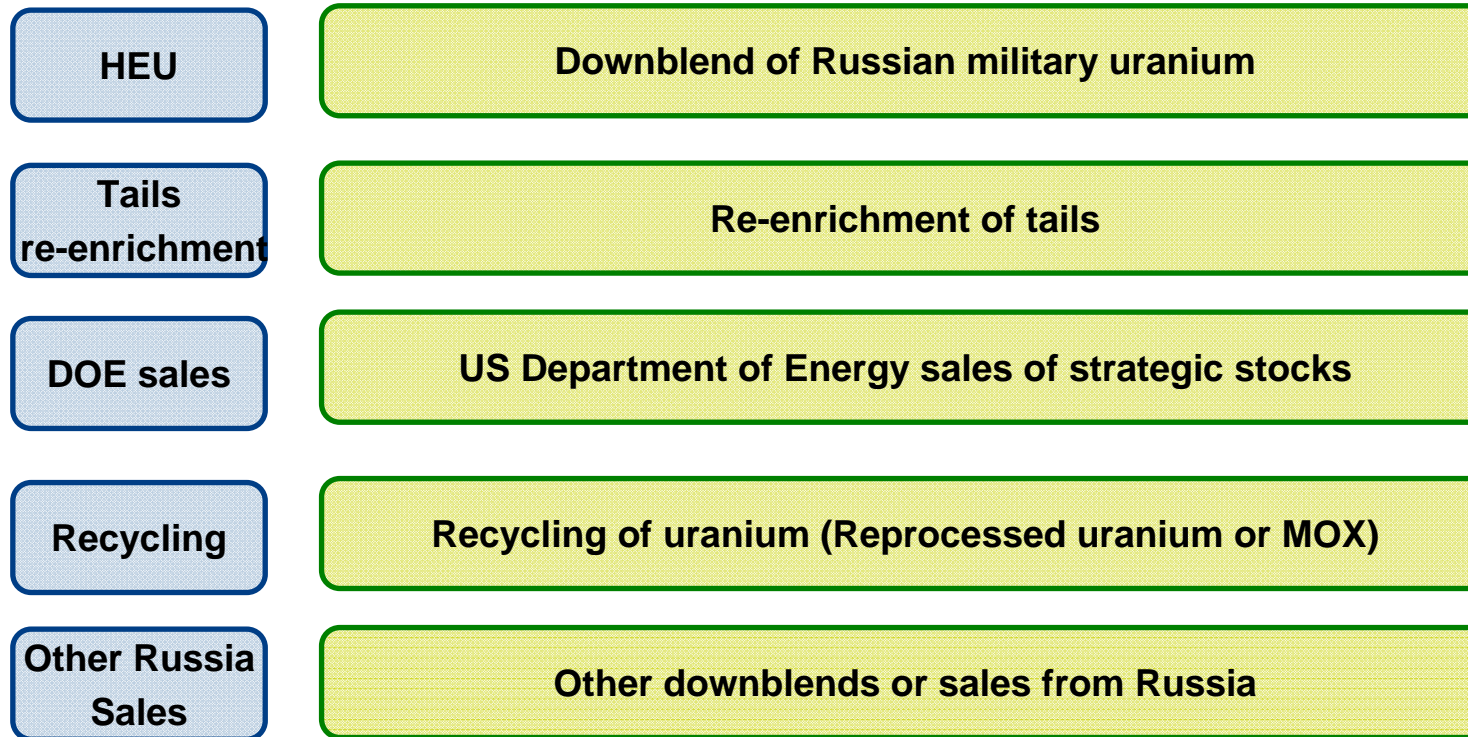


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- ▶ Economical, political & technical challenges
- ▶ AREVA mining activities: key leverage

Primary production cannot supply the market on its own: secondary resources are making the bridge between requirements and mine supply



- ▶ Secondary resources are estimated 16 ktU in 2010
- ▶ In 2013, the end of HEU will drive lower available quantities down to approximately 13 - 15ktU



Several mining methods are used, depending on the deposit



MINING

▶ Open-pit mining



▶ Conventional underground mining



▶ Deep mining (freezing the ore body)

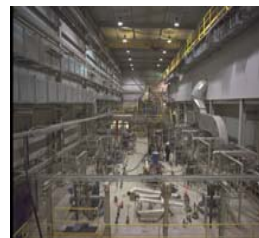


▶ In situ leaching



LEACHING

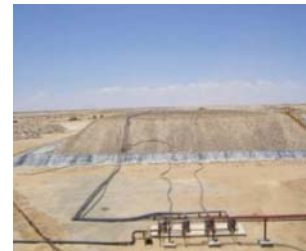
▶ Dynamic acid leaching



▶ Dynamic alkaline leaching



▶ Static leaching



EXTRACTION

▶ SX: Solvent Exchange (tertiary amines)



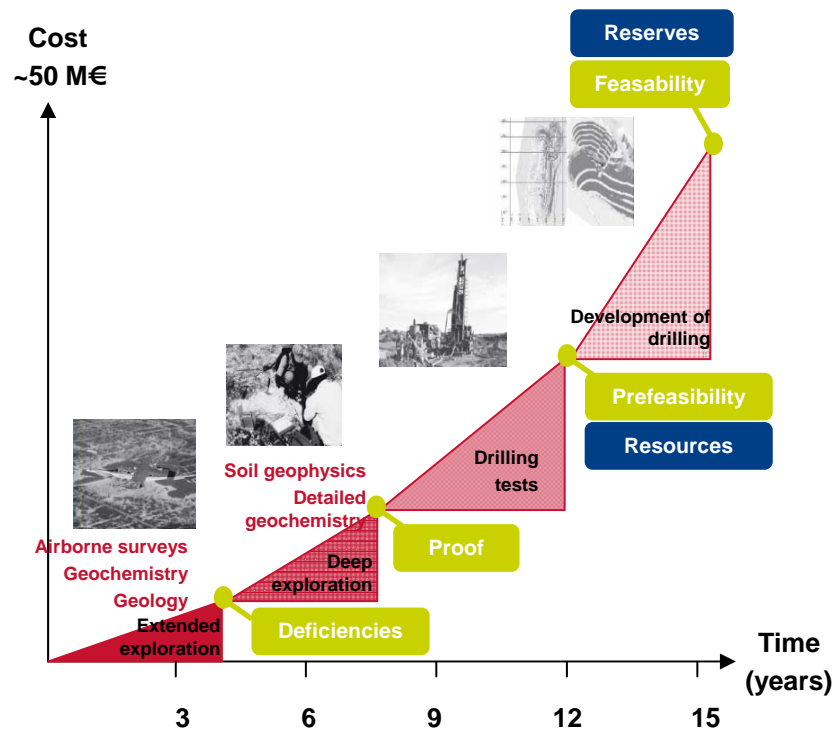
▶ IX: Ion Exchange (Resins)



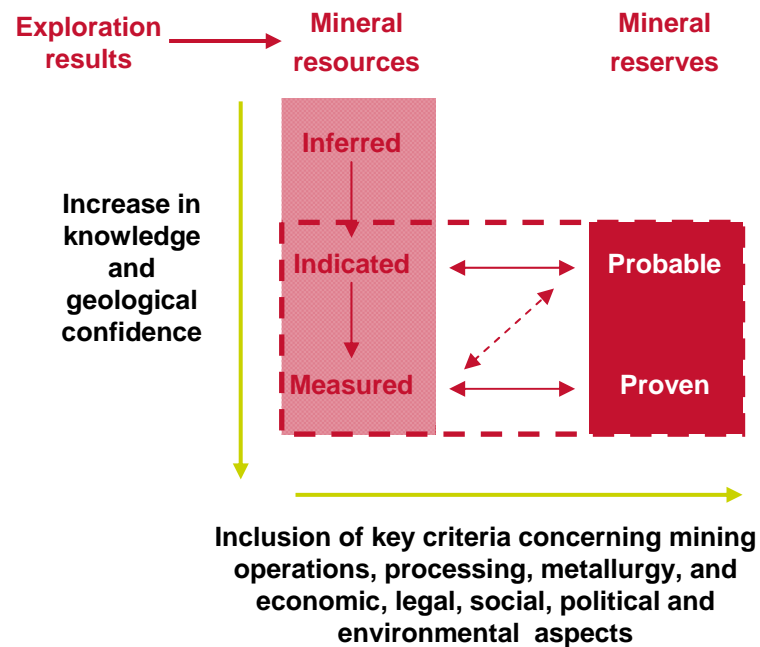
It takes 15 years of exploration to acquire enough knowledge of the seam to begin mining



Economic model of exploration



Principles of Resources & Reserves



At the same time, as technical efforts are stepped up to obtain data and characterize the deposit, project development requires phases of organized and iterative studies to determine the uranium present in the resources and reserves

Three main types of uranium mining operators



▶ Uranium mining operators fall into one of three principal and exclusive categories:

- ◆ Medium-size operators *in the nuclear industry* (more or less integrated)
- ◆ The *giant mining companies* for which uranium represents only a small share of their activity
- ◆ The *junior mining companies*

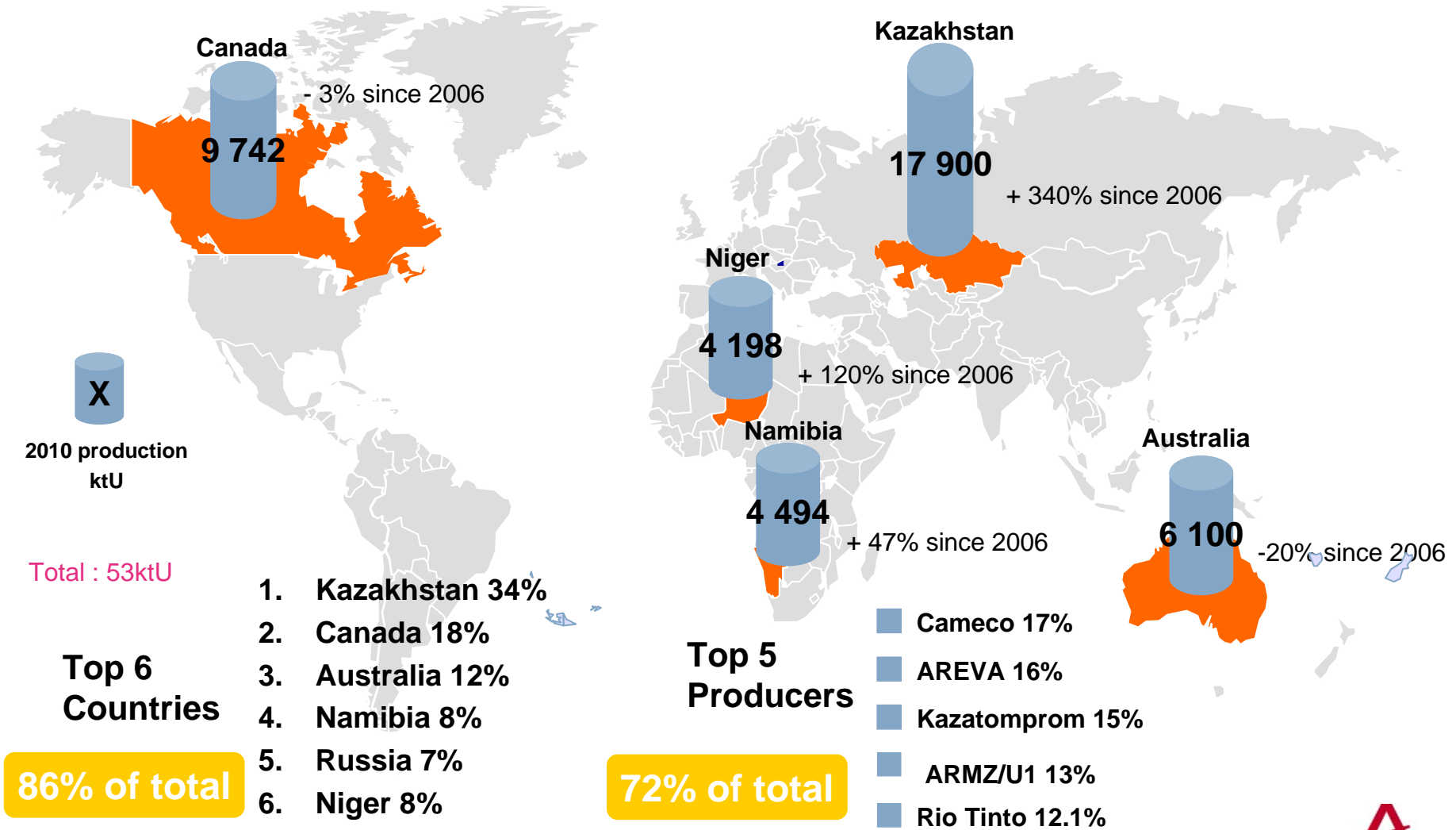
▶ AREVA is in the first category

▶ This category also includes the most active producers, which are also trying to imitate AREVA's integrated business model

	①			②		③	
	AREVA	ARMZ	Cameco	KAP	BHP	Rio Tinto	Paladin
Share of world production	19%	16%	20%	18%	5%	15%	5%
Integration in nuclear activities							
Mine other minerals							
Number of "uranium geographies"	3	3*	2	1	1	2	2

* Combined production of U1 and ARMZ

A decline in industrialized countries, an increase in emerging countries



Kazakhstan has accounted for most of the growth in production in recent years; it represents 34% of total production today



**Uranium production
- kt U, WNA 2011 market report -**

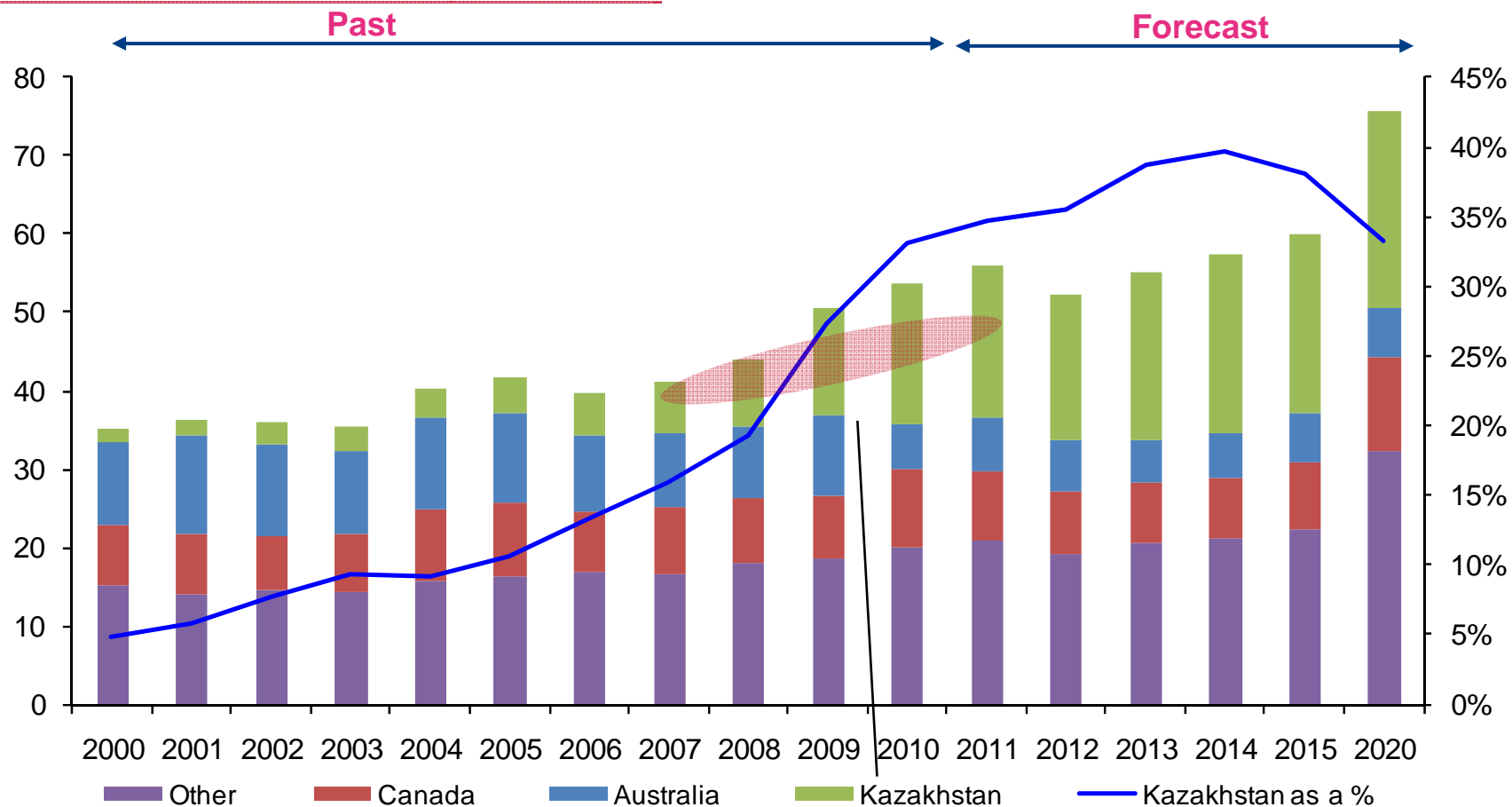
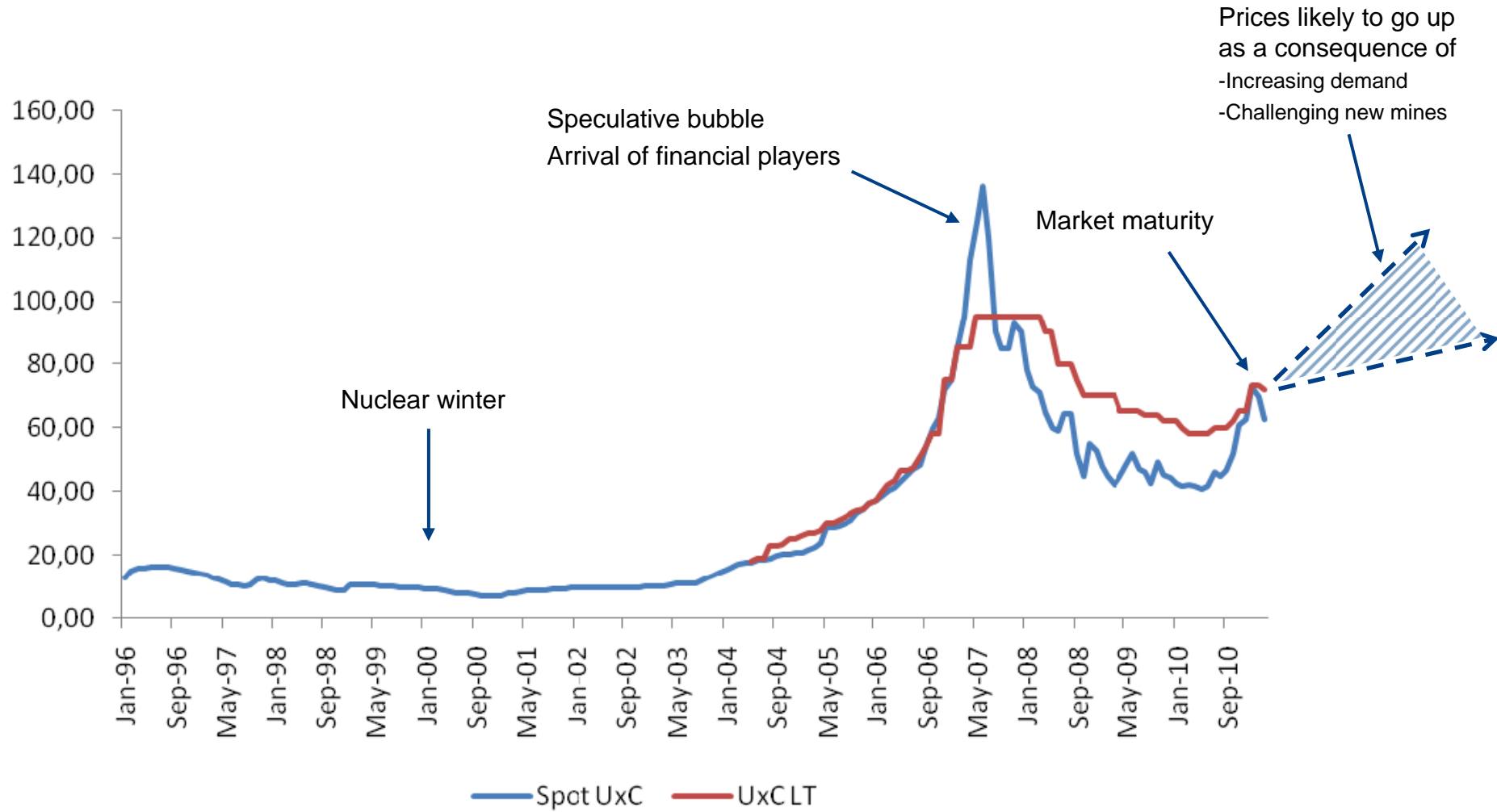


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Uranium prices evolution



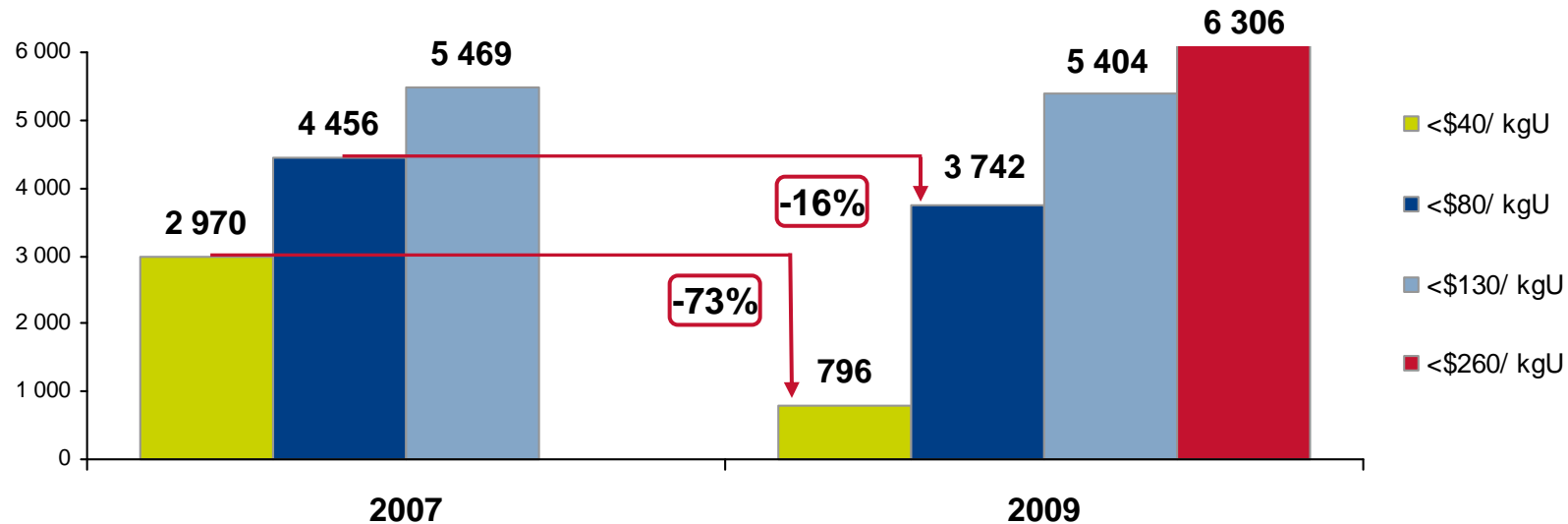
Factors impacting uranium cost



There is enough uranium in the ground, but the era of cheap resources is over



Uranium Identified resources, ktU, 2007 vs 2009 Red Book



Source: Red Book

- ▶ Total resources increased by ~15% between 2007 and 2009
- ▶ However, resources at less than \$40/kgU represented only 12.6% of total resources in 2009 vs 54% in 2007
- ▶ However, there are still adjustments to be made to the real cost of resources

Producer countries have increasingly captive policies



Increases in royalties and taxes

- ▶ **Canada: Tiered royalties up to 15% of income have been charged since 2009**
- ▶ **Kazakhstan: An increase in royalties from 2.5% of income to 20% of production costs**

Other ways of capturing value

- ▶ **Governments are now requiring free portage rights in mining projects (Niger, Mongolia, etc.)**
- ▶ **Negotiations of transfer prices are increasingly difficult, with a portion of the value blocked in the local subsidiary**

New production will come from challenging mines...



Technical challenges

Deeper deposits
Low grade
Multi-metal deposits
Complex-to-treat ores

geographical challenges

Need to built new infrastructures
Complex transport logistics of reagents and uranium

Financing challenges

Free carry of national companies
Higher capex
Strong local inflation

- ▶ **In such environment, only companies like AREVA who are heavily investing in R&D and that are technically focused will be able to put new mines into production in a profitable fashion**
- ▶ **Prices need to be at the right level to face the challenges of the new mines**

...coupled with bigger challenges to bring new mines into production

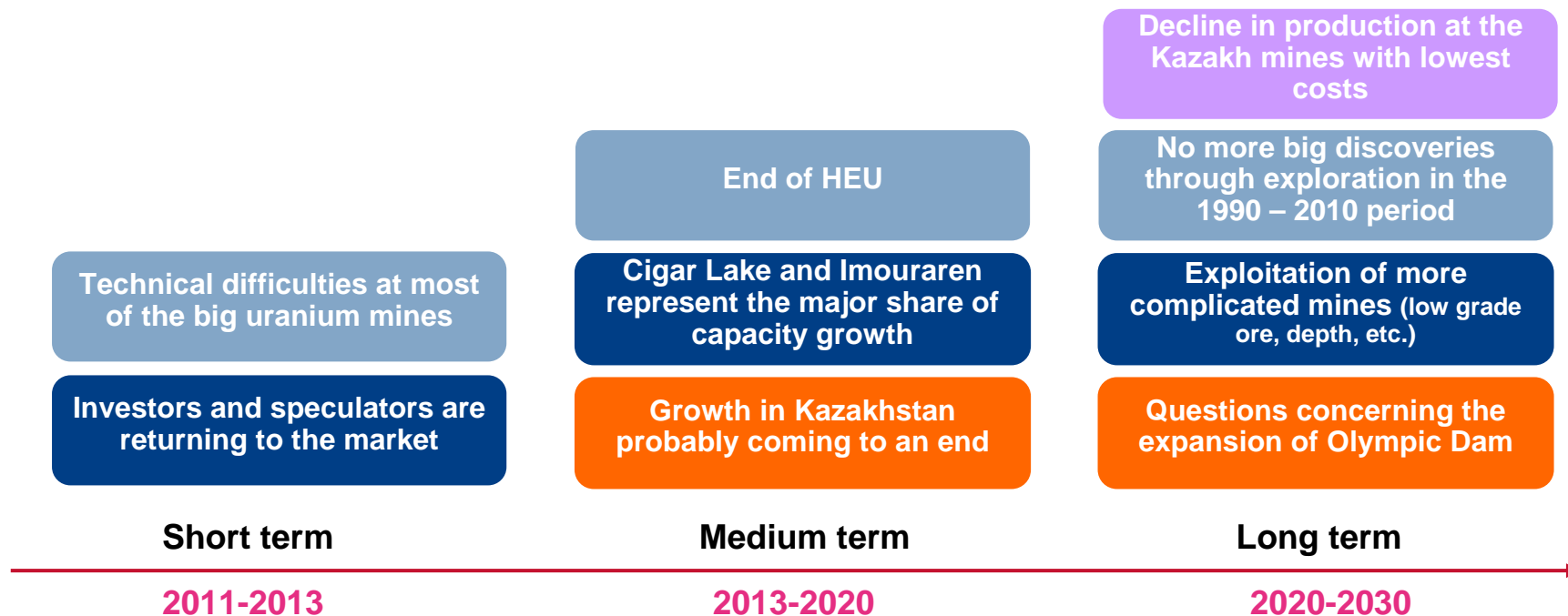


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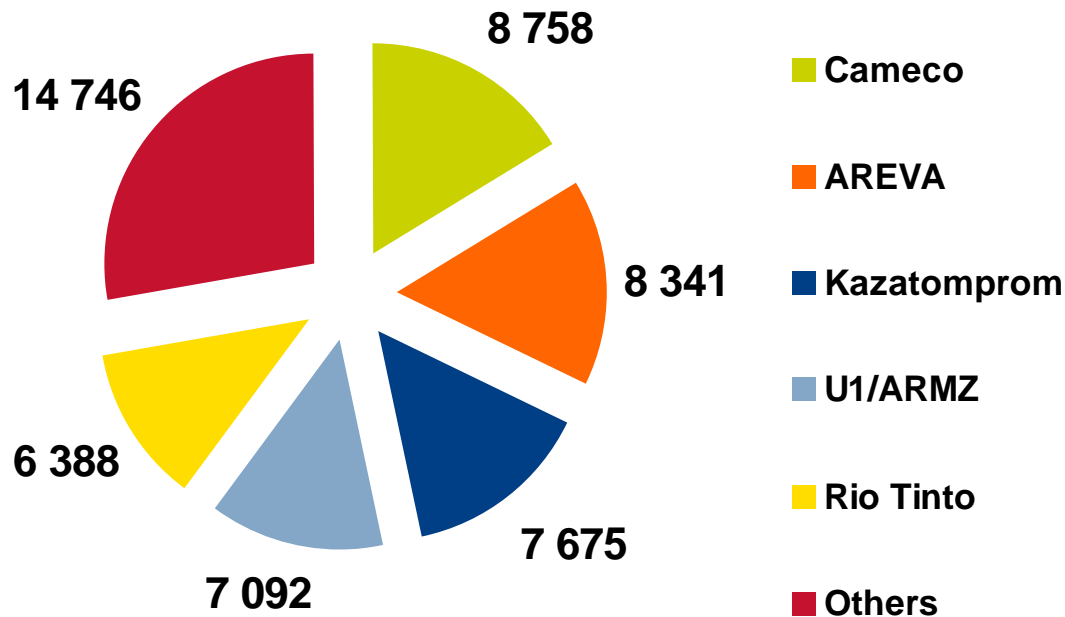


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AREVA has multiple assets in a market dominated by a handful of players



Total 53 000 tU



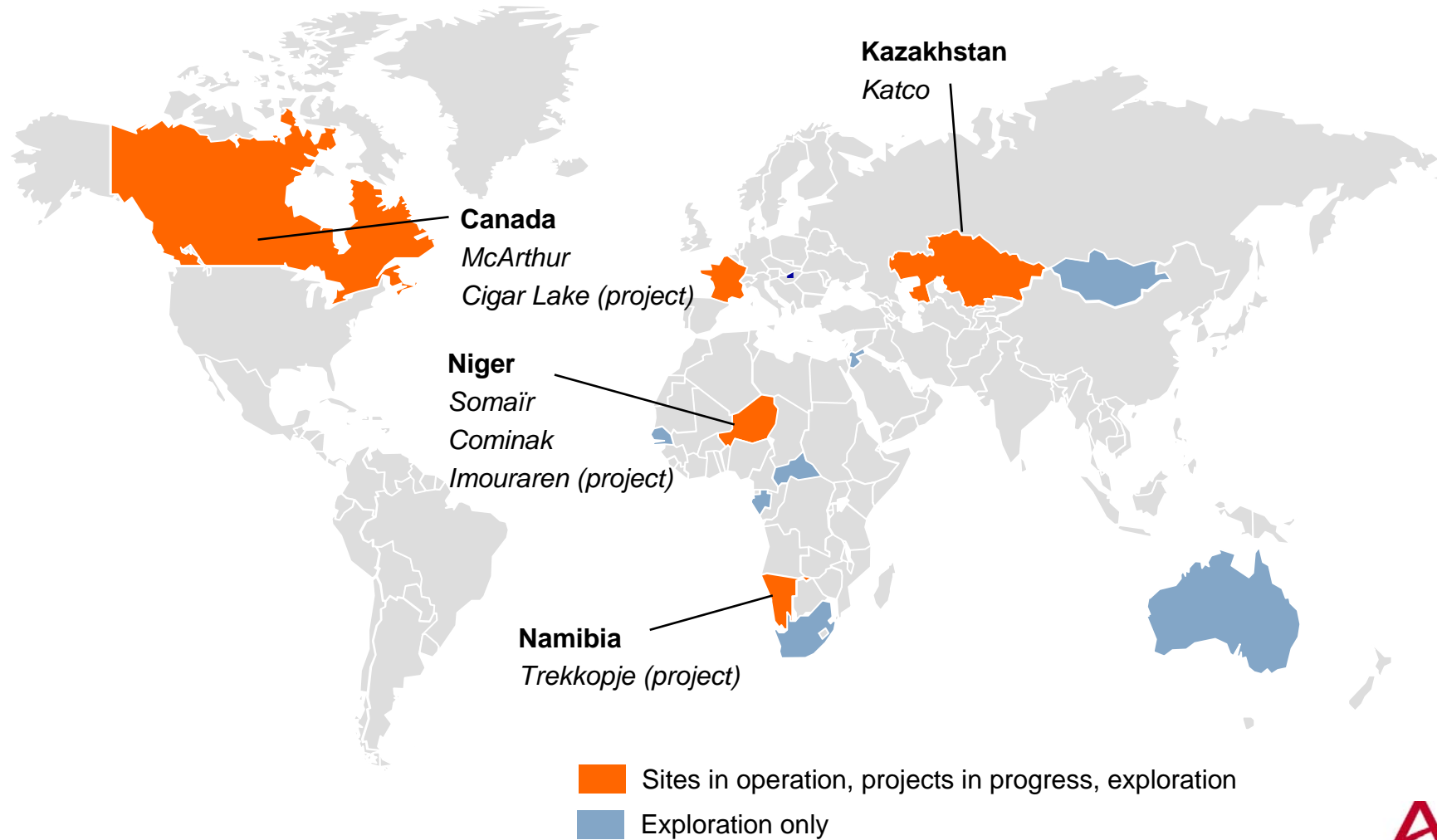
Present in 3+ countries

Integrated nuclear player

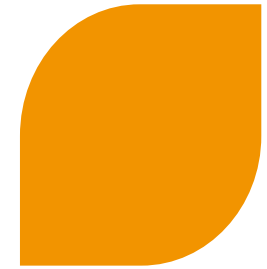
Cameco	X	✓
AREVA	✓	✓ ✓
Kazatomprom	X	X
U1/ARMZ	X	✓
Rio Tinto	X	X

The top 5 producers gather 72% of the world production

AREVA has diversified its geographic footprint



The diversification strategy will assure AREVA leadership



Portfolio diversification

- ▶ Geography: Canada, Niger, Kazakhstan, Namibia, etc.
- ▶ Technology: Open pit / Underground, Dynamic Leach / Heap Leach

Long-term management

- ▶ Projects at different stages of development in the pipeline
- ▶ A sustained exploration effort that will maintain production thanks to the level of reserves and resources



Mitigation of risk

- ▶ Technical: Cigar Lake
- ▶ Political: Niger
- ▶ Fiscal: Katco

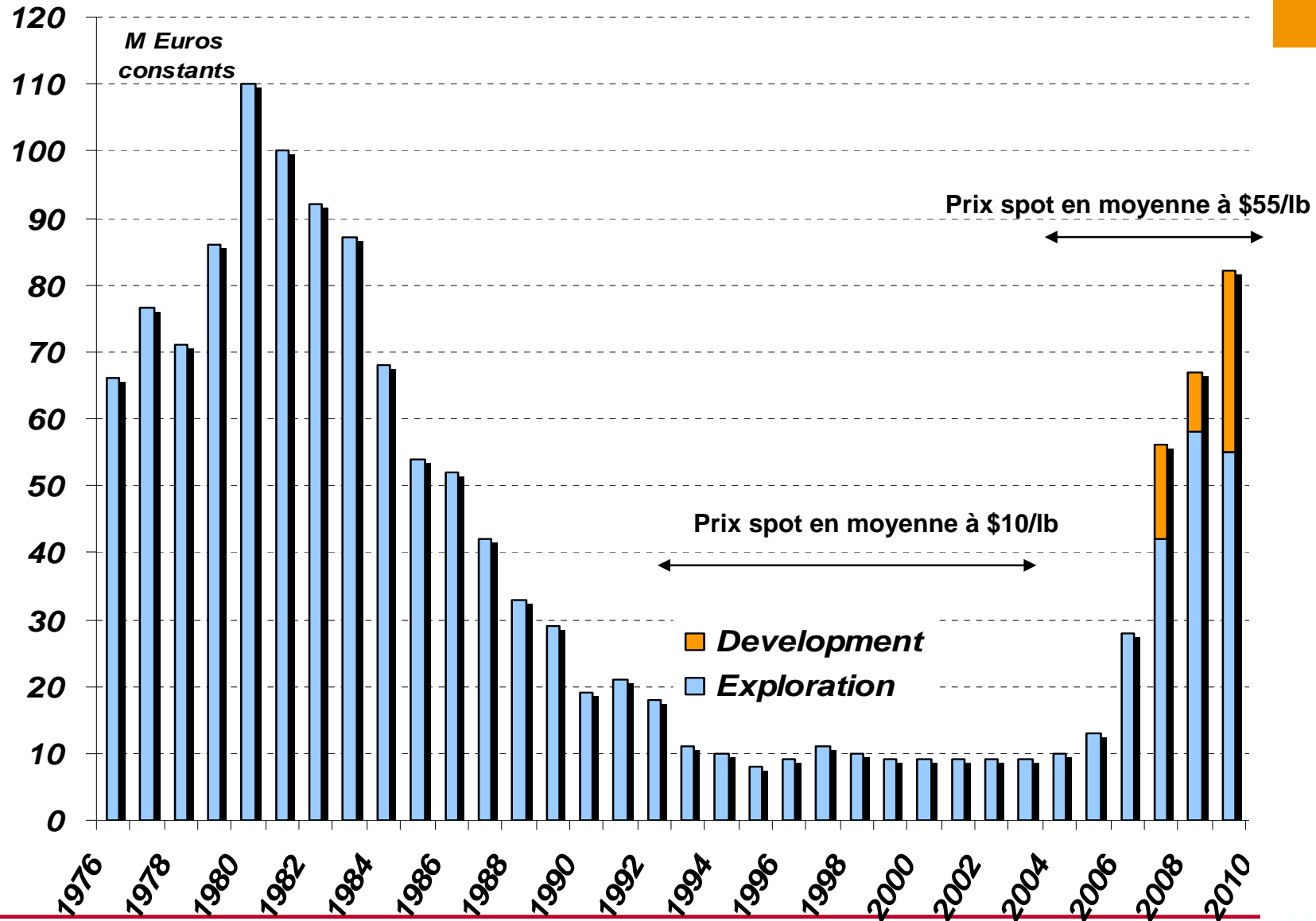
Performance through flexibility

- ▶ Allocation of capital
- ▶ Optimization of the production mix

Competitive sales advantage

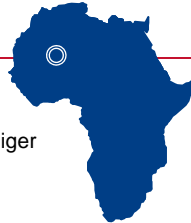
- ▶ Security of supply
- ▶ Long-term visibility

AREVA Historical Exploration Spending



Key projects in line with a strategy to diversify resources

Imouraren



Mine operator: AREVA
Shareholders: AREVA NC Expansion* (67%), State of Niger (33%)
**15% owned by KEPCO*
Planned production⁽¹⁾: 5,000 MTU / yr
Investment⁽¹⁾: > €1,2 Bn



Katco 4000



Mine operator: KATCO
Shareholders: AREVA (51%), Kazatomprom (49%)
Resources: 54,400 MTU
Planned production⁽¹⁾: 4,000 MTU / yr
Investment⁽¹⁾: > €400M



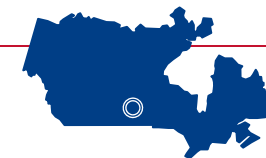
Trekkopje



Mine operator: AREVA
Shareholder: AREVA (100%)
Resources: 45,500 MTU
Planned production⁽¹⁾: 3,000 MTU / yr
Investment⁽¹⁾: > €700M



Cigar lake

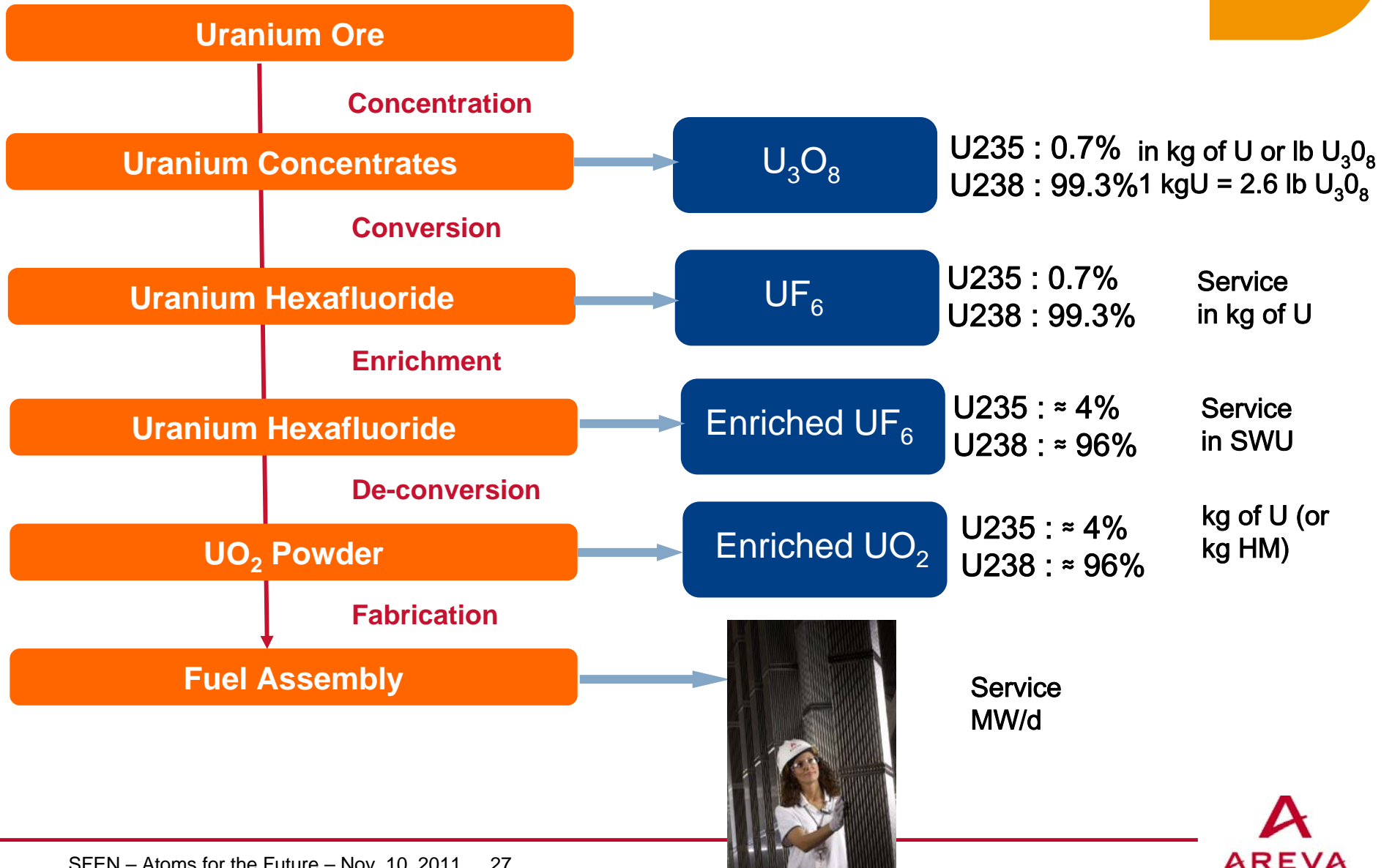


Mine operator: Cameco
Shareholders: Cameco (50%), AREVA (37%), third parties
Resources: 135,000 MTU (19% U₃O₈)
Planned production⁽¹⁾: 6,900 MTU / yr
Investment⁽¹⁾: > €1 Bn€



Note: ⁽¹⁾ Production and Capex figures are 100% basis

Integrated offer: from uranium ore to fuel assembly



What are the strengths of AREVA in the Mining Business?



- ▶ Clear leader – Leveraging the integrated model

- ▶ Diversified
 - ◆ Present in all areas where uranium is abundant.
 - ◆ The diversity of our sites attenuates the high technical and political risks
 - ◆BUT the location of deposits depends on geological factors which we do not choose !

- ▶ R&D and Experience
 - ◆ A plus when mining future new deposits
 - ◆ 40 years of experience in exploration and ore treatment is unique...



**Thank you
for your attention**