



AREVA sustainable back-end solutions for smooth and optimized nuclear development

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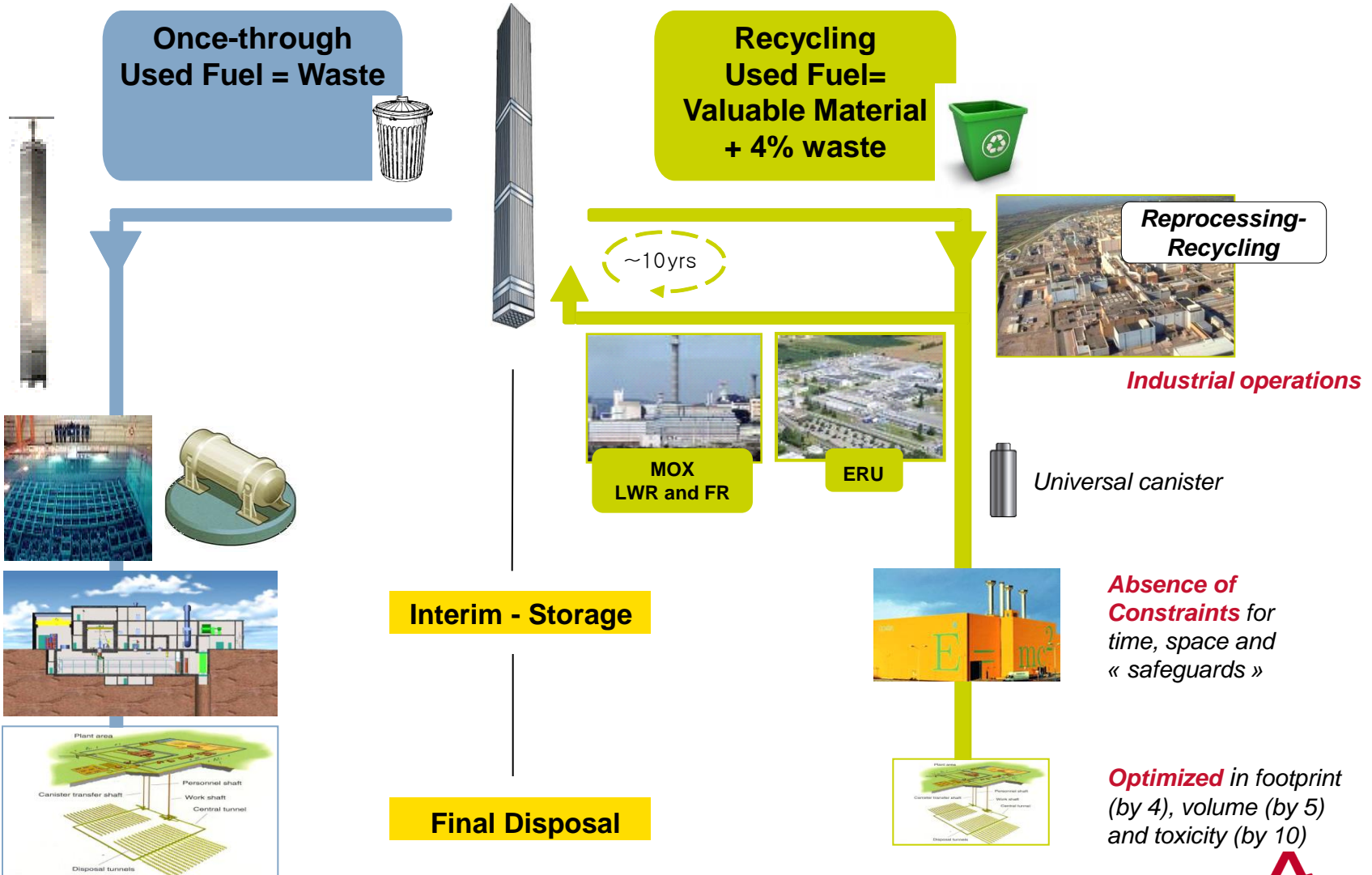
- 1. Introduction**
2. French back-end approach
3. Addressing today's world market

Two Main Options for Used Fuel Management

Once-through
Used Fuel = Waste



Recycling
Used Fuel =
Valuable Material
+ 4% waste



Constraints for
time, space, and
safeguards

Reconditioning for
transport
Encapsulation
Under development

Technical and
economical
uncertainties

Industrial operations

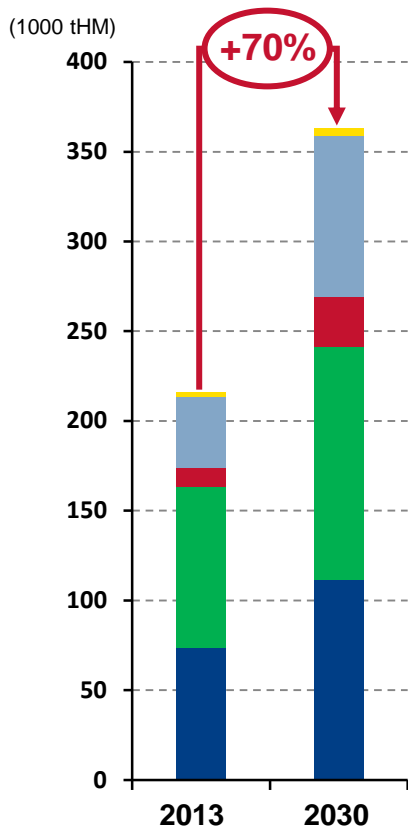
Universal canister

**Absence of
Constraints** for
time, space and
« safeguards »

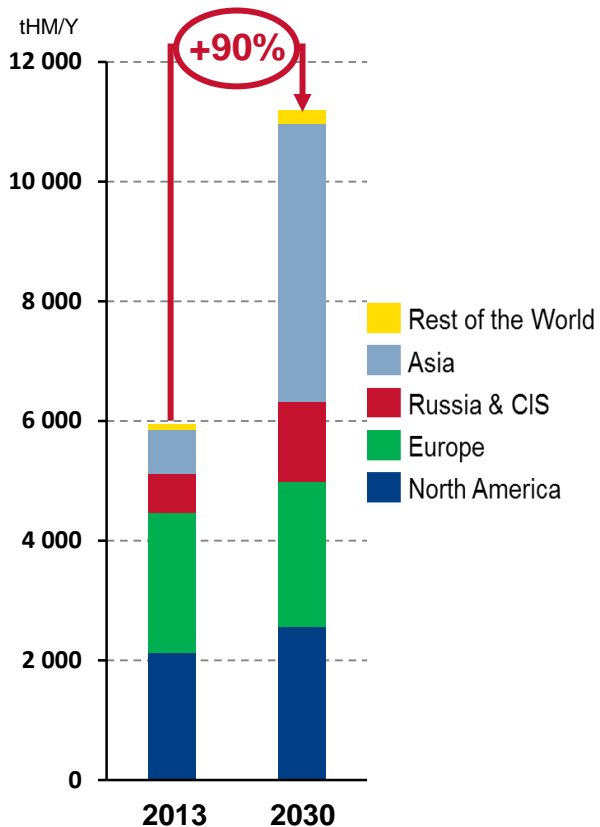
Optimized in footprint
(by 4), volume (by 5)
and toxicity (by 10)

Amount of used fuel will rise by 2030 while disposal and reprocessing capacities will remain limited

LWR Used Fuel Inventories



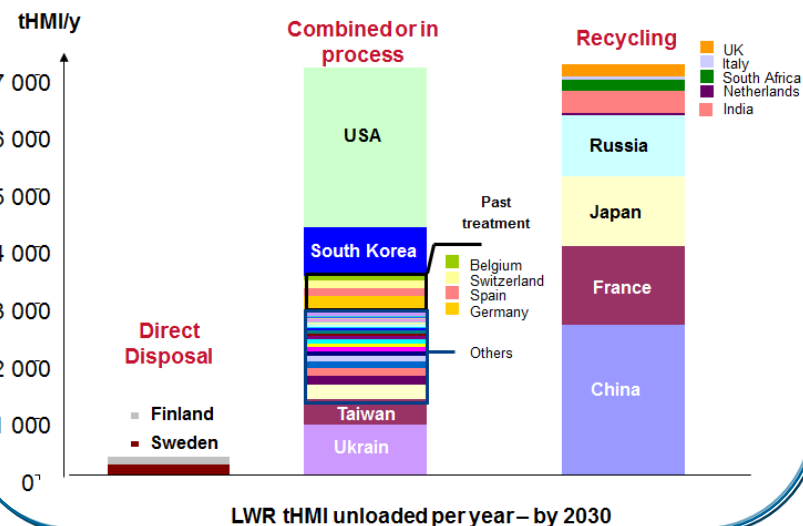
LWR Used Fuel Annual Unloading



Deep geological repository will remain a scarce resource



Available reprocessing capacities will remain well below the needs



Key players of the closed fuel cycle could coordinate their efforts to address a huge market

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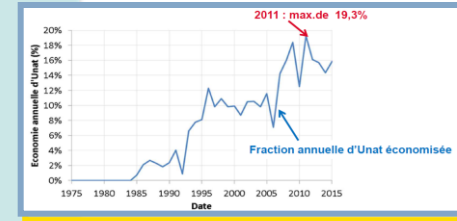
France's closed fuel cycle policy has led to significant savings

Uranium mining and concentration
~ 8000 t/year

Conversion

Enrichment
~ 5.5 MUTS/year

Fuel fabrication



25 500 tons

Natural Uranium Savings

Reprocessed Uranium (RU)

Plutonium

58 NPPs
22 with MOX
4 with REPU
430 TWhe /year



~120 t/y MOX

ERU

ENU
~1050 t/y

Fuel Assemblies



Reprocessing

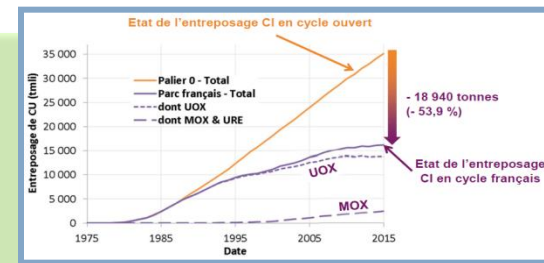
UC-V
UC-C

Spent fuel 1200 t/y

Very low, low and intermediate level waste



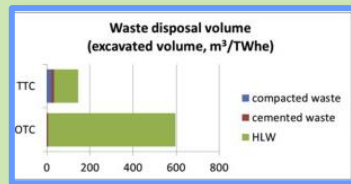
Near Surface Disposal



18 940 tons

Interim Storage savings

Geological Disposal



AREVA has an undisputed leadership on the reprocessing/recycling of used fuel

Existing French capacities

La Hague



29 650 tHM
reprocessed as of 2013

Melox



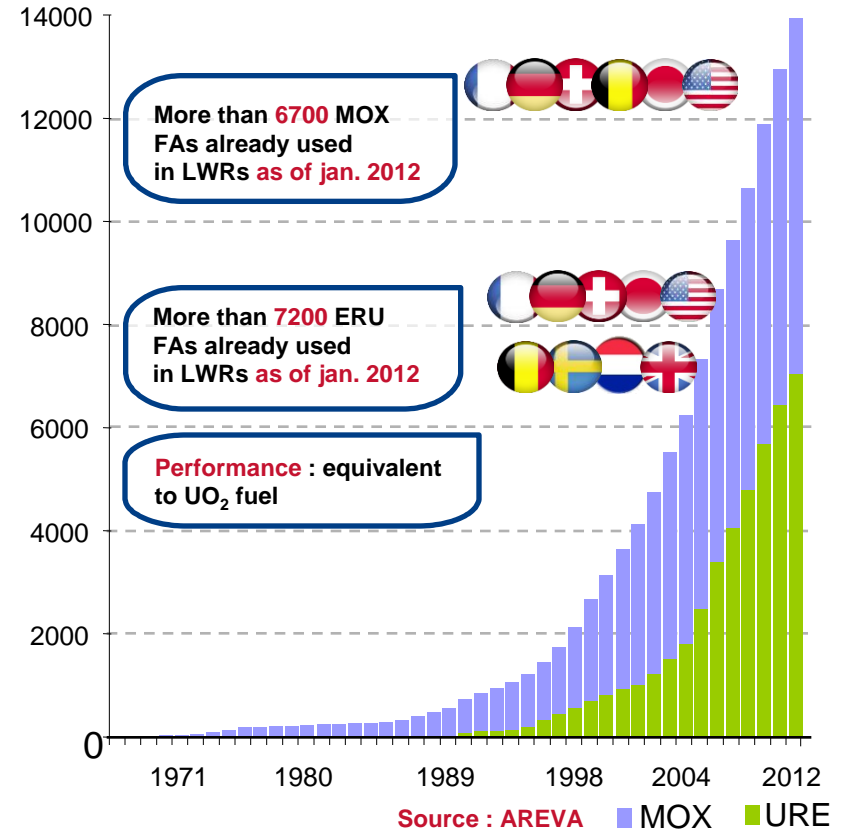
~2 140 tHM of MOX fuel
produced as of 2013

AREVA reprocessing customers



A proven industrial performance

Assemblies



» Recycling is a fully available and proven industrial solution with more than 40 years of experience

Strict environmental monitoring at La Hague plant



Monitoring is carried out on:

atmosphere, land (surface water, grass, milk, etc.), sea (coastal water, seaweed, shellfish, fish, etc.)



Gaseous and liquid emissions strictly managed:

- ◆ Low-level radioactive effluents purified prior to emission
- ◆ Emissions largely reduced over the years
- ◆ Full compliance with strict authorizations



A wide range of measurements:

- ◆ Around 20,000 samples are taken each year
- ◆ Around 70,000 analyses are performed each year



**Under the control of the authorities, who
also perform their own inspections**



No health impact from operation of La Hague plant



From a radiological standpoint, the site's impact* is
100 times lower than natural radioactivity levels

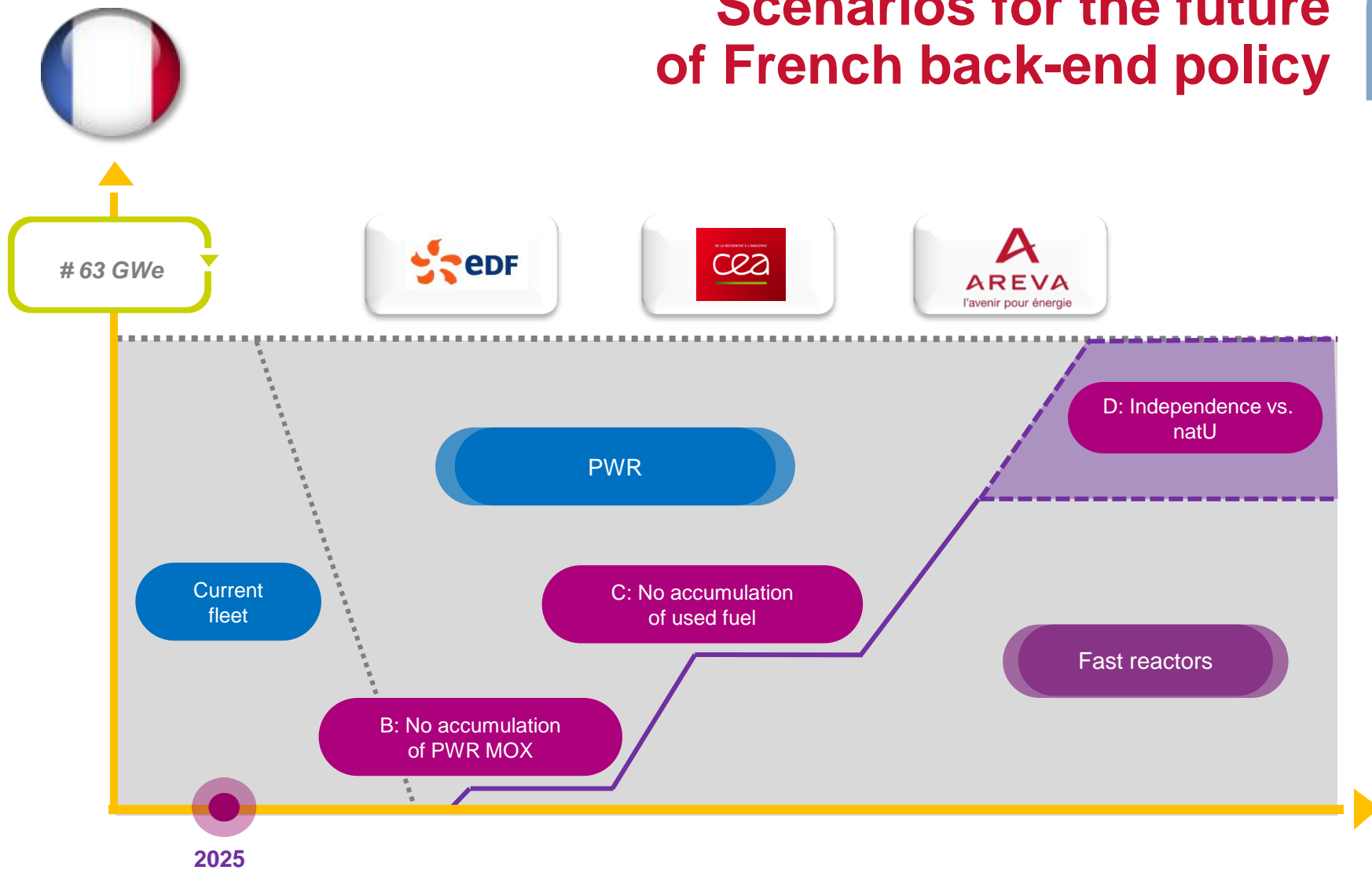
Natural exposure
2,4 mSv / year

AREVA
La Hague
< 0,02 mSv / year



*Impact calculated since 2004 using a model produced by the GRNC (Groupe Radio-écologie Nord-Cotentin), making allowance for the results of the AREVA public enquiry (1998), for a reference group: population likely to be the most highly exposed due to its position and lifestyle.

Scenarios for the future of French back-end policy



» **Coordinated approach by key French players**

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Historical nuclear utilities are facing major challenges

Used Fuel Management

- ▶ Significant inventories
- ▶ Lack of (or major delay in developing) final disposal path
- ▶ Industrial interim systems not capable of bridging the gap
- ▶ Uncertainty over used fuels LT behavior

Reactors' life extension

Reactors' shut-down

New reactors

Main issues

- ▶ Saturation of reactors pools and constraints on operations
- ▶ Safety demonstration
- ▶ Pool unloading for phase out
- ▶ Damaged fuels
- ▶ Difficulty to get new license

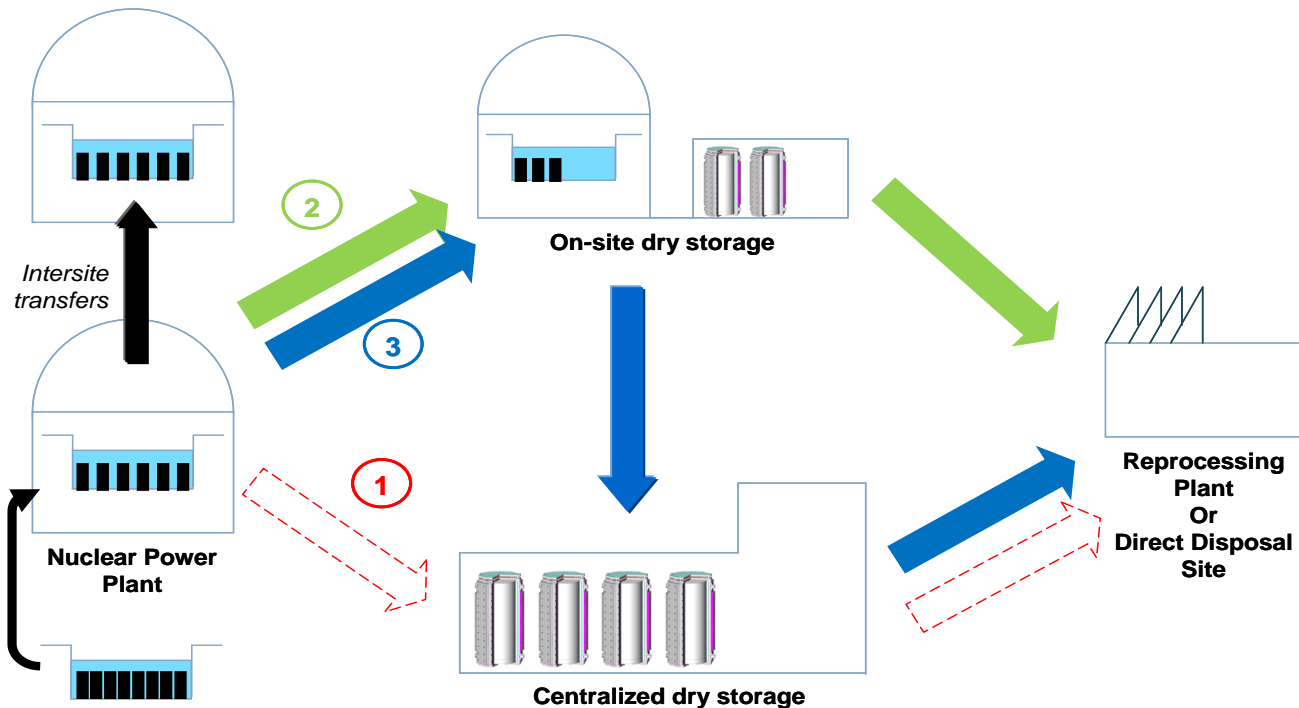


Recycling is a way to mitigate main risks

Comprehensiveness and flexibility of chosen solutions are key

► Paths for countries considering interim storage must encounter:

- ◆ Potential delay for centralized storage,
- ◆ Public / regulatory pressure for emptying Used Fuel pools before saturation, as a safety measure,
- ◆ difficulty with inter-site transport of Used Fuel (public/regulatory pressure)



Storage systems need to be compatible with transport and all possible schemes of used fuel management

AREVA can provide Sustainable Cycle Solutions

RECYCLING & HLW STORAGE



RECYCLING

INTERIM OPTIONS FOR USED FUEL

DRY STORAGE



WET STORAGE



TRANSPORTATION SYSTEMS



Sustainable Cycle Solutions

» For an optimized, long-term and responsible management of used fuel