Les progrès scientifiques et technologiques peuvent s'imposer à la société ?

Apport des Sciences Humaines et Sociales pour la prise en compte de la dimension sociétale

Illustration pour l'énergie nucléaire

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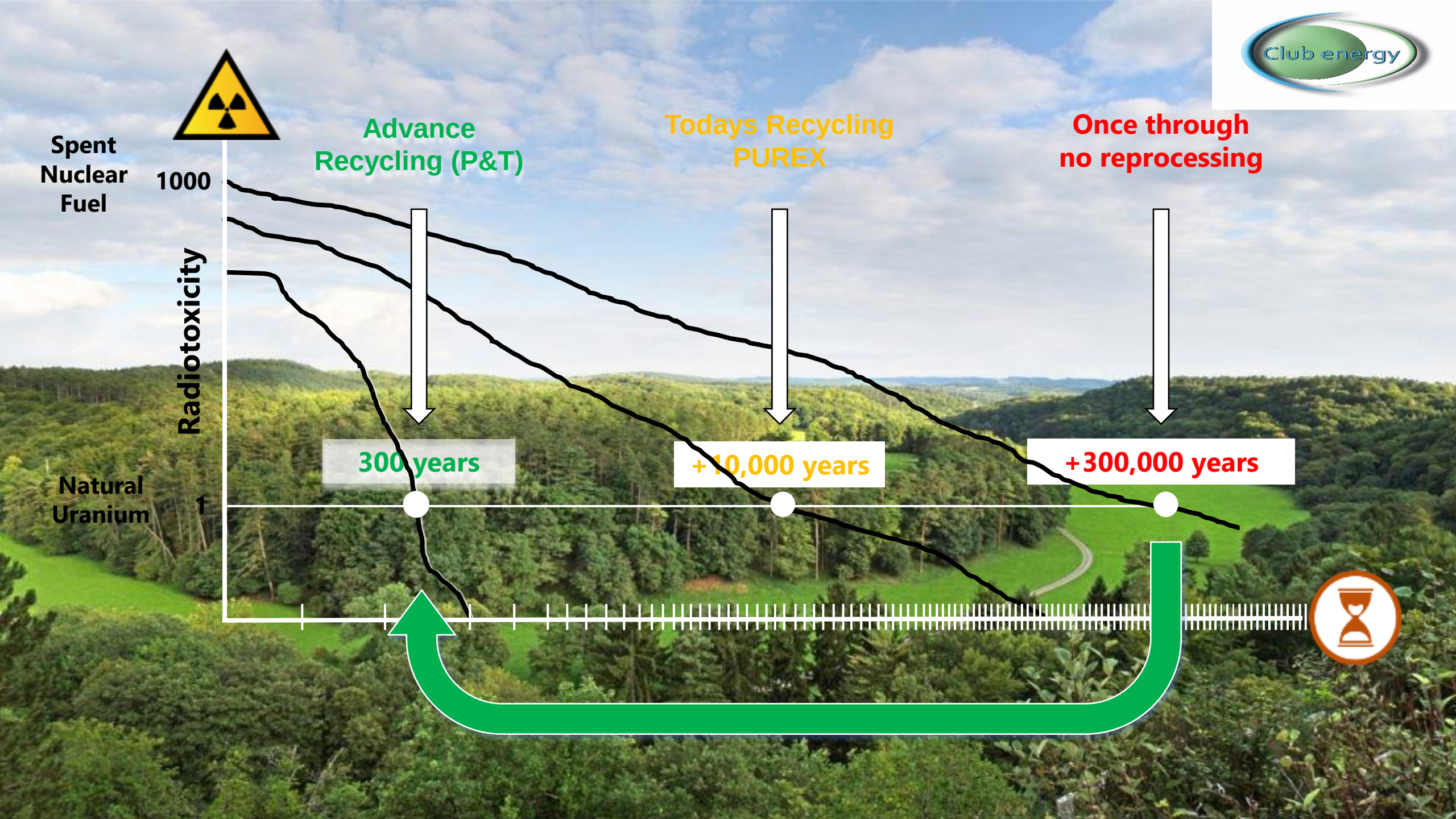
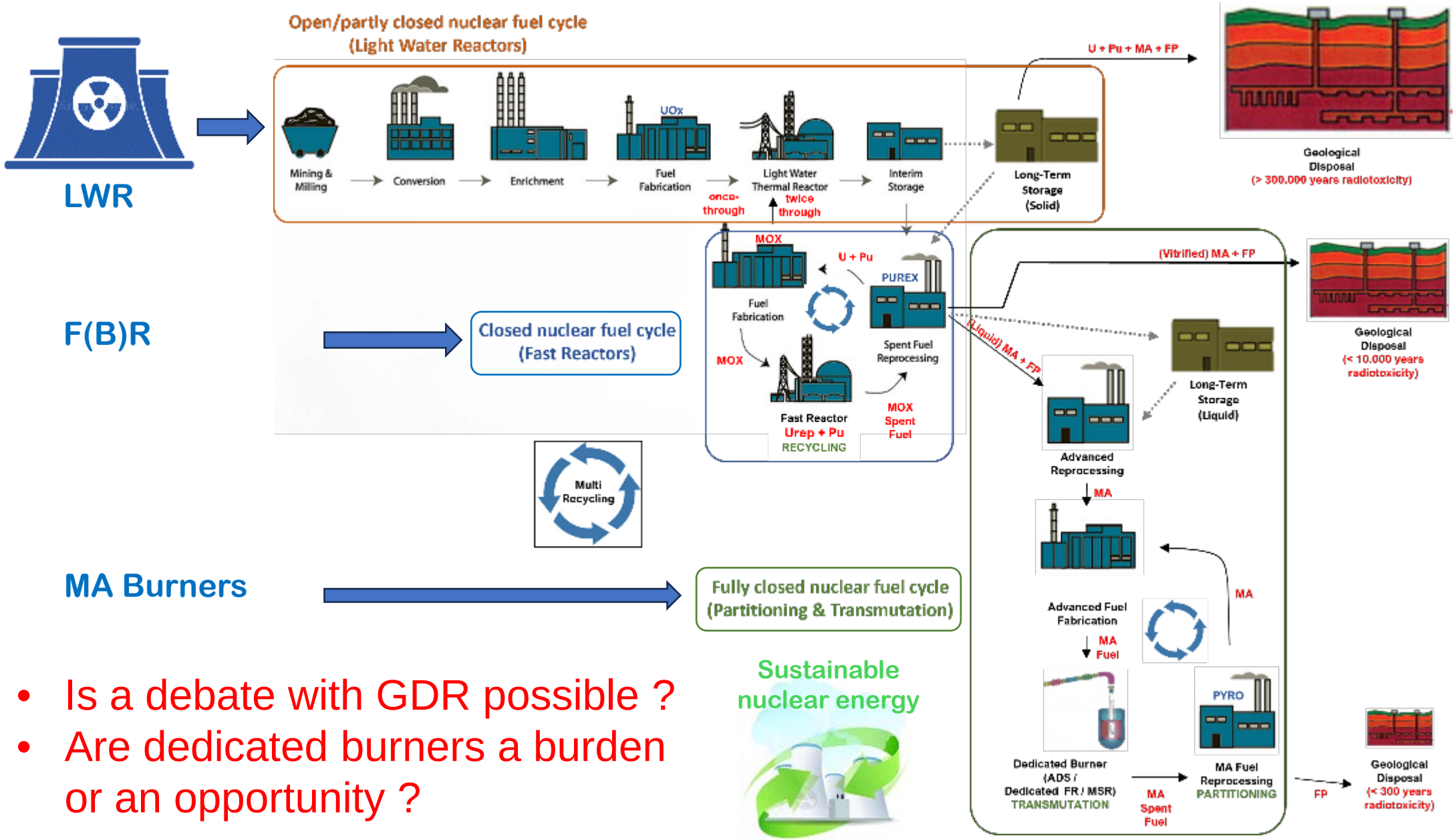
Contribution à la table ronde **« Le rôle des sciences sociales dans le développement économique de l'Algérie : regards croisés »**, Club Energy Algérie, 21 juin 2025

1- Déchets nucléaires hautement radioactifs


Club energy
Spent Nuclear Fuel
1000
Radiotoxicity
Natural Uranium
1
Advance Recycling (P&T)
Todays Recycling PUREX
Once through no reprocessing
300 years
+10,000 years
+300,000 years

from waste to full closed fuel cycle

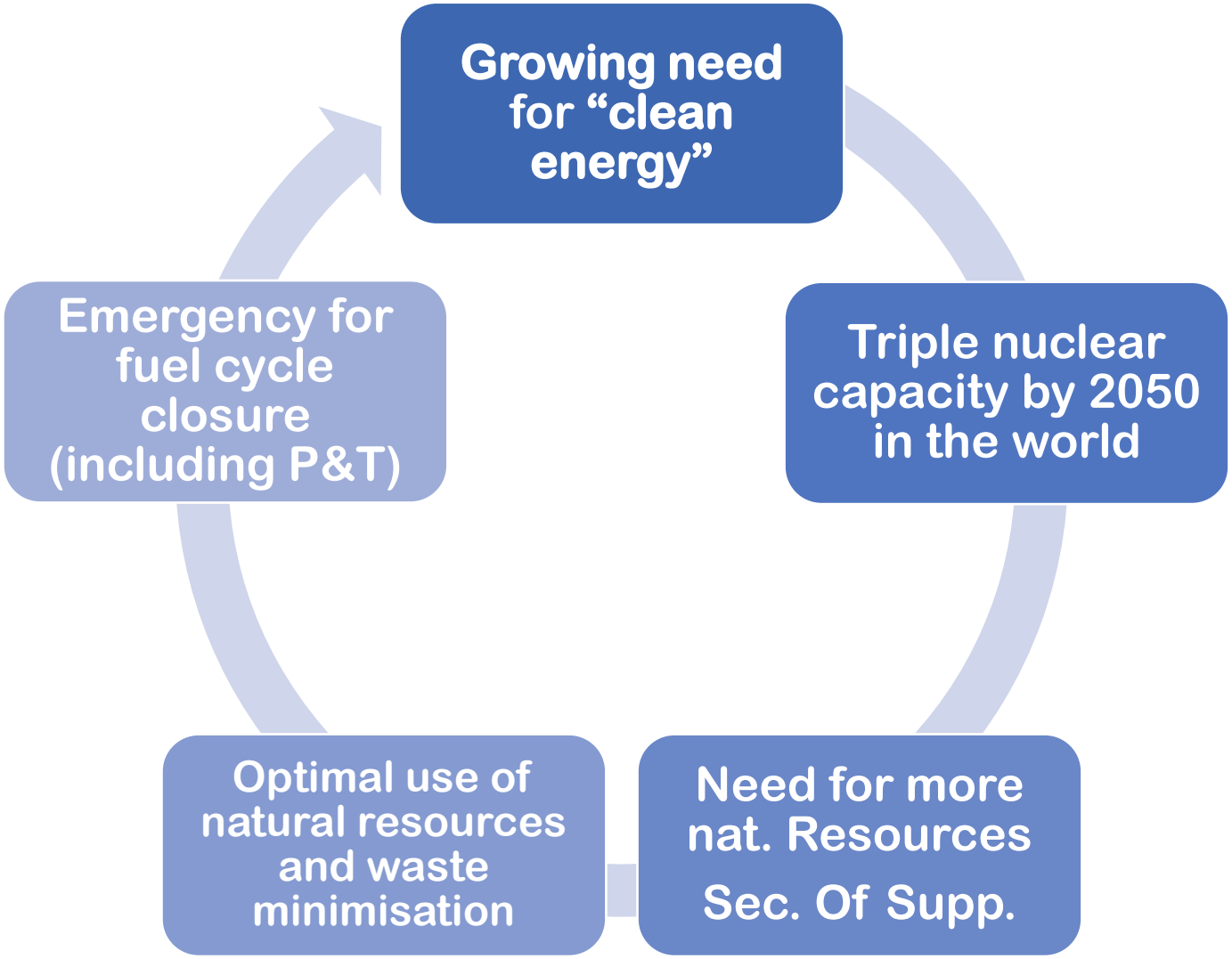


Sustainable nuclear energy

- Is a debate with GDR possible ?
- Are dedicated burners a burden or an opportunity ?

2- Fermer le cycle du combustible

Why full recycling nuclear fuel today



Quantities at different stages for 1GWe PWR

220 t depl. UF_6 + 32 t enrich. UF_6

250 t nat. UF_6

45 to 50,000 t ore

24 t recover. UO_2 (1% ^{235}U)
230 kg Pu for recycling
750 Vitrified HLW (FPs & MAs)

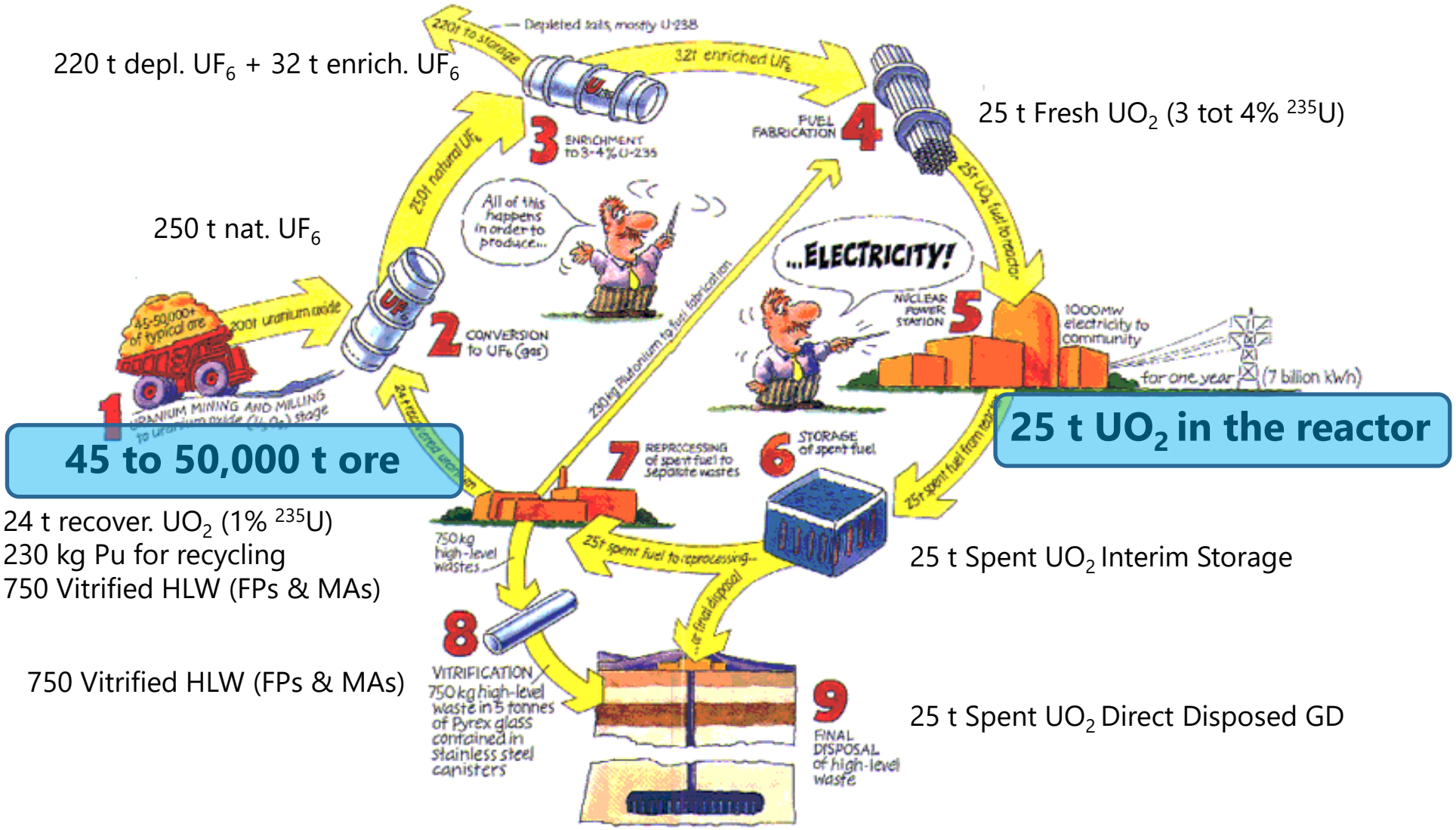
750 Vitrified HLW (FPs & MAs)

25 t Fresh UO_2 (3 tot 4% ^{235}U)

25 t UO_2 in the reactor

25 t Spent UO_2 Interim Storage

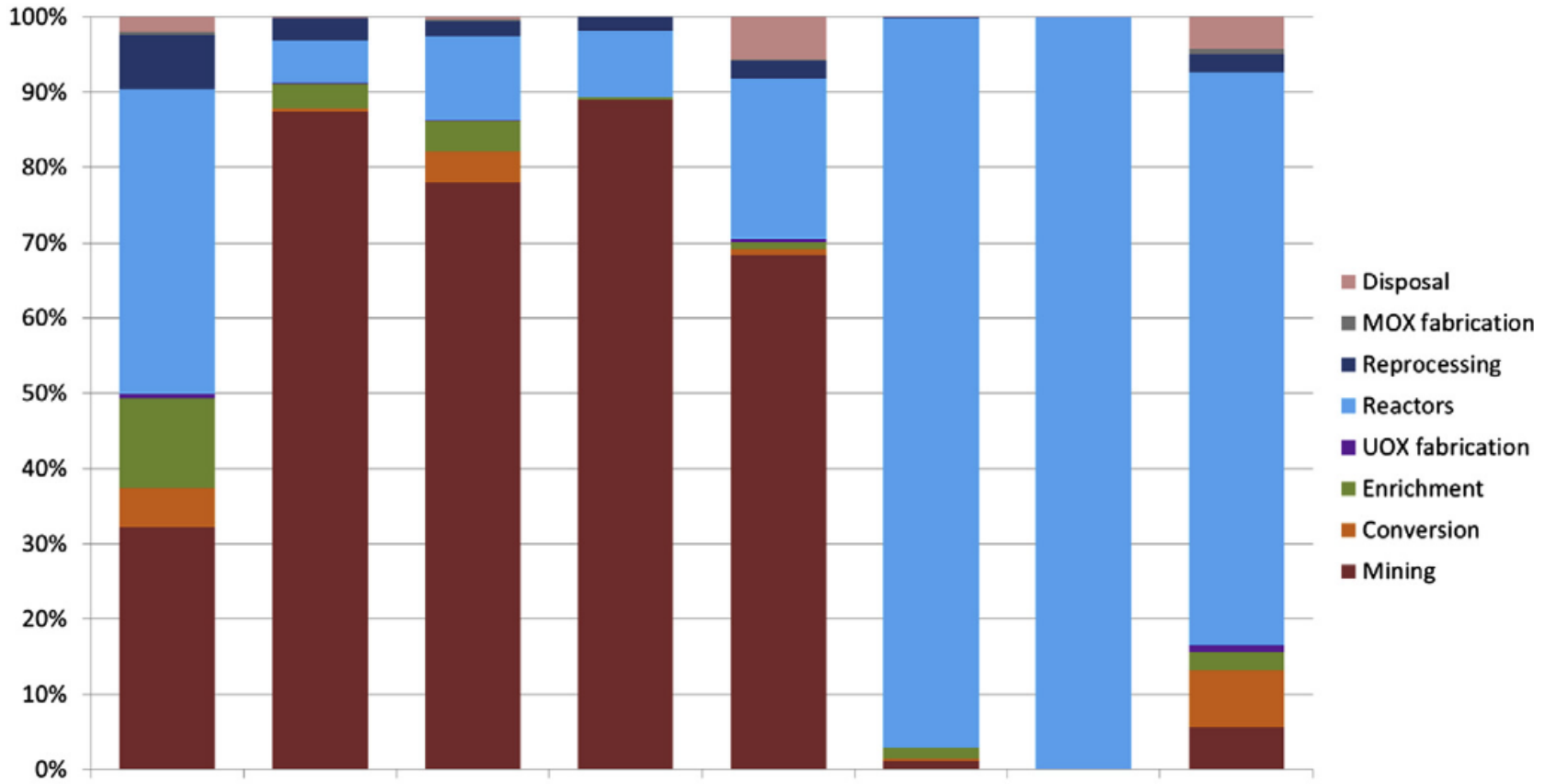
25 t Spent UO_2 Direct Disposed GD



Source:

Chap.II – results of the current French cycle

The general environmental indicators of the TTC

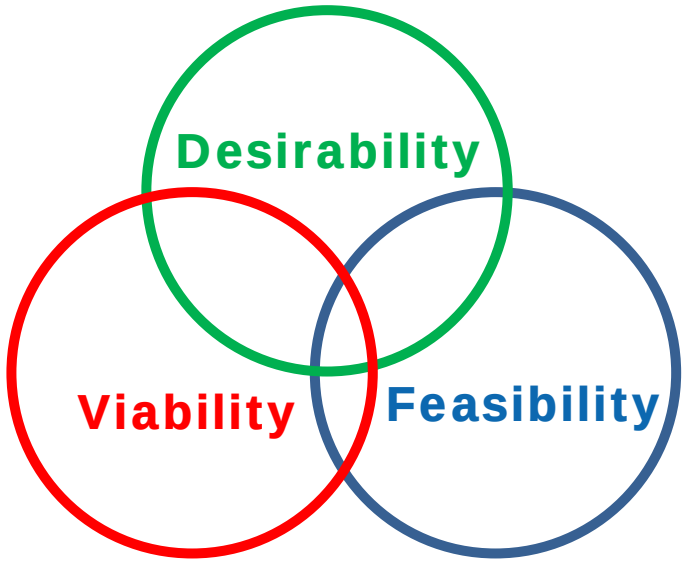


(gCO_2 eq/kWh_e)	(mg/kWh_e)	(mg/kWh_e)	(mg/kWh_e)	(m^2/GWh_e)	(L/MWh_e)	(L/MWh_e)	(g/MWh_e)
5,29	16,276	25,30	287,53	211,0	1507	72364	93,9

A Holistic Approach

Societal aspects

- Focus on society's worries and concerns



Economics

- Identification of the return on investment of the pre-industrial demonstration of full recycling

Advanced technologies for full recycling

- Advanced separation technologies for used fuels from Gen II-III LWRs
- Advanced fuel fabrication and performance
- Transmutation systems: SFR, LFR, ADS, MSR
- Reprocessing of advanced fuel
- Advanced fuel technological aspects: transportation, cooling, and handling

Investment Costs in transmuting machines

- Fast neutron spectrum is needed
- ADS safety parameters are less affected by MA

Investment needed for

reduction MA in A countries + reduction MA in B countries

- 20 EFITs = 30 G€ - 46 G€
- 29 ESFRs HOM mode = 174 G€ - 261 G€
- 67 ESFRs HET mode = 402 G€ - 603 G€

- Deployment
  - EFIT: small units can be local + shared investment
  - ESFR: large units cannot be local because of the number of the needed units

Progress of Work: Societal Aspects

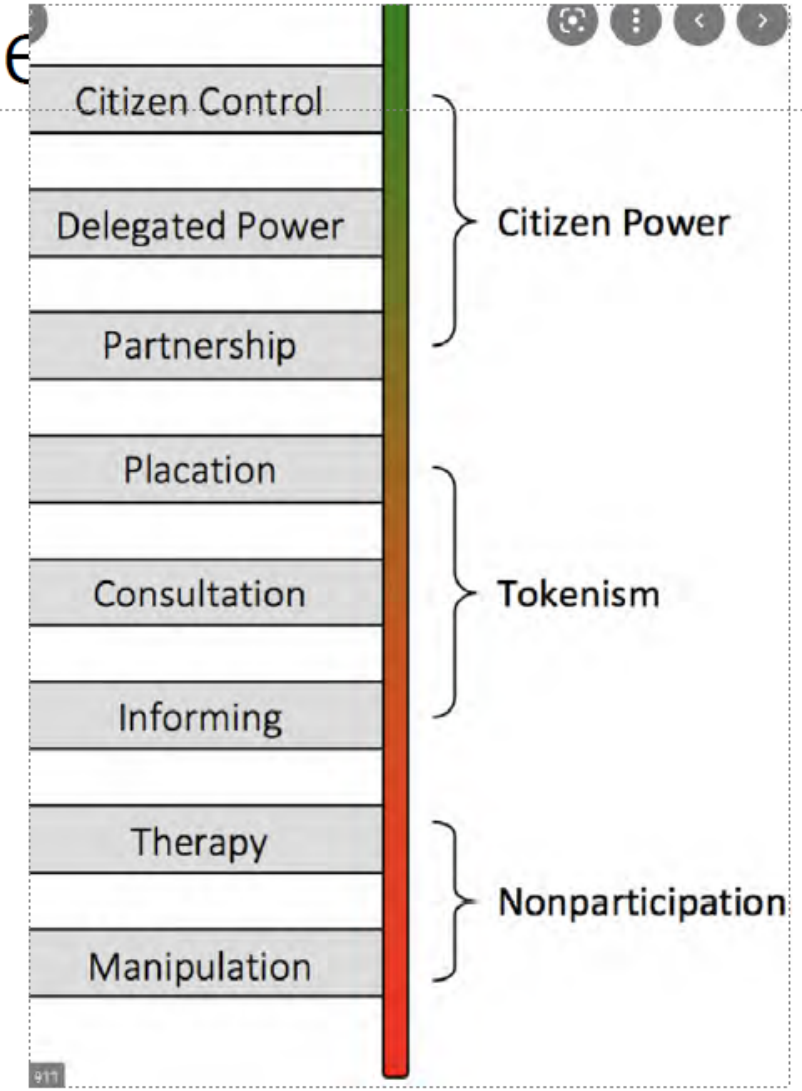
Key messages

- Closing the fuel cycle is a **“socio-technical” issue** and should be addressed accordingly
- It is crucial to **bring in the perspectives of all different stakeholders** – to make the overall approach more robust both technologically and socially (link with the monetisation of societal values – see economic chapter)
- Stress the need to take these views, perceptions, opinions and values into account to **engage with the stakeholders early in the innovation process**
- Now, very **limited scientific data** on how various stakeholders would perceive this innovation and its potential impacts. There are limited empirical social science studies in this field (fuel cycle closure and P&T): **need to** collect more data and consolidate **the Task Force’s assumptions on societal aspects**.

Ladder of Participation when engaging with public

Thinking theoretically about uncertainty, conflict and engageme

- Arnstein's
- Ladder of Participation (1969)
- Romanticizes participation



For the Discussion

1. If we demonstrate that technically and economically, we can realize industrially the Full closing Fuel cycle means recycling Pu and transmuting MAs.

   What should we do with the societal dimension ?
   and with which stakeholders ? [open discussion]

2. If the Geological Disposal Repository can do the job for managing the HLW. Should we accept it as such?

   If Yes why? If No why? [open discussion]

Thank you

For more information

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