Ressources d'Uranium, Scénarios, Dynamique du Nucléaire et de l'Energie (RUSDYN)

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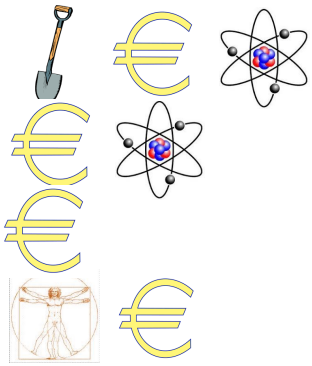
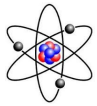
Pourquoi, Quand faire Quel nucléaire ?

Neutrons Thermiques	Neutrons Rapides
	Ya plus d'uranium
	On a du Plutonium
C'est pas cher ?	
	Vitrine Technologique



Geologues 

+ Economistes 

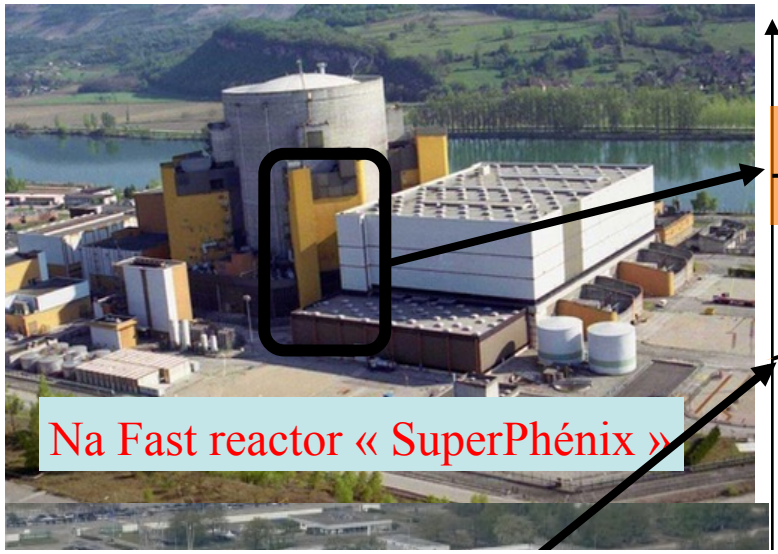
+ Physiciens 

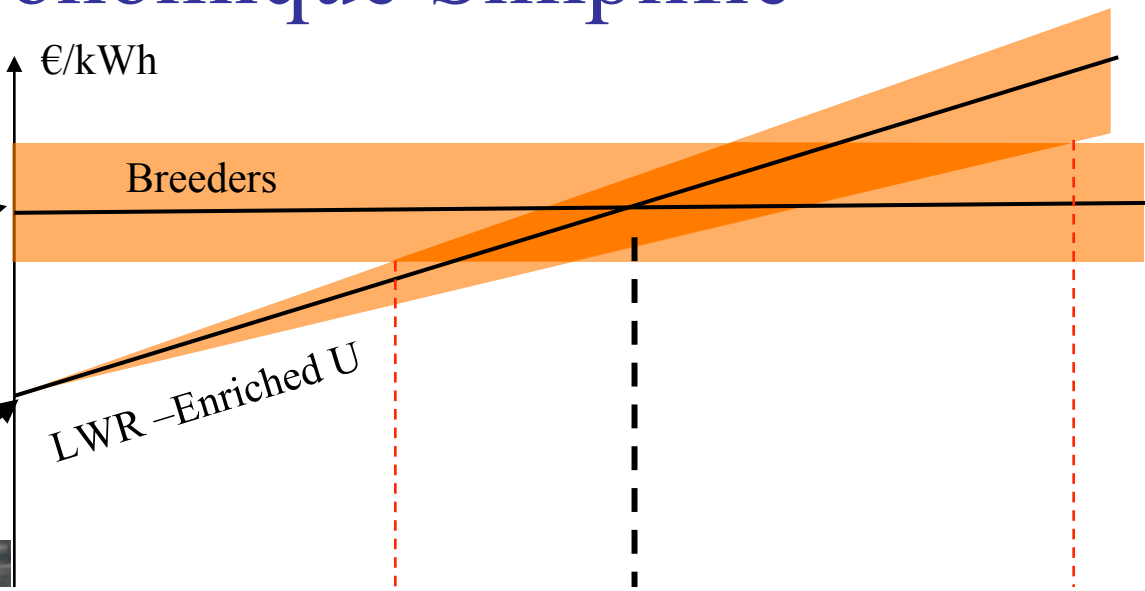
= RUSDYNE

Etude Technico-Economique ou pas

Modèle Economique Simplifié





A. Baschwitz et al. GLOBAL 2015, [5347]
S. Gabriel et al. ANE 2013

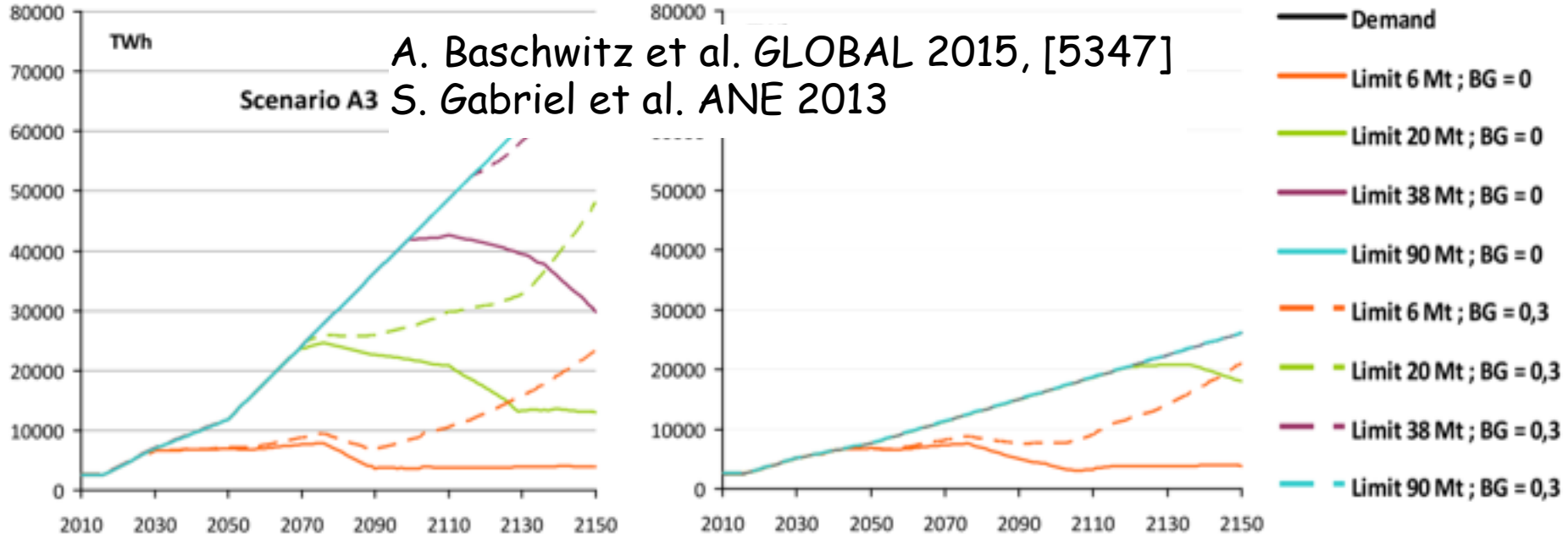
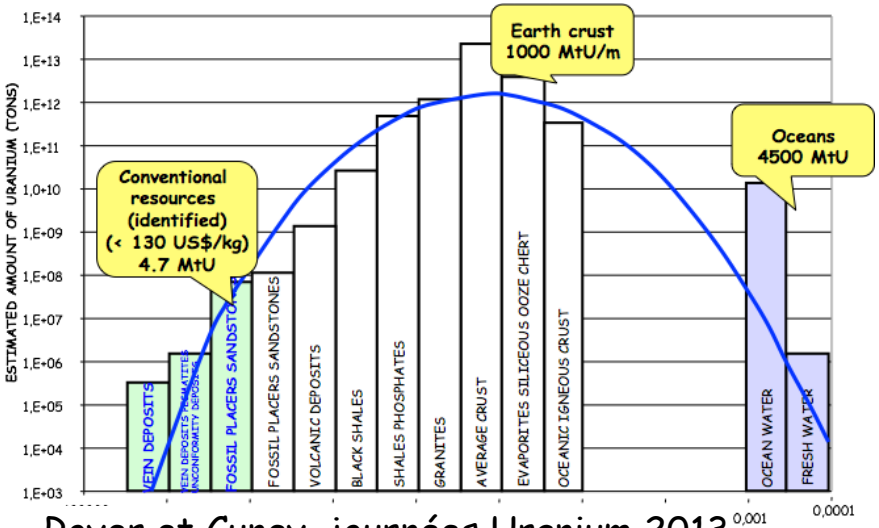


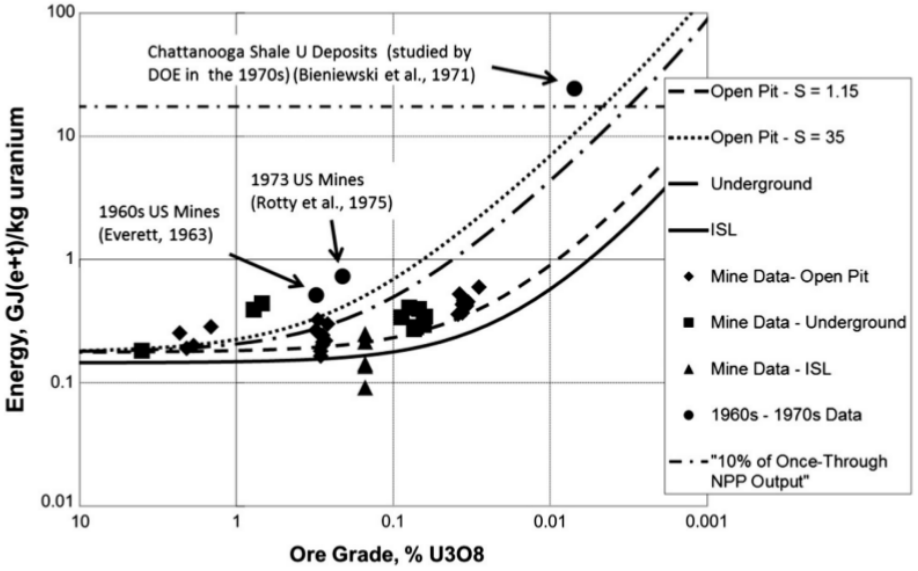
Fig. 3. Light water reactors and fast reactors – demand and power production according to the natural uranium limit (TWhe).

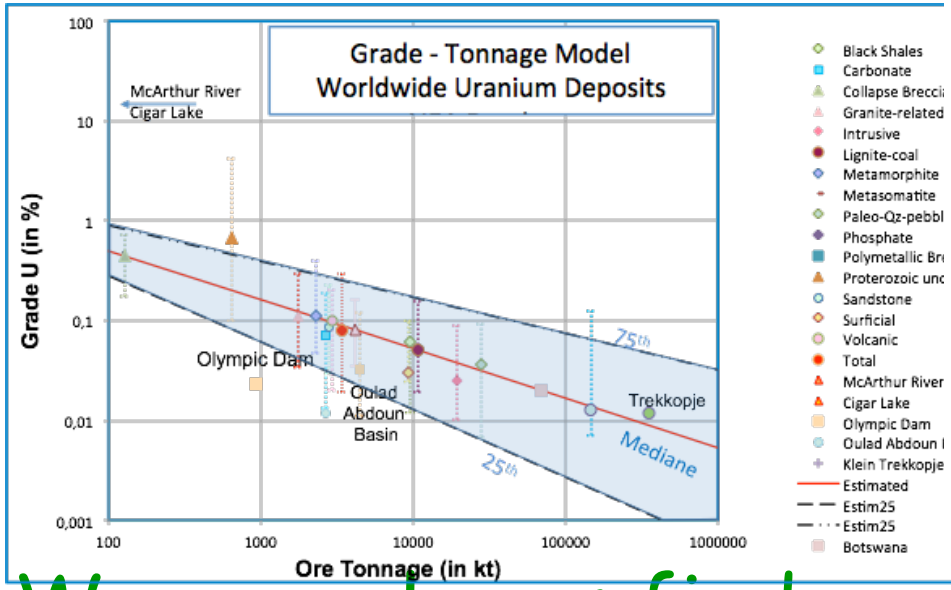
URANIUM RESOURCES

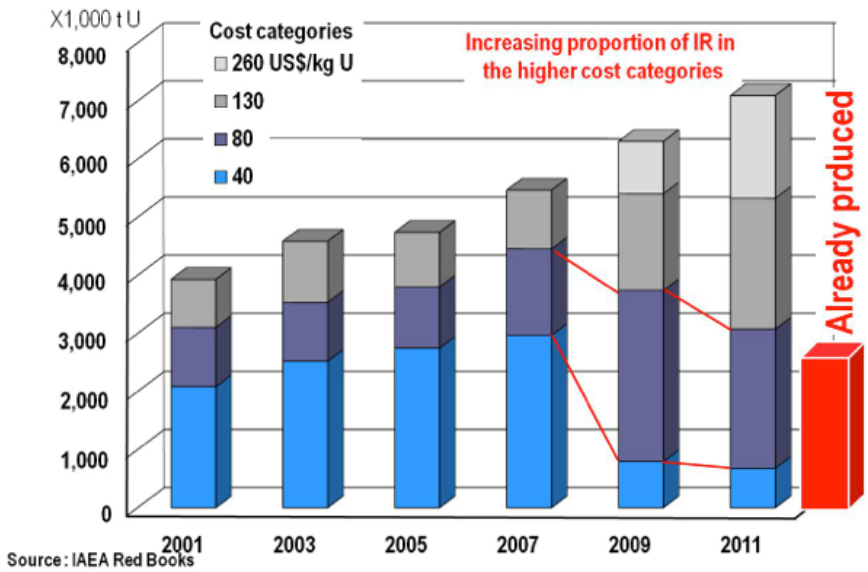


Royer et Cuney, journées Uranium 2013

Schneider et al. Energy Policy 2013





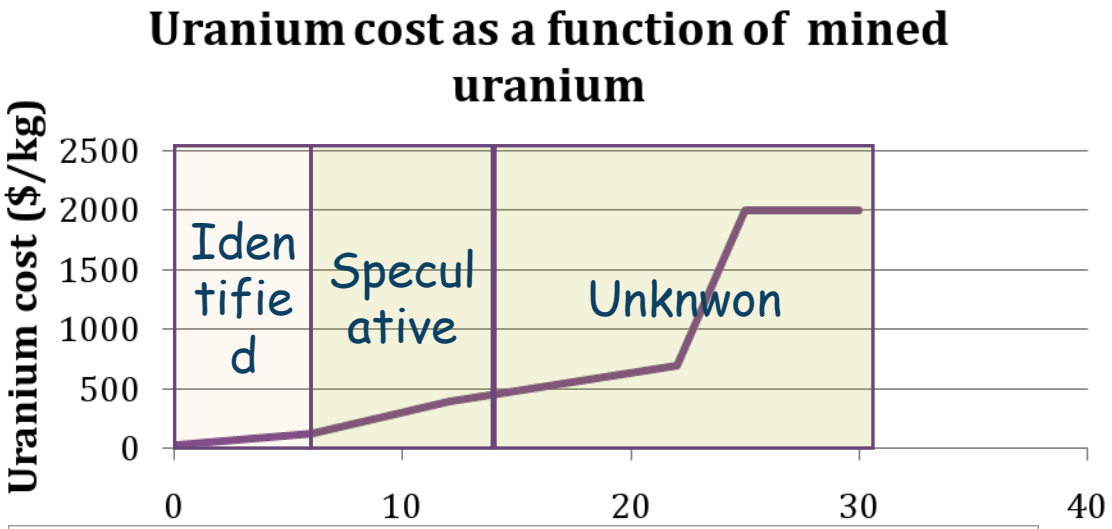


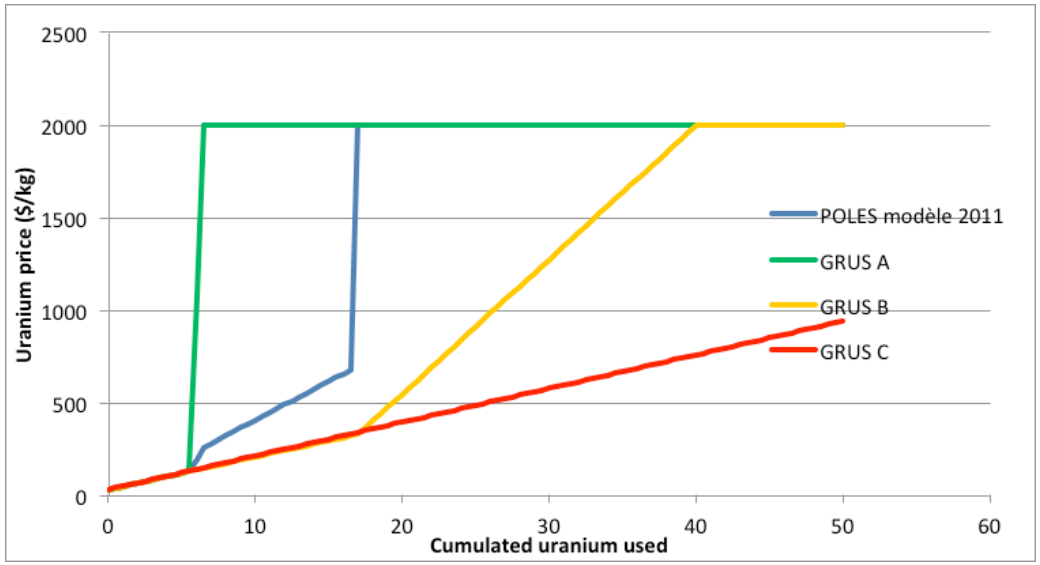
We may always find uranium. At what cost ?

Modélisation Coût de long terme

Courbe en S (A. Monet et al. [5309]@GLOBAL)

- ➢130$/kg Fin des « known reserves » ?
- ➢>6MT, Saut dans l'inconnu ?
- ➢ rupture technologique (phosphate, eau de mer J. Guidez [5025]@GLOBAL)





Qui a t'il après le petit livre rouge ?

A quelle vitesse sont elles exploitables ?

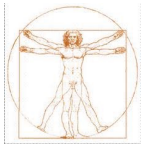
Quelles réserves d'uranium non conventionnelles?

Non Conventionnel = co-produit

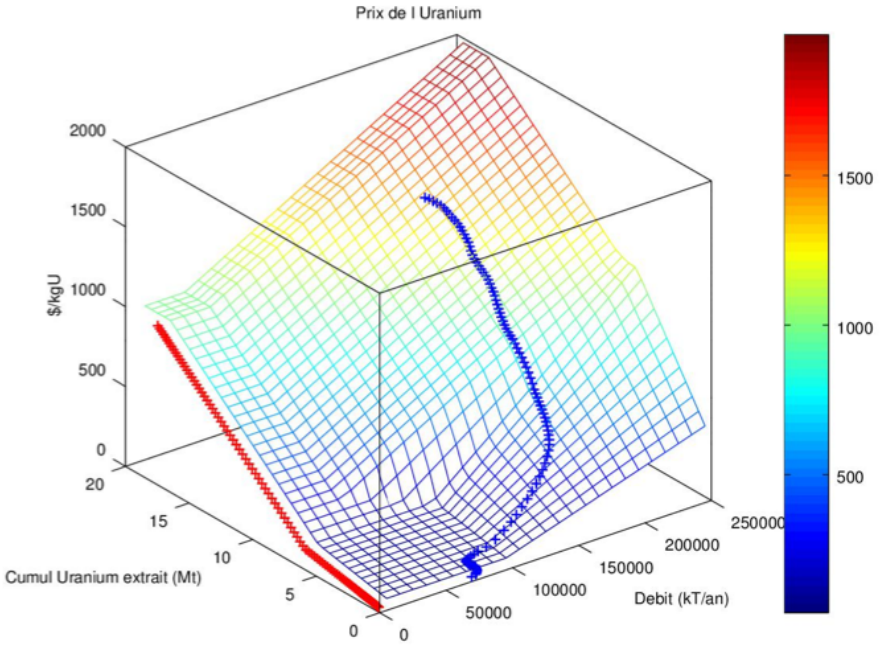
Olympic Dam mine de cuivre (3kt/y) = 5% demande mondiale

Ressources importantes
MAIS limitation en débit
Phosphates.
< 10kt Unat/a (cf AIEA, I-TESE).
Charbon mines < 1kt/y
Autres…

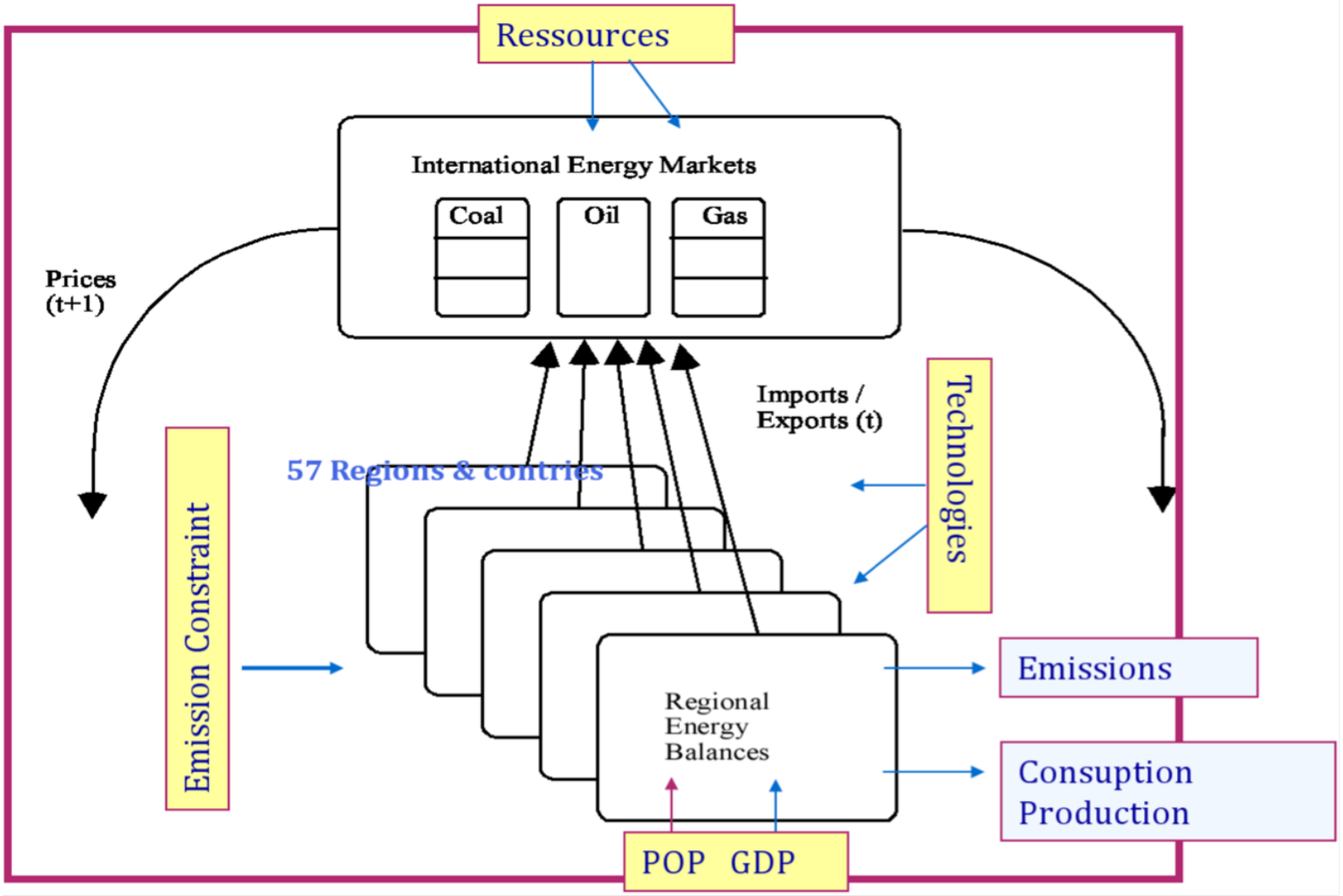
Nouveau modèle proposé
Dépendance volume
+dépendance débit



Cost category	Conventional			Unconventional (minimum)
	Identified		Undiscovererd	
	Total	co-product (%)		
Unassigned			5 609	7 260
<USD 260/kgU	7 635	28%	4 702	
<USD 130/kgU	5 903	30%	3 862	
<USD 80/kgU	1 957	15%	665	
<USD 40/kgU(	683	10%		
Total	7 635	2171	10 311	7 260

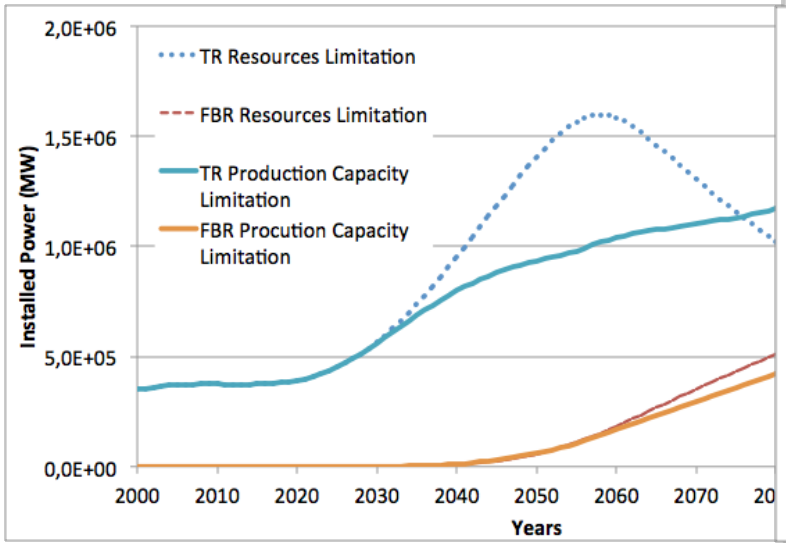


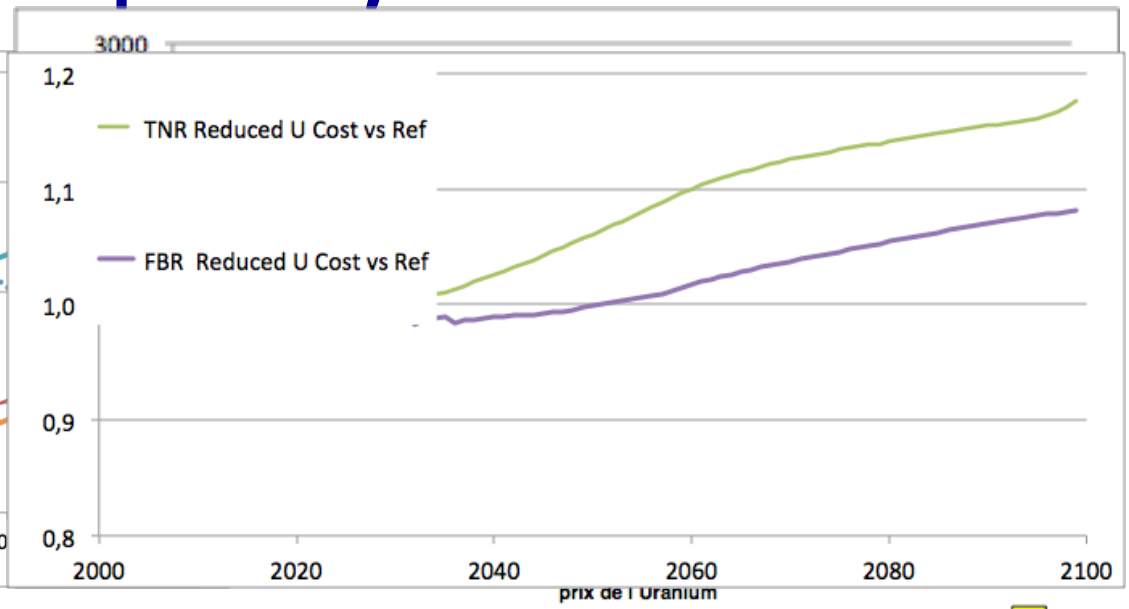
POLES : « Prospective Outlook on Long Term Energy System »
partial equilibrium model of world Energy System



2 technologies Nucleaire : Neutron Thermiques consommant de l'Uranium naturel et Neutrons Rapides utilisant les matières recyclés des précédents au démarrage

Production capacity limitation



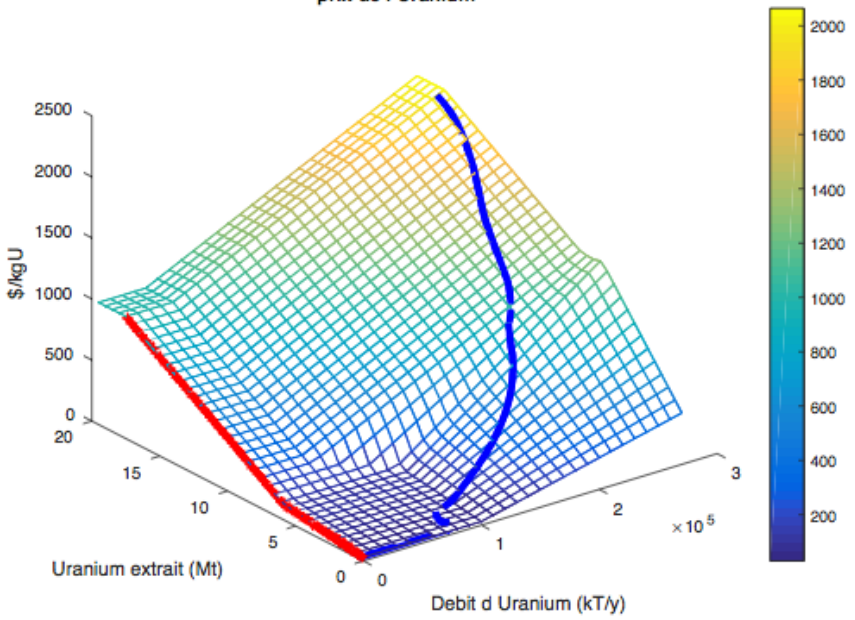


No more Uranium Peak
No Ultimate resources definition

- Higher Uranium costs
- Equivalent FR development

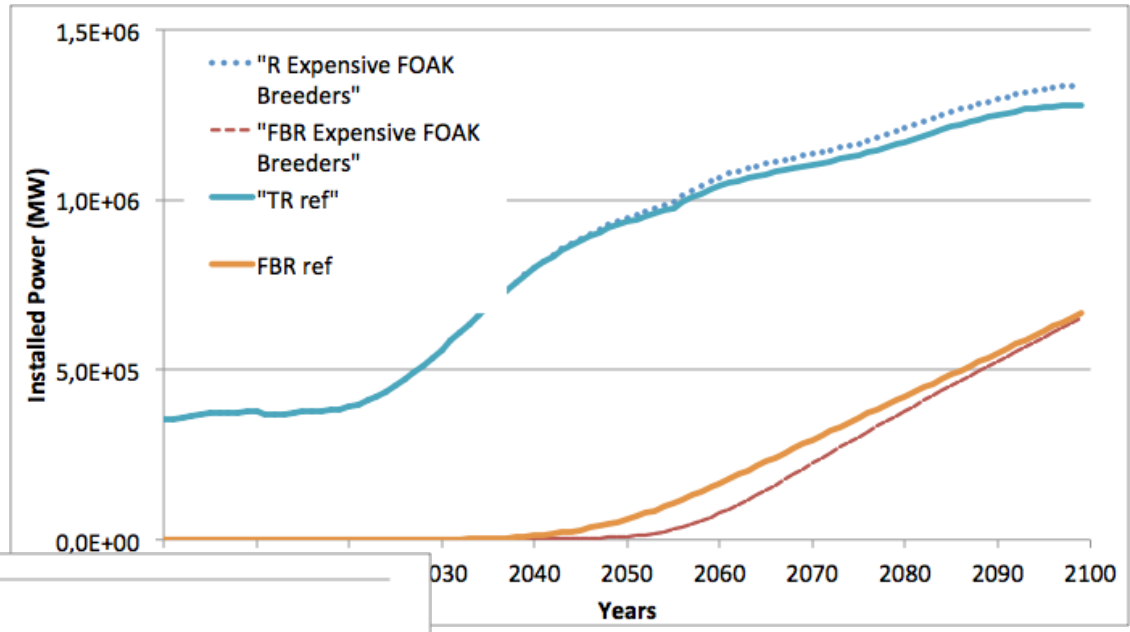
Reduced Uranium costs (-20%)

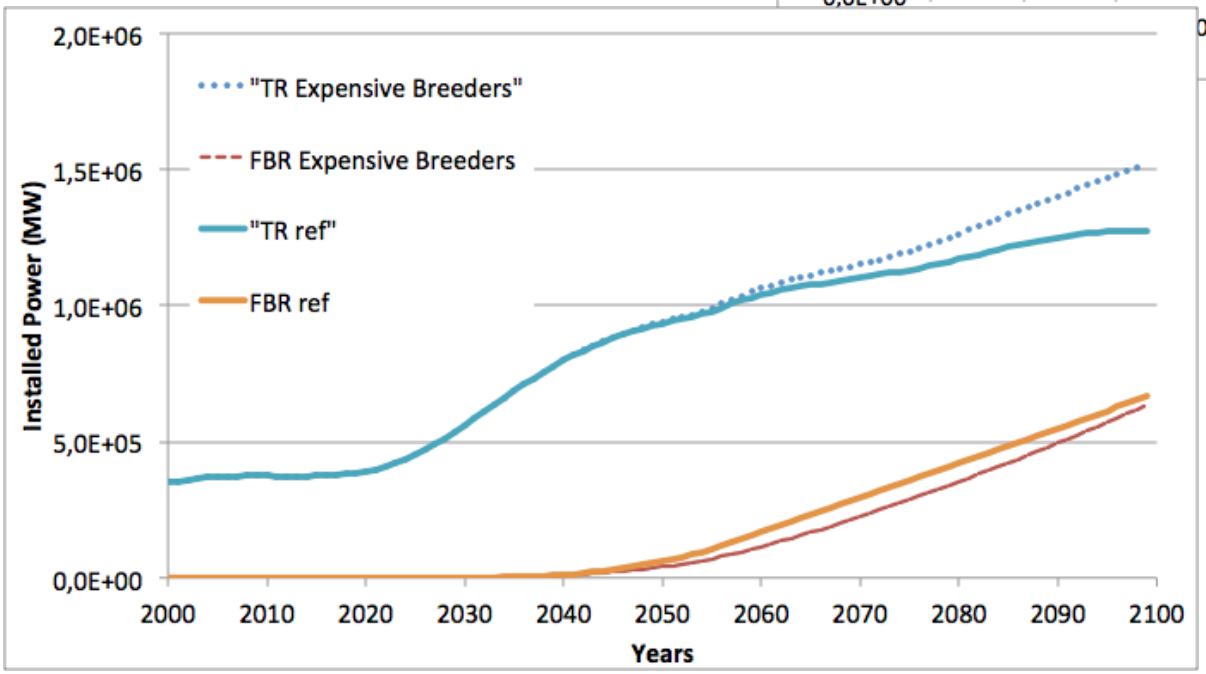
- Increase of TR
- Increase of FR !



Sensitivities to FR costs

- +50 % First Of A Kind (FOAK) Reactors costs
  - ➢ Delayed FR startup and equivalent long term deployment
  - ➢ Very late extra TR (learning curve effects)



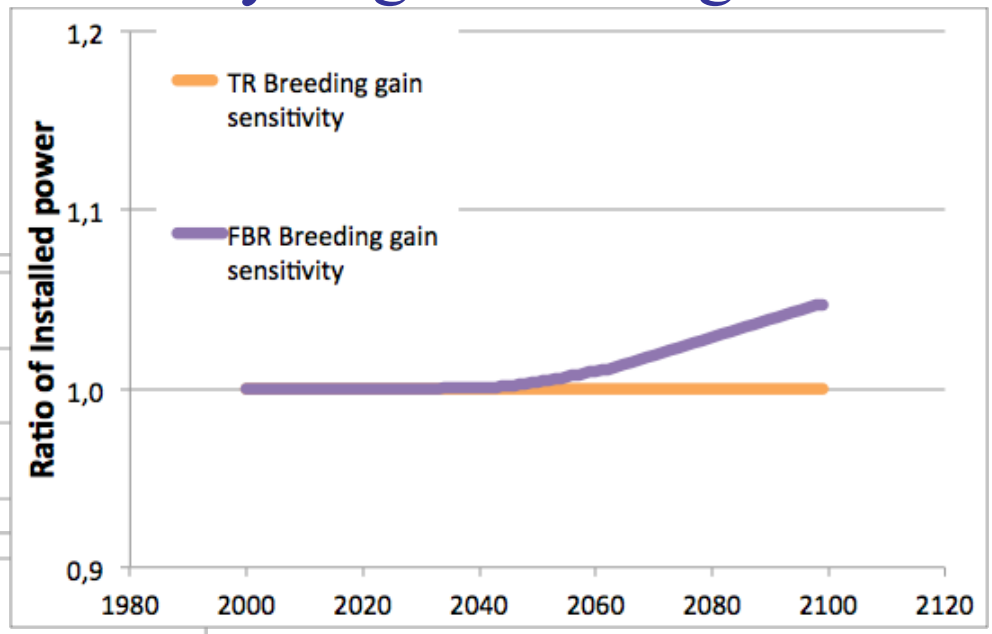


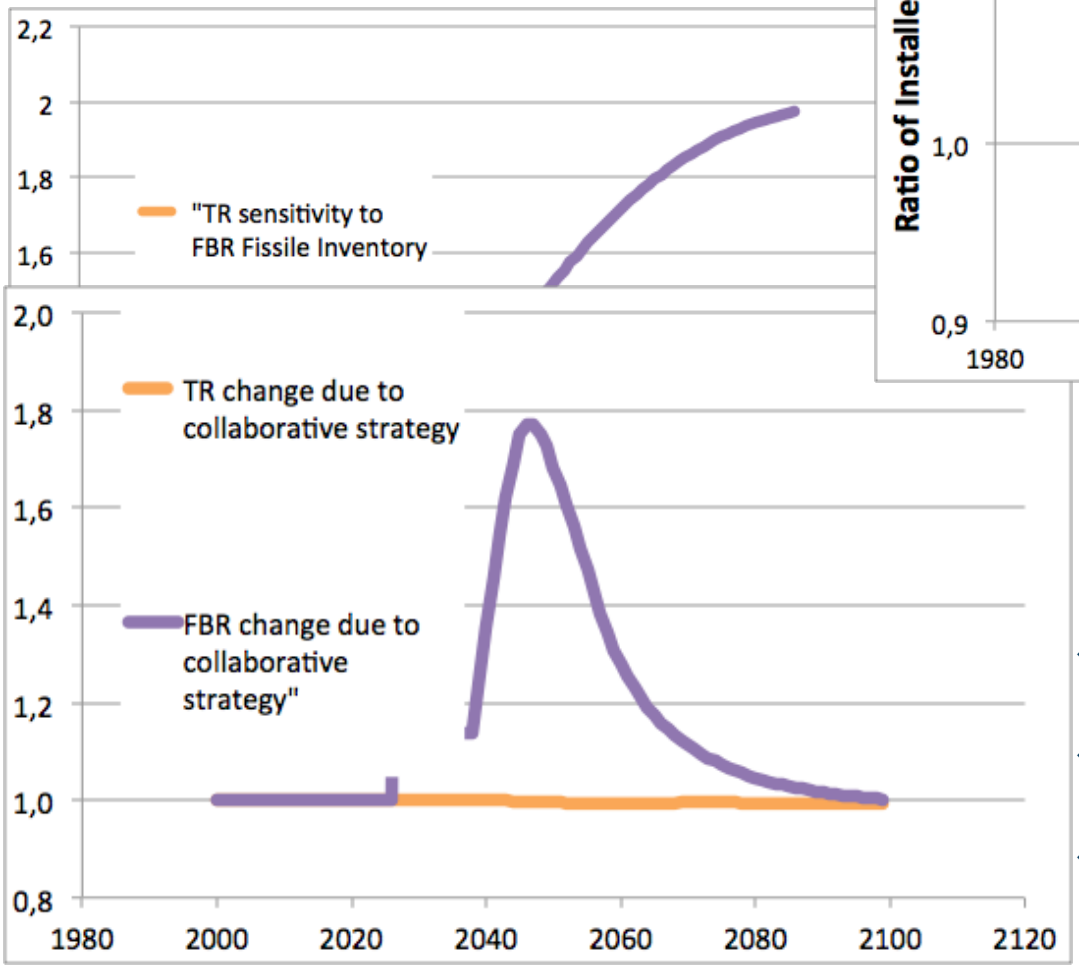
+30 % long term FR (floor costs)

- ➢ Strong long lasting n reduction of FR deployment
- ➢ Very late extra TR

FR physical parameters and synergetic strategies

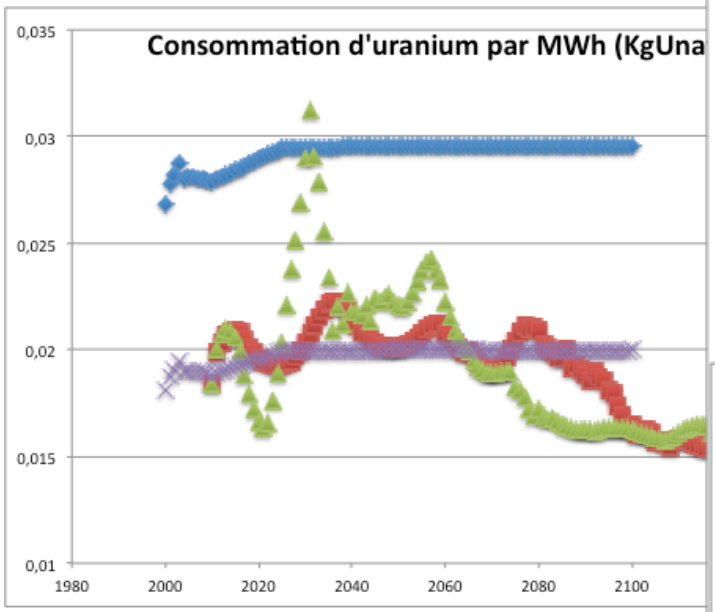
- FR initial inventory halved => FR doubled
- Breeding gain + 5% => FR + 5 %
- TR almost unchanged

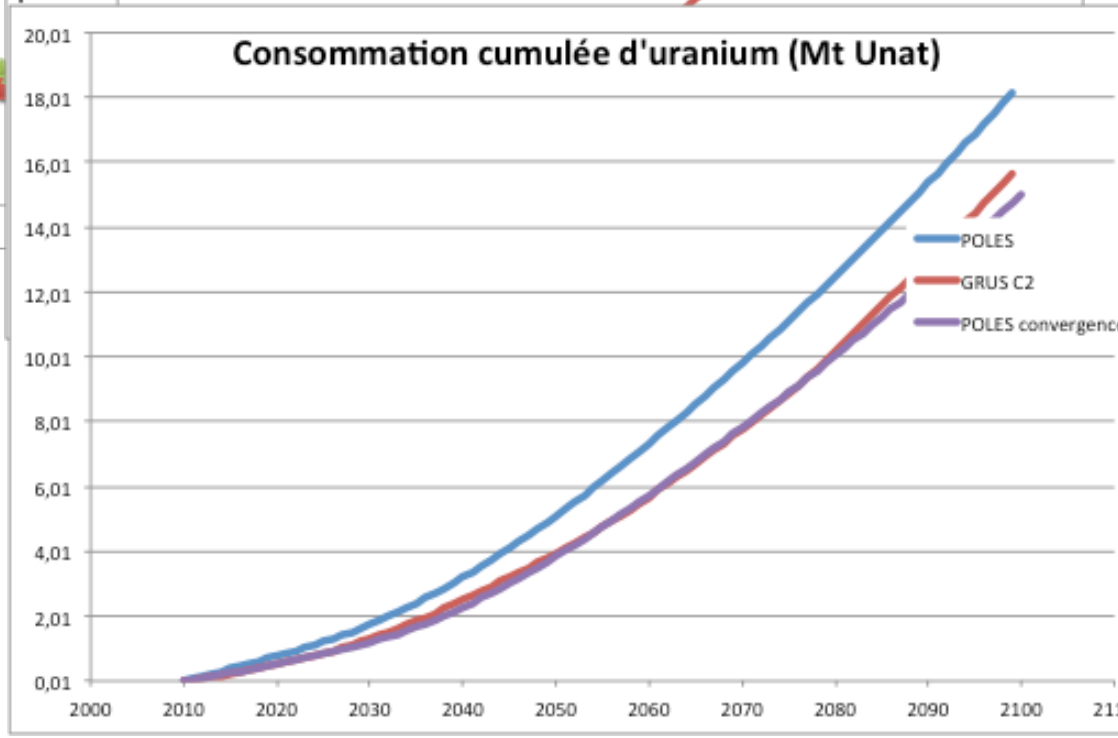




- Synertic scenario : FR have access to a « world TR used fuel bank »
- FR growth rate almost doubled during early deployment phase
- TR almost unchanged

Comparaisons GRUS /POLES





Equivalence des conso moyennes

Trajectoire sortie POLES

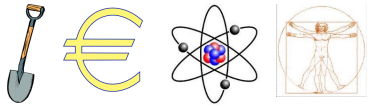
= IIASA C2 = entrée GRUS !

Cohérence des trajectoires
consommation cumulée d'uranium

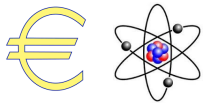
Cohérence équilibre RT / RNR

Conclusions

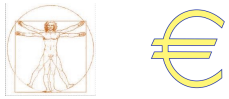
- **Résultats scientifiques**
- Justification Courbe 3D



- Mise en place Courbe 3D + limitations matières POLES

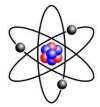


=> Conflit de générations peu évident



Importance hypothèses apprentissages

- Convergence/coherence GRUS (I-TESE) / POLES (EDDEN-PACTE-CNRS)



- **Apport NEEDS**
- « Label » important pour études interdisciplinaires / inter établissements
- Moyens supplémentaires :

Missions (Rencontres / Conférences)

Moyens informatiques (licences / puissance Calculs)

Moyens humain (Stages)

- **Suites**
- Dépot ANR
- Projet Interdisciplinaire sur les Scénarios Electronuclaires (PISE@Nantes)
- PROSPEN Institut Carnot Grenoblois
- NEEDS 2016 ? (Comparaison POLES / OPTIMIX, Suite PISE…)

Merci de votre attention !
Thank you !