Intergenerational Risk Decision Making: A Practical Example

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"No generation should needlessly, now and in the future, deprive its successors of the opportunity to enjoy a quality of life equivalent to its own."

Supporting Principles

- Trusteeship
- Sustainability
- Chain of obligation
- Precaution

No decision can be "final"

but decisions need to be made.

Suggest a "rolling futures" approach with credible intragenerational standards

Repository Approach Proposal

- Design the repository to meet long term disposal to defensible standards
- License the repository for underground storage – completely retrievable
- Monitor post fillup to validate computer performance models
- Decide whether spent fuel is a waste or not prior to closure if acceptable repository
- License for closure based on performance
- If not acceptable, use as underground storage facility until alternative disposal or usage is decided.

Yucca Mountain Example

- Trusteeship – Manage wastes
- Sustainability – use of nuclear to preserve fossil fuels for future generations
- Chain of Obligation – two periods
  - Engineered Barrier Period 1000 years – complete containment
  - Geological Period – PRA for Design to reasonable standards
- Precautionary
  - Load repository
  - Assure real retrievability – entire repository
  - Monitoring – if predictions not valid – keep underground storage – find alternative
- Rolling Future – allow for changes in technology and uses of spent fuel – no perfect 1 million year solution - make standards to assess costs and benefits and alternative uses of money for commensurate reduction of societal risk.

Intergenerational Considerations Affecting the Future of Nuclear Power:
Equity as a Framework for Assessing Fuel Cycles

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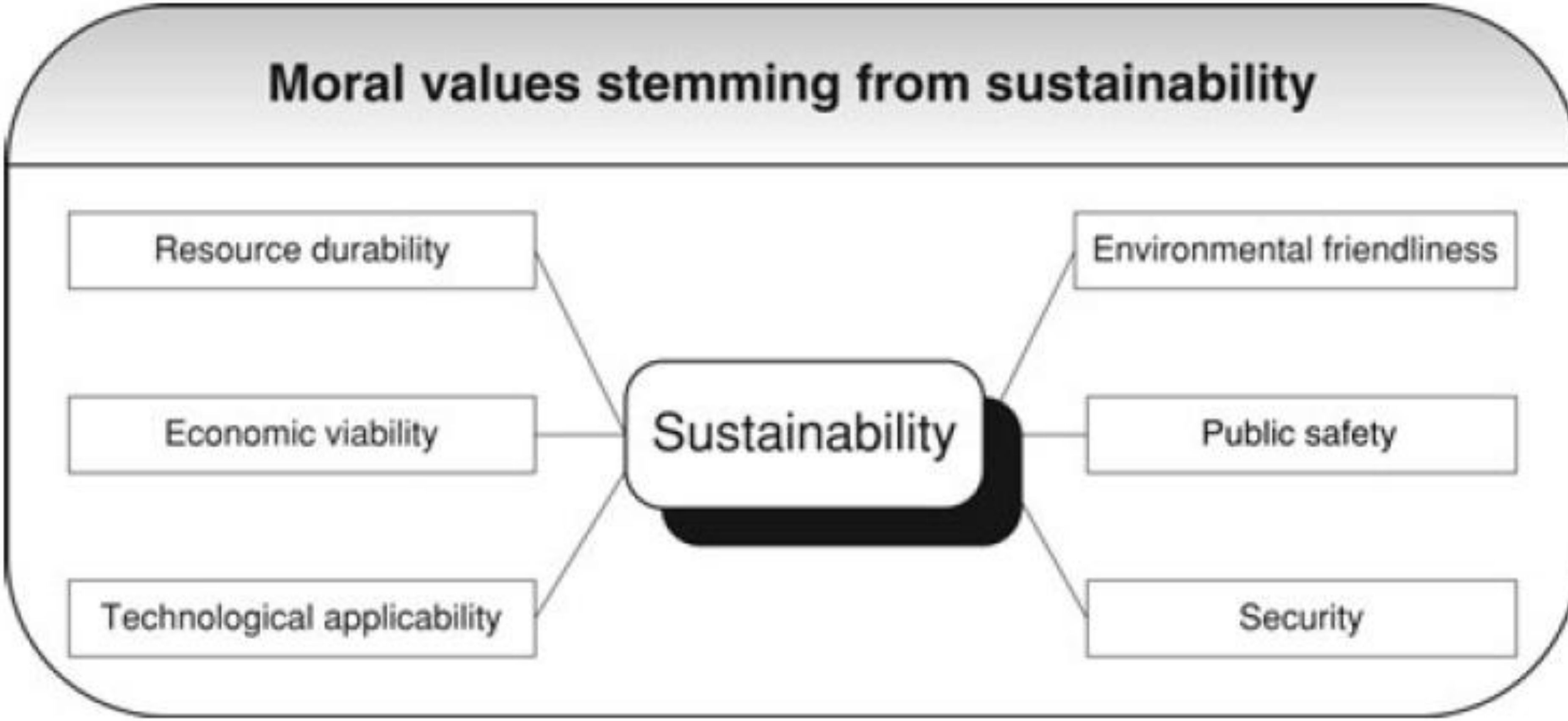
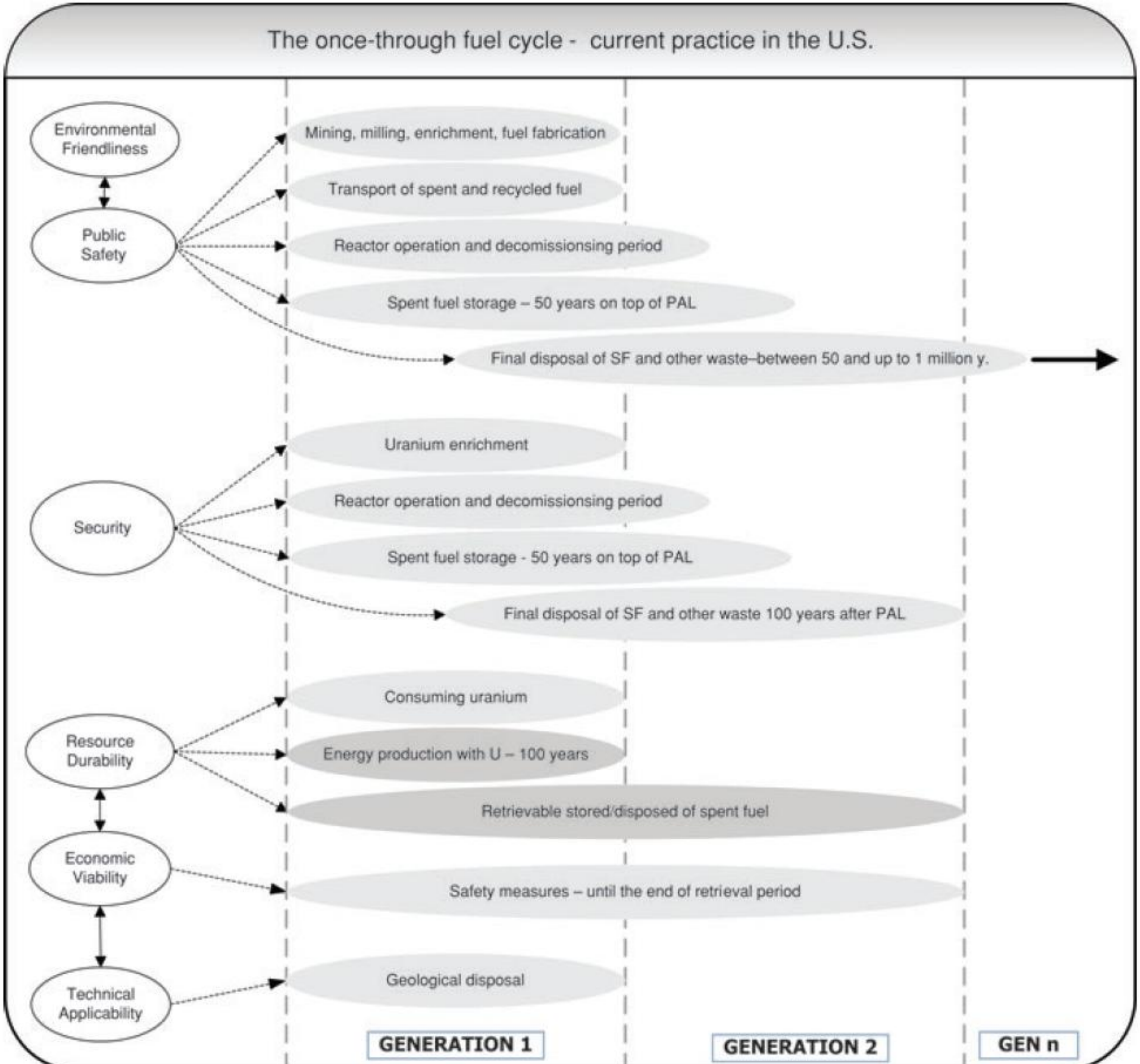
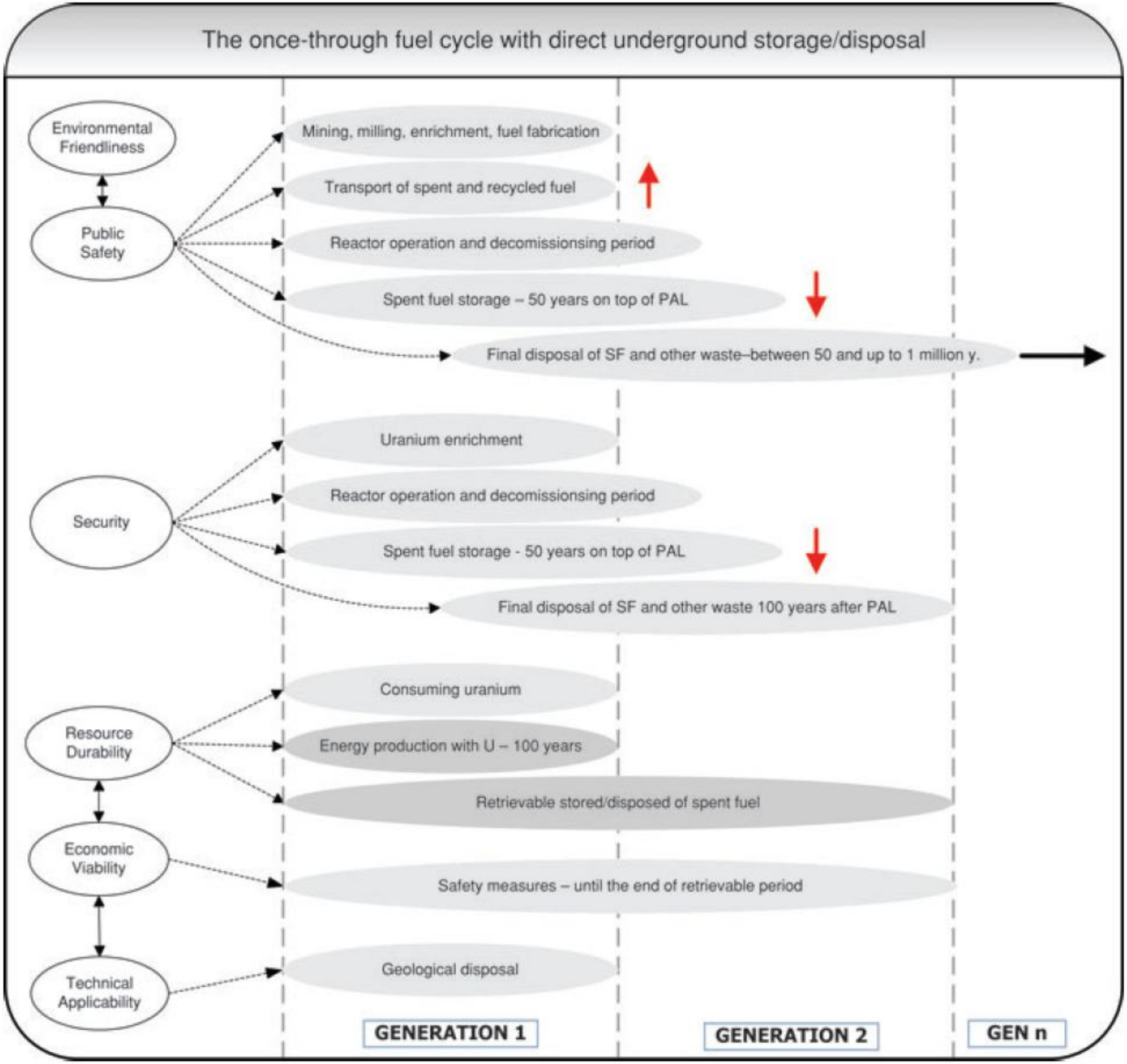


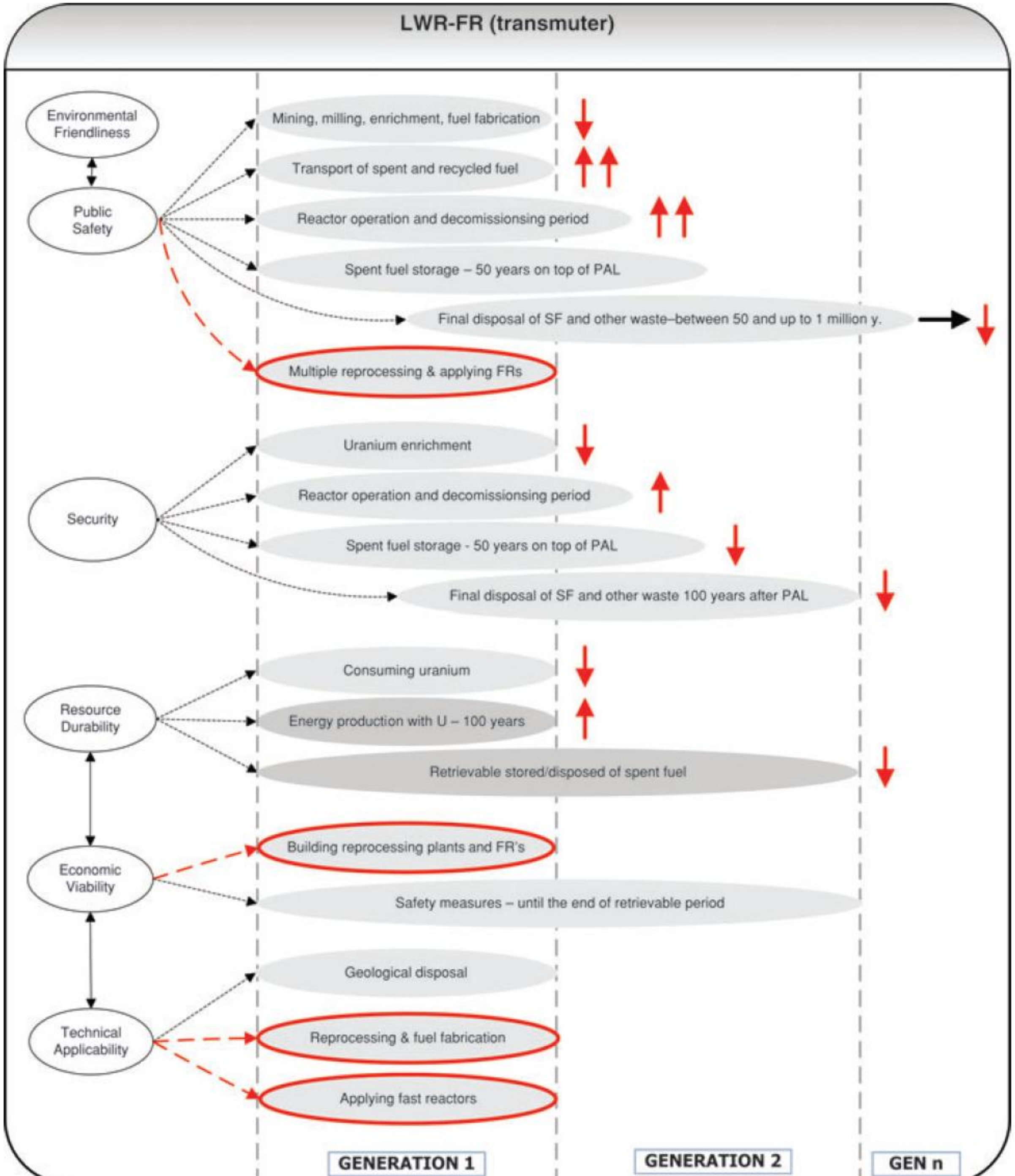
Intergenerational Criteria Defined as a set of Moral Values built around the principle of Sustainability.

They contribute to the environment and humankind's safety, security, and overall welfare of society in terms of sustainability

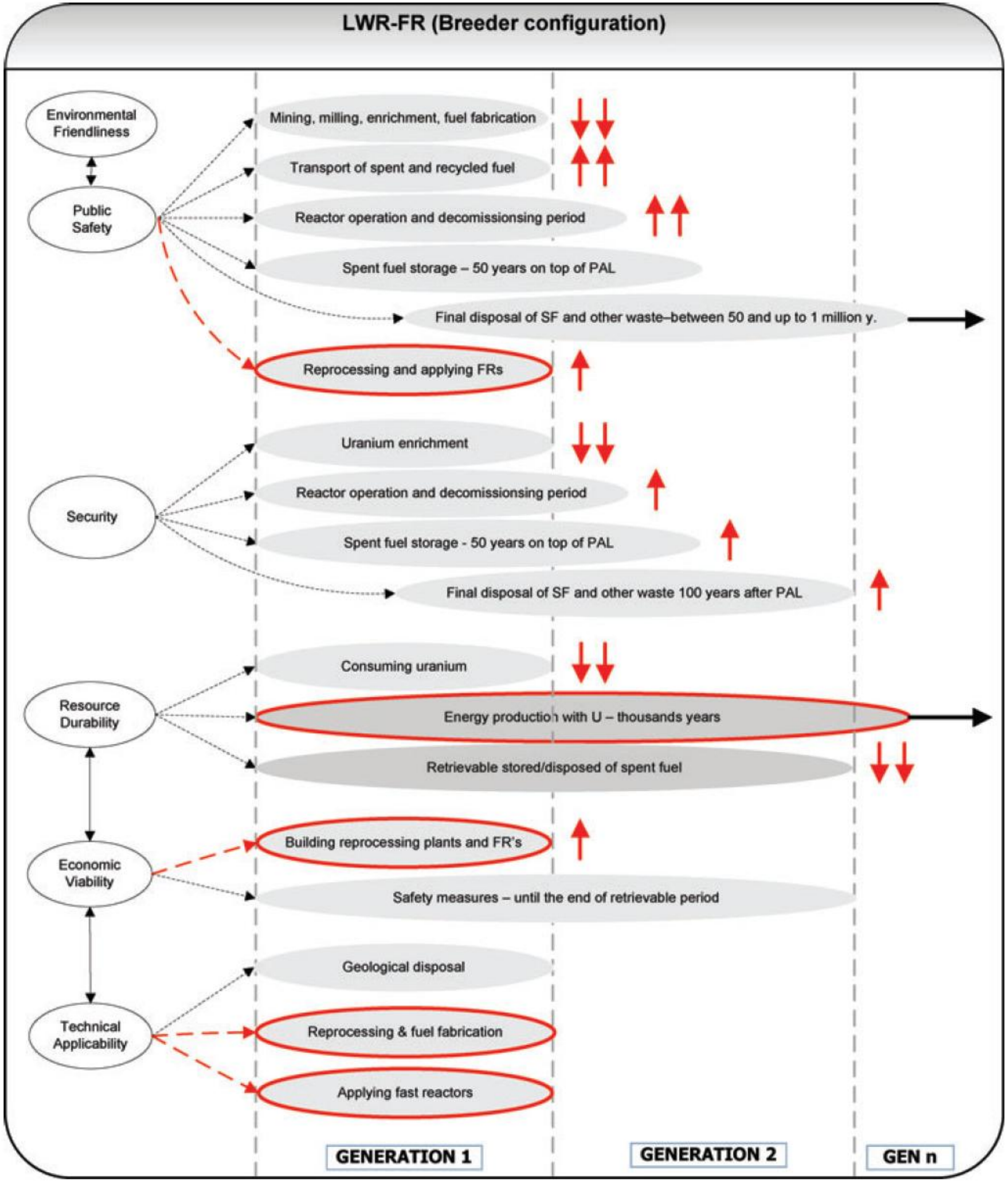

The once-through fuel cycle - current practice in the U.S.
Environmental Friendliness
Public Safety
Security
Resource Durability
Economic Viability
Technical Applicability
Mining, milling, enrichment, fuel fabrication
Transport of spent and recycled fuel
Reactor operation and decomissionsing period
Spent fuel storage – 50 years on top of PAL
Final disposal of SF and other waste–between 50 and up to 1 million y.
Uranium enrichment
Reactor operation and decomissionsing period
Spent fuel storage - 50 years on top of PAL
Final disposal of SF and other waste 100 years after PAL
Consuming uranium
Energy production with U – 100 years
Retrievable stored/disposed of spent fuel
Safety measures – until the end of retrieval period
Geological disposal
GENERATION 1
GENERATION 2
GEN n



The once-through fuel cycle with direct underground storage/disposal
Environmental Friendliness
Public Safety
Mining, milling, enrichment, fuel fabrication
Transport of spent and recycled fuel
Reactor operation and decomissionsing period
Spent fuel storage – 50 years on top of PAL
Final disposal of SF and other waste–between 50 and up to 1 million y.
Security
Uranium enrichment
Reactor operation and decomissionsing period
Spent fuel storage - 50 years on top of PAL
Final disposal of SF and other waste 100 years after PAL
Resource Durability
Economic Viability
Technical Applicability
Consuming uranium
Energy production with U – 100 years
Retrievable stored/disposed of spent fuel
Safety measures – until the end of retrievable period
Geological disposal
GENERATION 1
GENERATION 2
GEN n



LWR-FR (transmuter)
Environmental Friendliness
Public Safety
Mining, milling, enrichment, fuel fabrication
Transport of spent and recycled fuel
Reactor operation and decomissionsing period
Spent fuel storage – 50 years on top of PAL
Final disposal of SF and other waste–between 50 and up to 1 million y.
Multiple reprocessing & applying FRs
Security
Uranium enrichment
Reactor operation and decomissionsing period
Spent fuel storage - 50 years on top of PAL
Final disposal of SF and other waste 100 years after PAL
Resource Durability
Consuming uranium
Energy production with U – 100 years
Retrievable stored/disposed of spent fuel
Economic Viability
Building reprocessing plants and FR's
Safety measures – until the end of retrievable period
Technical Applicability
Geological disposal
Reprocessing & fuel fabrication
Applying fast reactors
GENERATION 1
GENERATION 2
GEN n


LWR-FR (Breeder configuration)
Environmental Friendliness
Public Safety
Mining, milling, enrichment, fuel fabrication
Transport of spent and recycled fuel
Reactor operation and decomissionsing period
Spent fuel storage – 50 years on top of PAL
Final disposal of SF and other waste–between 50 and up to 1 million y.
Reprocessing and applying FRs
Security
Uranium enrichment
Reactor operation and decomissionsing period
Spent fuel storage - 50 years on top of PAL
Final disposal of SF and other waste 100 years after PAL
Resource Durability
Consuming uranium
Energy production with U – thousands years
Retrievable stored/disposed of spent fuel
Economic Viability
Building reprocessing plants and FR's
Safety measures – until the end of retrievable period
Technical Applicability
Geological disposal
Reprocessing & fuel fabrication
Applying fast reactors
GENERATION 1
GENERATION 2
GEN n

APPENDIX: SCORECARD AND EXPLANATION OF IMPACTS AND RANKINGS

IMPACTS	ALTERNATIVES							
	Current Practice		Direct Storage		Trnasmuter		LWR-FR (Breeder)	
	Gen 1	Gen 2-n	Gen 1	Gen 2-n	Gen 1	Gen 2-n	Gen 1	Gen 2-n
Environmental Friendliness/Public Safety								
Mining, milling, enrichment, fuel fabrication	High		High		Medium		Low	
Transport of spent and recycled fuel	Low		Medium		High		High	
Reactor operation and decommissioning period	Low	Low	Low	Low	High	High	High	High
Spent fuel storage	High	High	Low	Low	High	High	High	High
Final disposal of spent fuel and other waste	Indifferent	High	Indifferent	High	Indifferent	Low	Indifferent	High
Reprocessing – applying fast reactors	×		×		Indifferent		Indifferent	
Security								
Uranium enrichment	High		High		Medium		Low	
Reactor operation and decommissioning period	Low	Low	Low	Low	High	High	High	High
Spent fuel storage	Medium	Medium	Low	Low	Low	Low	High	High
Final disposal of spent fuel and other waste	Medium	Medium	Medium	Medium	Low	Low	High	High
Reprocessing – applying fast reactors	×		×		Medium		High	
Resourse Durability								
Consuming uranium	High		High		Medium		Low	
Energy production with uranium (benefit)	Low	Low	Low	Low	Medium	Medium	High	High
Retrievable stored/ disposed of spent fuel (benefit)	High	High	High	High	Medium	Medium	Low	Low
Economic Viability								
Safety measures costs until the end of retrieval	Indifferent	Indifferent	Indifferent	Indifferent	Indifferent	Indifferent	Indifferent	Indifferent
Building reprocessing plants and fast reactors	×		×		medium		High	
Technological Applicability								
Geological disposal	Indifferent		Indifferent		Indifferent		Indifferent	
Applying reprocessing and fuel fabrication	×		×		High		High	
Applying fast reactors	×		×		High		High	

Legend

Least Favorable

Intermediate/Indifferent

Most Favorable