Sustainability: one more decision making element

Image: https://www.initial.co.uk/about-initial-hygiene/sustainability/

Valeria Cuccia

Nuclear Tecnology Development Center (CDTN), Brazil

March, 2023

CENTRO DE DESENVOLVIMENTO DA TECNOLOGIA NUCLEAR

Nuclear Technology Development Center

Research center of the Nuclear National Commission – CNEN - Brazil

Nuclear Technology

- *Neutrons and gamma irradiations*
- Radioactive tracers applications

Mineral

- Mineral Optimization Processes
- Study of Fluid and Minerals Inclusions

Materials Science

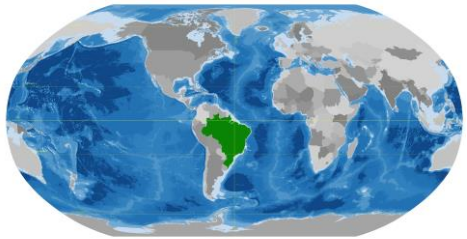
- Nuclear Fuel
- *Nanotechnology*
- Structural Integrity

Health

- Health Physics
- Radiobiology
- Radiation Metrology

Environment

- *Radioactive Tracers*
- Aquifers Characterization



Postgraduate courses

- M.Sc. And D.Sc. - Radiations, Minerals and Materials
- Specialization *lato sensu* – Waste Management

Nuclear and Radiological Safety

- Radioactive Waste Management
- Emergency Response
- Training in Radiation Protection
- Routine Radiation Monitoring
- Nuclear Safeguard

Main team for LCA


Cuccia, V.


Almeida, R.S.S.P.


Castro, L.


Alcântara, P.


Santos, Y.


Freire, C.B.

Rio 92 Declaration to COP 27

COP 1- 1995

1997 – Kyoto protocol

Nuclear Energy:

option for less greenhouse gases

What about other radioactive applications and radioactive waste management?

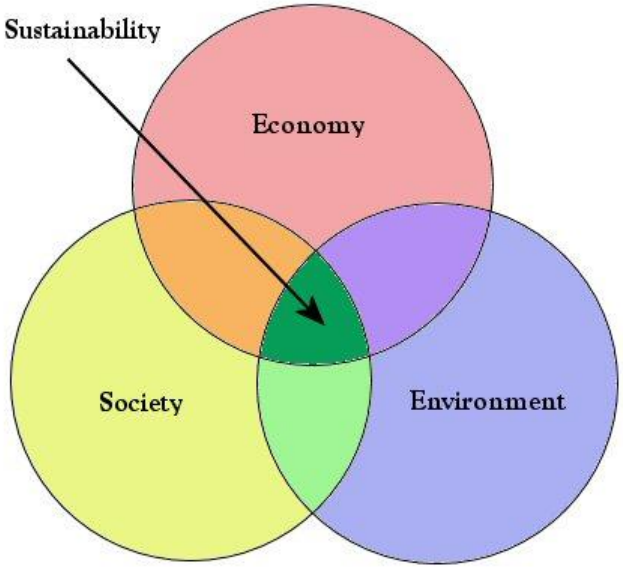
Source: Goody, Sarah. https://redwoodbark.org/76370/news/cop27-outcome-disappoints-local-youth-activists/

What is Sustainability?

Sustainability is a societal goal that relates to the ability of people to safely co-exist on Earth over a long time. (Wikipedia)

Meeting our own needs without compromising the ability of future generations to meet their own needs (UN Documents).

Sustainability is not just environmentalism.
Concerns for social equity and economic development.



Source: https://en.wikipedia.org/wiki/Sustainability

Sustainability and Radiation Protection

Fundamental Safety Principles IAEA

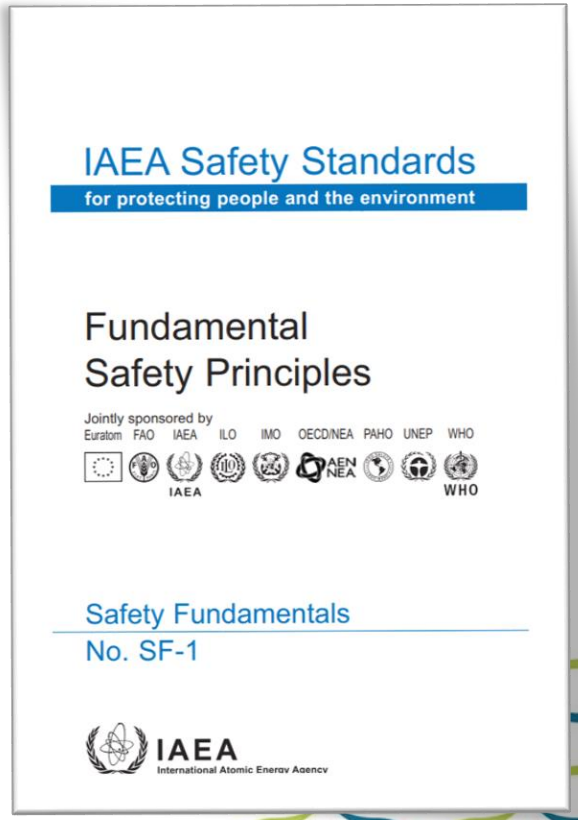
Principle 5: Optimization of protection

Protection must be optimized to provide the highest level of safety that can reasonably be achieved.

Principle 7: Protection of present and future generations

People and the environment, present and future, must be protected against radiation risks.

(Safety Fundamentals No. SF-1, 2006)



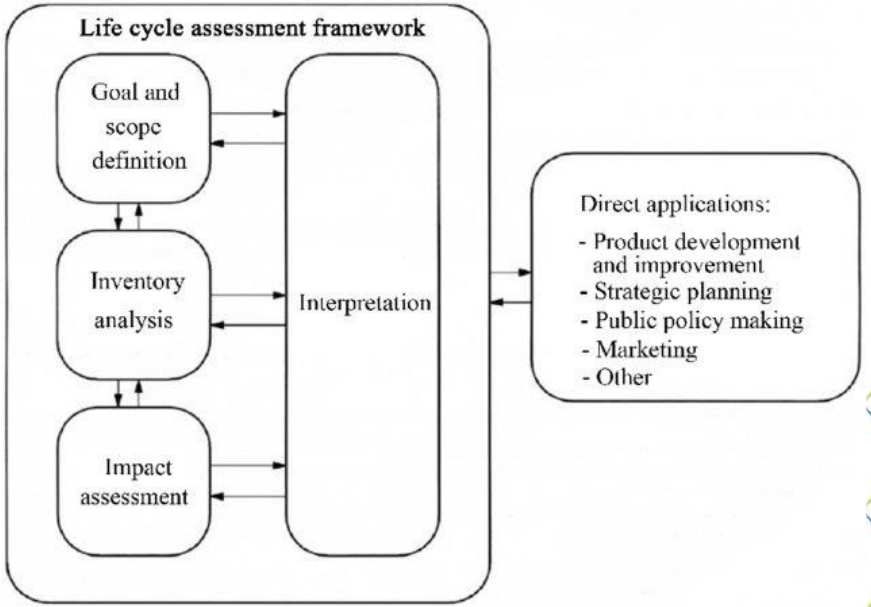
How can we adress sustainability?

- LCA – Life Cycle Assessment (methodology)
- ISO 14040: compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.

European Commission proposed the Product Environmental Footprint (PEF) and Organisation Environmental Footprint (EF)

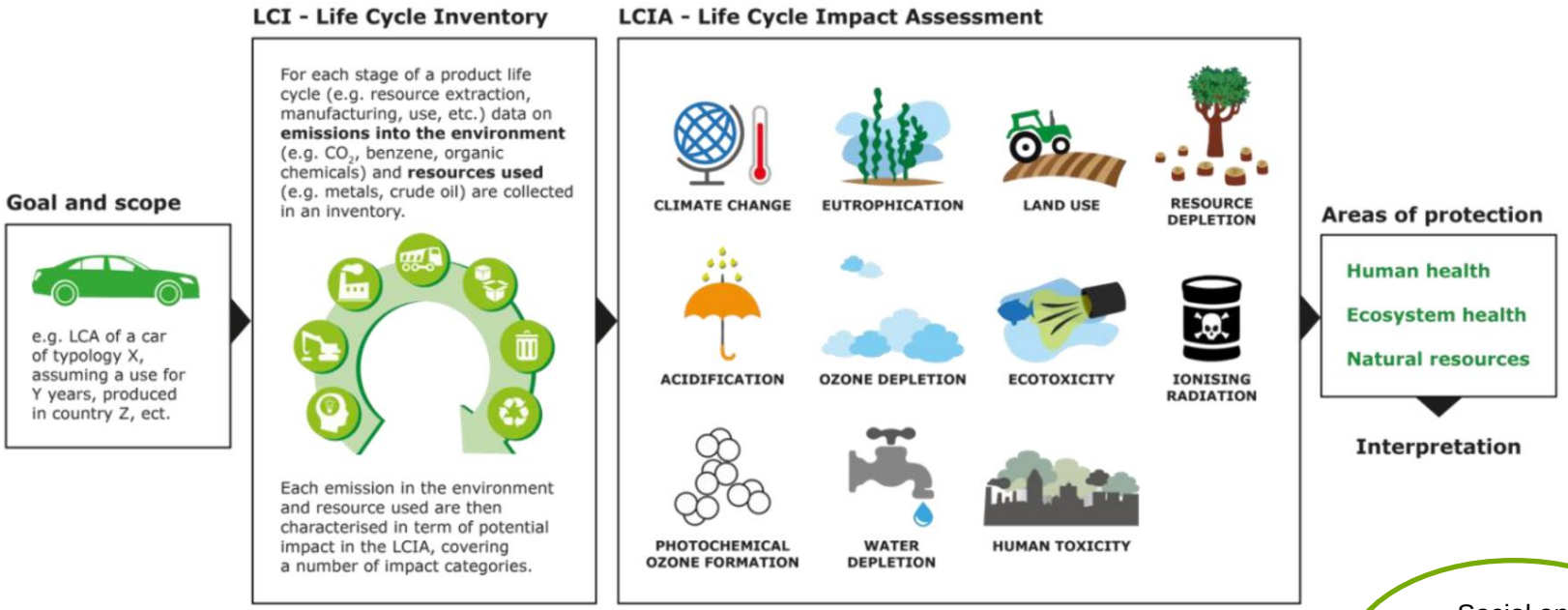
#Atoms4Climate COP27 pavilion:

LCA cited by a pannelist as a methodology to show that nuclear Energy in already constructed plants is a low carb energy source.



Source: ISO 14040: 2006

Life Cycle Assessment (LCA)



Source: European Commission. https://eplca.jrc.ec.europa.eu/lifecycleassessment.html

Social and economic impacts may be evaluated LCS and LCC

Software usage in Life Cycle Assessment

- Extremely popular
- Provide a complete analysis of the ecological footprint in a short time.

Notable Softwares

SimaPro
Developed by PRé Sustainability

OpenLCA
open source and free software

GaBi
Sphera's Product Sustainability (GaBi)

Notable Databases

ecoinvent:
contains more than 18,000 datasets, modelling human activities or processes.

AGRIBALYSE:
French LCI database for the agriculture and food sector. For imported products, Agribalyse 3.1 relies on ecoinvent and WFLDB data.

Carbon Minds:
environmental assessment of chemicals and plastics.

First approaches applying Life Cycle Assessment to radioactive waste management

Example 1: Cuccia, V; Almeida, R; Castro, L; Freire, C.

Geopolymer x cement for radioactive waste immobilization

Cement:

- consolidated for radwaste immobilization
- Elevated footprint and CO_2 emmissions

Cement

Geopolymer

Geopolymer:

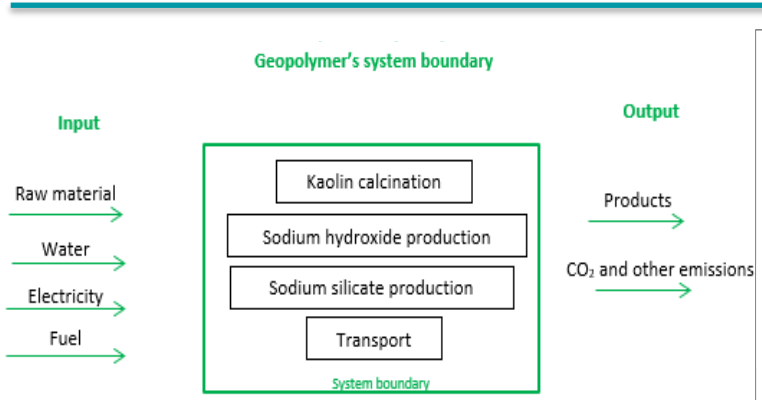
- Sinthesis with no heating: less emission of greenhouse gases
- Good mechanical properties; resistance to fire and acids.
- Can be produced from waste material reducing ecological footprint

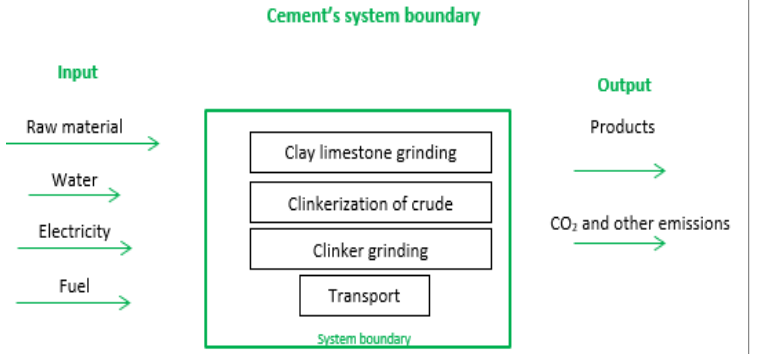
In the literature, comparisons using LCA, considering only climate change, not applied to radwaste immobilization

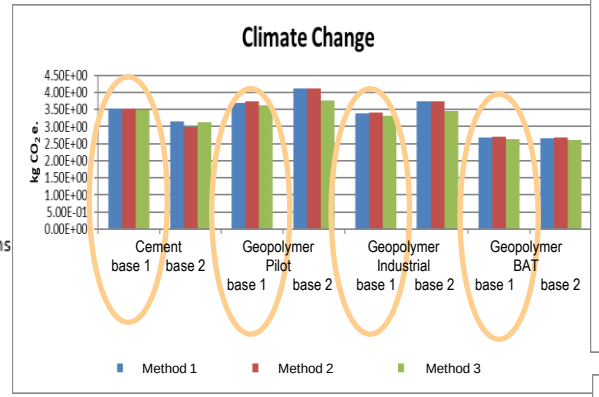
Comparison of sustainability aspects - LCA

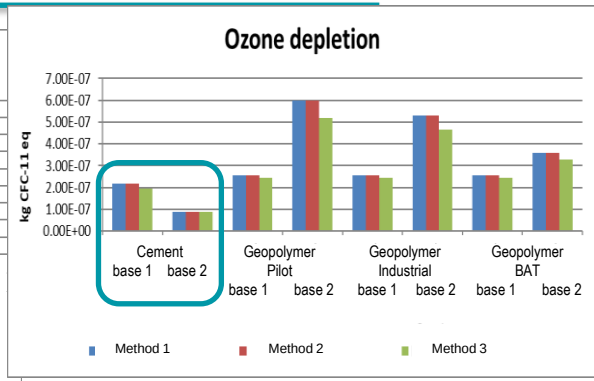
Geopolymer x cement for waste immobilization

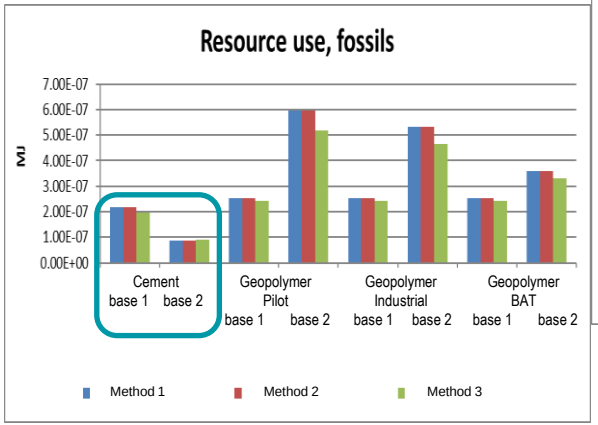
Preliminary results

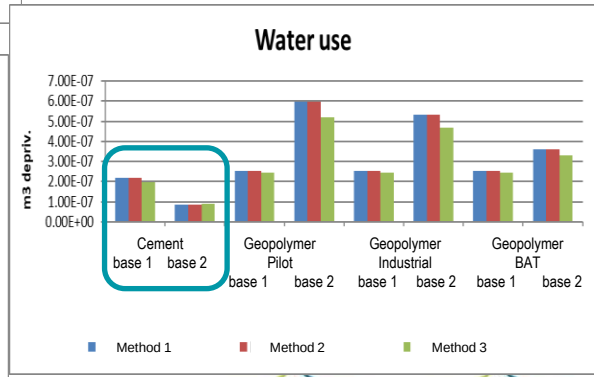












Working on geopolymers formulas or reagents

First approaches applying Life Cycle Assessment to radioactive waste management

Example 2: Cuccia, V; Almeida, R; Alcântara, P.

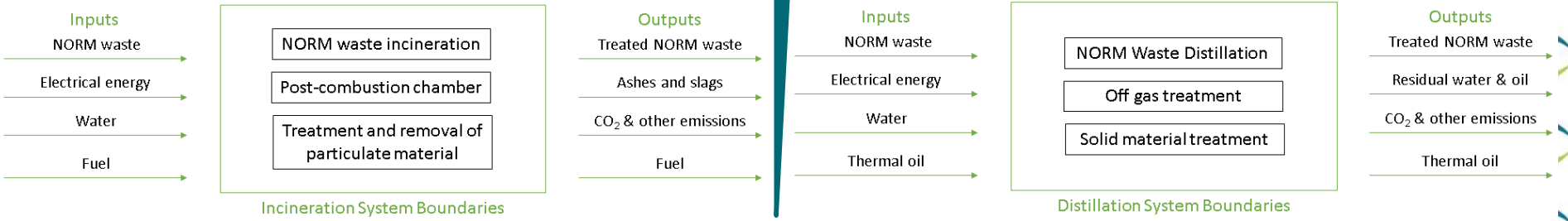
Thermal treatments for NORM waste from Oil & gas industry

Incineration

Source: https://tecamgroup.com/takreer-and-intecsa-industrial-trust-tecam-environmental-technology-for-first-project-worldwide-for-norm-waste-incineration/

Vacuum distillation

Source: https://recyclinginside.com/vacudry-oily-waste-recycling-in-the-21st-century/

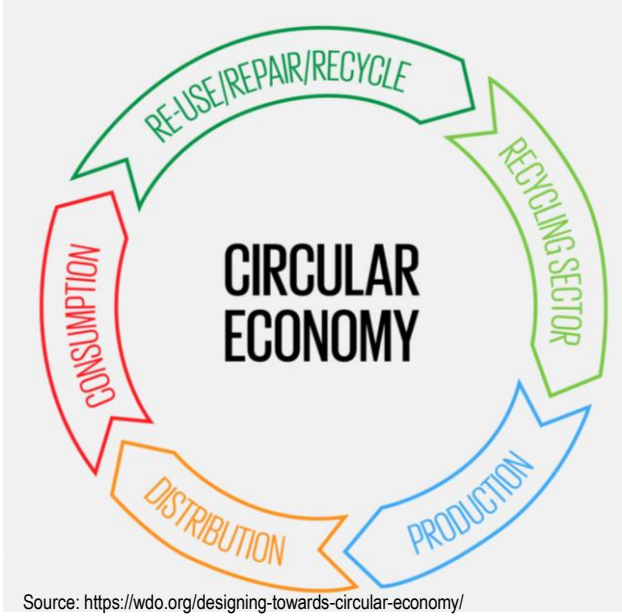


Sustainability for radioactive waste management

Where sustainability concepts might be applyed?

- Generation of waste (Justification)
- Pre treatment
- Treatment – immobilization
- Disposal

From cradle to grave?



Source: https://wdo.org/designing-towards-circular-economy/

Source: https://scientificpakistan.com/chemistry/what-is-green-chemistry/

Final Considerations

- Environmental and social aspects must be part of a multicriteria decision making
- Important to have a methodology to prove that the sustainability is adressed in a cientific manner – transparency, realiability

Is adressing sustainability important for the nuclear area?

The conference will be an oportunity for this essencial discussion!

Source: https://schoolsweek.co.uk/what-do-schools-need-to-embed-sustainability/

Thank you!

Image: https://www.lucksyardclinic.com/sustainability-and-our-children-a-parents-purpose/

vc@cdtn.br
www.cdtn.br