

Building technical and public confidence in geological disposal

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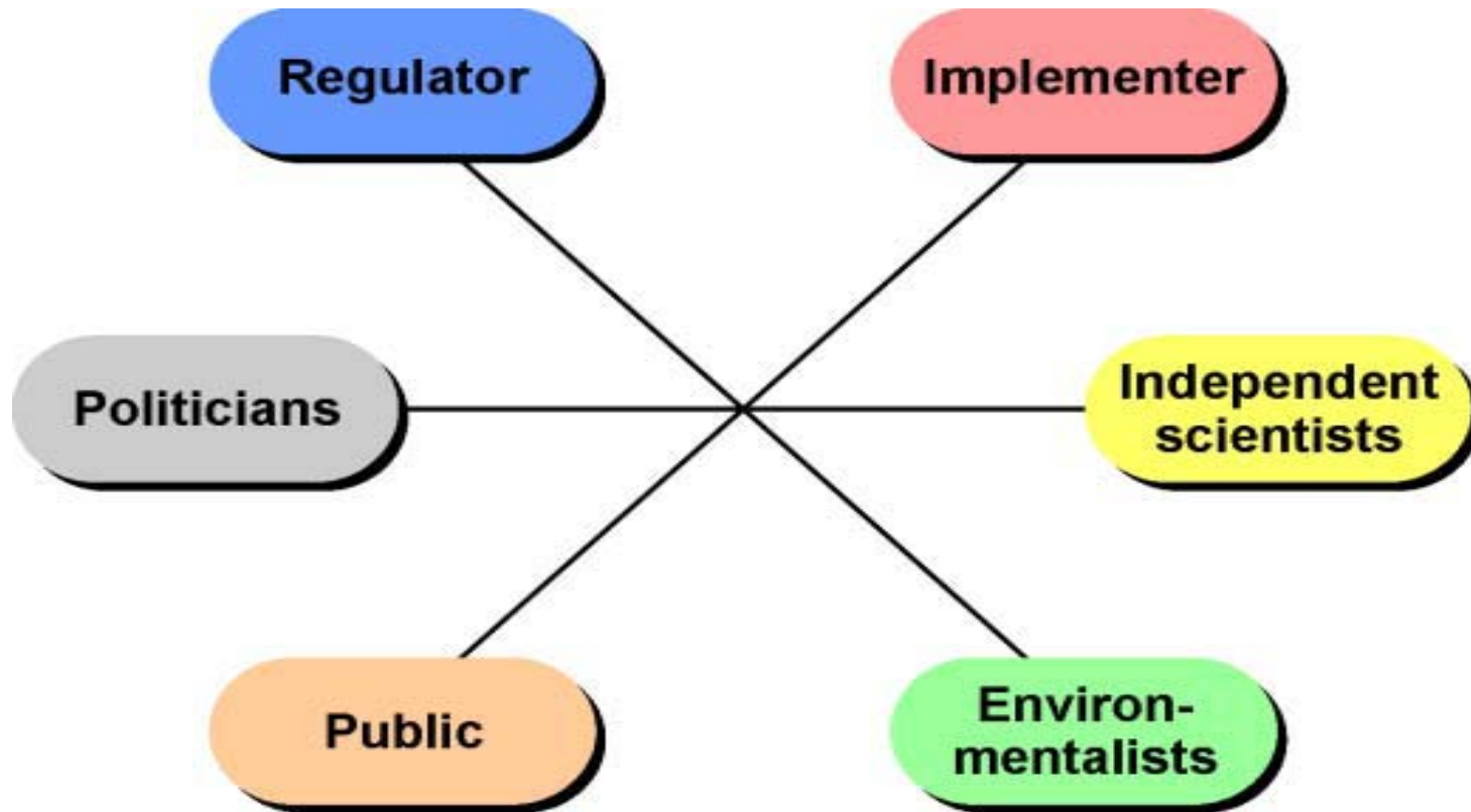
Outline of presentation

- **What is confidence?**
- **Technical aspects**
- **Societal aspects**
- **The challenge of siting**
- **Conclusions**

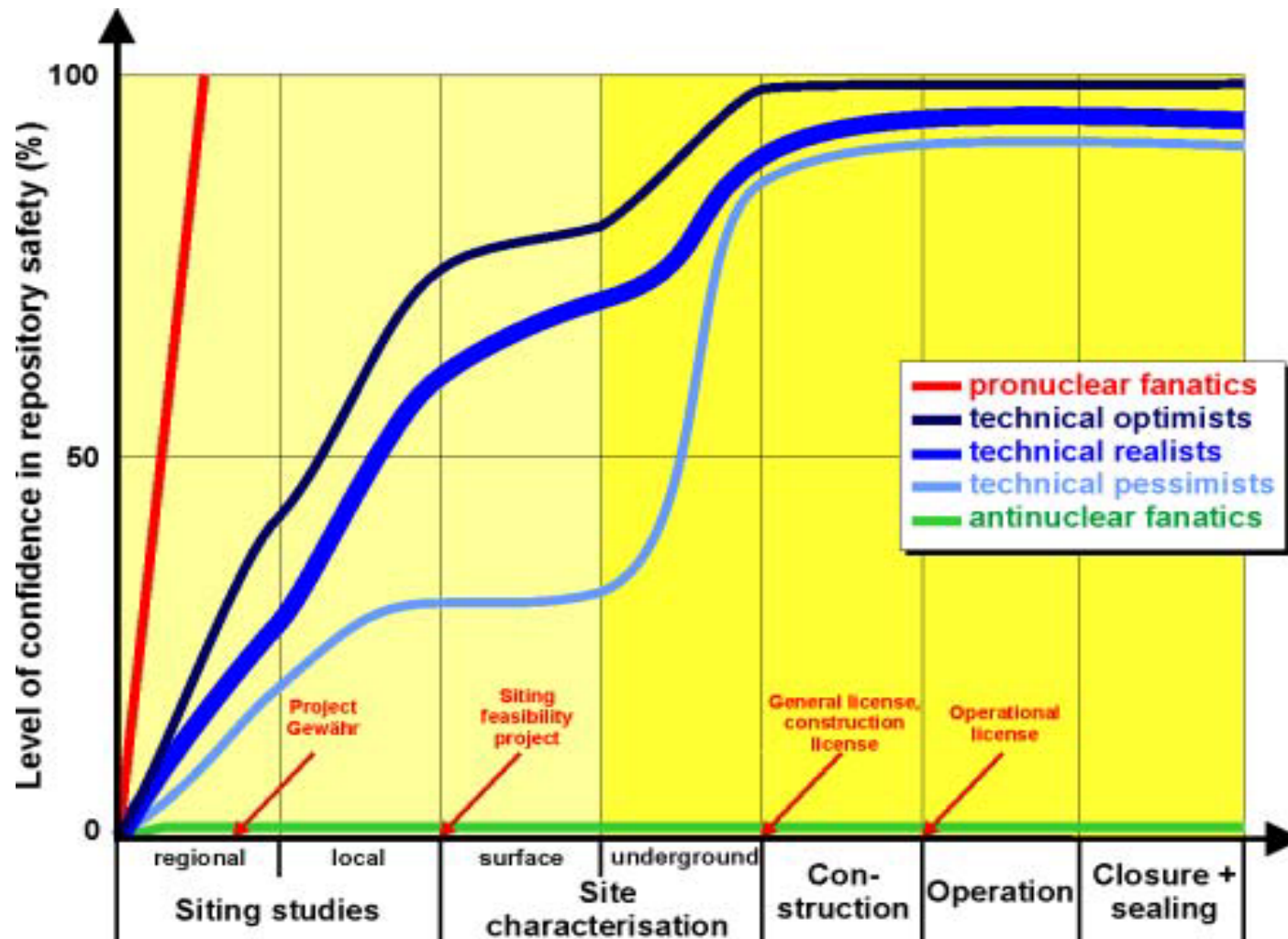
Confidence

- The goal is a **sufficiently** broad consensus that one can implement a safe repository
- Confidence is needed in:
 - ❑ the product – i.e. the repository
 - ❑ the process – i.e. how to get there
 - ❑ the responsible people – i.e. implementers and regulators
- Many stakeholders are involved ...

A multitude of stakeholders



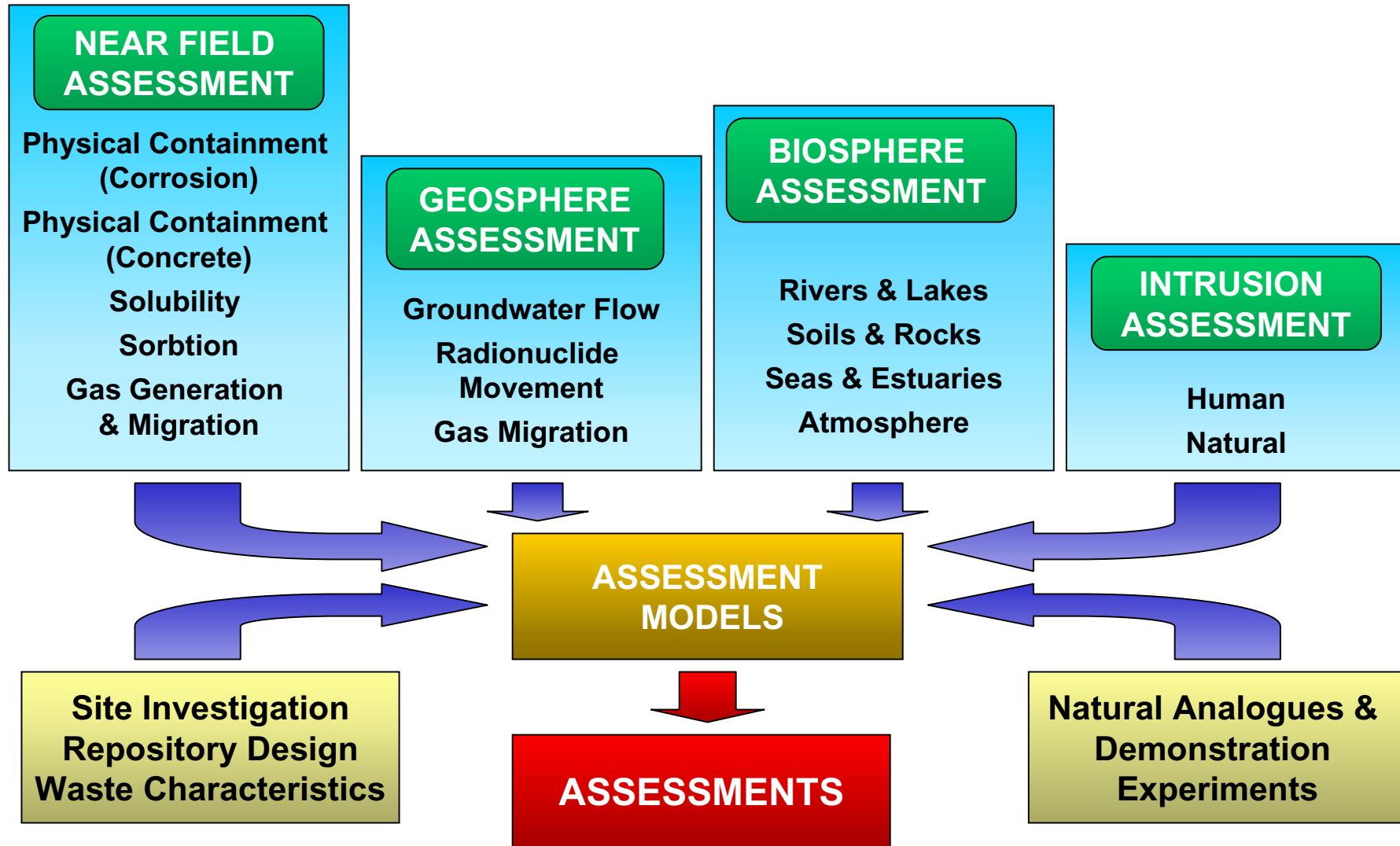
Growth in confidence of different groups



Timescales...

- **30 years since serious work began**
- **10 – 50 years to implementation of 1st HLW repositories**
- **50 – 300y of operation; inspection**
- **10 – 500y of institutional control**
- **Over 100'000y hazardous lifetime**

Science in Radwaste Disposal Assessment



What ensures technical confidence - 1

- ➔ **A consensus in the technical community that the system is sufficiently well understood to quantify the ways in which it can evolve with time**

What ensures technical confidence - 2

- ➔ **Reliable estimates**, under all reasonably conceivable future developments, that humans and the environment will be adequately protected now and at all future times

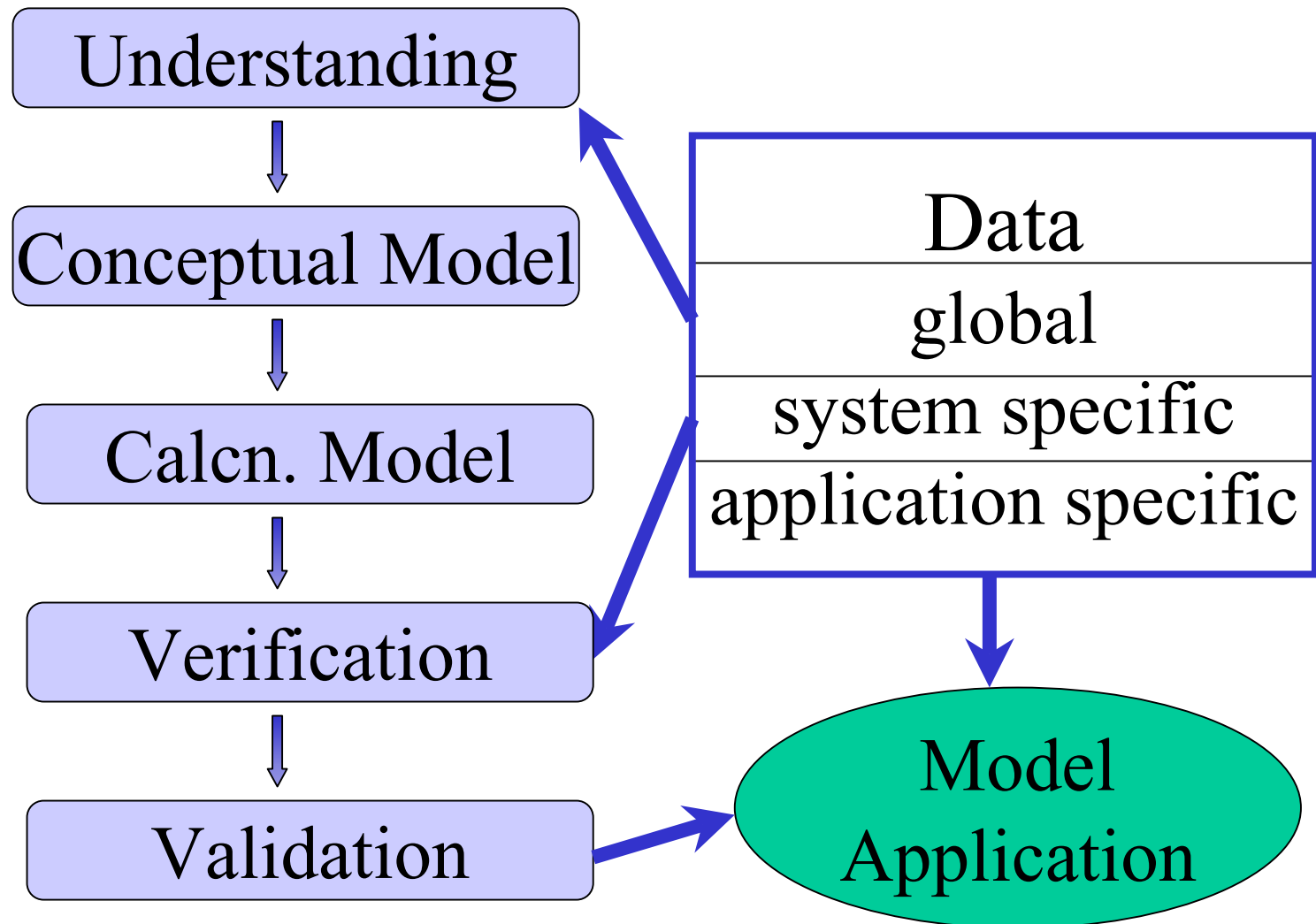
Why is safety analysis feasible? 1/2

- the **laws of natural science** which govern key processes do not change with time
- the **geological database** extends over longer timescales than the toxic lifetimes of most wastes

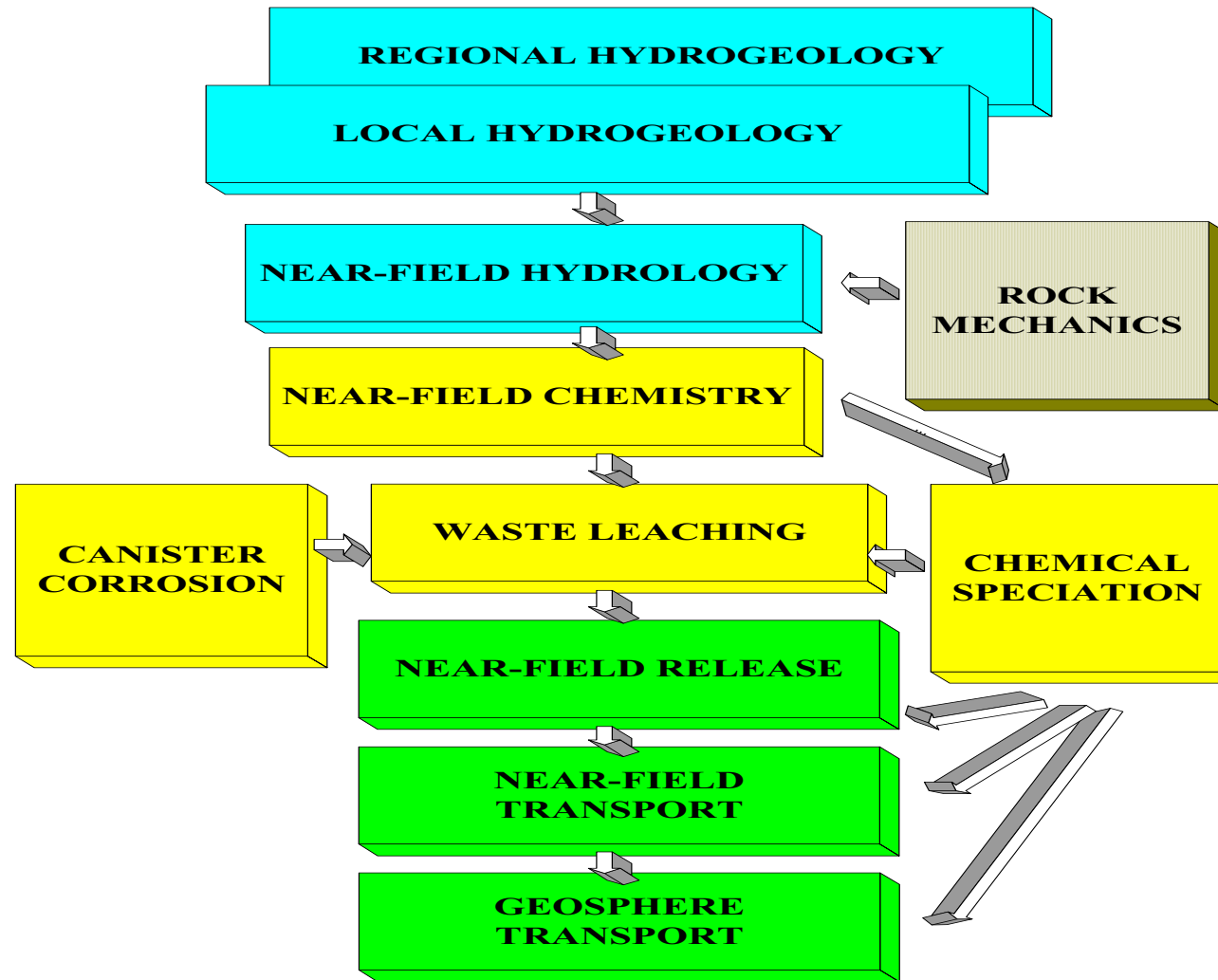
Why is safety analysis feasible? 2/2

- **accurate** predictions of actual system behaviour are not required; it suffices to provide conservative estimates
- **precise** estimates are not needed; even with some orders of magnitude of residual uncertainty we may be clearly within defined safety goals or limits.

Modelling the System



TYPICAL MODELLING CHAIN FOR SAFETY ANALYSES



Validation: key elements

- **Laboratory experiments**
- **Field experiments**
- **Natural analogues**
- **Peer review**

FEBEX

**Full-scale
engineered
barrier
expt.**

**Grimsel
Switzerland**



Natural analogues

can play an important role in explaining some of the essential components of the safety case.



Bison Painting

Altamira, Spain- 14000years old



Confidence in Deep Geologic Disposal can be built up by: (NEA)

- **Development of detailed repository concepts**
- **Improved understanding through site characterisation and R&D**
- **The demonstration of the safety through rigorous safety-assessment methods**
- **Independent review by national and international groups of experts**
- **The development, and in some cases demonstration, of technologies**

Collective Opinions of the RWMC

- ➔ **1985: Geologic disposal can provide long-term safety**
- ➔ **1991: Methodologies exist for adequately assessing the long-term safety of geologic repositories**
- ➔ **1995: Geologic disposal is ethically and environmentally justifiable**

..... all “expert” opinions (in wrong order!)

.... and the public?

Acceptance of Geologic Disposal Concept



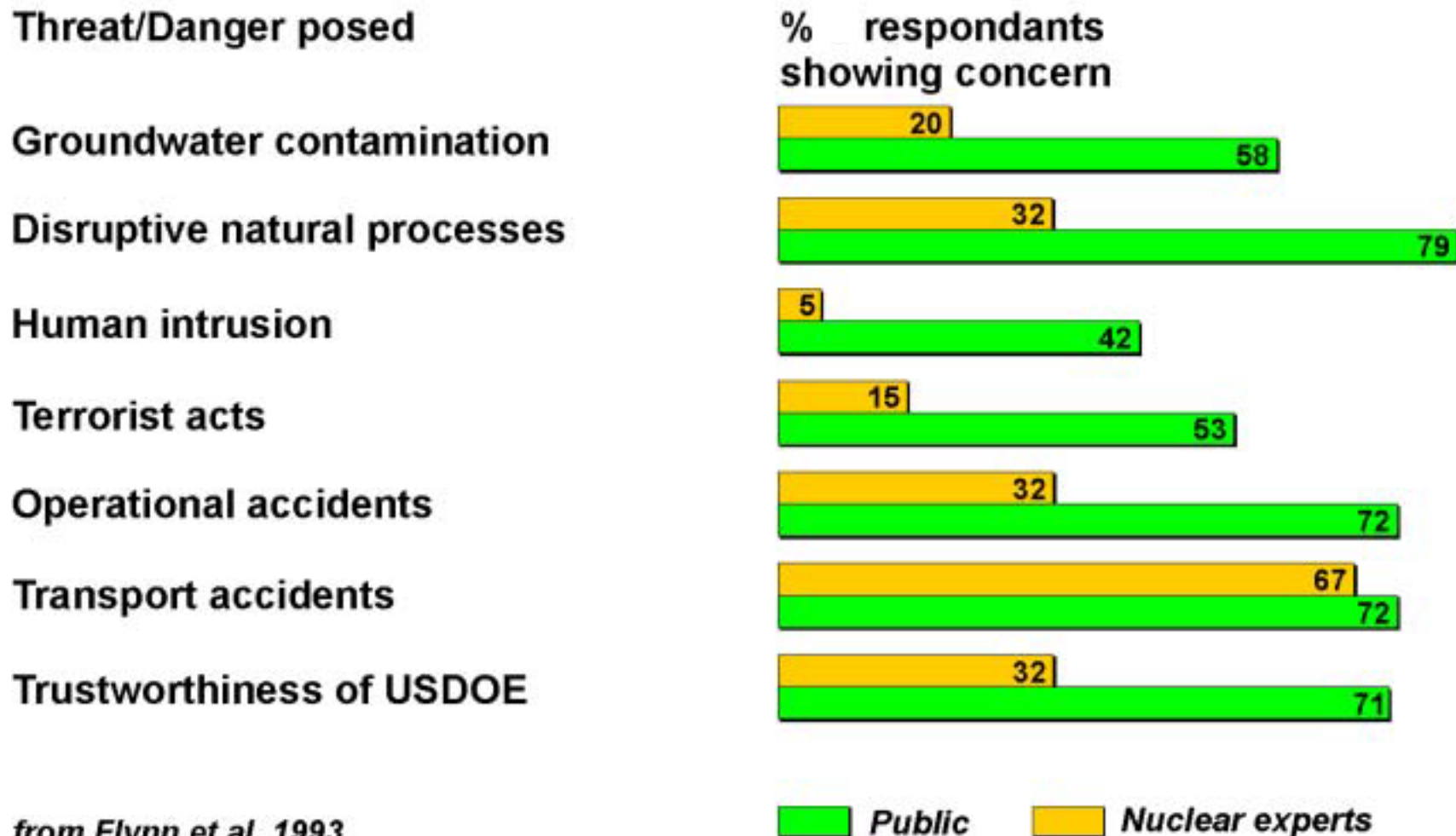
By the public/politicians

- Widespread scepticism (timescales!)
- Emotional rather than factual debate
- Less political support (NL, UK, CAN)
- Increased support for storage
- Desire for monitoring/retrieval
- NIMBY at national and international scales
- Doubts remain on **safety** of disposal

What ensures public confidence?

- **Open access** to all important information
- **Trust** that the waste community will perform high quality and honest work
- **Belief** that a repository will be "**safe for all time**"

Perception of risks in waste disposal

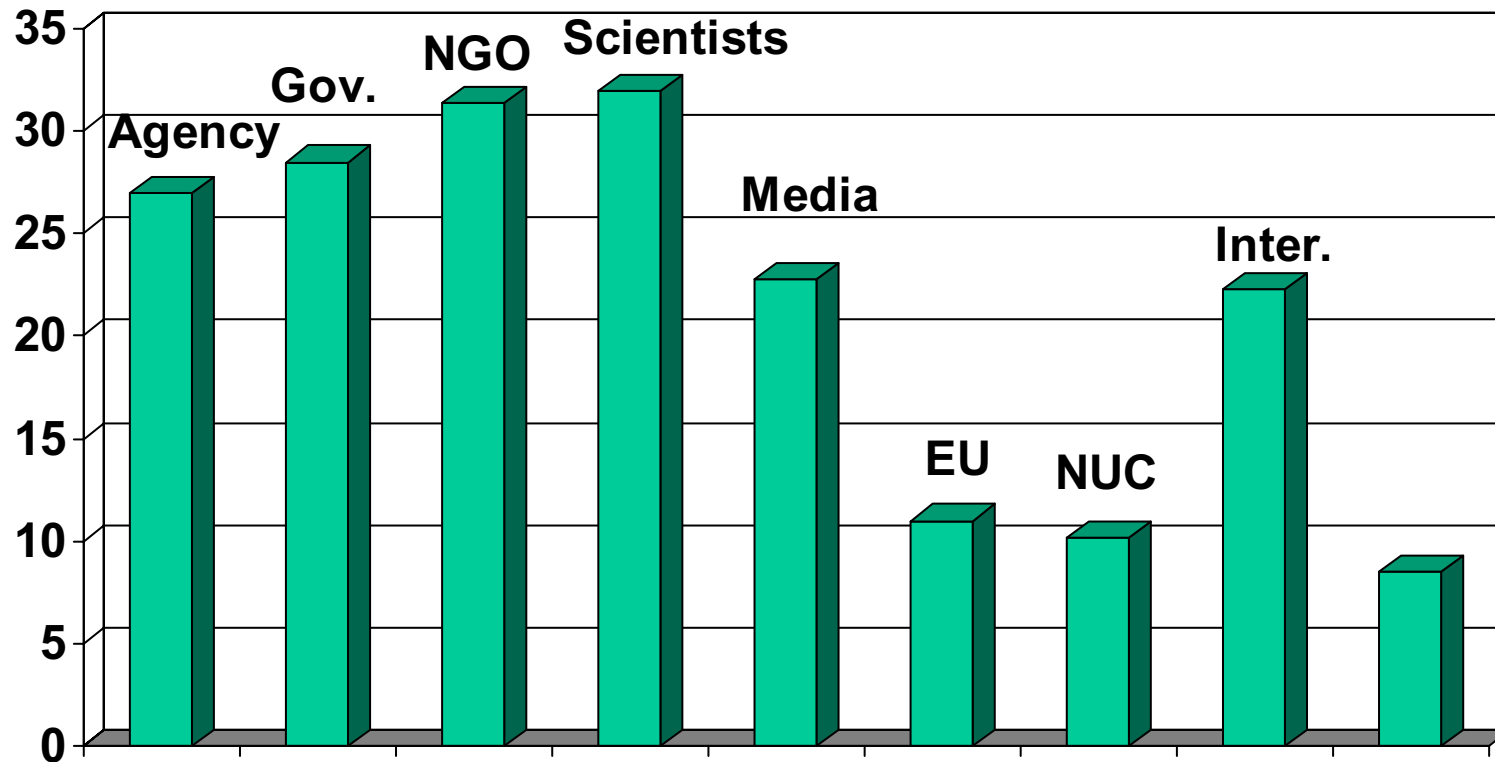


from Flynn et al. 1993

Public Opinion in the EU

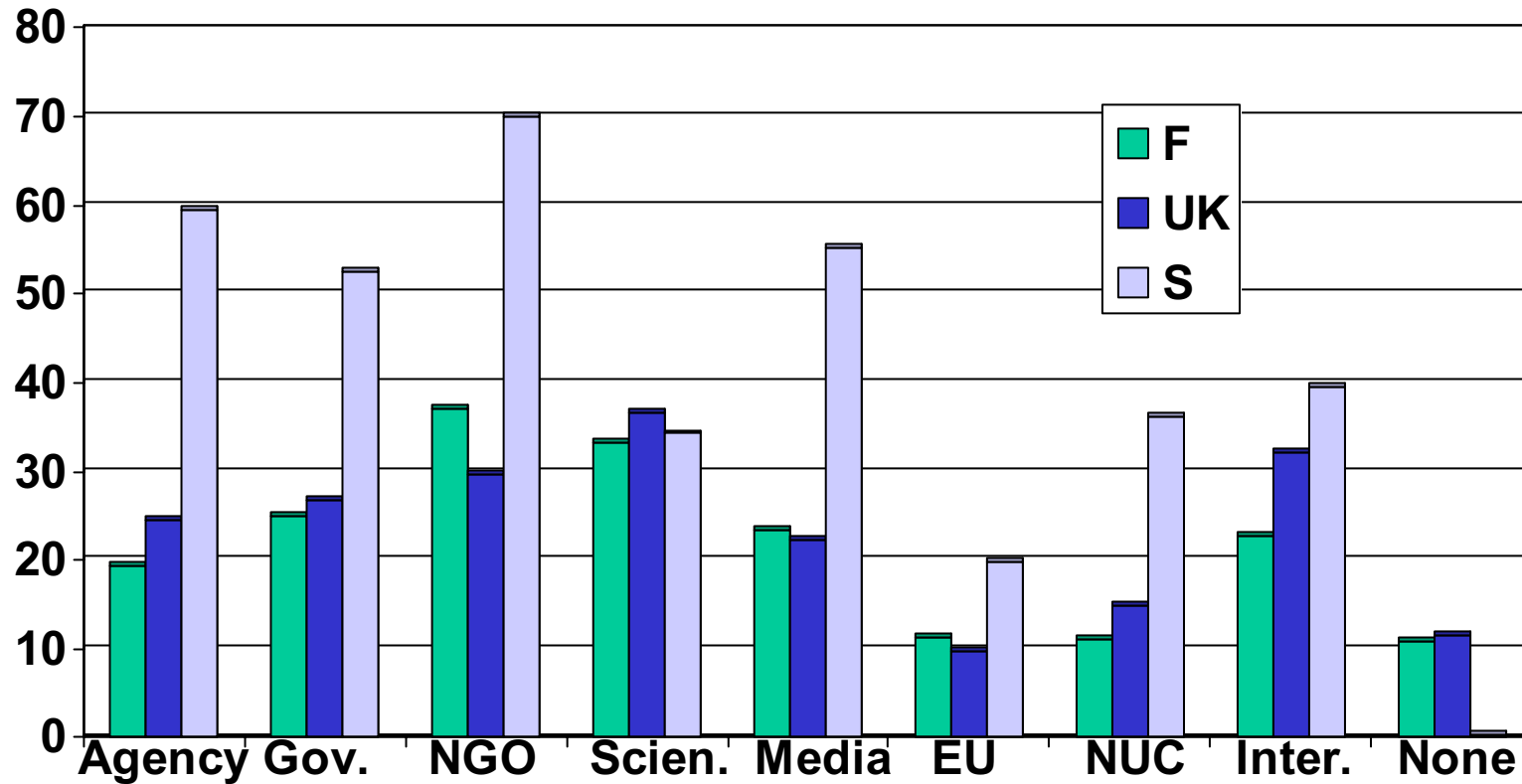
- **Question: Why has no country disposed of HLW?**
- **Answer: ... because there is no safe way to do this.**
- **1998 – 75%**
- **2001 – 46%**

Who do the public trust?



EU Averages

Who do the public trust?



National differences

Interactions with the Publics

- Public information is no longer sufficient - public **participation** is needed
- The degree of **public participation in site selection** varies greatly from country to country
- Directly addressing **compensation** of communities has become normal
- Subjective opinions and objective facts are **BOTH** important
- **Both implementer and regulator** should include interactions with the public in their programmes

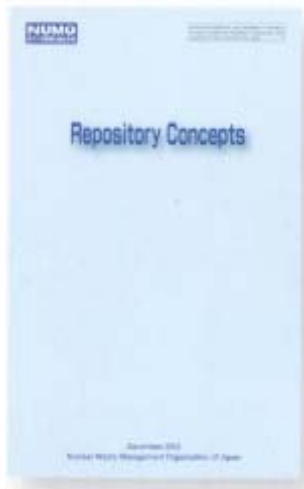
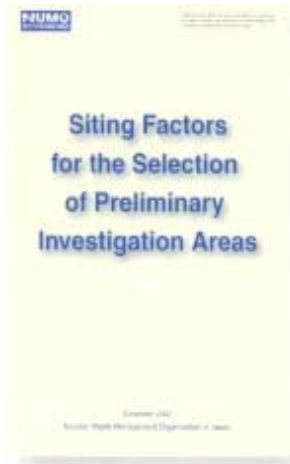
"Best" Site or "Sufficiently Safe" Site?

- It is widely recognised that identifying the "safest" site is neither feasible nor necessary
- **A "best" site can be chosen from a selected set by a multi-attribute analysis - but weighting of selection criteria will be subjective and open to debate**
- **Current consensus:**
 - ❑ a site must be sufficiently safe to satisfy all safety criteria in a demonstrable manner
 - ❑ optimisation of selection must consider also other criteria – in particular socio-political

The evolution of nuclear facility siting

- remote siting
- co-location with existing facilities
- expert opinion ("Decide, Announce, Defend")
- technocratic; traceable, defensible?
- pragmatic (multiattribute analyses)
- volunteering

Siting process underway at NUMO, Japan



**A courageous
modern
approach!!**

Conclusions 1/2

- **Confidence is a prerequisite for repository implementation**
- **Technical and public confidence are both needed**
- **The biggest test of confidence is in siting**

Conclusions 2/2

- **Good science and engineering are an essential start – but not enough alone**
- **Openness, transparency, and involvement of all stakeholders are also needed**
- **NUMO has made an excellent start and its progress is being observed with interest by the global community**

The End