I wear two hats: academic (ETH) and public administrator (Canton of Zurich), plus (i. a.):
- 1992-2004 Member of the Swiss Federal Nuclear Safety Commission,
- 2012+ Member of the oversight committee of the URL Mont-Terri (Commission de suivi)

Strategic Monitoring – a proposal for the institutional surveillance of complex and long-term disposal programmes

2nd International Conference on Monitoring in Geological Disposal of Radioactive Waste, Paris, 9 – 11 April 2019

thomas.flueeler@env.ethz.ch

Canton of Zurich
Office of Waste, Water, Energy and Air

Strategic Monitoring – a proposal for the institutional surveillance of complex and long-term disposal programmes

2nd International Conference on Monitoring in Geological Disposal of Radioactive Waste, Paris, 9 – 11 April 2019

Thomas Flüeler, Nuclear Technology Unit Head

I do not participate in MODERN2020 but I am part of the ongoing Swiss site-selection process (and have monitored it for 10 years)

thomas.flueeler@bd.zh.ch

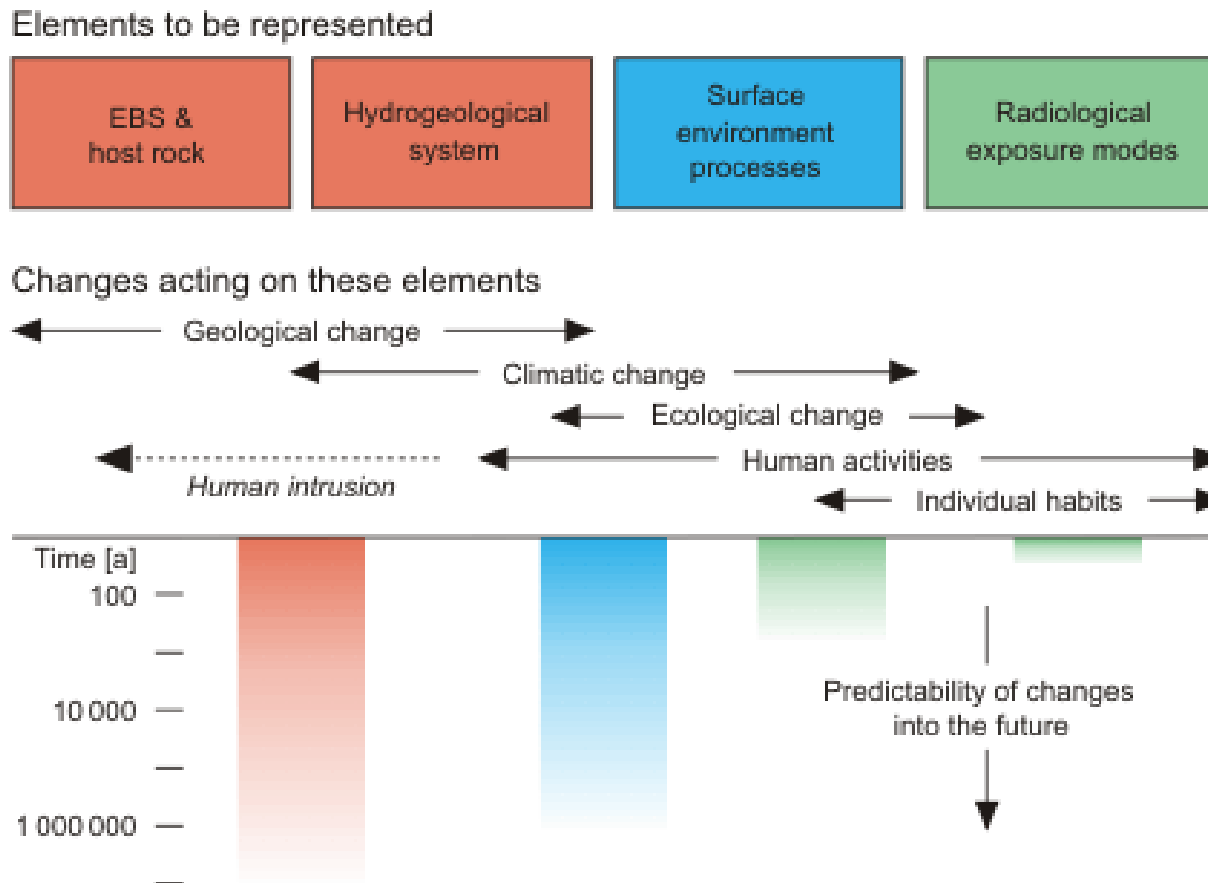# Radioactive waste management, RWM: monitoring!

confirmatory (near-field)

operational

environmental (far-field)

Up to now we have been dealing with repository monitoring during the Conference
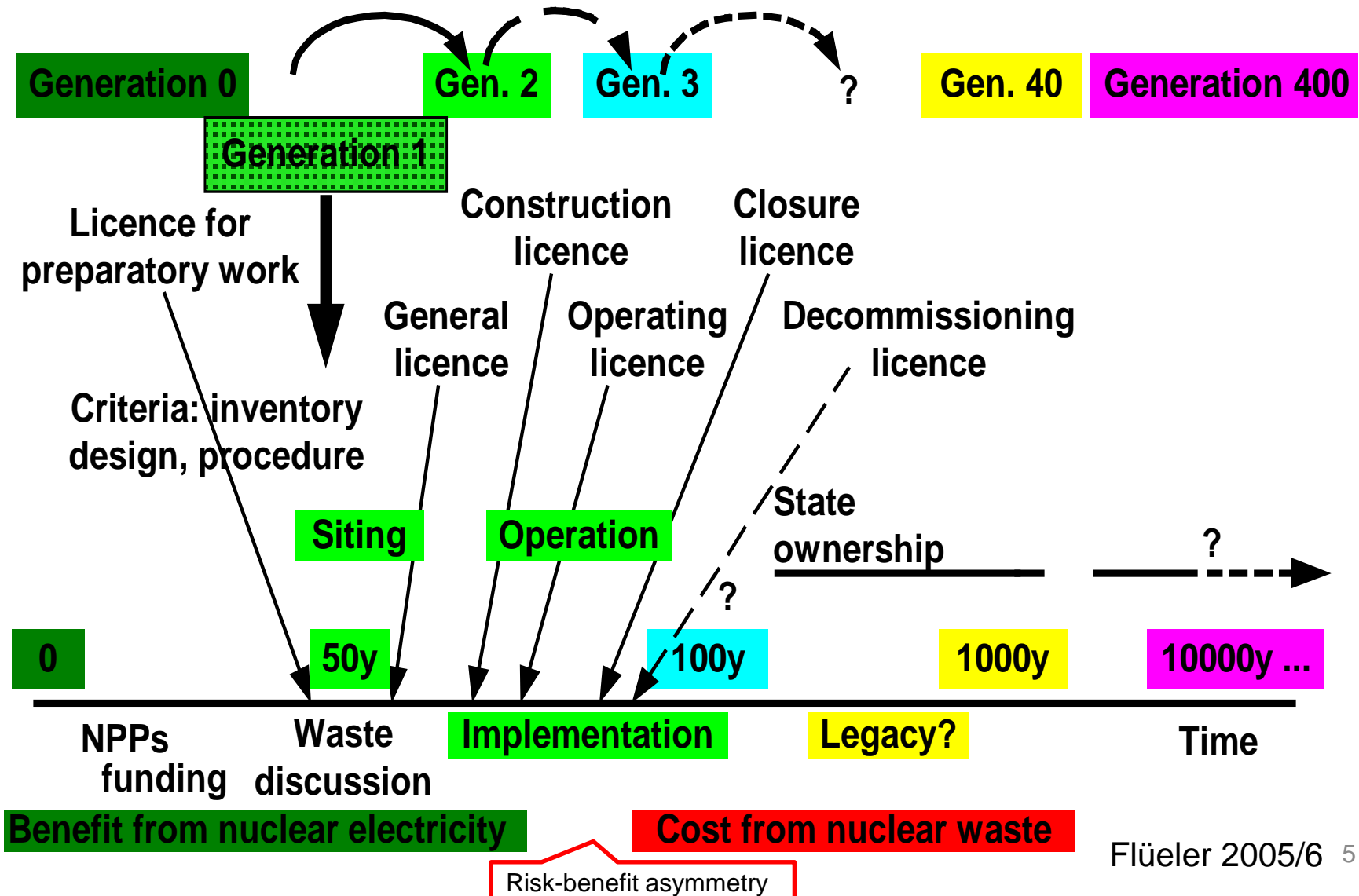
Deep geological repositories …

… are a long-term issue (regarding long-term safety) …

Elements to be represented

| EBS & host rock | Hydrogeological system | Surface environment processes | Radiological exposure modes |

Changes acting on these elements

Geological change

Climatic change

Ecological change

Human intrusion

Human activities

Individual habits

Time [a]
100 —

—

10 000 —

—

1 000 000 —

—

Predictability of changes into the future

NEA (1999). The role of the analyses of the biosphere (...)

4

… require long-term involvement

Flüeler 2005/6 5

... **require long-term involvement**

So they are a long-term <u>institutional</u> issue

= objective

<u>and</u> institutional long-term issue
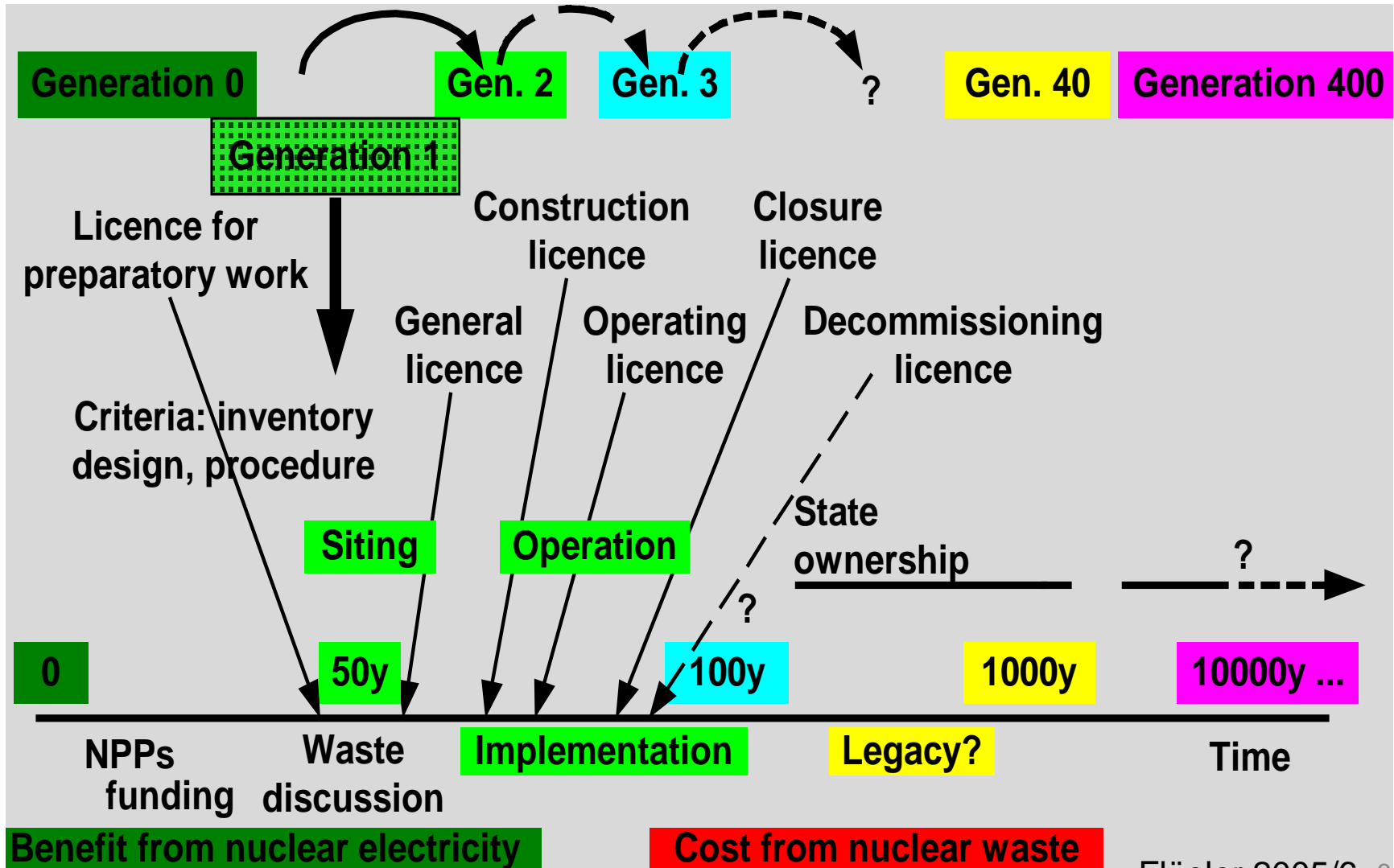
Generation 0   Gen. 2   Gen. 3   ?   Gen. 40   Generation 400

Generation 1

Licence for preparatory work

Construction licence

Closure licence

General licence

Operating licence

Decommissioning licence

Criteria: inventory design, procedure

Siting   **Operation**

State ownership   ?

0   **50y**   **100y**   **1000y**   **10000y ...**

?

NPPs funding   **Waste discussion**   **Implementation**   **Legacy?**   **Time**

Benefit from nuclear electricity   **Cost from nuclear waste**

Flüeler 2005/6

Today
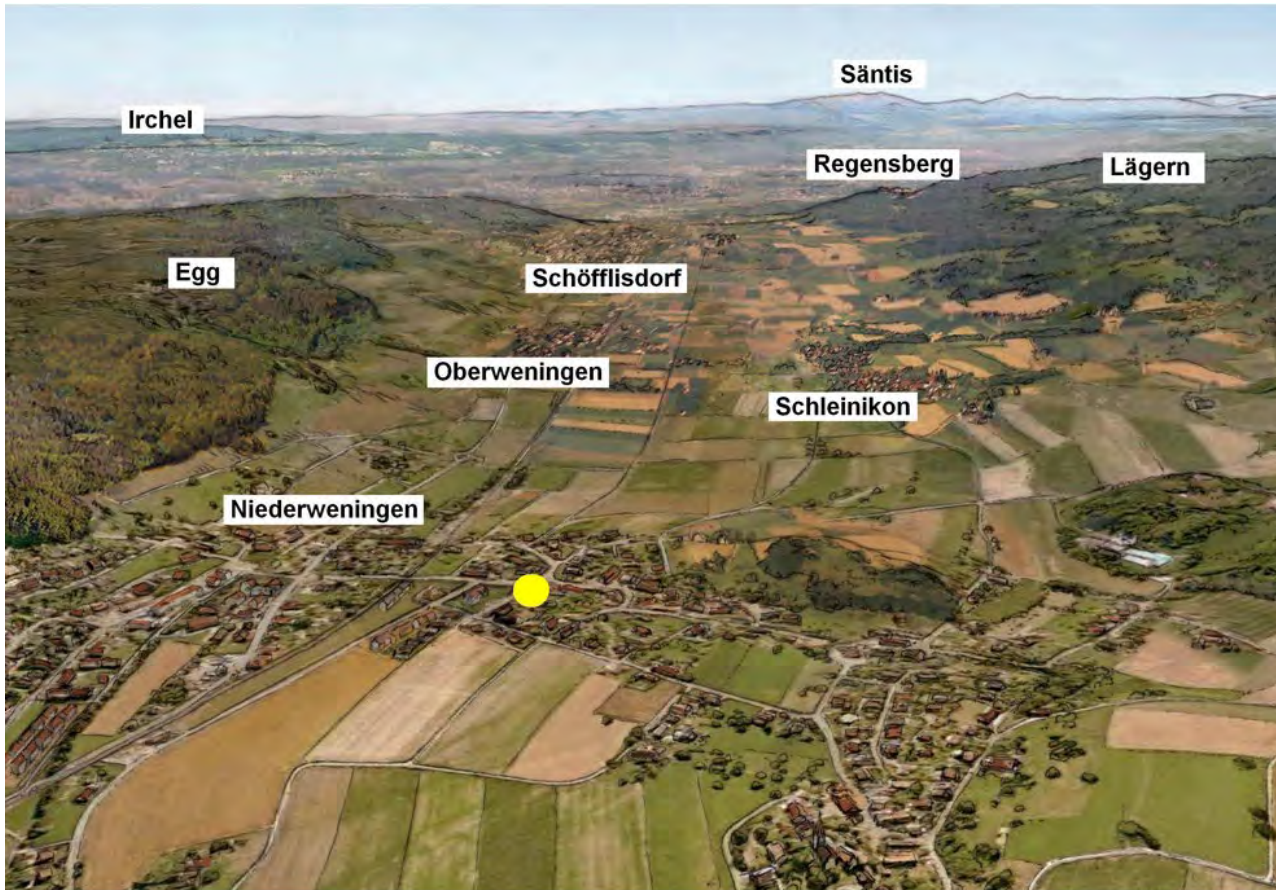
Wehntal (potential siting region N Zurich)

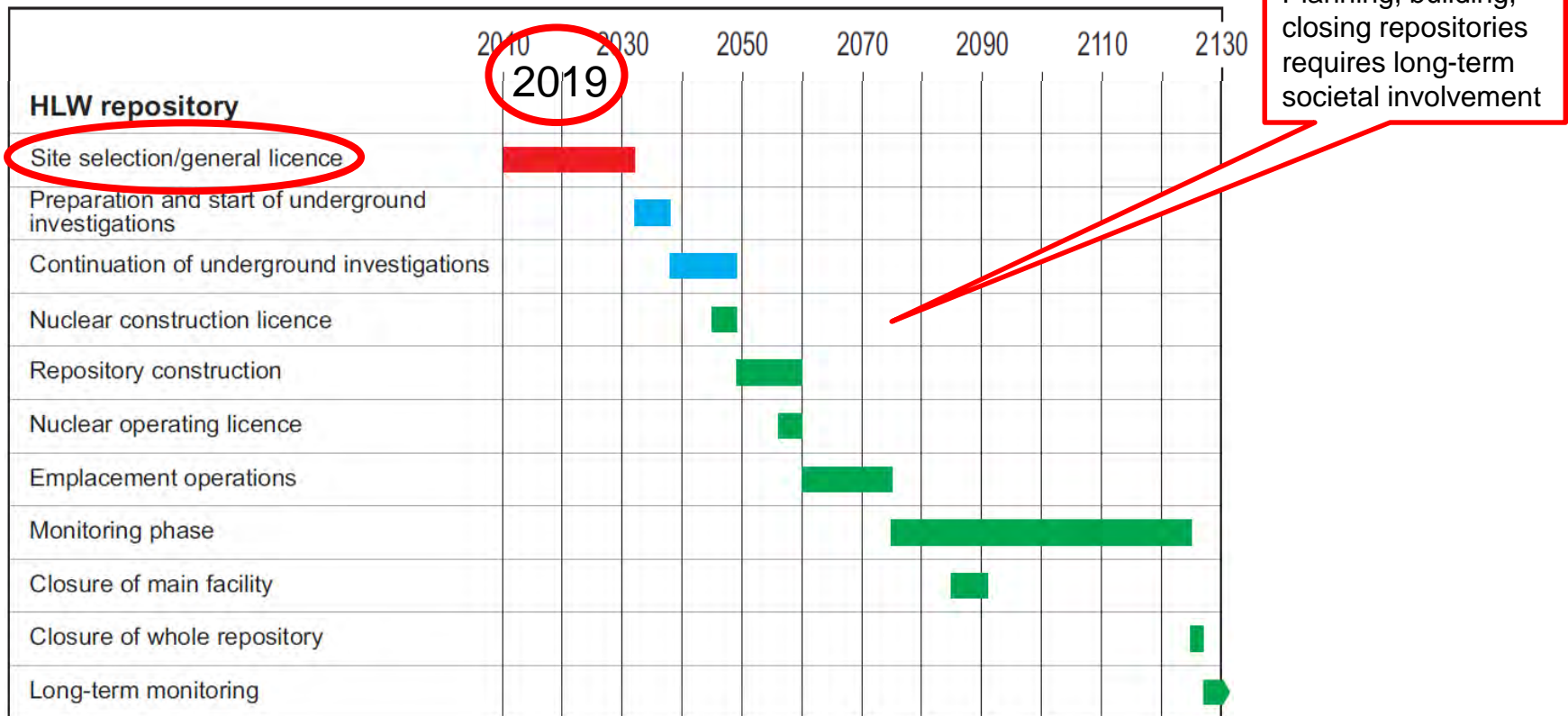# «Tomorrow»: <u>long-term disposal</u> of waste
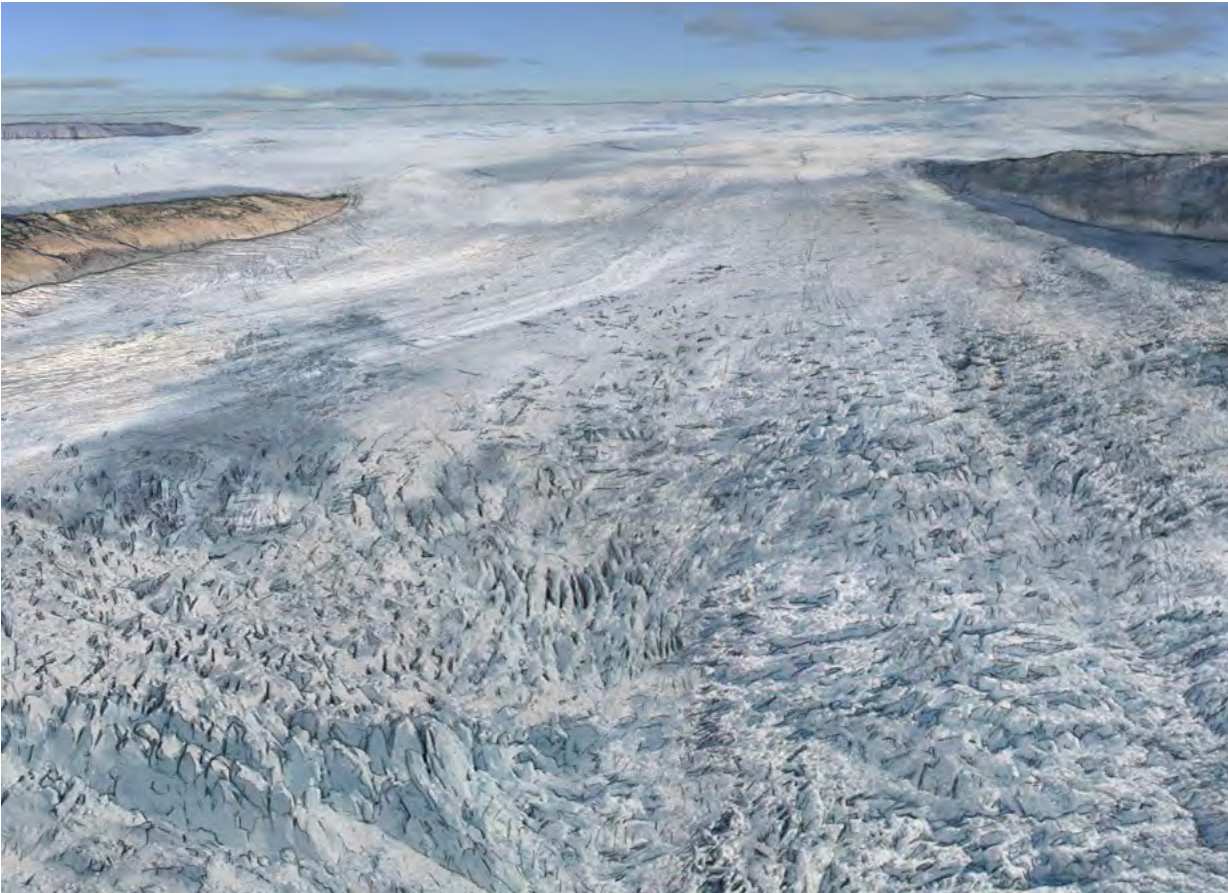
Wehntal
140,000 y
ago

… require <u>long-term societal involvement</u> (1)

e. g., Swiss case

Planning, building, closing repositories requires long-term societal involvement

HLW repository	2010	2030	2050	2070	2090	2110	2130
Site selection/general licence							
Preparation and start of underground investigations							
Continuation of underground investigations							
Nuclear construction licence							
Repository construction							
Nuclear operating licence							
Emplacement operations							
Monitoring phase							
Closure of main facility							
Closure of whole repository							
Long-term monitoring							

2019

Nagra, NTB 16-02, p. 12

… **require long-term societal involvement (2)**

e. g., Swiss case

	2010	2030	2050	2070	2090	2110	2130
HLW repository							
Site selection/general licence							
Preparation and start of underground investigations							
Continuation of underground investigations							
Nuclear construction licence							
Repository construction							
Nuclear operating licence							
Emplacement operations							
Monitoring phase							
Closure of main facility							
Closure of whole repository							
Long-term monitoring							

In around **70 years** (or later): technical, regulatory, political, and societal decision(s) due to close high-level (HLW) waste facility

Today (Swiss site selection, phase 3 started)

But think …

Dome of Cologne

Tomorrow (70 y from now: waste facility closed)
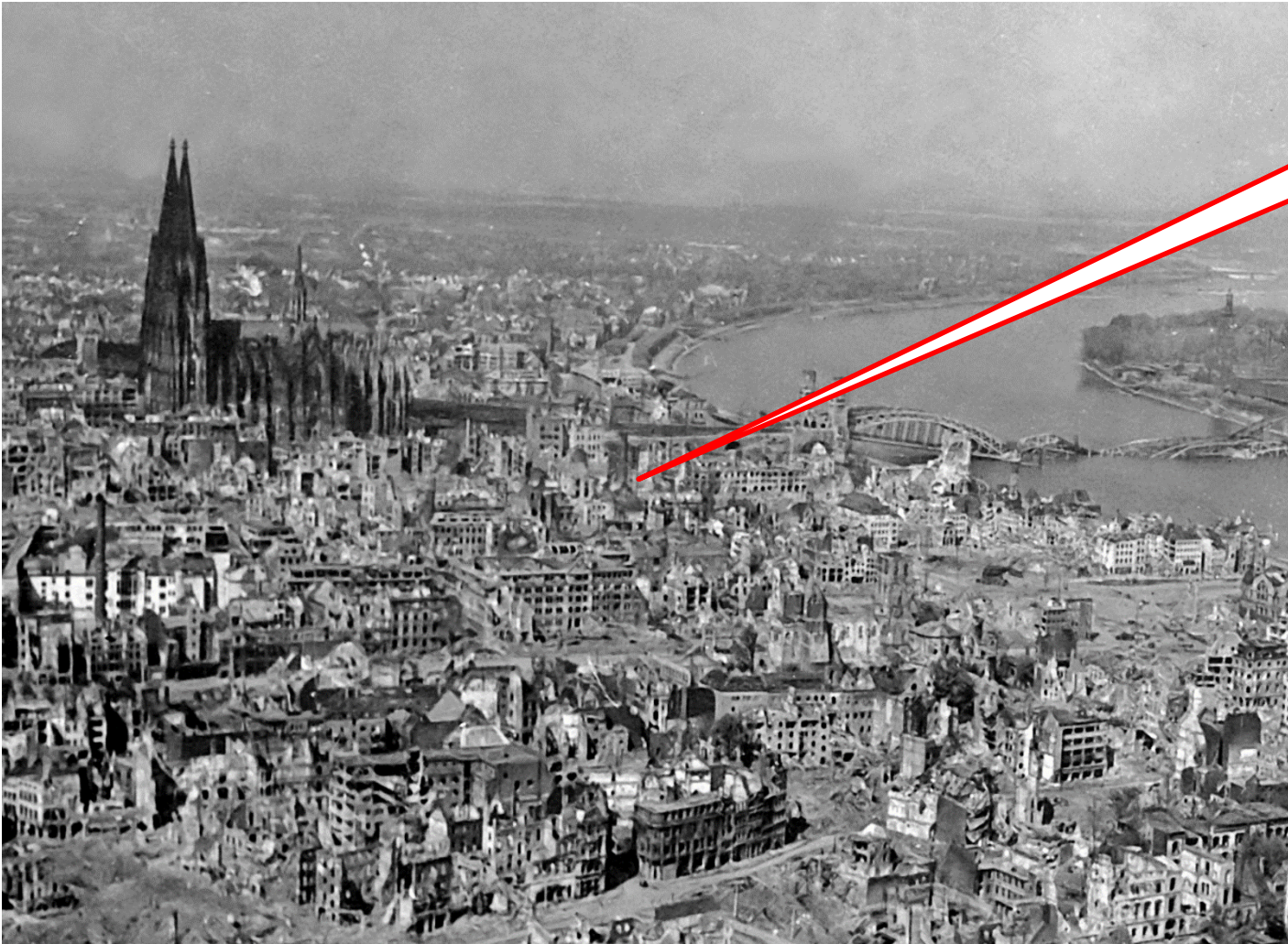
… what can happen in that period of time …

70 y back: Dome of Cologne, April 1945

Nuclear waste as a "wicked problem"

(High-level) "nuclear waste management has the deserved reputation as one of the most intractable policy issues facing the United States and other nations using nuclear reactors for electric power generation"

"Ill-defined" in the sense that there is not <u>one</u> solution but there are, e. g., many (national) solutions

- – Complex, ill-defined, ill-structured
- – Problem framing difficult
- – Lack of stopping rules (no "closure" – no "solution"?)

Rittel & Webber 1973
D. W. North, Risk Analysis 1999

Rather: nuclear waste as a "messy problem"

(High-level) "nuclear waste management has the deserved reputation as one of the most intractable policy issues facing the United States and other nations using nuclear reactors for electric power generation"

... as "wicked" is drastically negatively connotated

- Complex, ill-defined, ill-structured
- Problem framing difficult
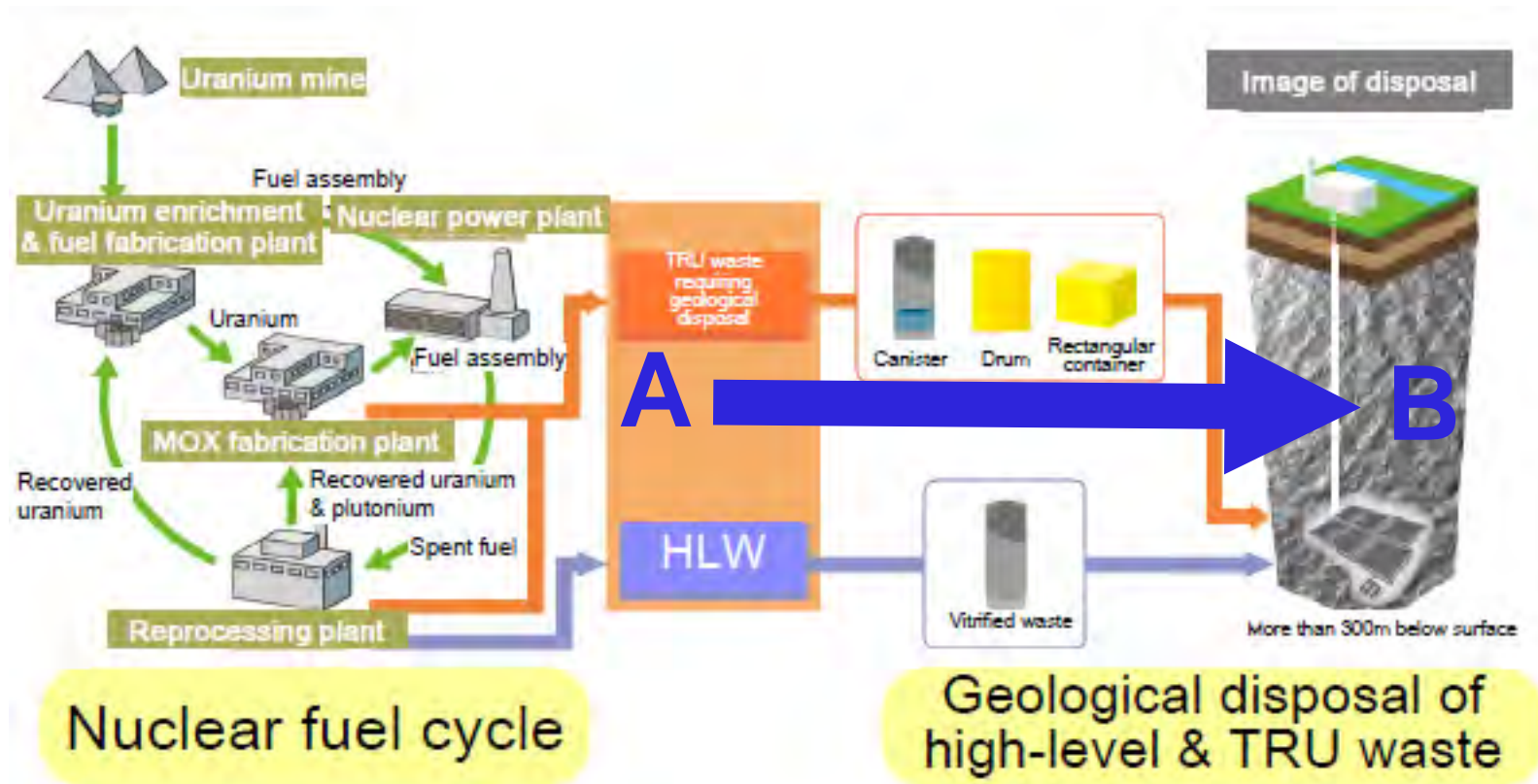- Lack of stopping rules (no "closure" – no "solution"?)

Metlay & Sarewitz 2012
Rittel & Webber 1973
D. W. North, Risk Analysis 1999

In need: **strategic** monitoring!

… to get from **A** to **B**

Long time schedules: up to site restoration

e. g., Swedish case (in *ca.* 60 y)

SFR

SFL

SF repository

	Planning, licensing, design, project management
	Defueling
	Service operation
	Preparations, dismantling within the controlled area
	Waste management
	Conventional dismantling, demolition and site restoration

SFR — low-level waste
SFL — long-lived waste
SF — spent fuel

SSM (2017) ↓2019-3-20 16

Long time schedules: interruptions?!
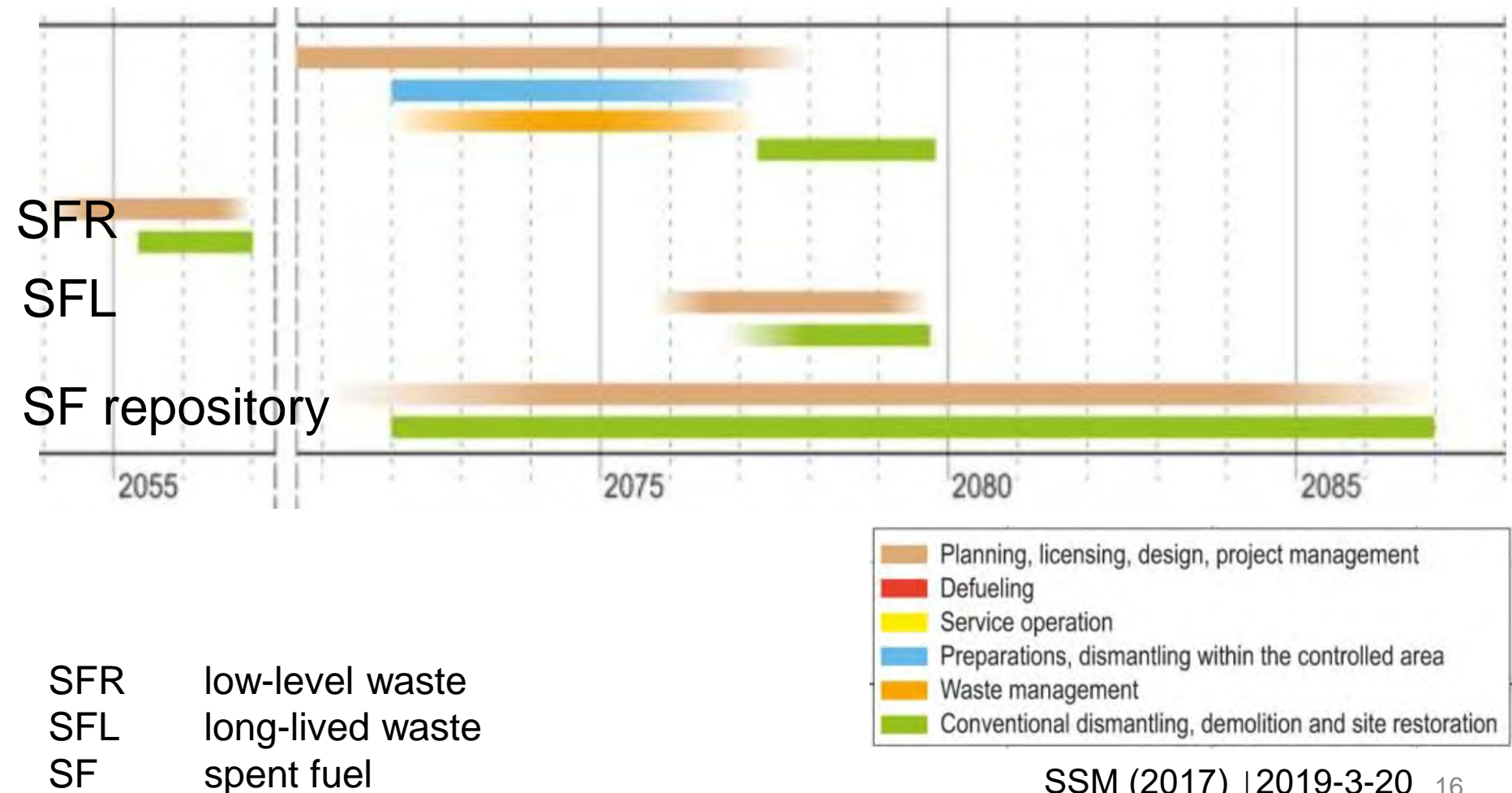
Maybe there will be disruptions (not necessarily wars)

Project abandoned
Resumed (?)

The main challenge is to hand over the project and programme: from one generation to the next and after next …

Main issue of RWM and Records, Knowledge & Memory:
Handing over the torch

Main issue of RWM and Records, Knowledge & Memory: **Handing over the torch**

Hopefully in good condition(s)

Asse (Germany)
(to be recovered)
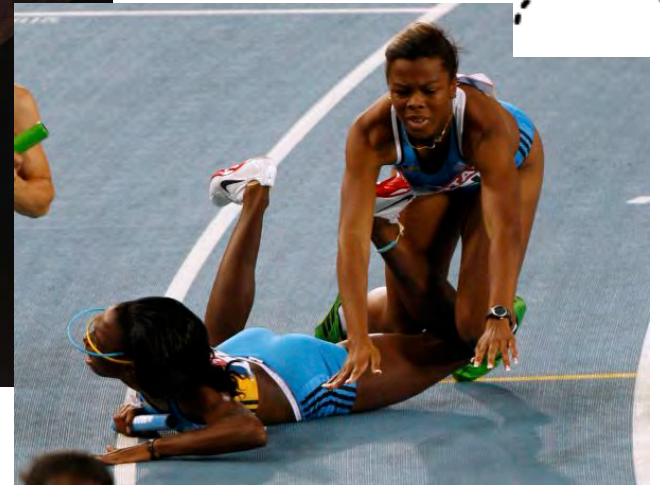
The system is highly complex: contents …

Long-term safety of repositories

"is not … a rigorous proof of safety ... but **rather a convincing set of arguments**"*

Diversified lines of arguments must lead to the same result(s)

Think of Ele Carpenter's networks: neither centralised nor decentralised but distributed

*NEA (1999): Confidence in the long-term safety …

The system is highly complex: process …

Long-term safety of repositories

As we all have learned the hard way – painful and arduous:

"is not … a rigorous proof of safety ... but **rather a convincing set of arguments**"

The **proof over time** is decisive (site selection to closure of facility)

… in a lengthy process

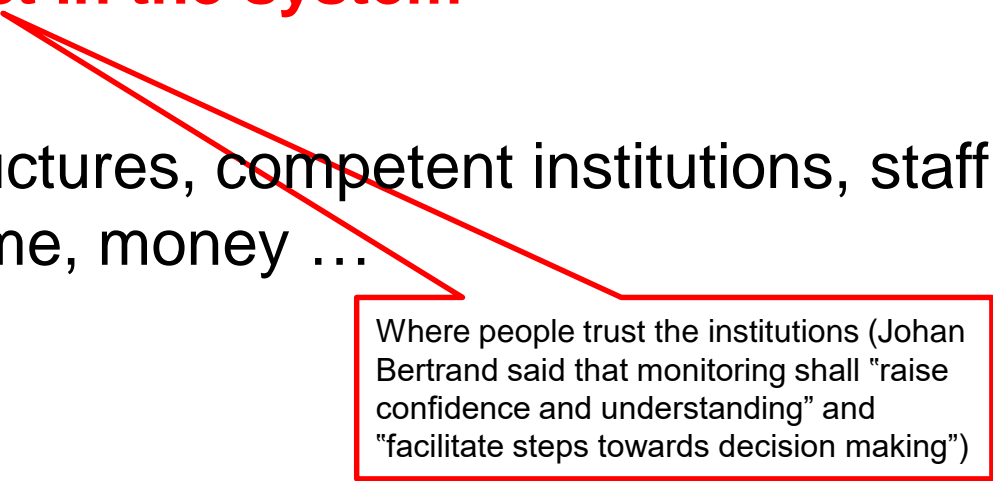**The system is highly complex: actors …**

The reasoning is difficult (few experts have full insight)

– 99 per cent of all are lay persons (also experts)

– conclusion: the process, not just the product, is in focus

Confidence in the process, trust in the actors

Trust in the system

– Needs resources: structures, competent institutions, staff (persons), discourse, time, money …
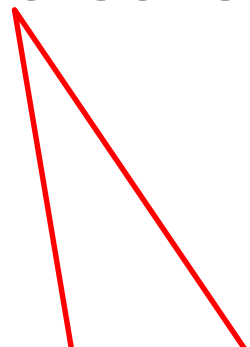
Where people trust the institutions (Johan Bertrand said that monitoring shall "raise confidence and understanding" and "facilitate steps towards decision making")

The system is highly complex: persons …

Staff needs …

– an adequately developed culture

– respect for others

– admitting failures

– stamina *and* flexibility

– change of perspective

– empathy

But it isn't just the system – it's you <u>personally</u> that are decisive (don't hide behind statements like "it's up to politics to decide")

Respect

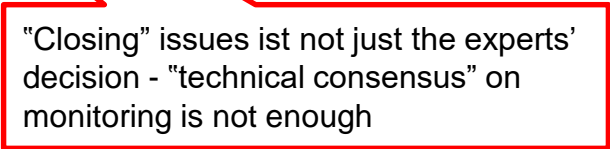Lay people concentrate on the process and on actors whom they are very well able to judge:

– Were the rules complied with?

– Are the experts credible, even authentic?

– Are they arrogant?

– Do they admit mistakes?

– Do they really address (my) questions/remarks?

Indicator:

Trust of the public in process and personnel

Approach towards "closure" (of issue)

– Comprehensive, transparent and participatory manner

– Some fundamental rules proposed

– Juxtaposed with "reality"

"Closing" issues ist not just the experts' decision - "technical consensus" on monitoring is not enough

Stepwise procedure

1. Discuss: comprehensive societal discourse

2. Decide: "common ground" in goals and stepwise strategy

3. Implement: execute programme and prepare long-term knowledge basis

1.-4. Evaluate: assess programme (policy, process) regularly

1. Discuss: comprehensive societal discourse

– "Involvement of stakeholders": as many relevant perspectives (not as many individuals as possible)

– "Social robust": most arguments, evidence, social alignments, interests and cultural values lead to a consistent option (Rip 1987)

– Have pros and cons thoroughly scrutinised, to successfully "close" certain issues, and proceed to the following step, stage or phase

Dörte Themann is right in claiming that it needs a societal dialogue, and Mansueto Morosini recognised that monitoring involves "value judgements" – the whole undertaking does!
And start early (cf. Canada's "Choosing a way forward")

2. Decide: "common ground" in goals and stepwise strategy

No consensus will be reached "at heart", in the stakeholders' core beliefs.
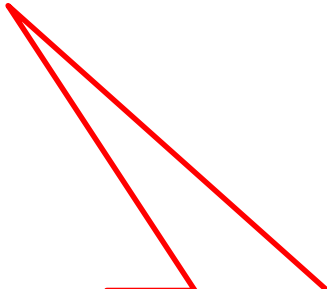
Society must agree, though, on three levels:

– **Problem recognition** (waste exists, problem to be tackled, eventually "solved", at least set on track to be solved)

– **Main goal consensus** (degree of protection and intervention)

– **Procedural strategy** ("rules of the game")

Over thirty years ago Luther Carter* called in to find "a common ground" yet without specifying –
Let me make it crystal clear: Passive safety must prevail!

*Carter, L. J. (1987). Nuclear imperatives and public trust: dealing with radioactive waste. Resources of the Future, Washington, DC

3. Implement: execute programme and prepare long-term knowledge basis

– Necessity to integrate different requirements

– Step-by-step approach

– Chance of "institutional constancy"

– Special "national" task of the issue

$\rightarrow$ calls special attention to the **role of the regulatory authorities**

This is out of the scope of this talk

Proposal for policy evaluation (ongoing: 1.-4.) (1a)

Area	Approach/ concept			
	"Good" governance	**(Regulatory and other) capture**	**Safety culture**	**Path dependence, lock-ins**
A. Formal (system) structure	Legitimation	(A-)Symmetry	Continuous learning	Persistence
	Legislation: goal, time frame, players, boundary conditions, etc.	*Research & development plan*	*Code of conduct, guidelines*	Crucial is an ongoing policy, process and implementation evaluation with an institutional surveillance: 4 concepts on 3 levels (A-C)
	Participation: de-gree, who/what for	*Resources: staff, money*	*Feedback of staff & stakeholders*	*Research financing*
	Goal orientation, effectiveness/ efficiency	*Competence(s) and experience*	*Education, permanent training*	*Review organisation*

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Proposal for policy evaluation (ongoing) (1b)

Area	Approach/ concept			
	"Good" governance	**(Regulatory and other) capture**	**Safety culture**	**Path dependence, lock-ins**
A. Formal (system) structure	Legitimation	(A-)Symmetry	Continuous learning	Persistence
… (cont'd)				
	Degree of consensus, inclusiveness, capacity building	*Expert blocking*	*Organisa-tional learning*	
	Rule of law			

Proposal for policy evaluation (ongoing) (2)

Area	Approach/ concept			
	"Good" governance	**(Regulatory and other) capture**	**Safety culture**	**Path dependence, lock-ins**
B. Under- standing of roles	Division of roles	Institutional analysis	(Senior manage- ment) commitment	Openness of decision making
	Programme tasks	*Interrelations with other players*	*Leadership*	*Comparison of options*
	Strategic planning	*Structure analysis*	*Employee involvement*	
	Responsibilities			

Proposal for policy evaluation (ongoing) (3a)

Area	Approach/ concept			
	"Good" governance	**(Regulatory and other) capture**	**Safety culture**	**Path dependence, lock-ins**
C. Internal structures	Transparency/ accountability	Mental models	Failure culture	Resistance vs. innovation
(organisatio-nal, person-nel)	*Justification of decisions*	*Recurrent key statements*	*Openness of communi-cation*	*Mechanism of selection*
	Framework and respective guidelines	*Terms of reference, code of conduct*	*Trust*	*Components of self-reinforcement*
	Controlling: target analysis	*Performance analysis*	*Compliance analysis*	

Proposal for policy evaluation (ongoing) (3b)

Area	Approach/ concept			
	"Good" governance	(Regulatory and other) capture	Safety culture	Path dependence, lock-ins
C. Internal structures … (cont'd)	Transparency/ accountability	Mental models	Failure culture	Resistance vs. innovation
	Responsive-ness	*Agenda analysis*	*Incident reporting*	
	Quality management		*Complacency*	
	Reviewing		*Norms, values, and basic assumptions*	

For illustration purposes and in today's setting I just pick out one example (Peter Hocke asked what failure culture means)

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How to treat mistakes, failures

As Michael Jobmann nicely phrased: "monitoring is a learning concept"

A guardian should not be the National Monitoring Body as installed in Germany but one of the type National Council for the safe governance of radioactive waste: pluralistically composed, independent of the industry yet knowledgeable and not driven by daily politics

– *Conceptually:* robust site selection, regress

– *Regulatory:* safety assessments according to phase

– *Design-wise:* e. g., integration of control mechanisms (pilot facility for surveillance and control), (limited) retrievability

– *Organisationally, culturally:* Way to treat minority views, enlarged assessment, National Body (guardian)

– *The value of a dialogue, above all, depends on the diversity of controversial opinions*

– *No rational argument has a rational effect on somebody who does not want to assume a rational attitude*

Popper (1982): The open universe. An argument for indeterminism

Conclusions

Long term ist not <u>all</u> negative: We have "decades to learn" as Matt White rightly coined it – but we also HAVE TO!

– Inclusive, systematic and participatory approach needed to
 consider both technical and social issues and to
 single out goal priorities (presumably with safety first)
– Setting up a respective process is a prerequisite to proceed
in site selection (and subsequent steps)
– (National) lead agency in conjunction with

  - a clear division of roles among the players,

  - rules of the "game" and

  - criteria to judge

It is planned to apply the concept to other long-term sociotechnial policy fields such as CCS or (conventional) special toxic waste

And:

– Regular programme and policy evaluation (strategic
monitoring) mandatory to control if procedure on track