



TOPSEAL 2006, Olkiluoto, 17-20 September 2006

The Swiss High-Level Waste Programme – Status and Future Challenges

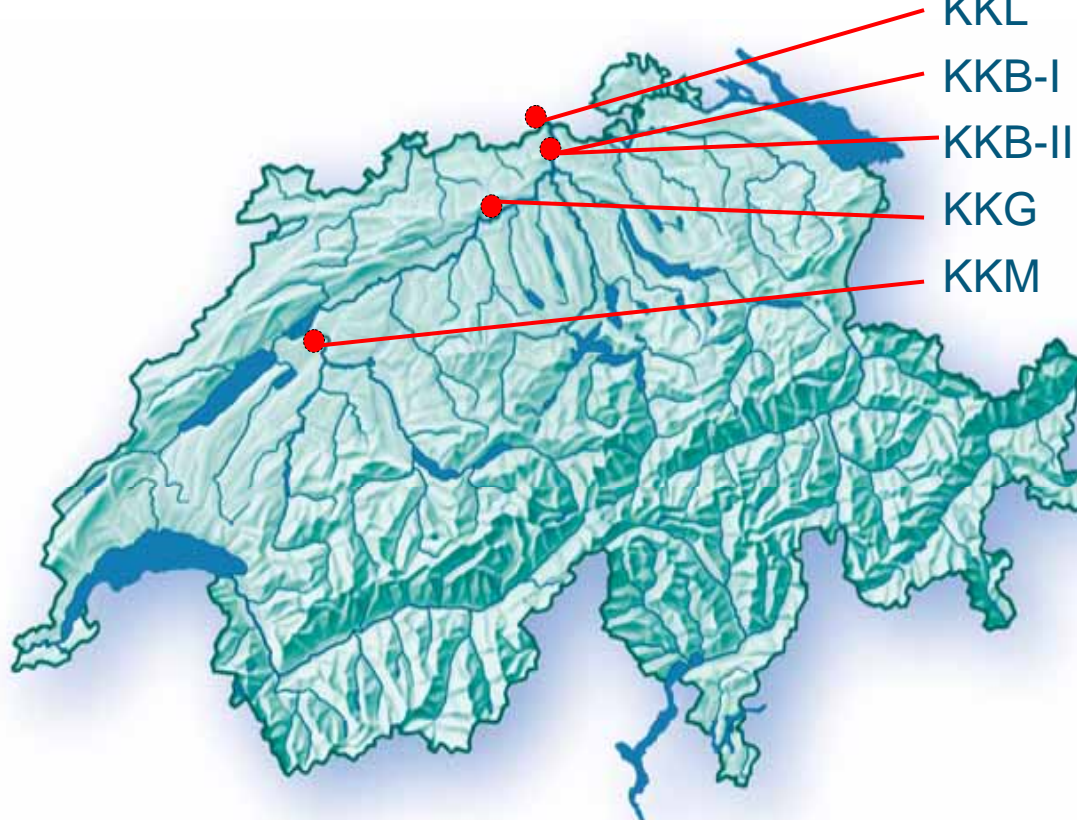
Jürg Schneider & Piet Zuidema

National Cooperative for the Disposal of Radioactive Waste (Nagra),
Switzerland

nagra.

Nuclear Power in Switzerland

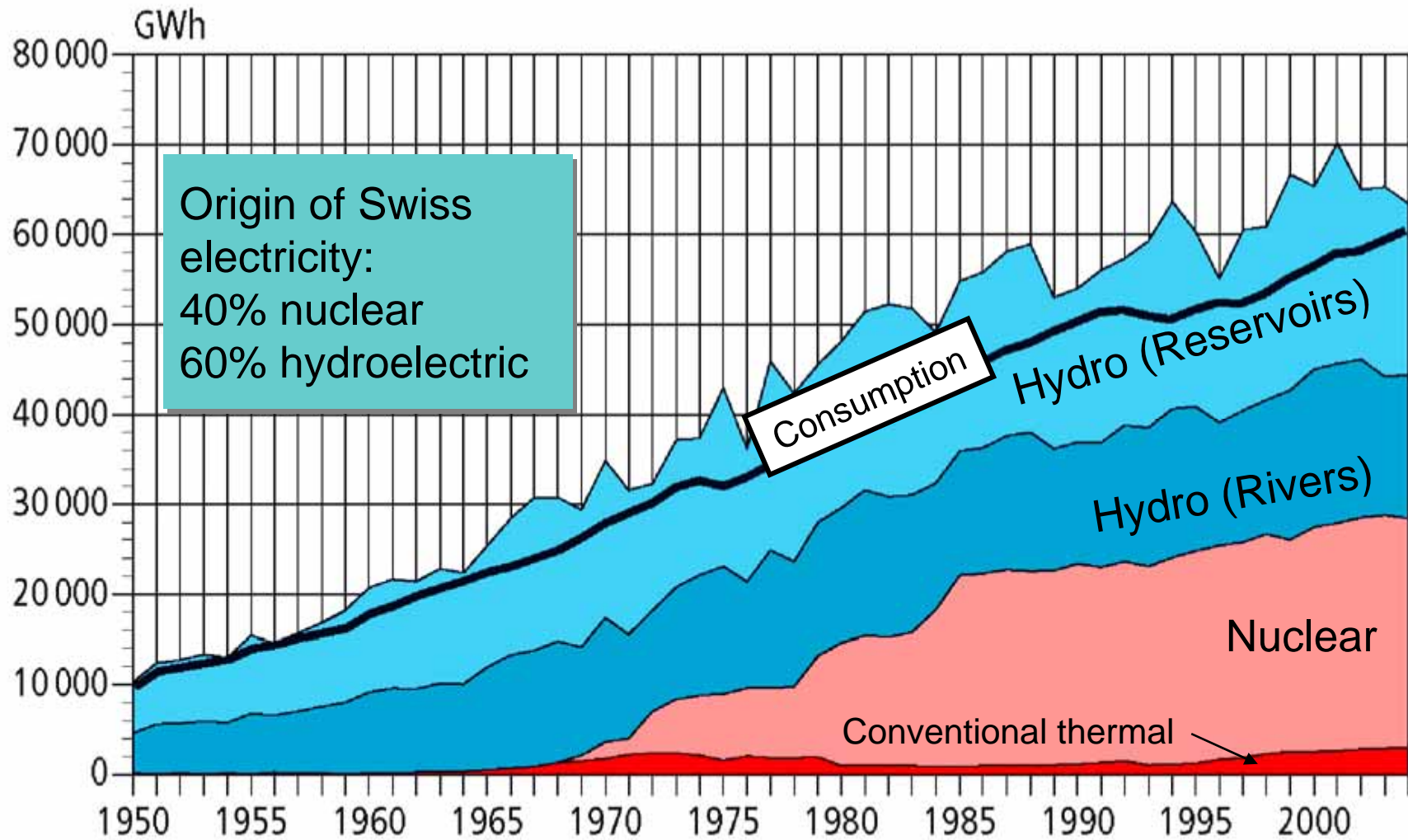
5 Nuclear Power Plants (3220 MW_e)



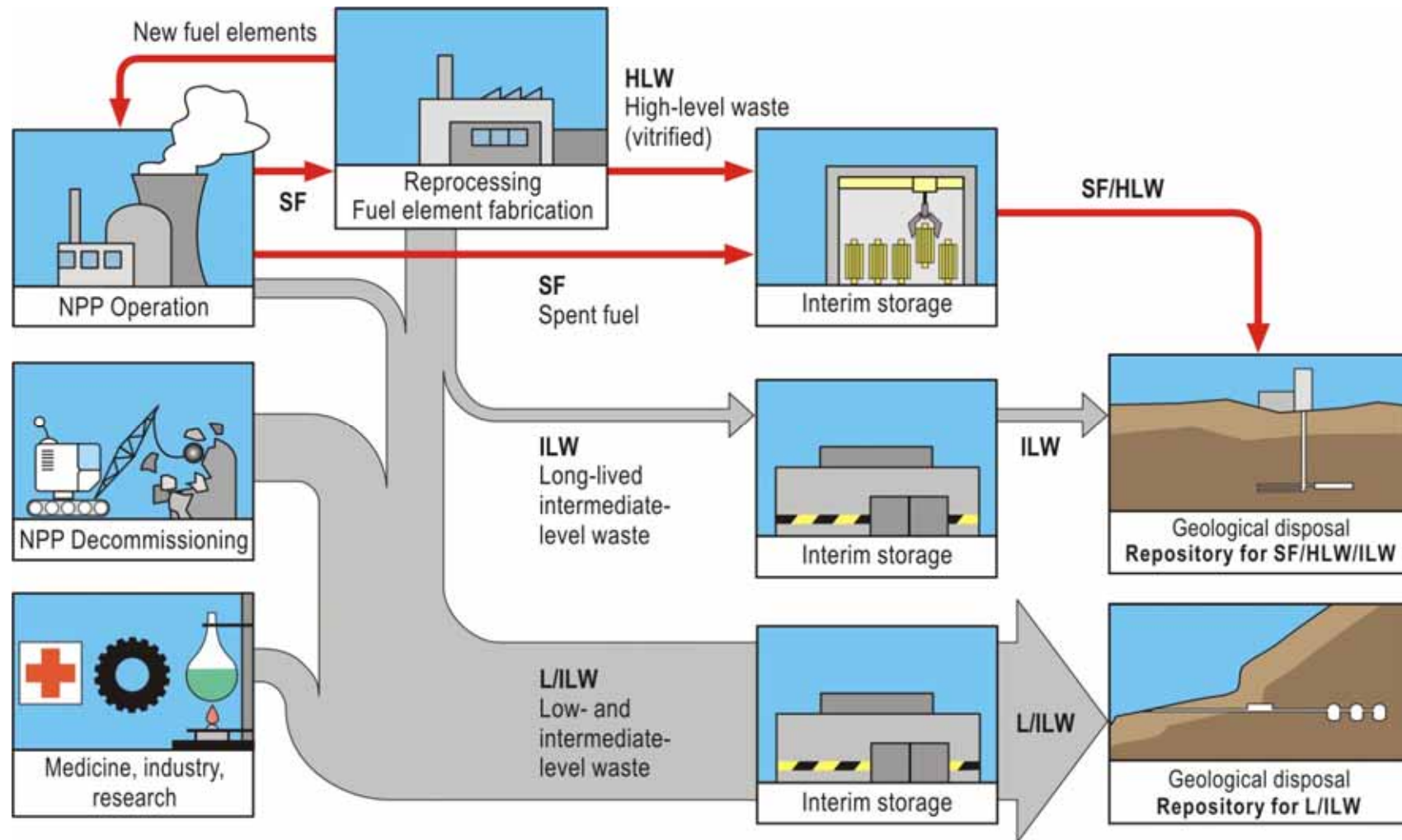
KKL	Leibstadt	(1984)	1165 MW _e
KKB-I	Beznau	(1969)	365 MW _e
KKB-II	Beznau	(1971)	365 MW _e
KKG	Gösgen	(1979)	970 MW _e
KKM	Mühleberg	(1971)	355 MW _e



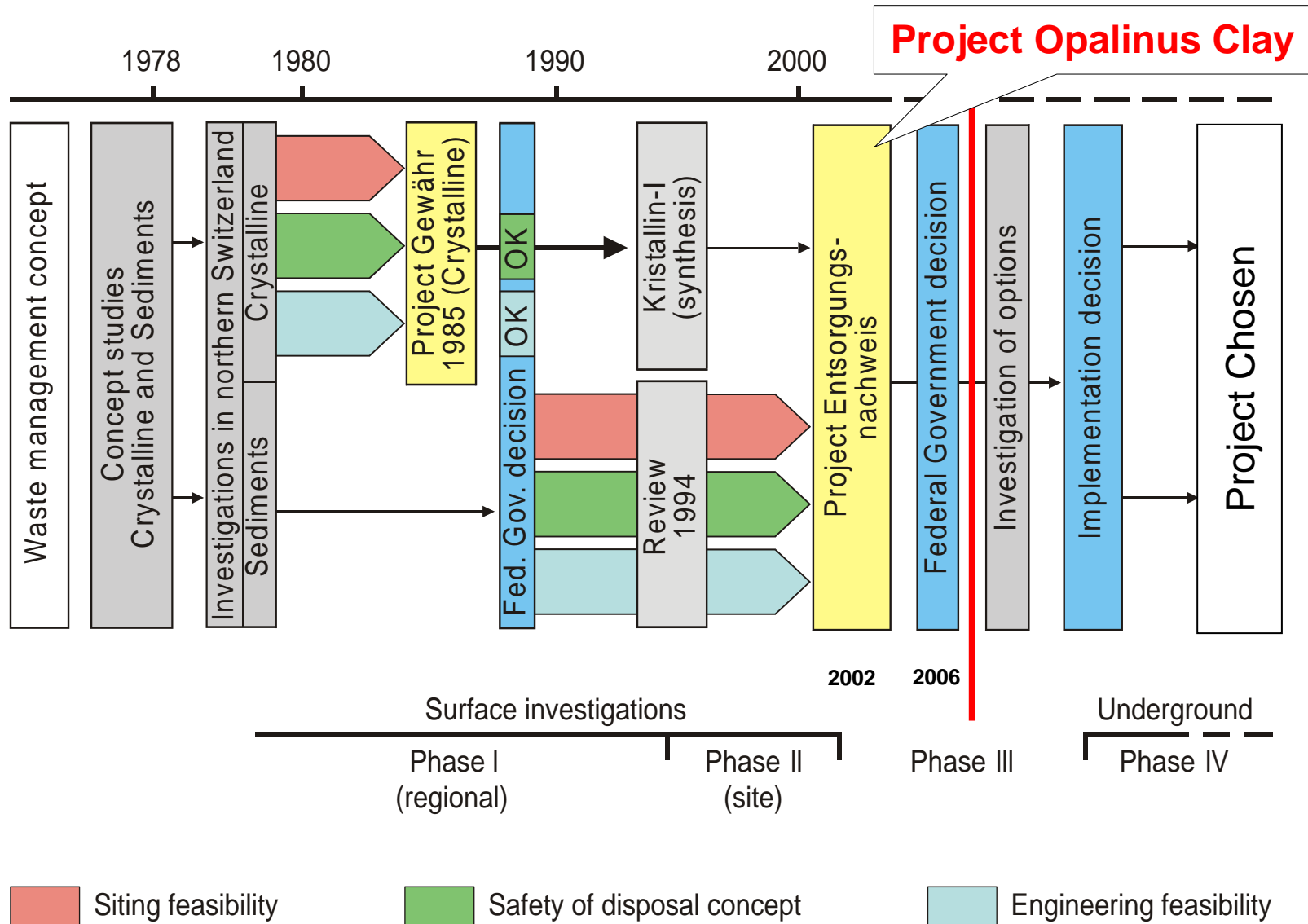
Electricity production and consumption



Swiss waste management concept



Swiss HLW programme: a stepwise approach

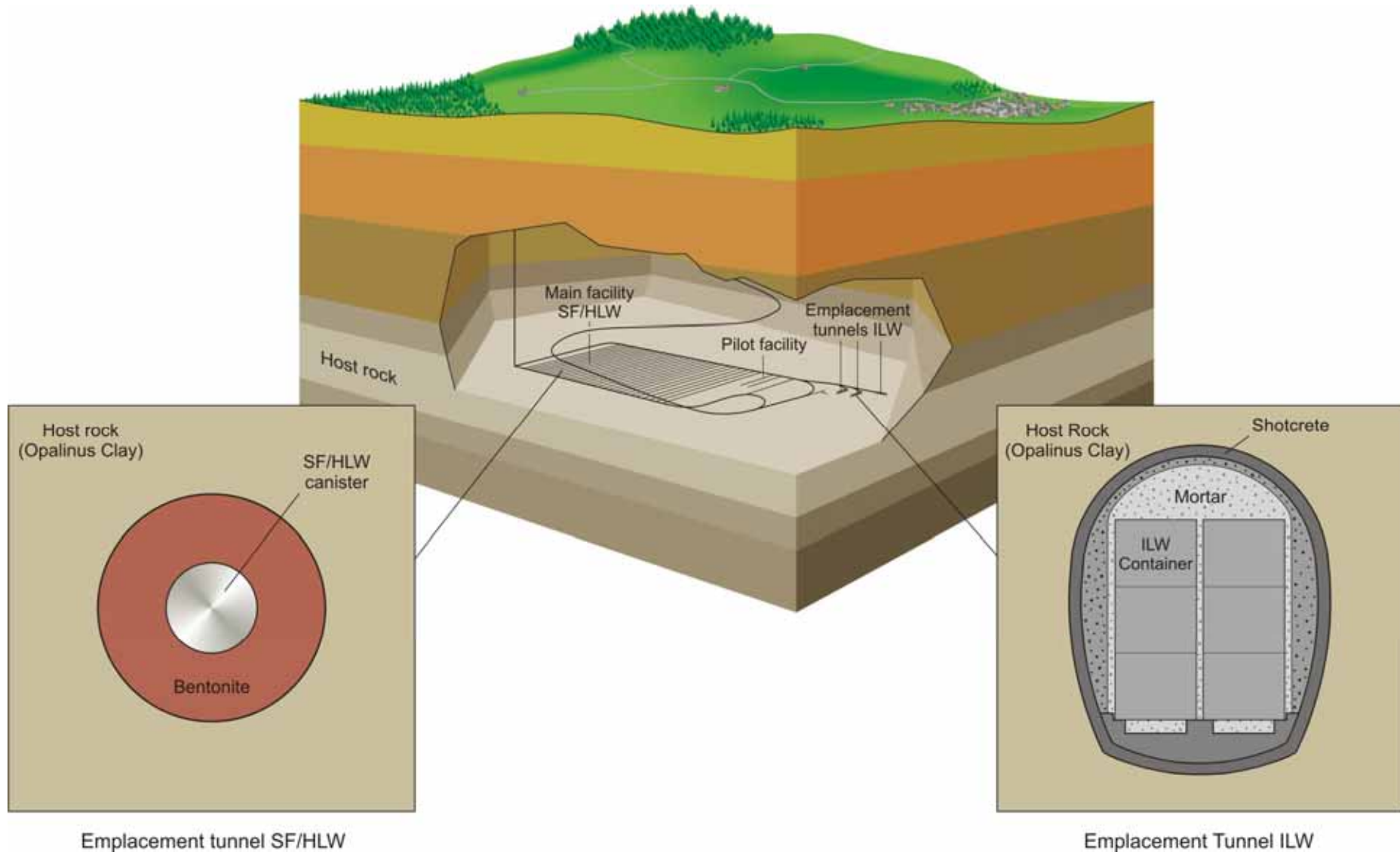


Project Opalinus Clay (*Entsorgungsnachweis*)

View on northern part of potential siting area (Zürcher Weinland)

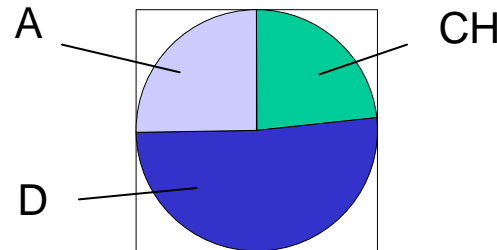


Disposal concept SF / HLW / ILW (Project Opalinus Clay)



Public consultation phase (13.09.05 – 12.12.05)

- All relevant documents put on “public display”
 - Nagra documentation
 - NEA / IRT review results
 - Swiss authorities’ review results (HSK, KNE, KSA)
- ~ 6800 statements submitted to the Federal Office of Energy (BFE)
 - CH: 23.3%
 - D: 51.5%
 - A: 25.1%
 - F: 0.1%
- All statements were evaluated by the BFE and summarised in a report (→ www.bfe.admin.ch)
- Key result: no new technical items compared to authority review



Decision by the Swiss Government (28.06.06)

Verfügung

zum Gesuch der Nagra vom 19. Dezember 2002 betreffend den Entsorgungsnachweis für abgebrannte Brennelemente, verglaste hochaktive Abfälle sowie langlebige mittelaktive Abfälle

Der Schweizerische Bundesrat

verfügt:

1. Der Entsorgungsnachweis für abgebrannte Brennelemente, verglaste hochaktive Abfälle und langlebige mittelaktive Abfälle ist erbracht worden.

“Disposal feasibility for SF, vitrified HLW and long-lived ILW has been demonstrated“.

Report on alternative options for HLW repository

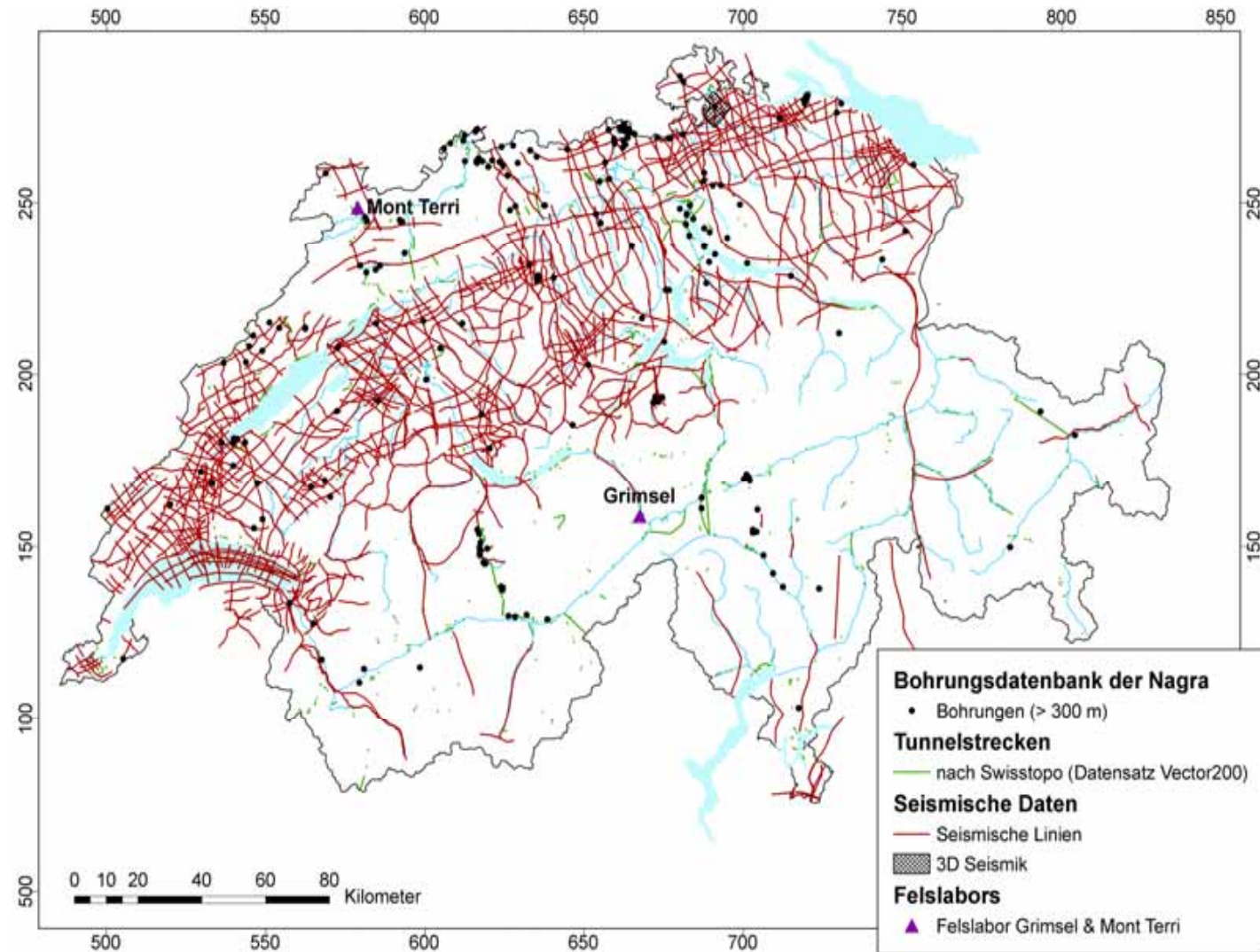
Report requested by Federal Minister (published in 2005)

- Evaluation with respect to safety / geology
- Comparison of potential host rocks
- Description of potential siting regions (no comparisons; to be done in framework of upcoming *site selection process*)
- Available as PDF from www.nagra.ch



Sources of geological information

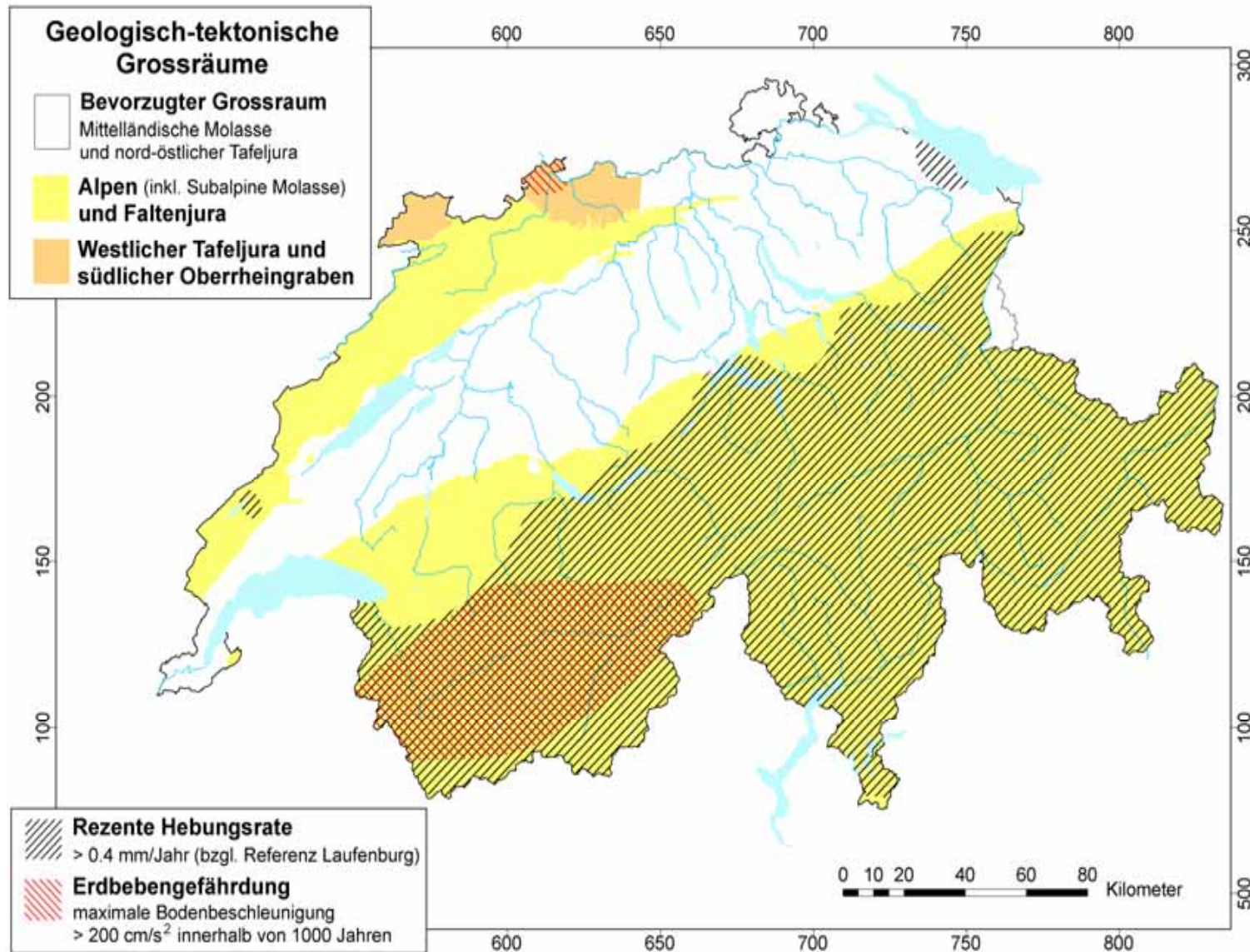
- Outcrops (rock faces, valleys, ...)
- Tunnels
- Boreholes
- Seismics
- 2 URLs



Identification of options: The steps

- 1** Where are the preferred **geologic-tectonic areas**?
(geological long-term stability)
- 2** Which rocks within the preferred areas can be considered as possible **host rocks**?
(barrier properties (incl. interaction with EBS), geotechnical properties)
- 3** Where do these **host rocks** occur with **sufficient lateral extent, at suitable depth & sufficiently unperturbed**?
(stability, feasibility, flexibility)
- 4** **Other factors** (land use planning, environmental impact, socio-economic issues, ...) → Site selection process

Step 1: Preferred geologic-tectonic areas



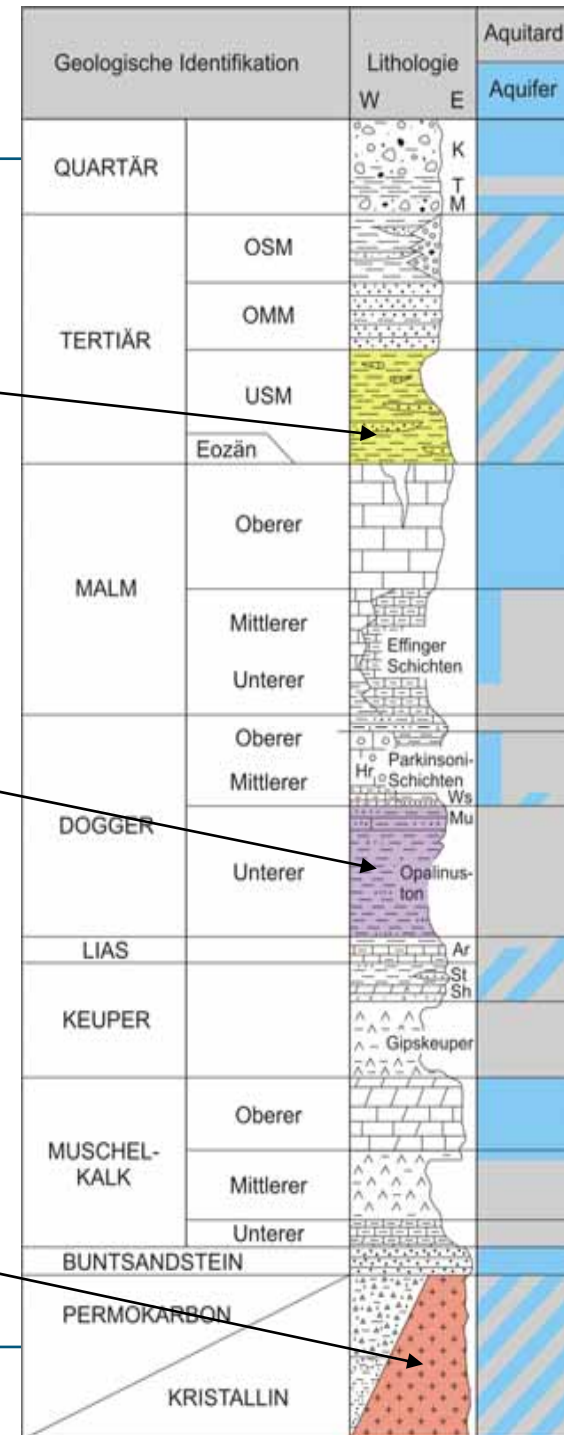
Step 2: Possible host rocks

- Clayey parts of Lower Freshwater Molasse

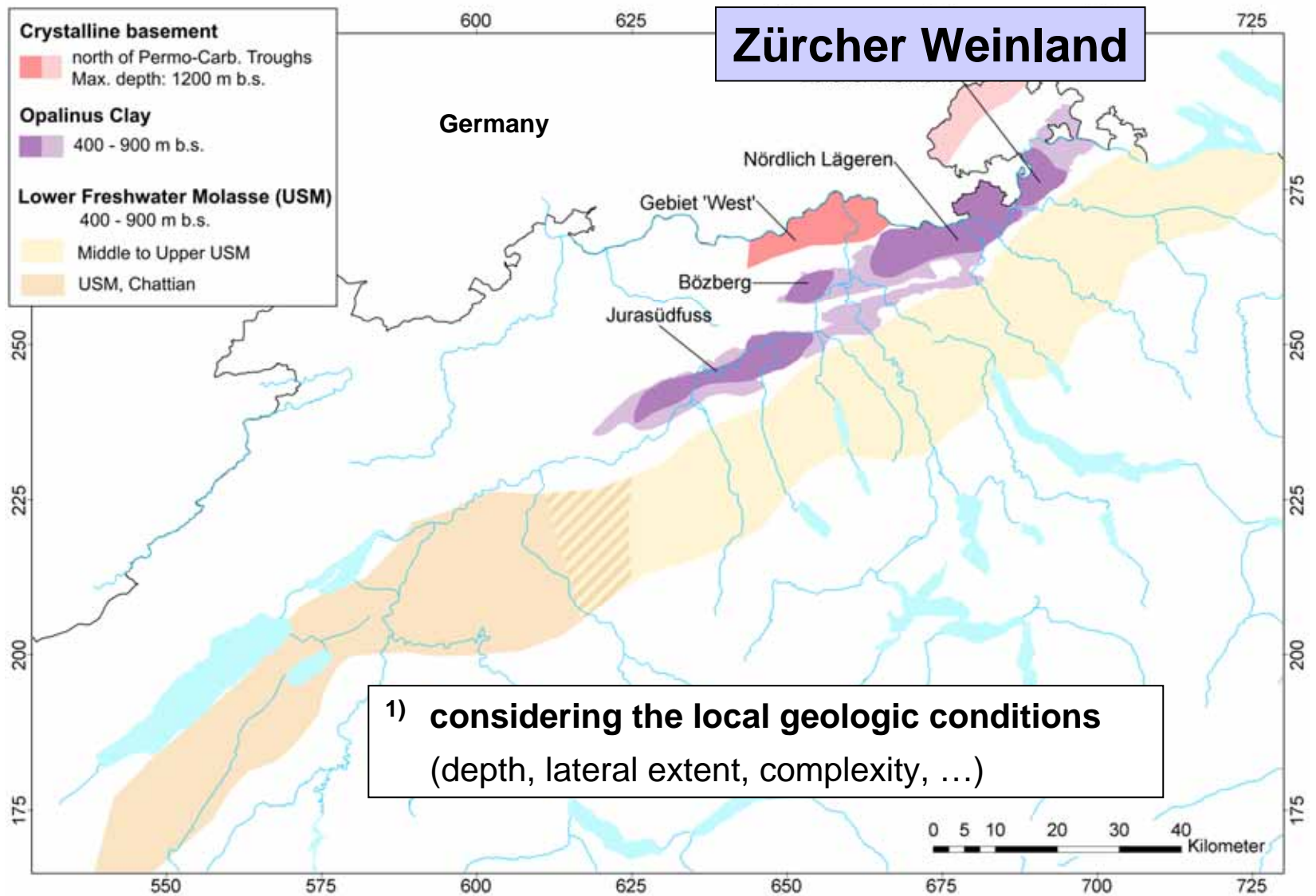
- Opalinus Clay

partially combined with clay-rich low permeability rock layers below/above

- Crystalline Bedrock



Step 3: Possible regions¹⁾



Past, present & future ...

Phase 1: Building the scientific basis

■ **This includes**

- building up infrastructure (labs, URLs, ...), tools (methods, models, data) & experienced team
- evaluation of geological possibilities (incl. regional & site-specific field work)
- development of projects (Project Gewähr, Kristallin-I, EN (Opalinus Clay))
- and the corresponding regulatory reviews

■ **The recent reviews (+ Swiss Gov't decision of 28.06.06) confirmed**

- the level of maturity of the Swiss HLW programme
- the sound scientific & technological basis

Phase 2: Taking the important decisions (*where to implement the repository*)

Phase 3: Implementation of repository according to decisions

Past, present & future ...

Phase 1: Building the scientific basis

Phase 2: Taking the important decisions (*where to implement*)

- **Based on**

- the possibilities that Switzerland offers (available understanding of geology)
- the understanding available on repository safety
- the needs of society (land use, environmental impact, socio-economic issues, ...)

..., **using a transparent societal process, take decision on where to build the repository** (integration of information & decision-making based on *Sectoral Plan 'Geological Disposal'*; → following slide)

- **In parallel: maintain & improve scientific / technological basis**

- broaden scientific support & enhance confidence
- maintain high level of scientific competence

Phase 3: Implementation of repository according to decisions

- **Importance of engineering & management (optimisation, ...)**
- **In parallel: be responsive to societal demands & maintain scientific basis**

Site selection procedure

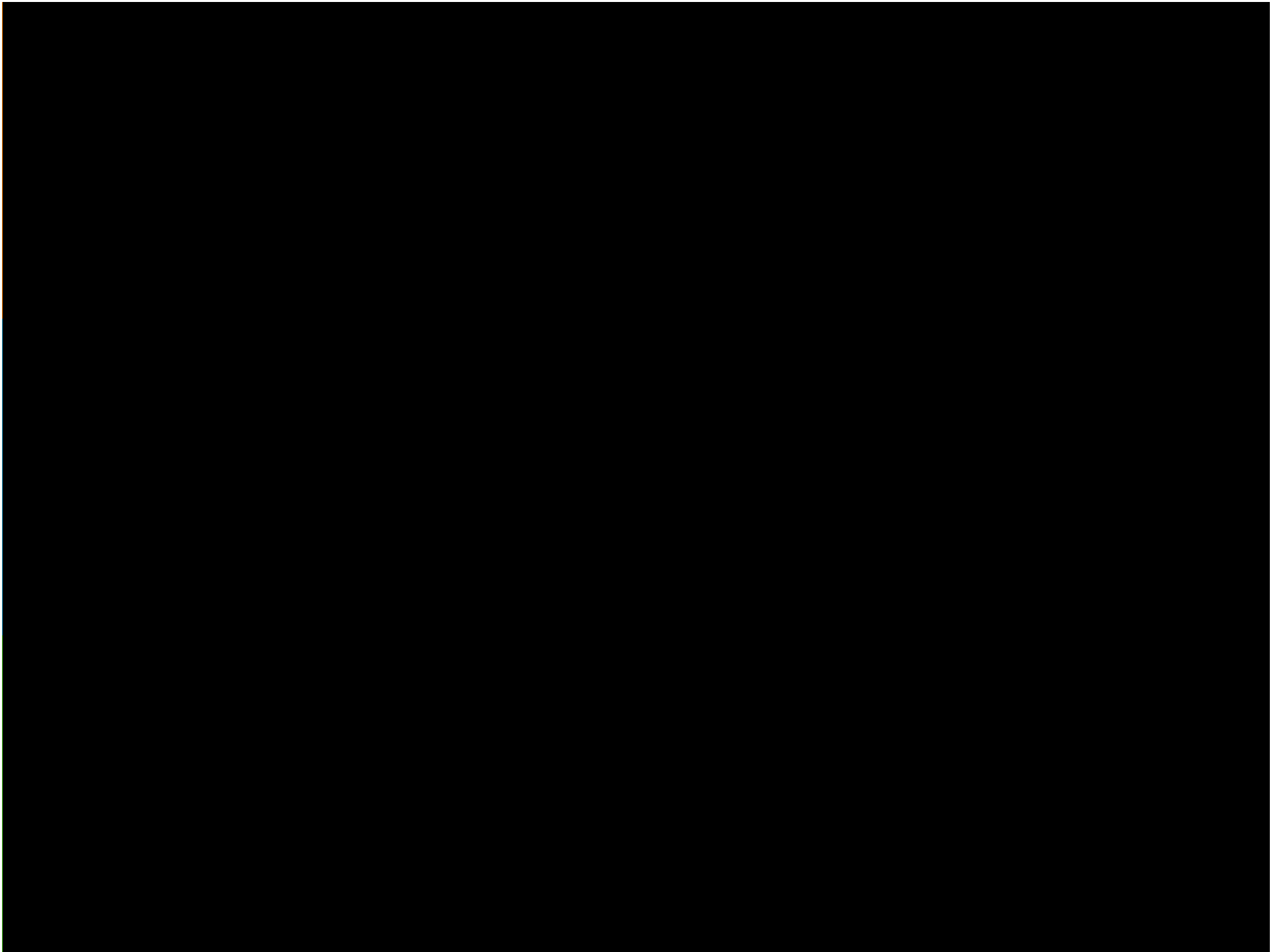
Sectoral Plan 'Geological Disposal'¹ (land use planning law)

- **Part 1: Concept** → www.bfe.admin.ch (Draft 6.06.06)
 - Aims, boundary conditions
 - Procedure (steps, role of stakeholders, products)
 - Criteria (safety / feasibility, land use planning, socio-economic issues)
- **Part 2: Implementation**
 - **1st step**: identification of potential regions (long-term safety → geology)
 - **2nd step**: within potential regions: identification of sites (land use planning, environmental impact, ... → surface infrastructure) & selection of 2 sites for more detailed evaluation
 - **3rd step**: selection of 1 site → general licence (as part of nuclear energy law)

¹ "Sachplan Geologische Tiefenlager"

Summary & conclusions

- **Significant level of technical maturity reached in Swiss HLW programme**
 - detailed projects demonstrate safety and engineering feasibility
 - several siting options identified
- **Next phase: site selection process**
 - procedure under development (with strong public involvement)
 - highest priority on safety
 - land use planning, environmental impact assessment & socio-economic issues also to be considered
- **Challenges ahead**
 - maintain / enhance scientific & technological basis
 - develop projects (esp. surface infrastructure) that consider needs of society (esp. in region)
 - interact with broad spectrum of stakeholders (region, cantons, neighbouring countries, ...)



Criteria (draft SGT of 6 June 2006)

Kriterien zur Standortevaluation hinsichtlich Sicherheit und technischer Machbarkeit

Kriteriengruppe	Kriterien
1. Eigenschaften des Wirtgesteins bzw. des einschlusswirksamen Gebirgsbereiches	1.1 Räumliche Ausdehnung 1.2 Hydraulische Durchlässigkeit 1.3 Geochemische Bedingungen 1.4 Freisetzungspfade
2. Langzeitstabilität	2.1 Beständigkeit der Standort- und Gesteinseigenschaften 2.2 Erosion 2.3 Lagerbedingte Einflüsse 2.4 Nutzungskonflikte
3. Zuverlässigkeit der geologischen Aussagen	3.1 Charakterisierbarkeit der Gesteine 3.2 Explorierbarkeit der räumlichen Verhältnisse 3.3 Prognostizierbarkeit der Langzeitveränderungen
4. Bautechnische Eignung	4.1 Felsmechanische Eigenschaften und Bedingungen 4.2 Untertägige Erschliessung und Wasserhaltung

Tabelle 1: Kriterien zur Standortevaluation hinsichtlich Sicherheit und technischer Machbarkeit

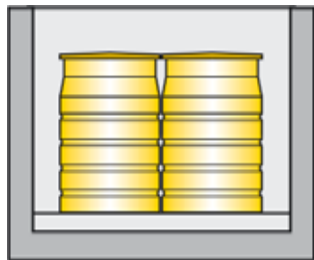
Quantities of SF / HLW / ILW (EN¹)



SF / HLW

- ~ 2000 canisters with SF
- ~ 700 canisters with vitrified HLW

SF in disposal canisters



ILW

~ 4400 m³ (emplacement containers)

ILW in emplacement containers