



University of Applied Sciences and Arts Northwestern Switzerland
School of Life Sciences

Interreg 
North-West Europe
Phos4You
European Regional Development Fund

Scenarios for implementation of phosphorus recovery in Switzerland

Using data from pilot and production plants

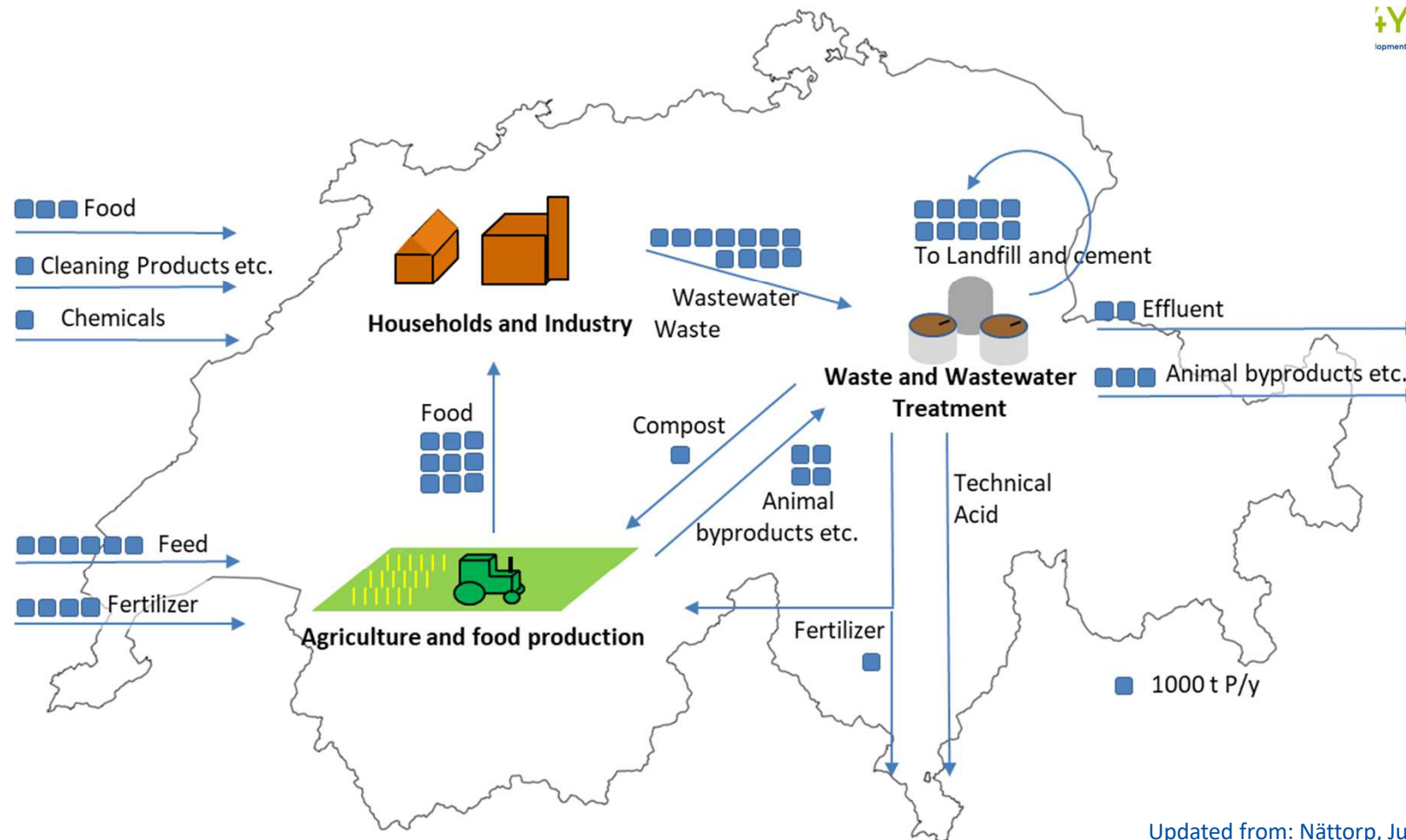
Phos4You final conference, Essen & online, 22-23 September 2021

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Outline

1. Swiss context
2. How were the scenarios developed?
3. Pros and cons of the scenarios
4. Conclusion

Phosphorus in Switzerland



Updated from: Nättorp, Jutz, ESPC3 2018

Swiss context

Legislation

- VVEA- recovery from sludge and meat and bone meal
- Implementation aid 50% recovery until 2026
- (validated) Vision SwissPhospor 75% until 2036
- Minrec- fertilizer limits, stricter than EU/DE

Infrastructure

- 180'000 t sludge DM (municipal and industrial)
- Sludge incinerated, 63% in SIP
- Hardly any fertilizer production

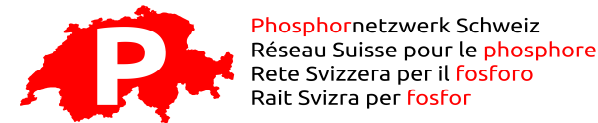
Northwestern Switzerland

- Northwestern Switzerland
 - 7% of Swiss area
 - 17% of Swiss population
 - 24% of Swiss sludge production
 - 38% of Swiss sludge disposal

Legislation and infrastructure similar
Scenarios applicable to Switzerland

Scenario development

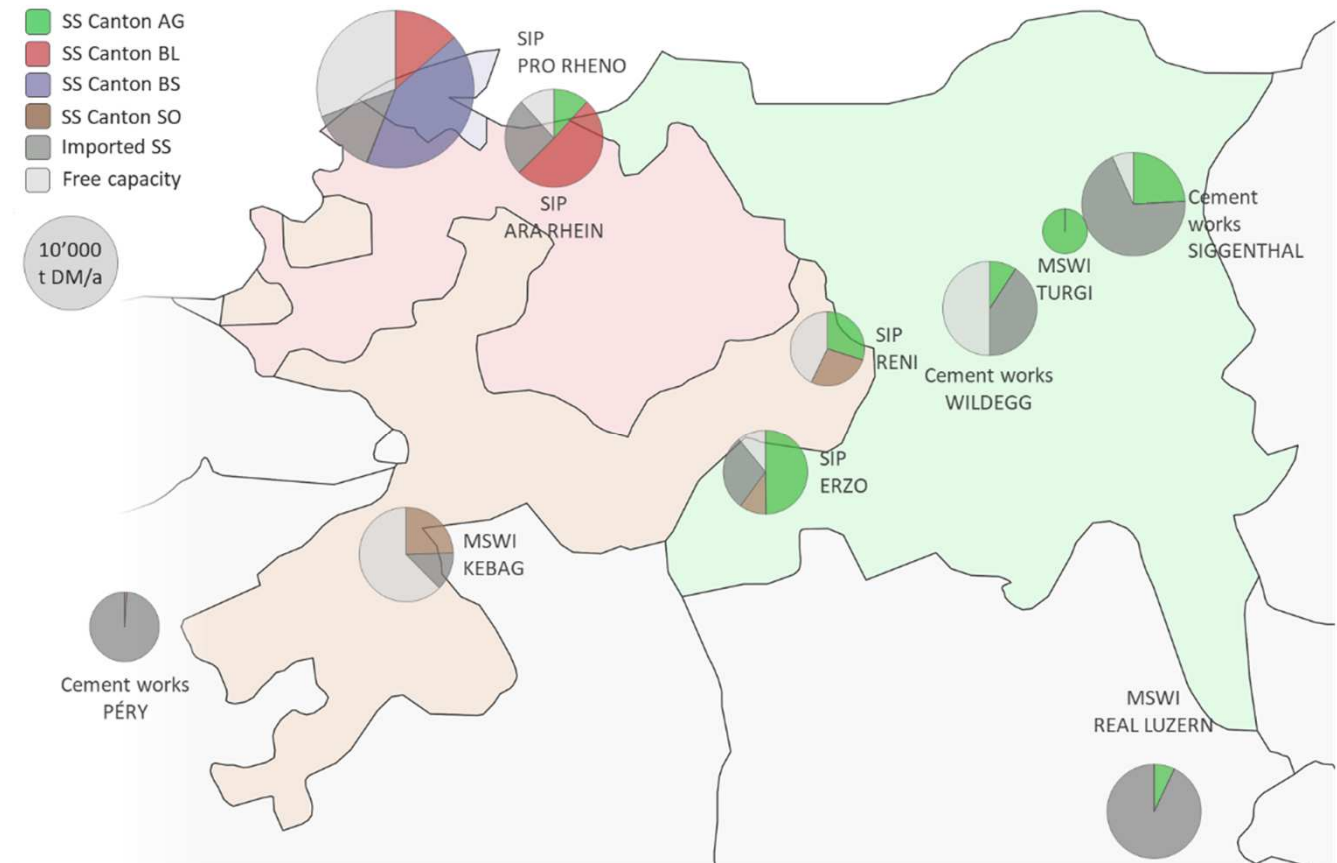
- Collect base data
 - Inventory of SIP of Switzerland
 - Inventory of sludge drying and cement works of Switzerland
 - Sludge balance NWCH
 - Suitable technologies
- Develop scenarios
 - Draft scenarios and target criteria with stakeholders
 - Validation workshop
 - Evaluation
 - Validation workshop for finished scenarios



Reports, News, Projects, Events
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Sludge balance

- 180% capacity
 - Replacement SIP next ~15y
- ➔ Flexibility recovery: technology & site



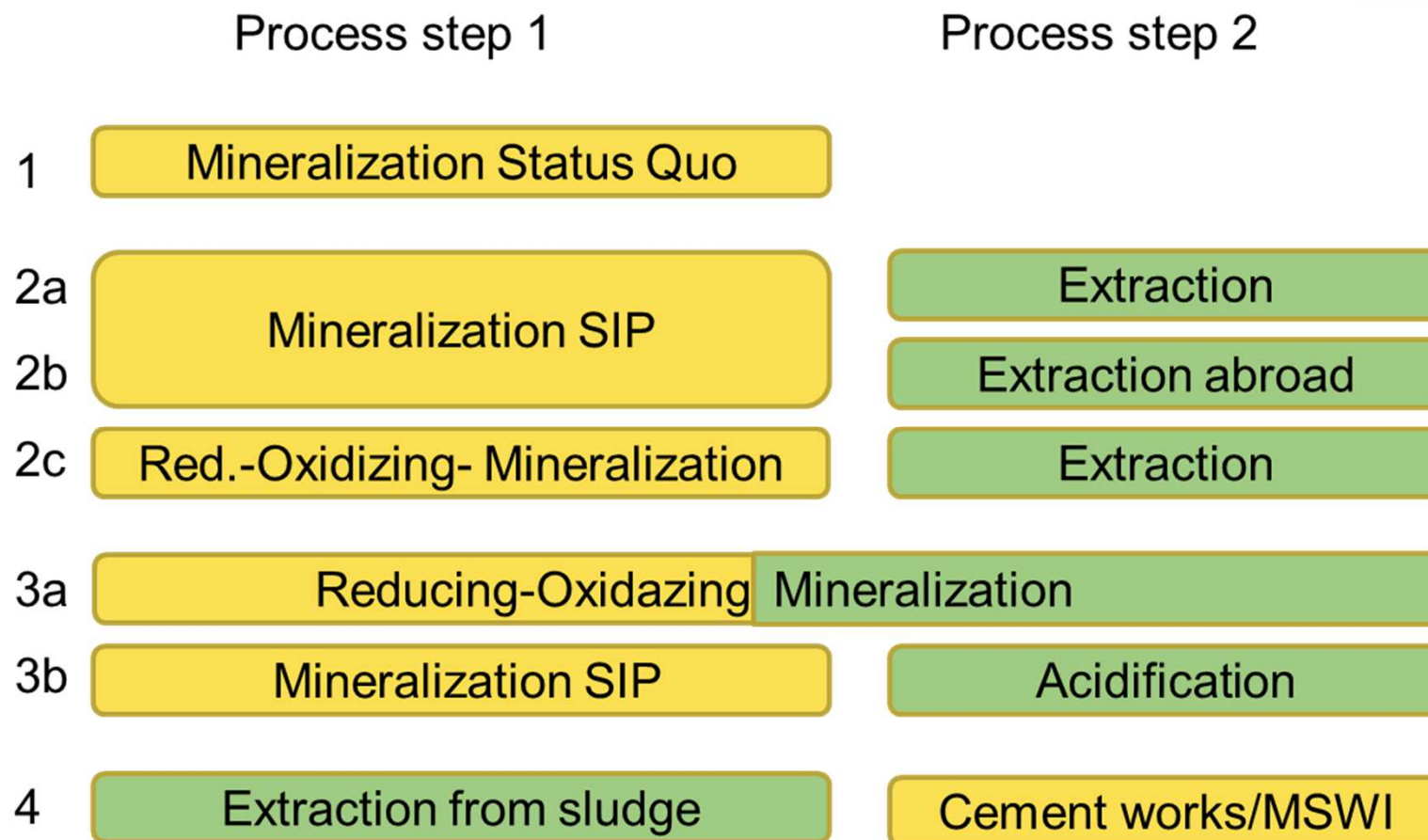
Technologies

- Technology selected and described for ministry of Northrhine- Westfalia MUNLV
 - TRL
 - Technology provider
 - European experience
 - ➔ publication pending
- Swiss context
 - Swiss target criteria
 - Cost updated
 - Bigmac-Index
 - Swiss disposal
 - Technologies
 - Less because of contaminants limits and yield requirement
 - New Swiss experiences

- 1 EcoPhos®
- 2 EuPhoRe®
- 3 PARFORCE
- 4 Phos4Life
- 5 PhosForce
- 6 Pyrophos
- 7 REALphos
- 8 Stuttgarter
- 9 ZAB/PHOS4green



Scenarios for recovery and disposal

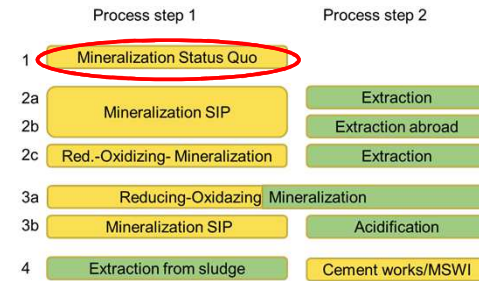


Scenario Evaluation- high influence of technology choice

					Red-Ox.-mineralization or acidification to increase plant availability (3a, 3b)		Extraction before mineralization (4)						
Mineralization in SIP and extraction of P from the ash													
					T1	T2	T3	T4	T5	T6	T7	T8	T9
Economic efficiency	Investment costs	●●●	●●●	●○○	●●○	●●○	●○○	●○○	●○○	●○○	●○○	●○○	●○○
	Operating costs	●●○	●●○	●○○	●●○	●●●	●○○	●●○	●●○	●●○	●○○	●○○	●○○
	Revenue process output	●●○	●●○	●●●	●○○	●○○	●●●	●●○	●○○	●○○	●○○	●○○	●○○
Environmental impact	Carbon footprint of phosphorus recovery process	●●●	●○○	●●○	●●●	●●●	●●●	●●○	●●●	●●●	●○○	●○○	●○○
	Removal of pollutants (heavy metals)	●●○	●●●	●●●	●●○	●●○	●○○	●●○	●●●	●●●	●●●	●●●	●●●
	Waste quantity:	●●○	●●○	●○○	●○○	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●
	landfill category B	●●○	●●○	●○○	●○○	●●●	●●●	●●○	●●○	●○○	●○○	●○○	●○○
Sustainability	heavy metal concentrate	●●○	●●●	●●○	●●○	●○○	●●○	●○○	●●○	●○○	●○○	●○○	●○○
	Recovery rate	●●●	●●○	●●●	●●○	●●●	●●●	●●●	●●○	●○○	●○○	●○○	●○○
	Contribution to closing the P cycle in Switzerland and in agriculture	●●●	●●●	●●●	●●●	●○○	●●○	●○○	●○○	●○○	●○○	●○○	●○○
Disposal safety	Phosphate solubility in neutral ammonium citrate (NAC)	●●●	No fertilizer	No fertilizer	●●●	●○○	●●●	●●○	●●●	●●○	●●●	●●●	●●●
	Technology Readiness Level (TRL)	●○○	●○○	●●○	●○○	●●●	●●●	●○○	●○○	●○○	●○○	●○○	●○○
	Experience in Swiss project	●○○	●○○	●●○	●●○	●●●	●●○	●●○	●○○	●○○	●○○	●○○	●○○

Mineralization status quo and recovery open until 2026

- Less cost with later implementation
- More technology experience on market
- Combine with disposal renewal
- Less partners for cooperation



Mineralization in SIP

Extraction of P from the ash

- High removal of pollutants
- High recovery rate and plant availability
- Closure of P cycle in Switzerland and in agriculture
- Complex processes with likely difficulties for first movers
- Limited Swiss experience



Mineralization in SIP extraction of P from the ash

...extraction abroad

- Requires stable cooperation partners
- Comparable cost
- German market w. additional potentially better options
in SIP in Red.-Oxidizing mineralization
- Today less experience and thus more risk than with SPI.
- No known advantages in cost or environmental impact.



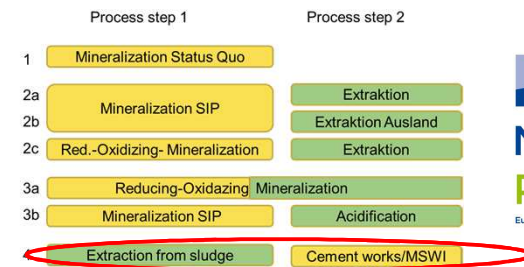
Reducing-oxidizing mineralization or acidification to increase of plant availability

- Relatively simple processes
- Rather positive warming potential
- Little landfilling
- High recovery rate
- Closing of P cycle difficult in Switzerland because of diluted fertilizer product
- Challenge: low contaminant input mix (e.g. MBM) to fulfill Swiss contaminant limits.



Extraction from sludge Mineralization in cement plant or MSWI (or SIP)

- High removal of pollutants
- No landfill needed if combined with cement works
- Low recovery rate
- Low output revenue
- No (positive) Swiss experience



Conclusion

- Recent, reliable data with all relevant process types
- NWCH disposal renewal gives large flexibility for disposal- recovery combinations
- No obvious best choice, stakeholder weighting of criteria decisive
- Scenario choice has considerable impact, e.g. 22 MEUR OPEX/a, 700 t P/a

The circular phosphorus future is wide open, stakeholder initiative is key

