

SAFE AND SUSTAINABLE-BY-DESIGN RODENTICIDES

(RESEARCH PROJECT FUNDED BY UBA PROJECT FKZ 3719 67 406)



EU GREEN WEEK 2021 PARTNER EVENT



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Sustainable Substitution by Design - SSbD

Systems Approach

1. Service needed? Control of populations of rats, mice etc. to avoid transmission of diseases (e.g. *Yersinia pestis*) and loss of food





Sustainable Substitution by Design - SSbD

Systems Approach

1. Service needed?
2. Non chemical alternatives available?
Different (systems) design, alternative business models available, developable?



Source: Umweltbundesamt IV1.4



Sustainable Substitution by Design - SSbD

Systems Approach

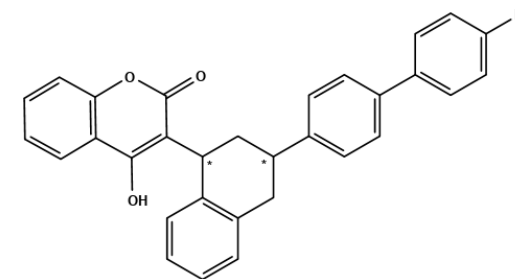
1. Service needed?
2. Non chemical alternatives available? (e.g. different (systems) design, alternative business models available, developable?)

3. Why is a certain chemical used? **Rodenticides-indispensible?**

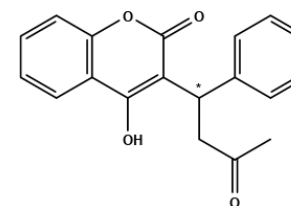
- A delayed effect is required for to avoid bait shyness
- Anticoagulant rodenticides have proven most effective

-> **Little effort only to develop them further since the 1980s**

- Toxic to reproduction
- Low target specificity
- Environmental Persistence
- Bioaccumulative



Brodifacoum



Warfarin



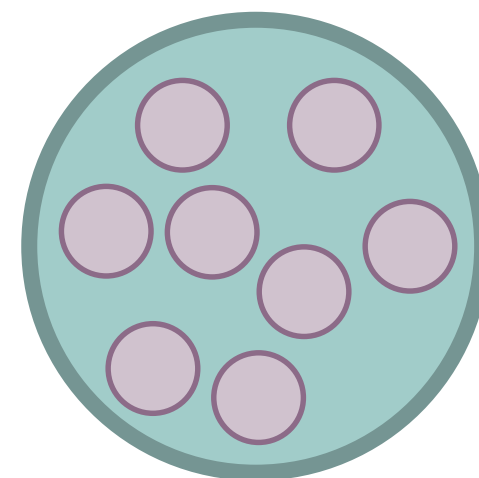
Sustainable Substitution by Design - SSbD

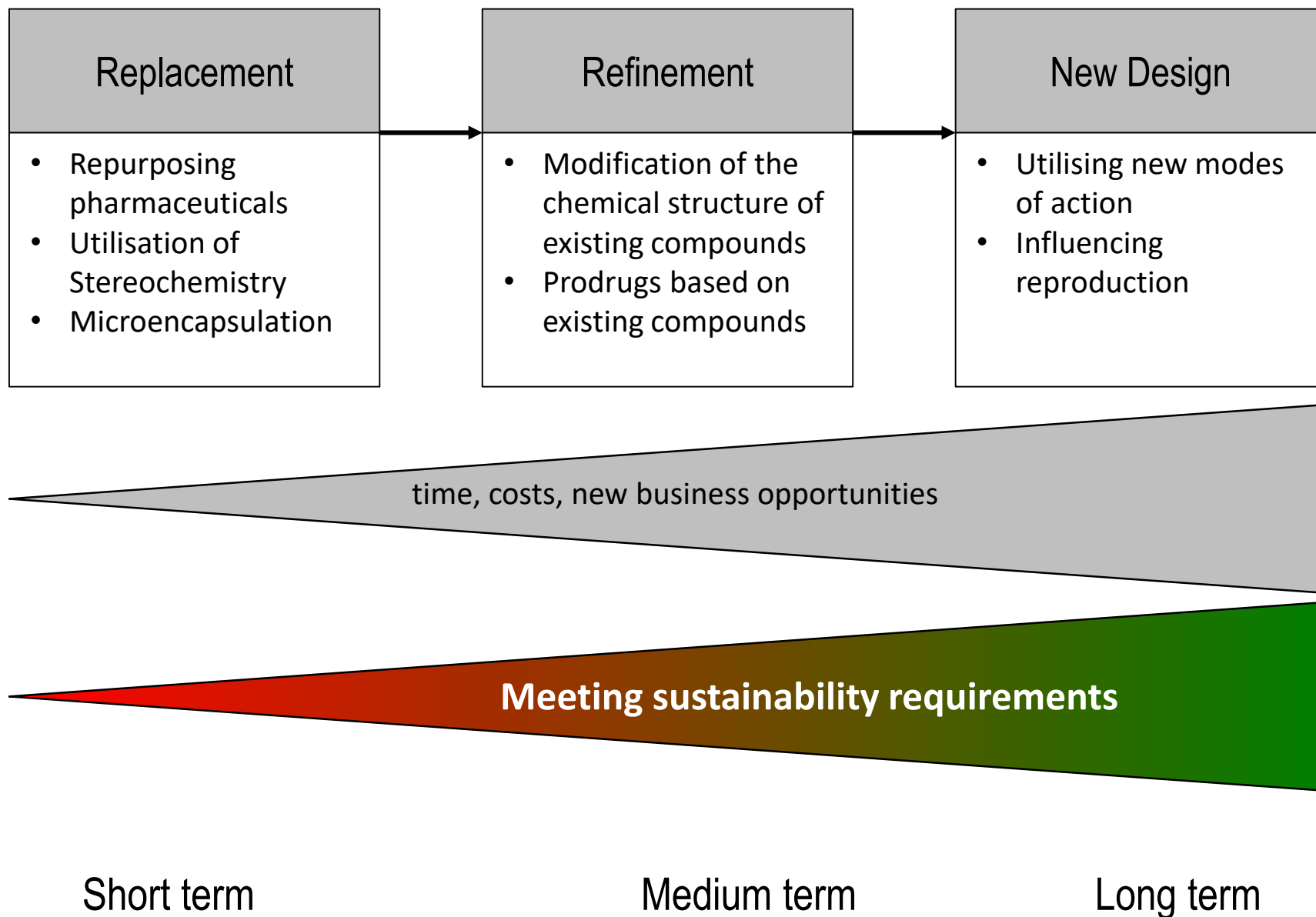
Systems Approach

4. Chemical alternatives

a. Existing rodenticides (same application field)

different mode of application e.g. microencapsulation







Sustainable Substitution by Design - SSbD

Systems Approach

4. Chemical alternatives

- a. Existing ones (same application field)
- b. From other other application fields
- c. Modification of existing compounds - Redesign
- d. Development of new compounds - De-novo design



Sustainable Substitution by Design - SSbD

Systems Approach

4. Chemical alternatives

- a. Existing ones (same application field)
- b. From other other application fields

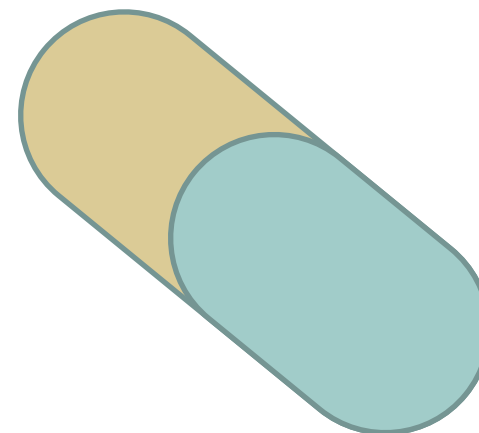
Alternative active compounds currently used in medicine

Advantages

- Same mode of action as anticoagulant rodenticides
- Oral application possible
- Already produced

Restraints

- No improvement of animal welfare
- No increased target specificity



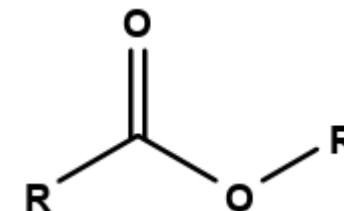
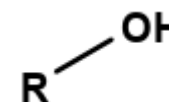
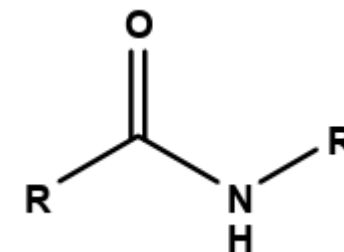
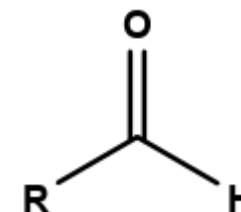
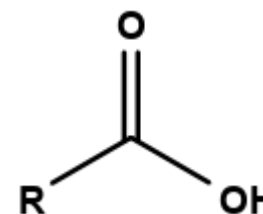


Re-Design: Modification of Known Rodenticides

Modification of the chemical structure

Introduction of e.g.

- hydrophilic groups decreases risk of bioaccumulation
- acid sensitive groups decreases risk of secondary poisoning
- degradable groups decreases persistence





De-novo Design

New modes of action, new molecules

Target specific modes of action

- Temperature regulation
- Blood sugar regulation
 - hepatic glucokinase
 - gluconeogenesis
- Vitamin A regulation



Conclusion

1. Sustainable Substitution by Design is a systems approach
2. Starts with service and function
3. Design on various levels needed (systems, application, molecules)
4. New molecules by molecular benign-by-design allows for of more target specific modes of action and improved environmental properties