

# Socio-economic analysis of PBT/vPvB substances in REACH: A concern-based approach

Silke Gabbert

Environmental Economics and Natural Resources Group  
Wageningen University & Research

[silke.gabbert@wur.nl](mailto:silke.gabbert@wur.nl)



# Outline

1. Background: Socio-economic analysis in REACH authorisation and restriction processes
2. The 'PBT/vPvB concern' and how it can feed into the evaluation of impacts in an SEA
3. An approach to concern-based cost-effectiveness analysis of PBT/vPvB substances
4. Illustrative case study
5. Conclusions and points for further discussion

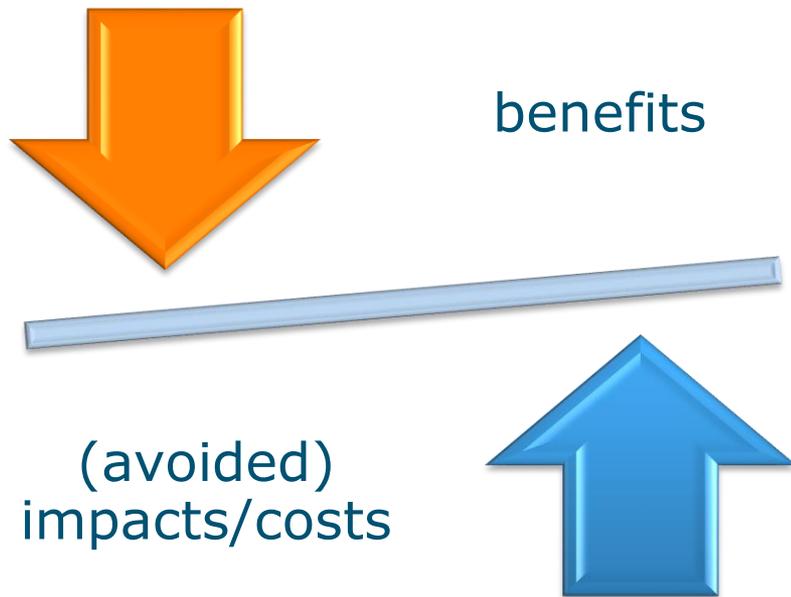
# 1. Background

- In REACH, PBT/vPvB substances are Substances of Very High Concern (SVHC)
- Two regulatory instruments: Authorisation and restriction

	<b>Authorisation</b>	<b>Restriction</b>
Key actor(s)	Companies	Member state or ECHA at the request of the Commission
Applies to	SVHC (substances included in REACH Annex XIV)	All substances on its own in mixtures or in articles
Aim	Progressive replacement of SVHC by suitable alternative substances or technologies where these are economically and technically viable	Stop manufacture or marketing of substances unless they comply with defined risk control measures
<b>SEA</b>	<b>Mandatory</b>	<b>Not mandatory (but recommended)</b>
Aim of SEA	<ul style="list-style-type: none"><li>• Show economic feasibility of alternatives in a substitution plan</li><li>• Show that the benefits of a continued use outweigh the risks/damage costs</li></ul>	<ul style="list-style-type: none"><li>• Provide supportive information on different sections of a restriction proposal, e.g. assessment of impacts/costs and benefits of the proposed restriction</li></ul>

# 1. Background

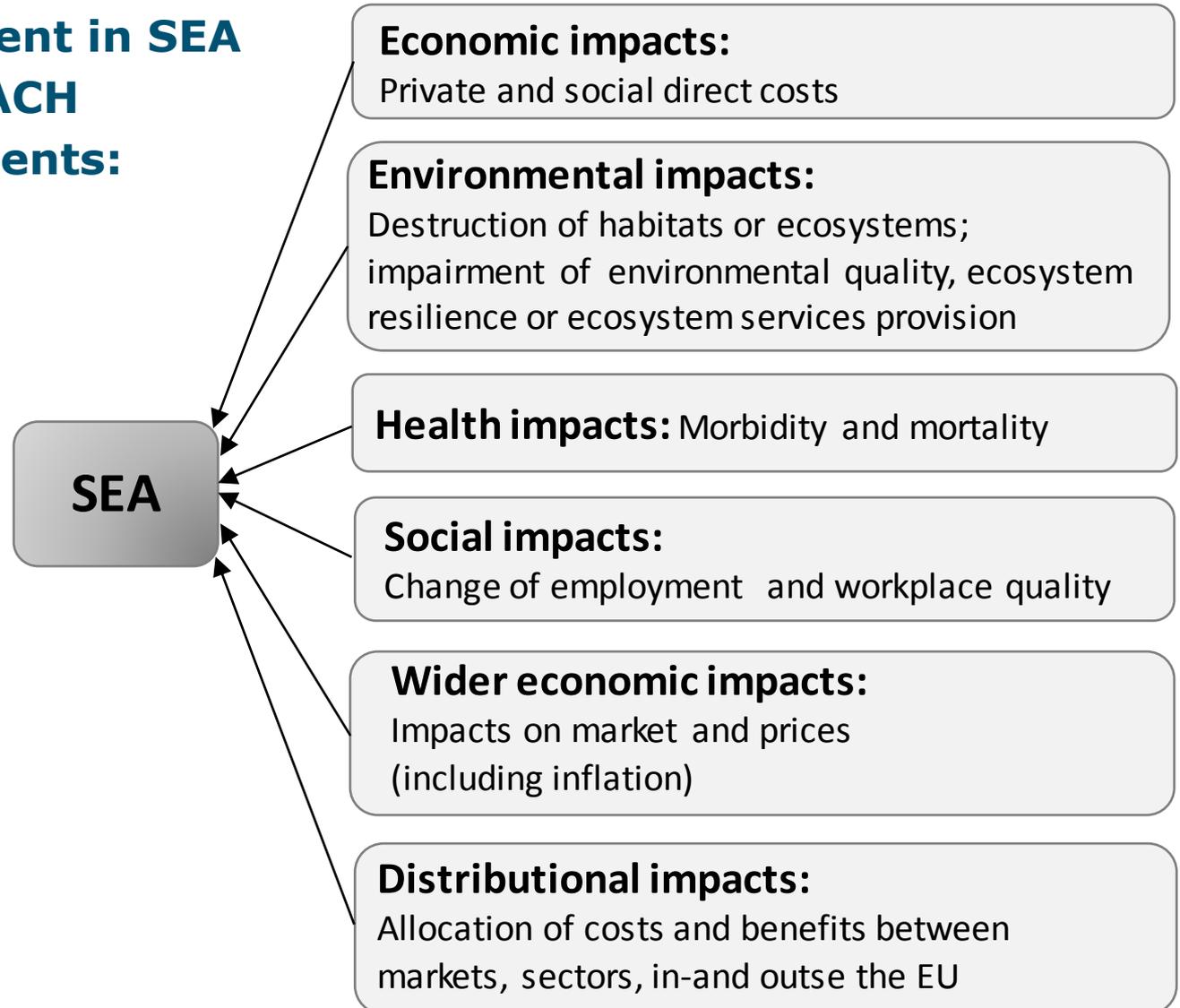
**Rationale of SEA:** Balancing the (expected) gains against the (expected) losses



- What defines a 'benefit' and an 'impact/cost' depends on the assessment perspective
- Different impact categories (impacts on human health and environment, social impacts, wider economic impacts, distributional impacts)
- In general, a societal perspective is adopted, i.e. costs and benefits comprise both private and external costs/benefits

# 1. Background

## Impact assessment in SEA according to REACH Guidance documents:



## 2. The PBT/vPvB concern

- **Regulatory concern** of PBT/vPvB substances:
  - REACH Guidance R.11: “Safe concentrations in the environment cannot be established using the methods currently available with a sufficient reliability for an acceptable risk to be determined in a quantitative way”
  - Potential to accumulate in the environment  
→ cessation of emissions will not necessarily result in a reduction of environmental concentrations
  - Existing testing methods and inappropriate to predict long-term effects
  - LRTP: Potential to be transported to remote areas

## 2. The PBT/vPvB concern

- **Regulatory concern** of PBT/vPvB substances (cont.):
  - Uncertainty and knowledge gaps about long-term effects, risks and impacts
  - A quantitative assessment and valuation of human health and environmental impacts is considered not possible
    - Prioritisation of a cost-effectiveness analysis approach (SEAC/31/2016/05 Rev. 1)

### 3. An approach to concern-based CEA

- Persistence = accumulation of environmental concentrations over time!
- Persistence = stock externalities!

→ What are the implications for SEA?

EC project “Approach for the Evaluation of PBTs Subject to Authorisation and Restriction Procedures in the context of Socio-economic analysis”

See reporting material at:

<https://publications.europa.eu/en/publication-detail/-/publication/ff4fea17-704d-11e8-9483-01aa75ed71a1/language-en/format-PDF/source-71972846>

# 3. An approach to concern-based CEA

## Outline of CEA approach:

**Step 1:**  
Assessment of  
stock dynamics

- Determine a PBT/vPvB substance's time path of pollution

**Step 2:**  
Impact  
evaluation

- Transfer information about (expected) environmental concentrations into impact information

**Step 3:**  
Cost  
assessment

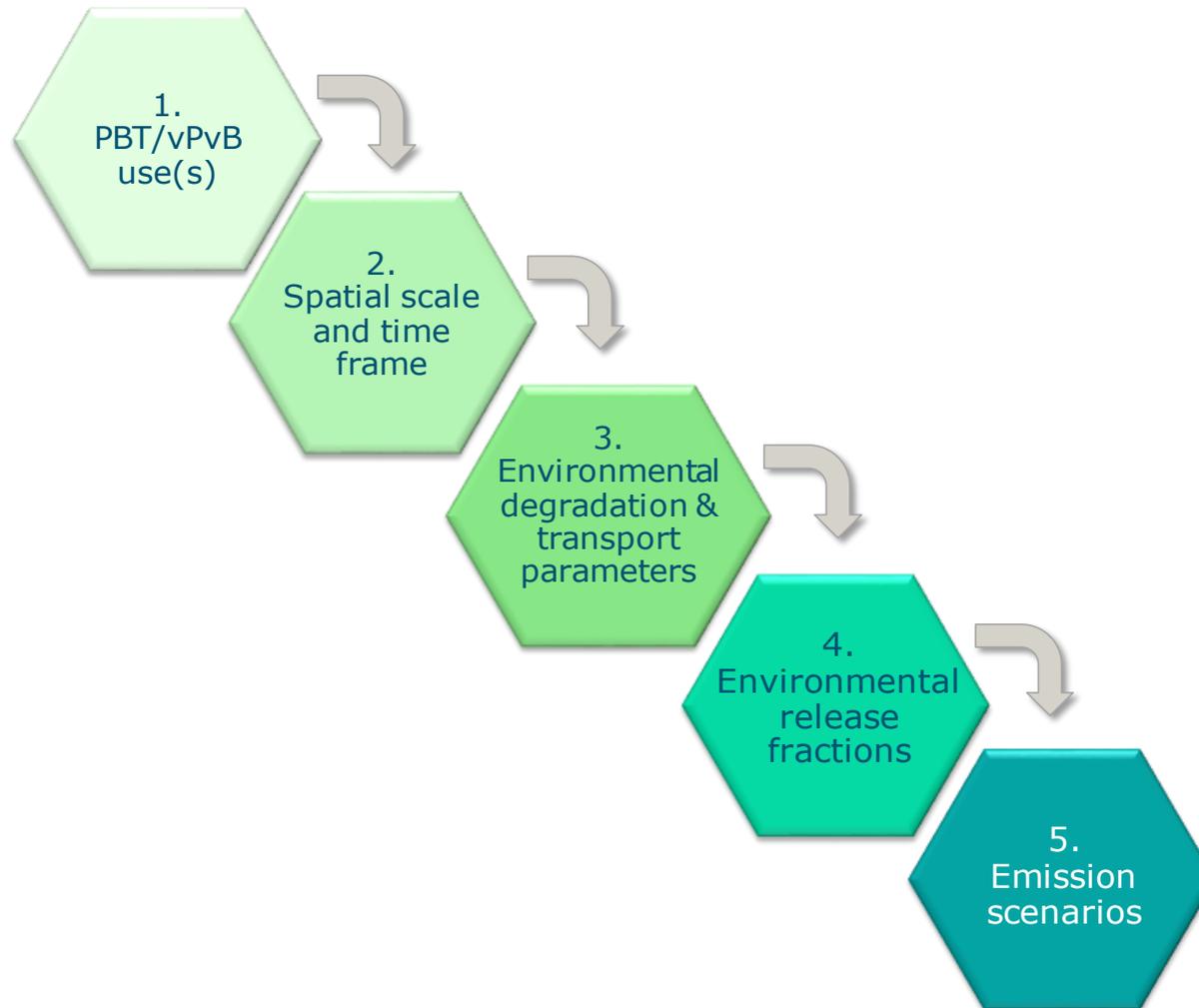
- Determine costs of PBT/vPvB emission reduction or abatement

**Step 4:**  
Definition of  
benchmarks

- Define benchmark values as upper proportionality bounds in an CEA

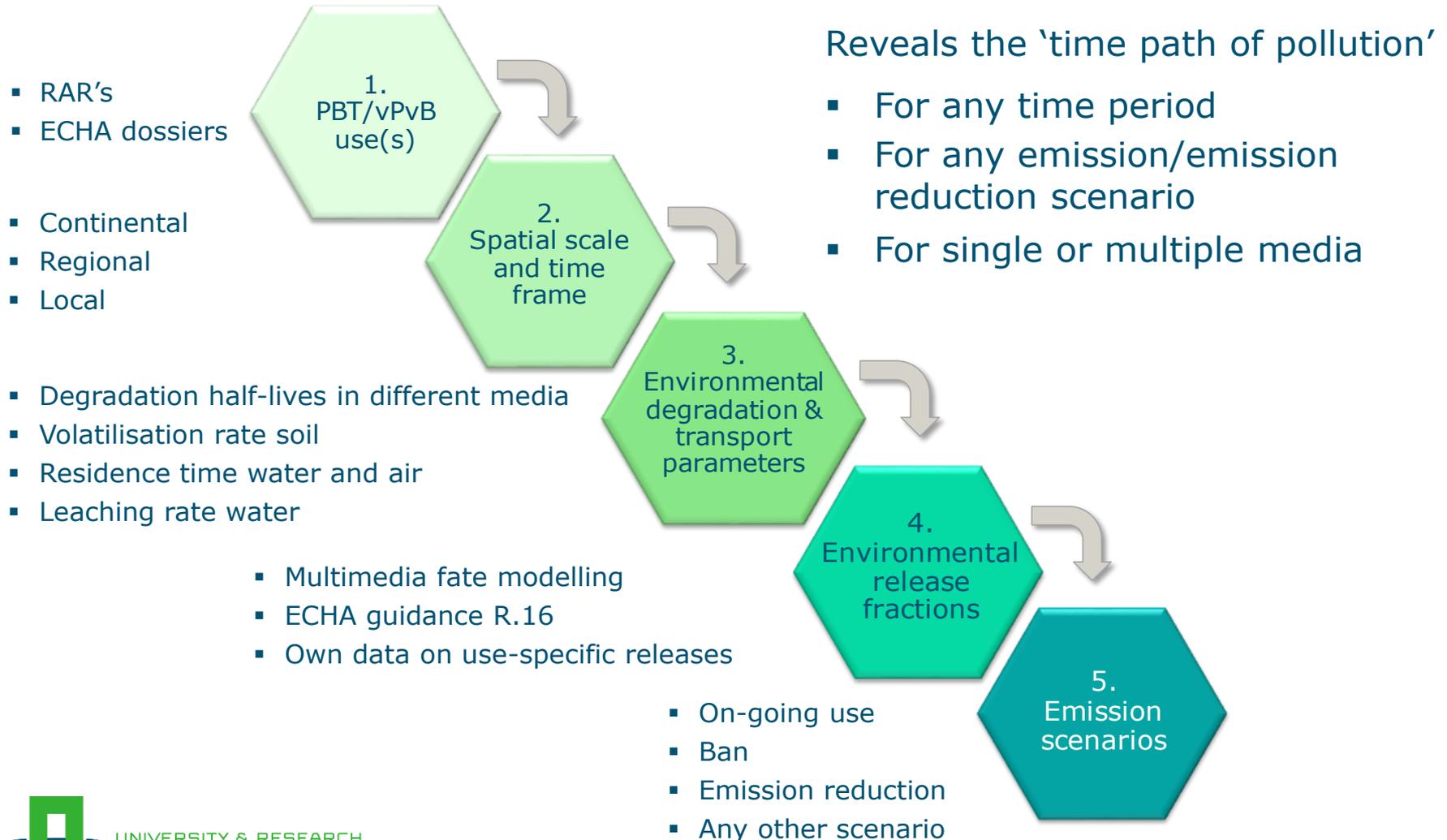
# 3. An approach to concern-based CEA

## Step 1: Assessment of stock dynamics



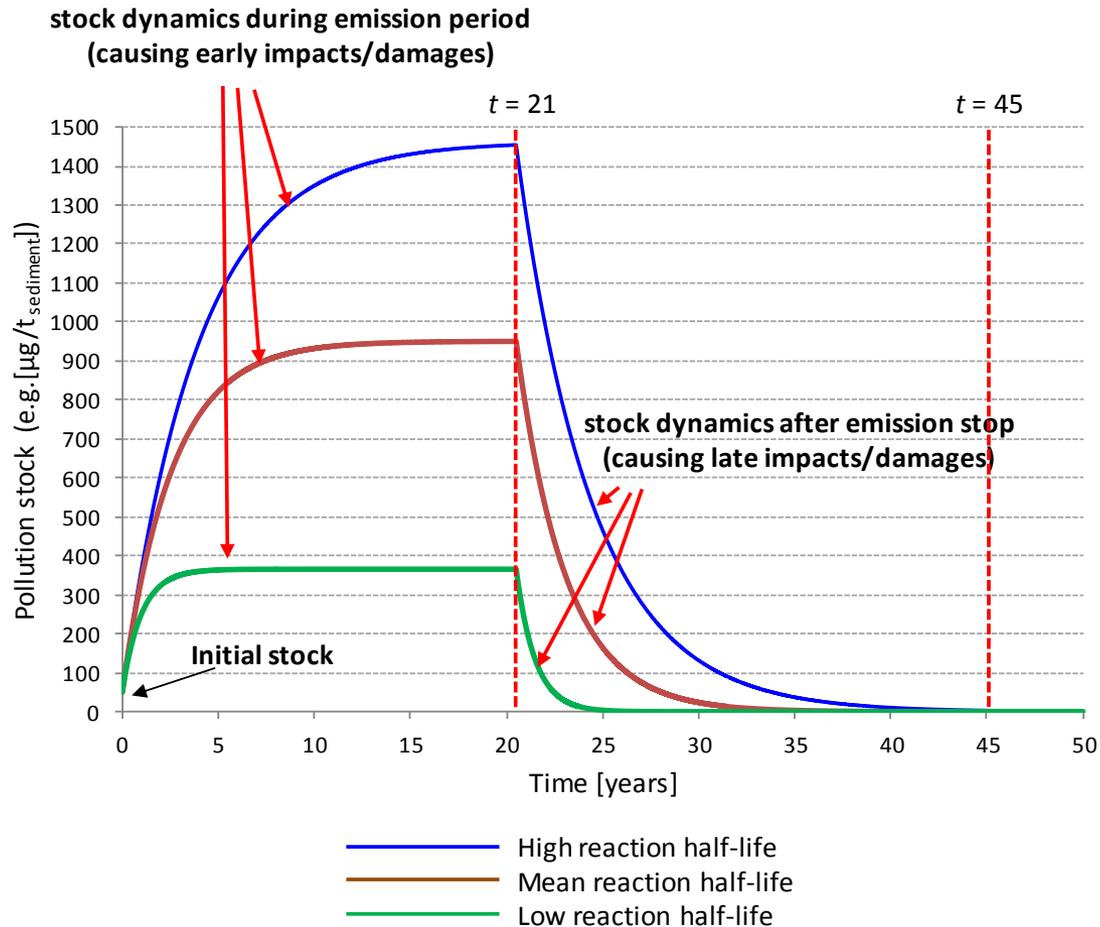
# 3. An approach to concern-based CEA

## Step 1: Assessment of stock dynamics



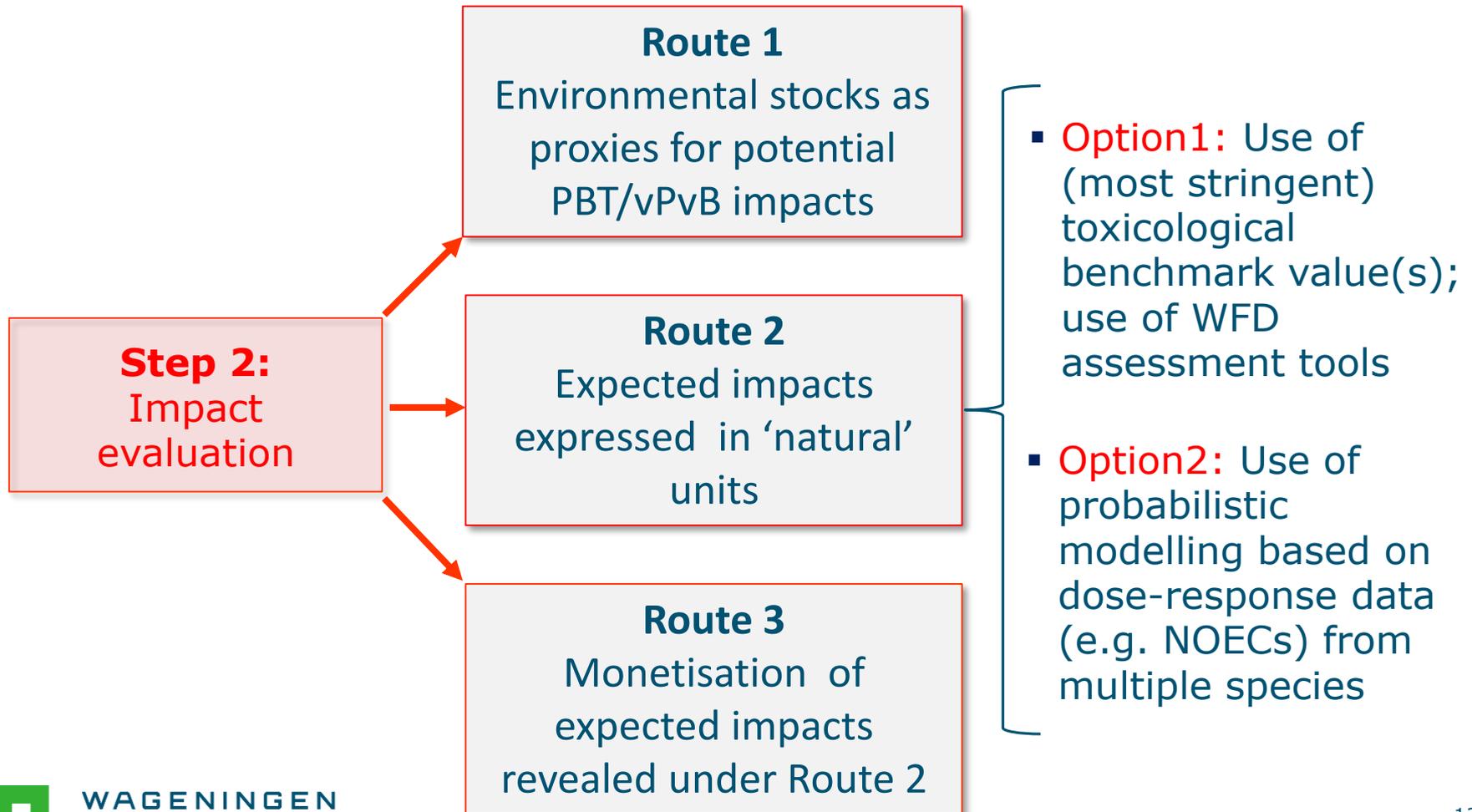
### 3. An approach to concern-based CEA

- Illustrative example of stock dynamics assuming constant emissions



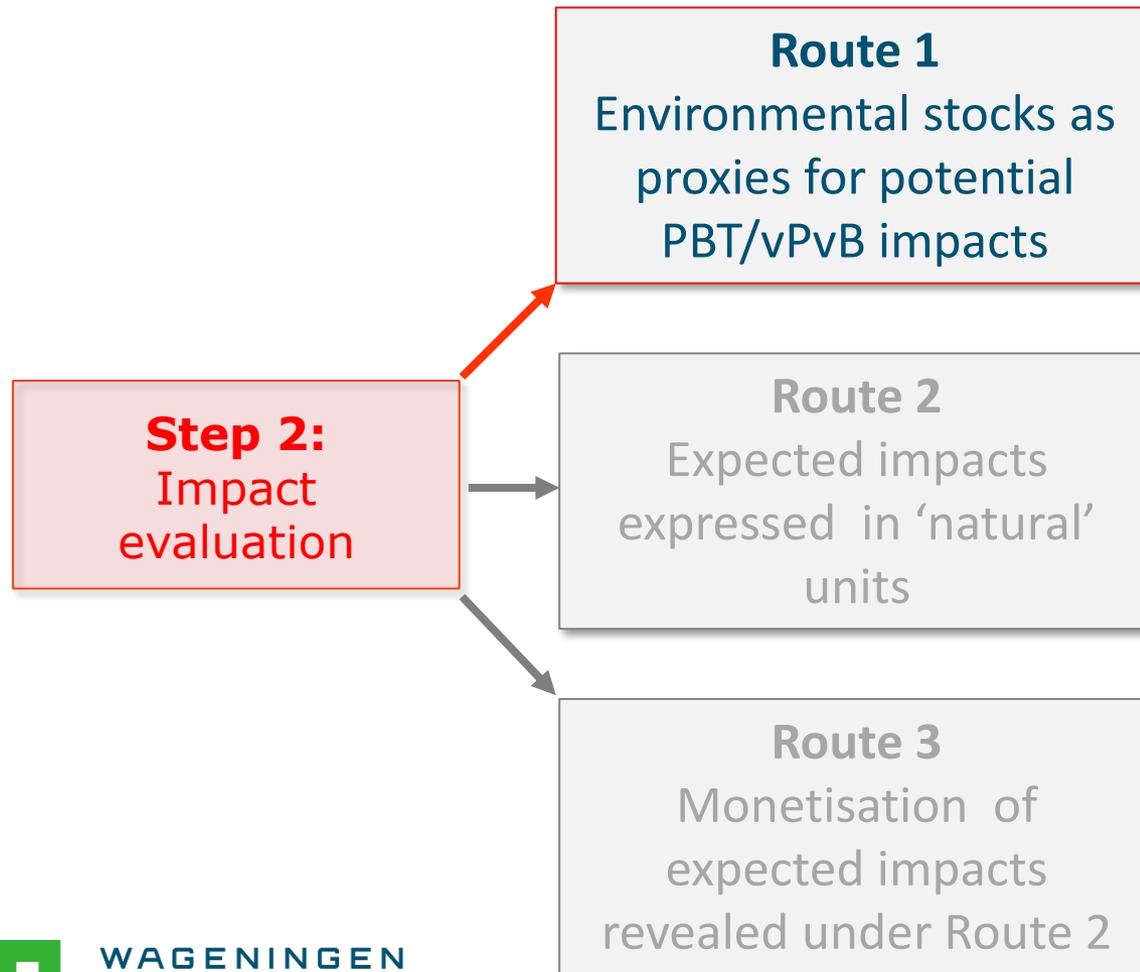
# 3. An approach to concern-based CEA

## Step 2: Impact evaluation



# 3. An approach to concern-based CEA

## Step 2: Impact evaluation/approximation



- Possible for all PBTs/vPvBs if data on emissions or production volume are available

- Possible for some PBTs/vPvBs

- Not possible due to lacking valuation data

# 3. An approach to concern-based CEA

## Step 3: Cost assessment

IVM Institute for Environmental Studies

---

### **Benchmark development for the proportionality assessment of PBT and vPvB substances**

IVM 2015: [https://echa.europa.eu/documents/10162/13647/R15\\_11\\_pbt\\_benchmark\\_report\\_en.pdf](https://echa.europa.eu/documents/10162/13647/R15_11_pbt_benchmark_report_en.pdf)

- Cost estimates are assumed to reflect policy preferences/WTP
- Costs are expressed in €/kg **emission reduction**
- BUT: Due to being persistent, impacts from exposure to PBT/vPvB chemicals arise from the environmental stock, NOT from emissions!
- The relevant cost unit for CEA of PBT/vPvB substances is €/kg **avoided stock!**

### 3. An approach to concern-based CEA

#### Step 4: Benchmarking

➤ **General definition 'benchmark':**

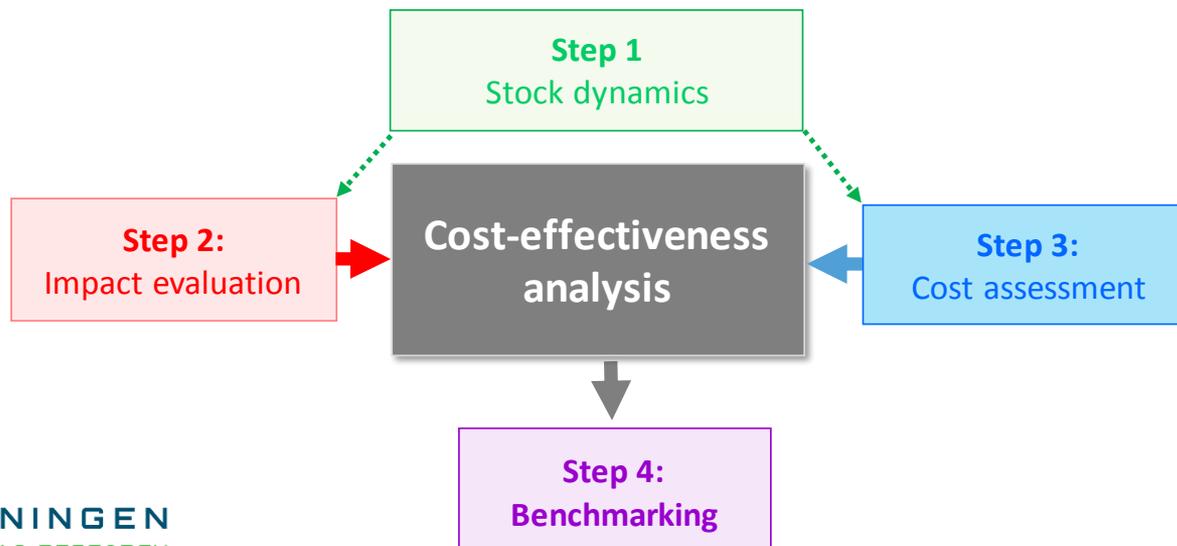
Standard value of a specific parameter to which the actual/estimated value of that parameter will be compared.

➤ **Definition 'benchmark' in REACH SEA applications:**

Value of a parameter indicating the cost-effectiveness of a (policy) measure.

→ Is a particular cost-effectiveness ration considered acceptable?

→ Benchmarks depend on the route to impact assessment!



# 3. An approach to concern-based CEA

## Step 4: Benchmarking

- Different approaches considered:
  - Benchmarks based on clean-up costs
    - linked to defined environmental quality standards (EQS)
  - Benchmarks based on remediation costs
    - similar to approach adopted in IVM study
  - Benchmarks based on affordability criteria
    - based on (additional) economic criteria such as determining 'disproportionate cost' criteria, or 'best available techniques' criteria
- Cost database for 17 PBT/vPvB substances published under <https://publications.europa.eu/en/publication-detail/-/publication/ff4fea17-704d-11e8-9483-01aa75ed71a1/language-en/format-PDF/source-71972846>

## 4. Illustrative case study: PFOS and D4

Step 1+2: Assessment of stock dynamics as an approximation of a PBT/vPvB's impact potential

Step	PFOS	D4	
1. PBT/vPvB use	Paper treatment	Wash-off PCPs	
2. Spatial scale and time frame	Continental: 28 years Local: 12 years	Continental: 12 years	
3. Elimination rate [1/days]	Continental: Water: 5.81E-03 Sediment: 6.93E-07 Soil: 7.57E-04 Air: 1.18E-01	Local: Water: 1.00E+01 Sediment: 6.93E-07 Soil: 7.57E-04 Air: 1.00E+01	Continental: Water: 4.15E-03 Sediment: 2.20E-03 Soil: 4.73E-02 Air: 1.61E-01
4. Release fractions [%]	Continental: Water: 73.6 Sediment: 0 Soil: 21.4 Air: 5	Local: Water: 90 Sediment: 0 Soil: 10 Air: 0	Continental: Water: 25 Sediment: 0 Soil: 75 Air: 0
5. Policy scenarios:	S1: 'No control', benchmark scenario S2: Emission stop of the considered use after $t=6$ years of the SEA assessment period S3: Linear reduction of emissions from the considered use at $t=1$ of the SEA assessment period S4: Emission stop of all uses at $t=1$ of the SEA assessment period (ban)		

## 4. Illustrative case study: PFOS and D4

Step 1+2: Assessment of stock dynamics as an approximation of a PBT/vPvB's impact potential

- 4 different emission scenarios (boxes represent emissions within SEA assessment period):

S1



- 'No control' or 'baseline' scenario:  
- On-going emissions from all uses for the entire time period

S2



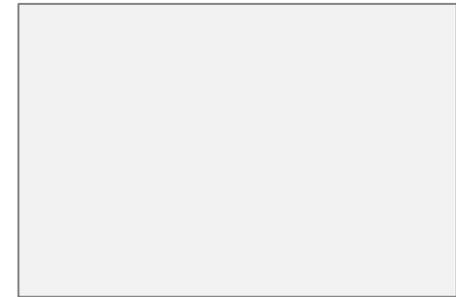
- Emission stop of the considered use after  $t=6$  years of the SEA assessment period

S3



- Linear reduction of emissions from the considered use starting at  $t=1$  of the SEA emission period to 20% of the initial emission level

S4

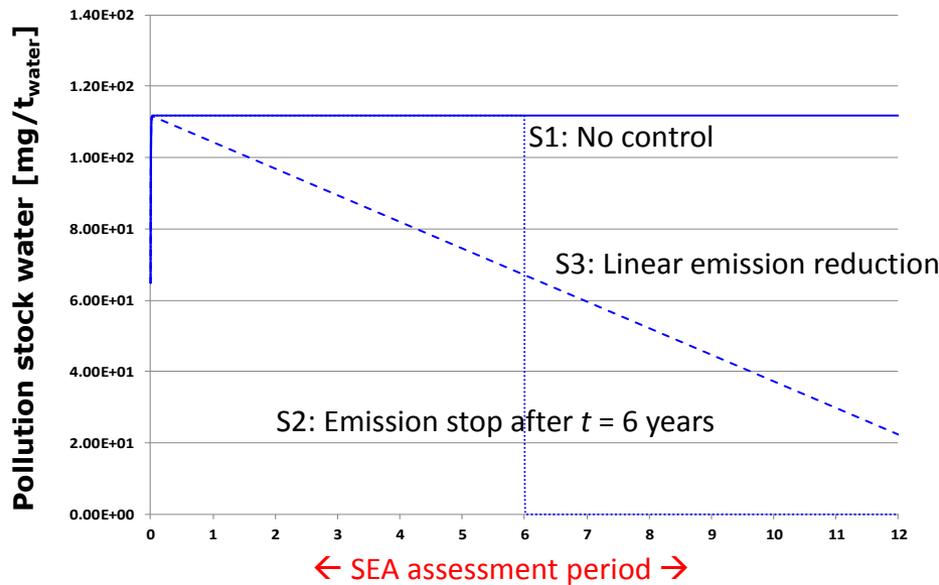


- Emission stop of all uses at  $t=1$  of the SEA assessment period (ban)

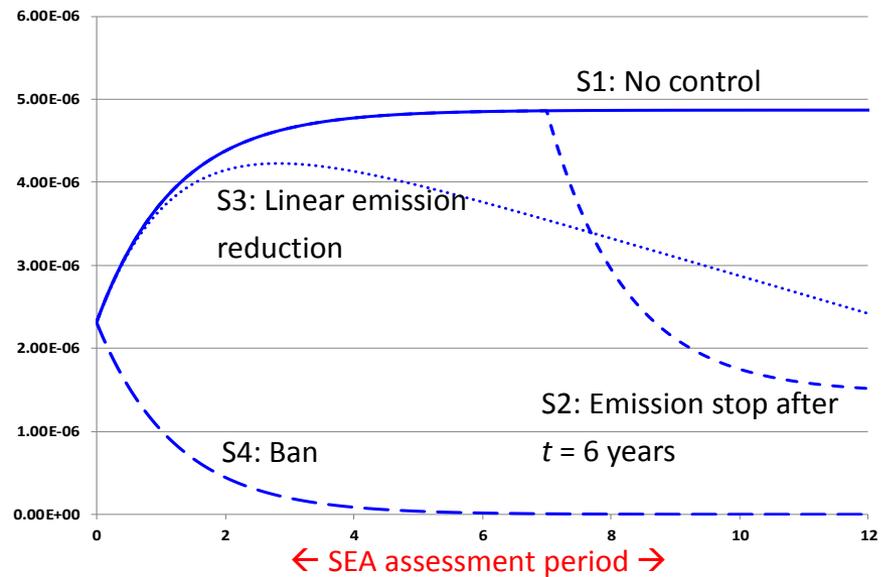
# 4. Illustrative case study: PFOS and D4

Step 1+2: Assessment of stock dynamics as an approximation of a PBT/vPvB's impact potential

### PFOS: Local scale



### D4: Continental scale



Source: Gabbert et al. 2017.

Time [years]

## 4. Illustrative case study: PFOS and D4

### Step 3: Cost assessment

PFOS, local scenario, SEA period 12 years

	Scenario S1	Scenario S2	Scenario S3
Total environmental stock [kg]	177	104	117
Total stock reduction compared to S1 [kg]	0	73	63
NPV of total cost [€ mln]	-	1.9	1.7
Cost per unit of avoided stock [€/kg]	-	26,000	27,000

D4, continental scenario, SEA period 12 years

	Scenario S1	Scenario S2	Scenario S3	Scenario S4
Total environmental stock [kg]	18,021	12,348	12,661	458
Total stock reduction comp. to S1 [kg]	0	5,673	5,360	17,563
NPV of total cost [€ mln]	-	10.6	13.1	30.3
Cost per unit of avoided stock [€/kg]	-	1,868	2,444	1,725

→ Emission stop (S3) is less costly than emission reduction (S2)!

## 4. Illustrative case study: PFOS and D4

Step 4: Benchmarking based on available EQS (clean-up/remediation cost approach) and prevention cost estimates

- Benchmark costs related to the **avoided stock**

<b>Substance</b>	Based on clean-up costs [€/kg removed]	Based on prevention costs [€/kg avoided]
D4 (prevention)	8 - 1,303	544 - 4,657
PFOS (clean-up)	274 - 34,000	0 - 441,629

Source: Gabbert et al. 2017.

## 5. Conclusions and points for further discussion

- SEA in REACH authorisation and restriction procedures provides underpinning to an evaluation of PBT/vPvB impacts
- Due to their persistence, PBT/vPvB chemicals are **stock pollutants**. That is, impacts to the environment and to human health arise from the stock in the environment, NOT from emissions
- We suggest an approach to account for the (long-term) **impact potential** of PBTs/vPvBs in SEA, and show how the different 'ingredients' of the CEA framework (effectiveness estimates, cost estimates, benchmarks) can be derived.
- The approach allows
  - for a **concern-based** evaluation of PBTs/vPvBs in SEA,
  - for a coherent comparison of policy options for a particular PBT/vPvB
  - for a more meaningful comparison of options across PBTs/vPvBs

## 5. Conclusions and points for further discussion

### Points for discussion:

- Should SEA apply to PBT/vPvB substances?
- Persistence is one component of the PBT concern, but there are also others (e.g. LRTP). Should they be included in an SEA?
- Is the current approach to assessing costs in REACH authorisation and restriction processes (compliance costs) sufficient?
- Are benchmarks based on (previous) cost estimates meaningful for (regulatory) decision-making?

# Thank you for your attention!

- **Further information:**

Gabbert, S., Hilber, I. (2016): "Time matters: A stock pollution approach to authorisation decision-making for PBT/vPvB chemicals under REACH."

<https://www.sciencedirect.com/science/article/pii/S030147971630576X>

Gabbert, S. et al. (2017): "Approach for Evaluation of PBTs Subject to Authorisation and Restriction Procedures in context of Socio-economic analysis",

<https://publications.europa.eu/en/publication-detail/-/publication/ff4fea17-704d-11e8-9483-01aa75ed71a1/language-en/format-PDF/source-71972846>

Oosterhuis, F., Gabbert, S. (2019): "Towards a concern-based regulation of PBT/vPvB substances: A cost-effectiveness analysis approach to REACH authorization and restriction procedures." In progress.

