How to find optimized recycling rates and more to establish a Circular Ecocomy

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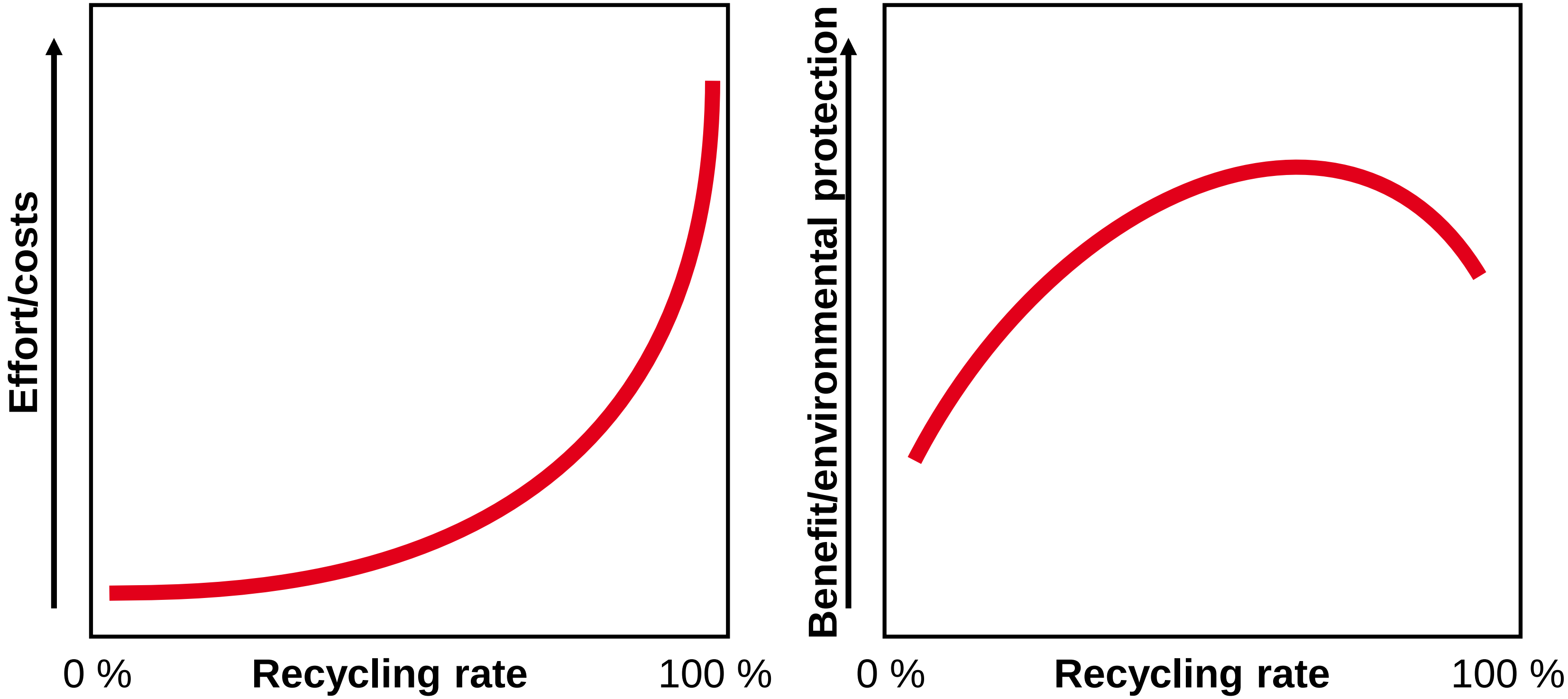
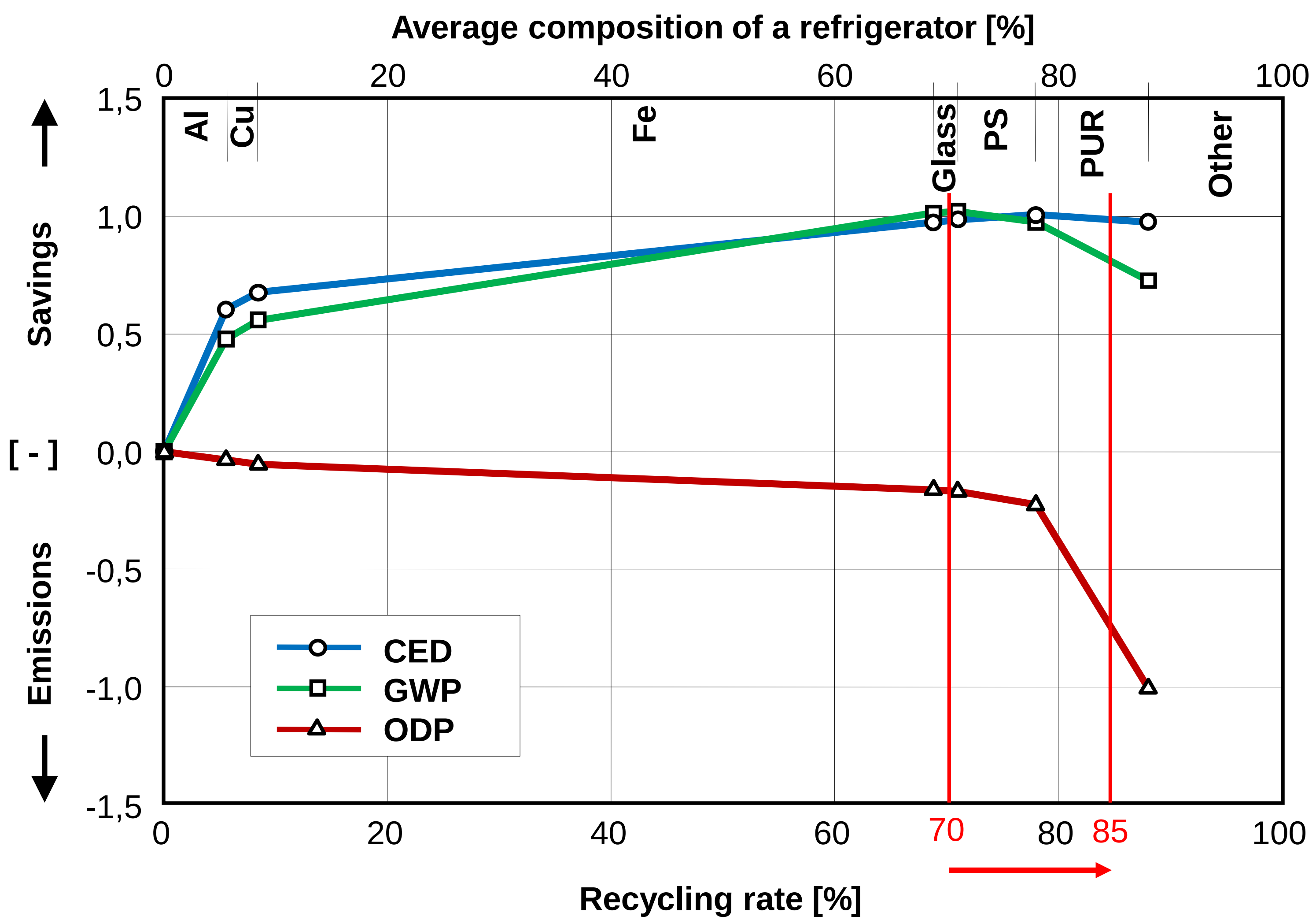
Costs and benefits of recycling



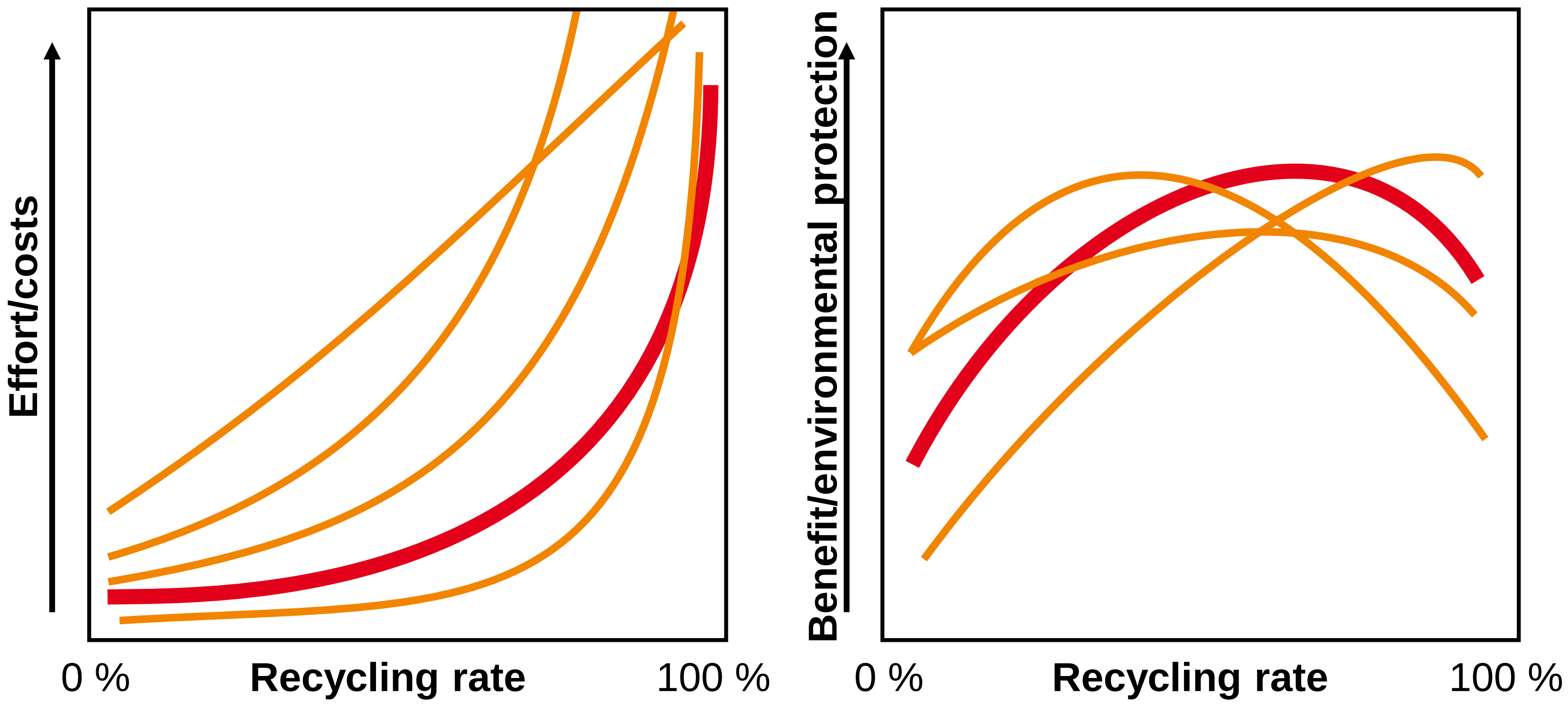
Real quantitative example



CED: Cumulative energy demand
GWP: Global warming potential
ODP: Ozone depletion potential

Source: Laner, D., Rechberger, H., Treatment of cooling appliances: Interrelations between environmental protection, resource conservation, and recovery rates. Resources, Conservation and Recycling, 2007, Vol 52, No. 1, 136-155.

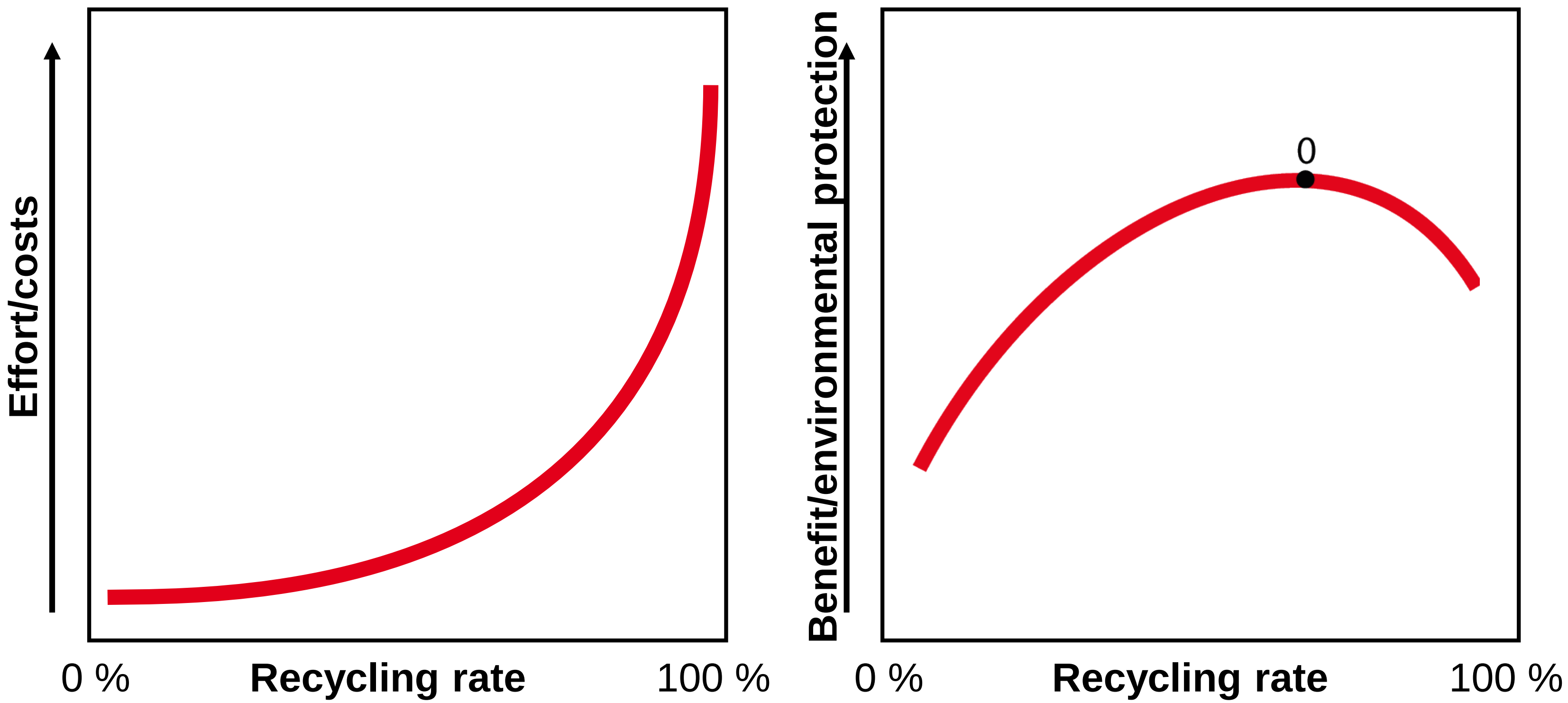
There are many such curves



These curves are a function of:

- **the type of waste**
- **the type of recycling technology**
- **the price of primary resource(s)**
- **the type of the primary production process**

The curve is a moving target



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Conclusions on the recycling rate

- **A higher recycling rate is not *per se* better.**
- **To find the optimal recycling rate requires profound understanding of the system.**

Recycling is not a goal – it is a means to achieve a goal.

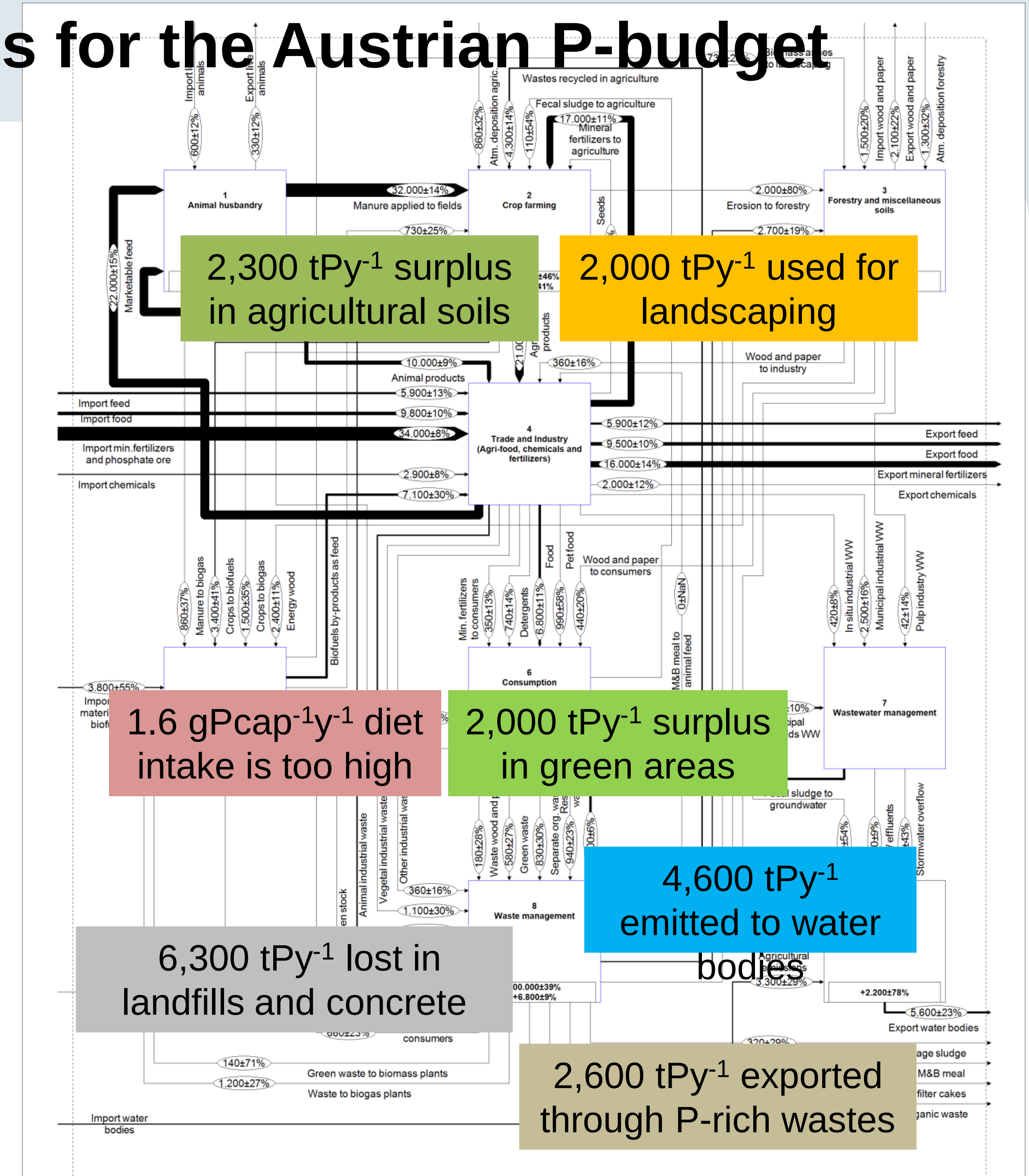
There is more than recycling and recycling rates:

Phosphorus as an example how we can derive sound decisions for optimization

A time series for the Austrian P-budget

1990 – 2013

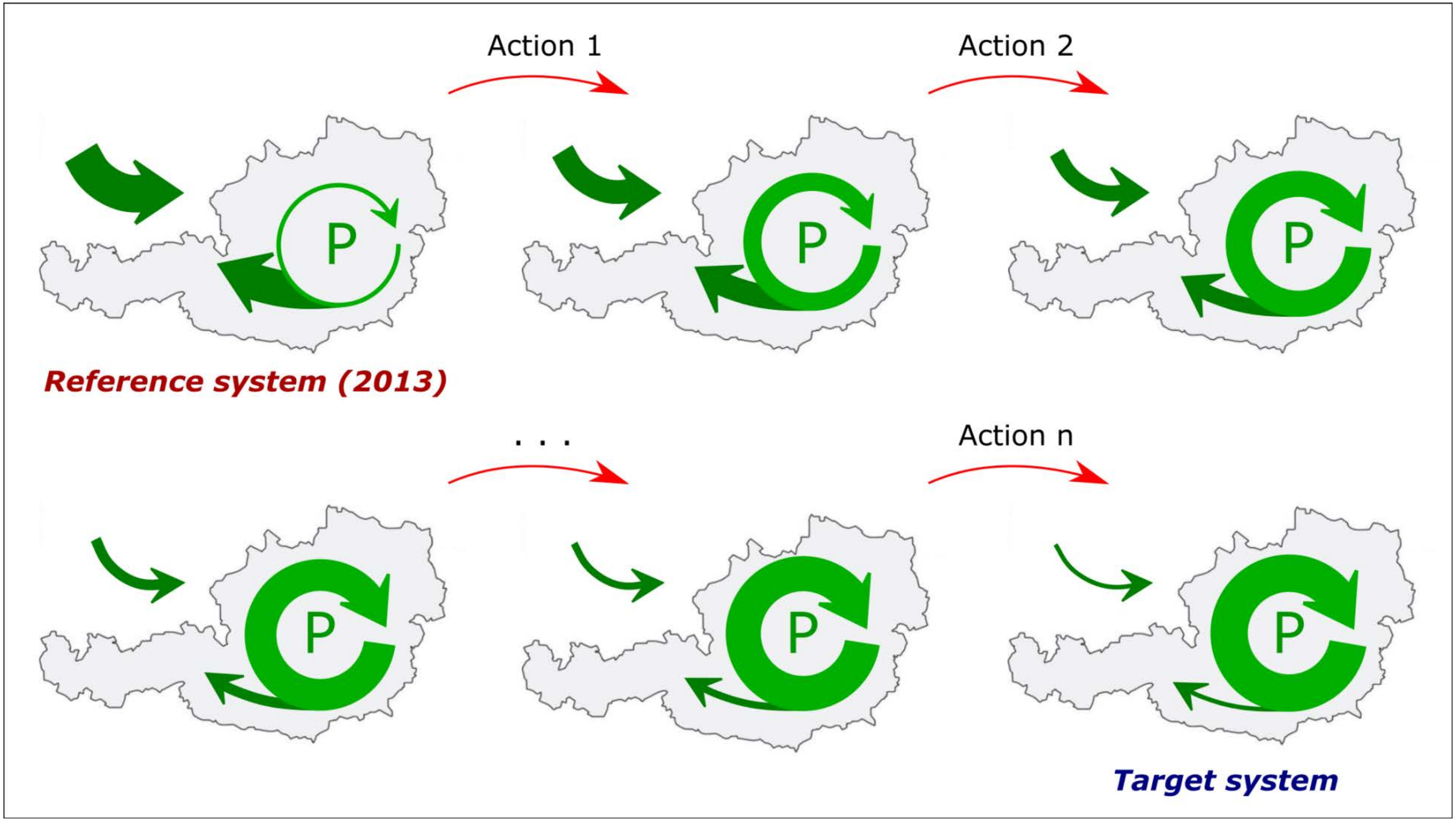
18,600 tPy^{-1}
Import dependency



Austrian phosphorus budget. Year 2011

Routinely MFA produces system understanding

How can the system be optimized?



Identified fields of action

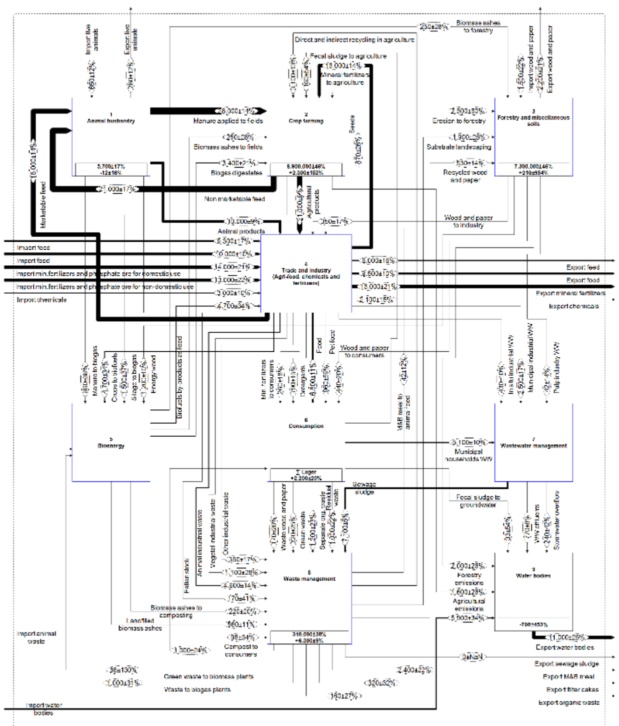
Field of action	Scope for reduction of *Import dependency*	Scope for reduction of *Mineral fertilizers consumption*	Scope for reduction of *Emissions to water bodies*	Uncertainty	Main data gaps	Main challenges
P recycling from meat and bone meal	16%	23%	-	Moderate	P concentration	Legal framework and market uncertainties for recovered fertilizers
P recycling from sewage sludge	23%	32%	-	Moderate	Technological performance and product quality	Legal framework and market uncertainties for recovered fertilizers
P recycling from compost	11%	15%	-	High	Current use shares; P concentration	Regulation/coordination of sales in large number of plants
P recycling from digestates	-	-	-	Low	Feedstock amounts and composition	[illegible] and heterogeneity of plants
P recycling from biomass ashes	2%	3%	-	Moderate	[illegible]	[illegible] incentives that offset [illegible] logistical costs
P recycling from manure	-	-	-	[illegible]	[illegible]	[illegible] agricultural advice services
Municipal and industrial organic waste manamgent	2%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] separate collection; increase of logistical efforts
Balanced and healthy diet	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] of system feedbacks	Resistance to change; Opposition of meat producers
Use efficiency in crop farming	[illegible]	[illegible]	[illegible]	Moderate	Livestock excretion factors; P content in crops	Enhancement of agricultural advice services
Optim. of P content in feedstuff	[illegible]	-	-	High	Current state of optimization; complex feedbacks	Enhancement of agricultural advice services
Reduction of P in detergents	4%	-	2%	Low	-	-
Reduction of P in other industrial uses	-	-	-	High	Materials flows in industrial applications	Substitutability of P
Reduction of accumulation in green areas	11%	15%	-	High	Home composting; sales of compost to privates	Resistance to change; Coordination of large number of people
Reduction of point discharges	-	-	10%	Low	Loads and perform. of industrial treatment plants	Higher Fe levels in SS pose a problem to P recovery
Reduction of erosion from agricultural soils	12%	17%	13%	High	Retention processes and transport of legacy P	Implementation at large scale; identification of hotspots
Indicator value in 2013	**18,600 tP y^{-1} 2.2 kgP cap^{-1} y^{-1}**	**13,200 tP y^{-1} 1.6 kgP cap^{-1} y^{-1}**	**4,600 tP y^{-1} 0.54 kgP cap^{-1} y^{-1}**			

15 actions to improve the current situation

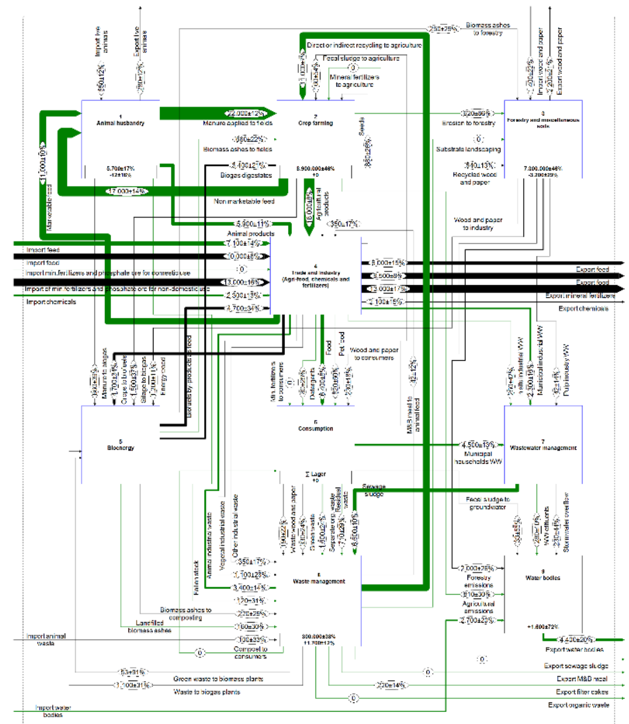
No recycling rates

Target system

P Austria 2013



Optimized (target) system

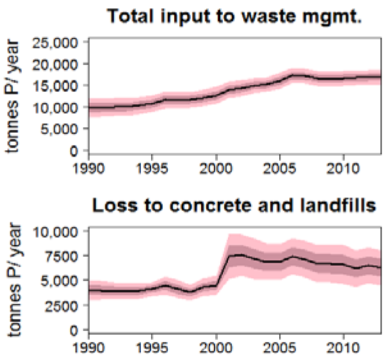


15 actions

- P-recovery from meat & bone
- P-recovery from sewage sludge
- Optimized compost use
- Separate collection of biowaste
- Healthy diet
- Optimized harvesting
- P in fodder
- Detergents
- P surplus on grassland
- Point sources
- Erosion
- ….

Import dependency	2,2 kgP/cap.yr	vs	0,23	kgP/cap.yr	(- 90%)
Consumtion of mineral fertilizer	1,6 kgP/cap.yr	vs	0,0	kgP/cap.yr	(- 100%)
Emissions to water bodies	0,54 kgP/cap.yr	vs	0,39	kgP/cap.yr	(- 28%)

Conclusions beyond recycling rates



The advantages of MFA (a relevant IE tool)

- Generates system understanding
- Serves to control data
- Provides hints where system has to be improved
- Supports decision making
- Can be well combined with EFA, LCA, economic assessment

Requirements

From academic to administration: these tools have to be routinely applied and used for informed decision making

Routinely applied by

- EPAs
- Ministries for the environment
- National statistical offices and Eurostat
- Resource agencies
- .....

Optimizing the industrial metabolism is more than just increasing recycling rates.

It is about understanding the metabolism (tools are available) and then identifying fields of action for optimization.

THANK YOU