

Multi-objective optimization of phosphorus management in Austria

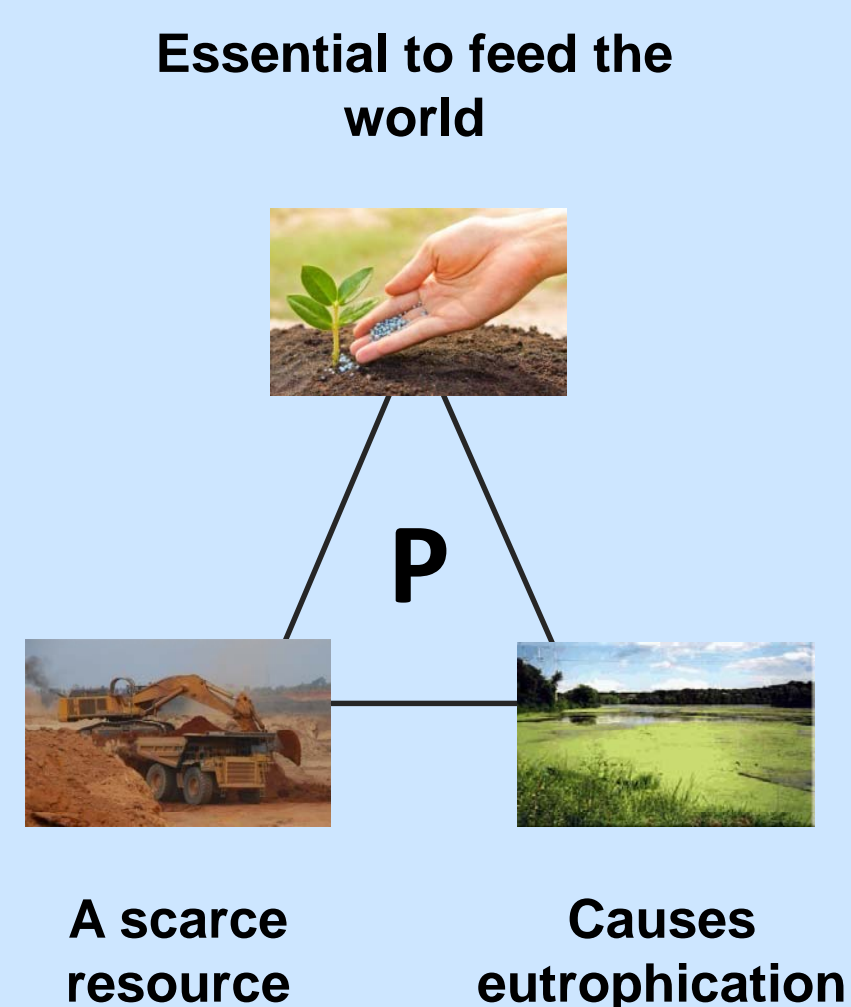
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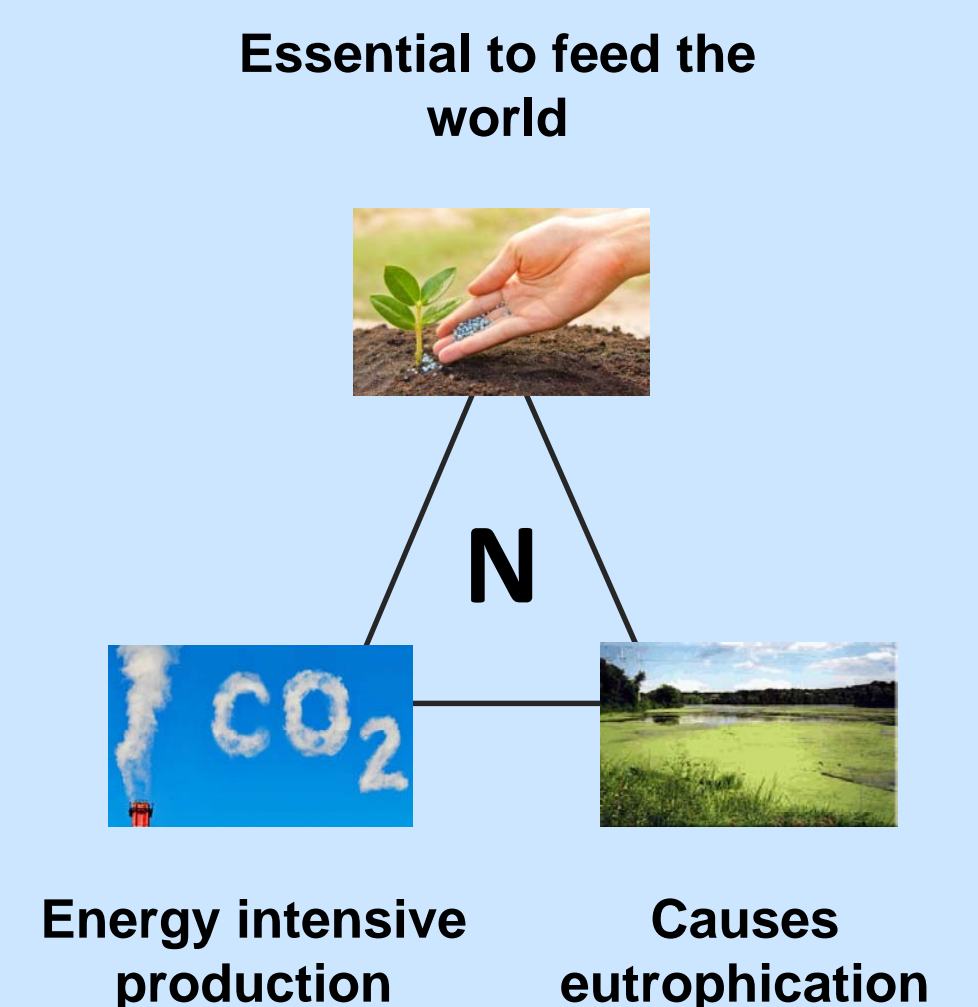
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PHOSPHORUS AND NITROGEN – FRIENDS OR FOES?



Phosphorus and nitrogen as the main crop fertilizers play a key role for global food security. Their emissions to water bodies however, are also the main cause for eutrophication and thus pose a risk to water ecosystems. Moreover, phosphorus is a finite resource, whereas the production of nitrogen is very energy intensive. Prudent management of both resources is therefore crucial to ensure long-term sustainability.

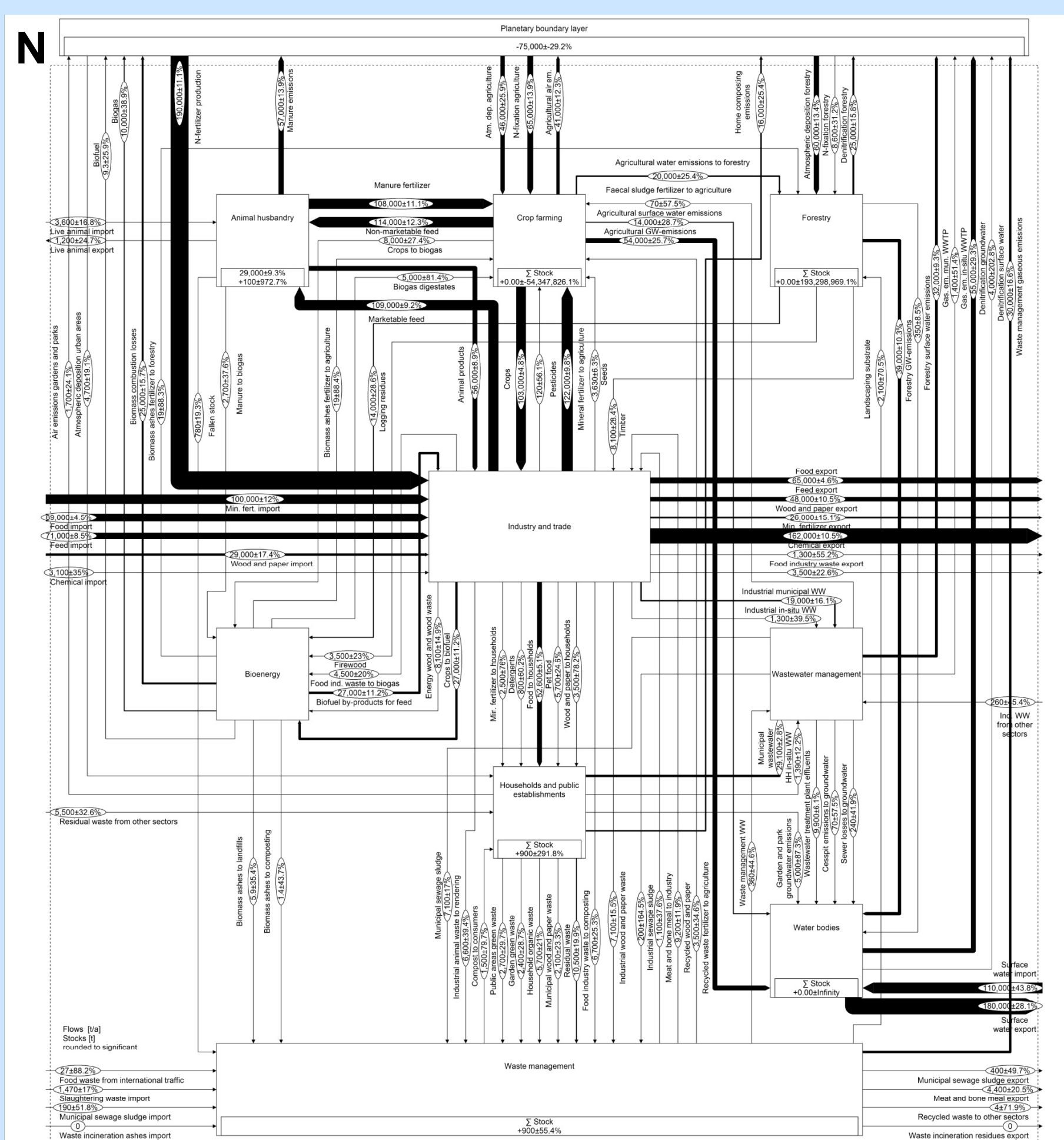
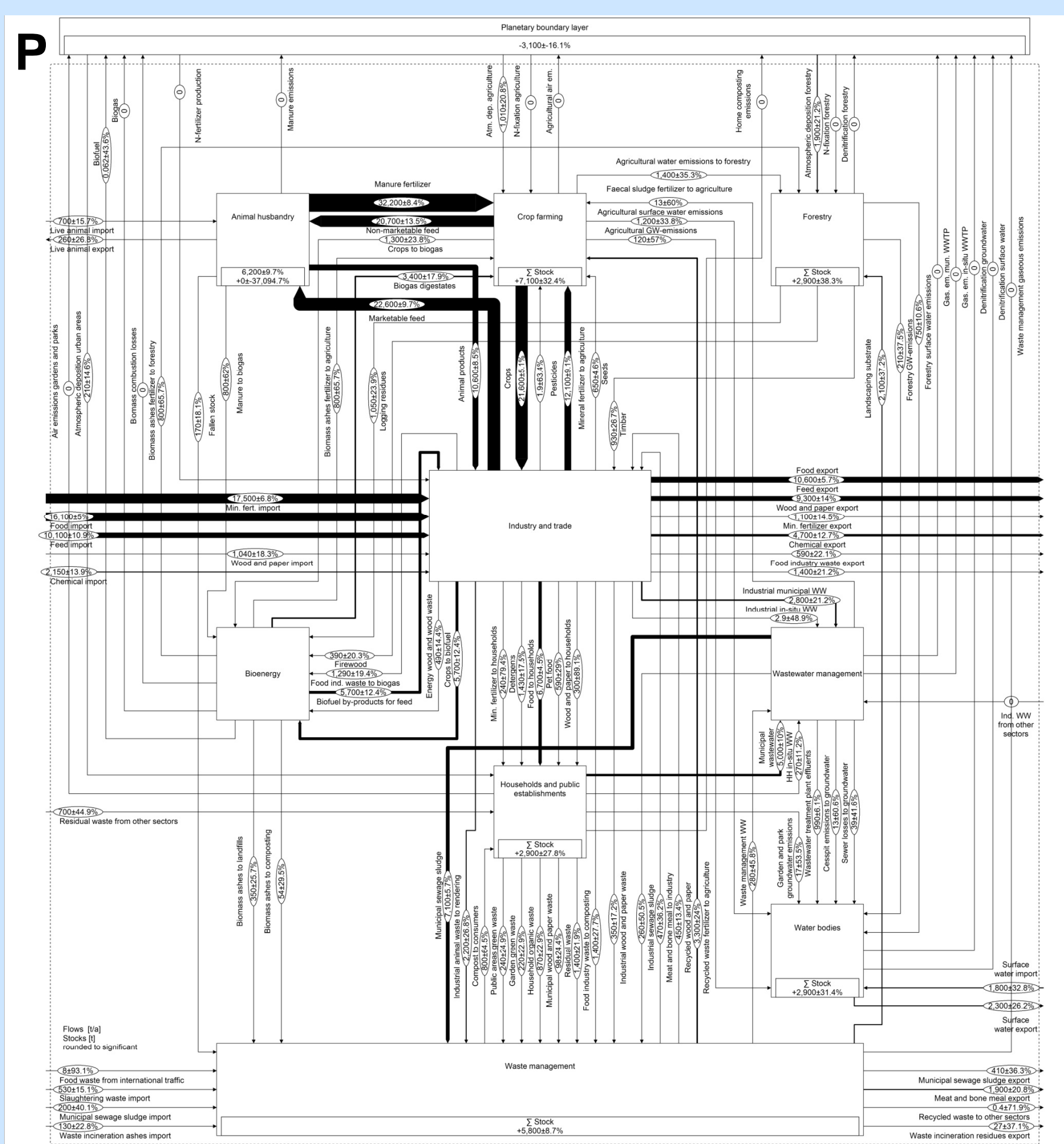
Previous work on the phosphorus cycle of Austria showed high potential for efficiency improvements. But how would such measures affect the national nitrogen budget? This project investigates co-benefits and conflicting goals of Austrian phosphorus and nitrogen management in order to identify an overall optimal solution.



TWO CLOSELY CONNECTED CYCLES

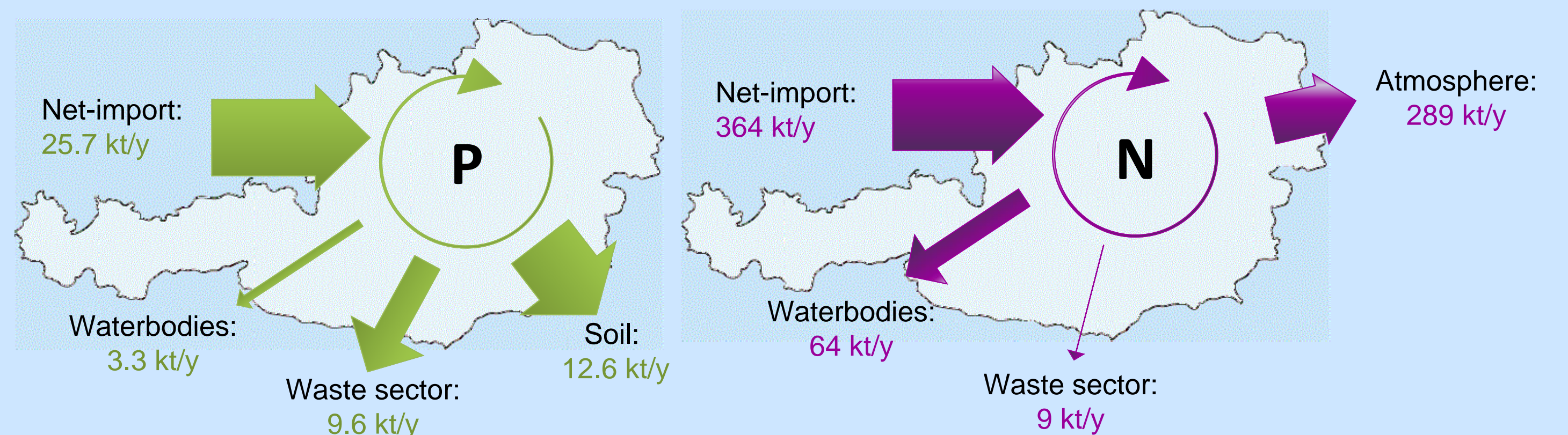
Material flow analysis (MFA) quantifies the stocks and fluxes of different substances in, through and out of a system.

Below, the current situation of P and N management in Austria are shown. The cycles are closely connected, however, while P predominately accumulates in soil and landfills, N is mainly lost by emissions to water and air.

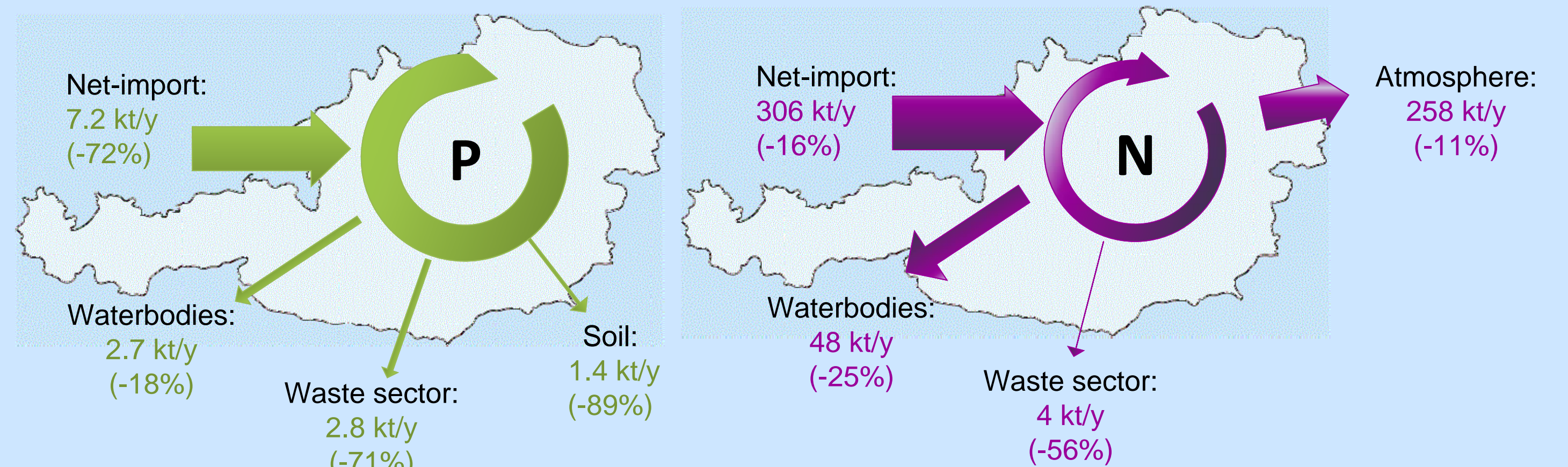


EFFECTS OF IMPROVED P-MANAGEMENT

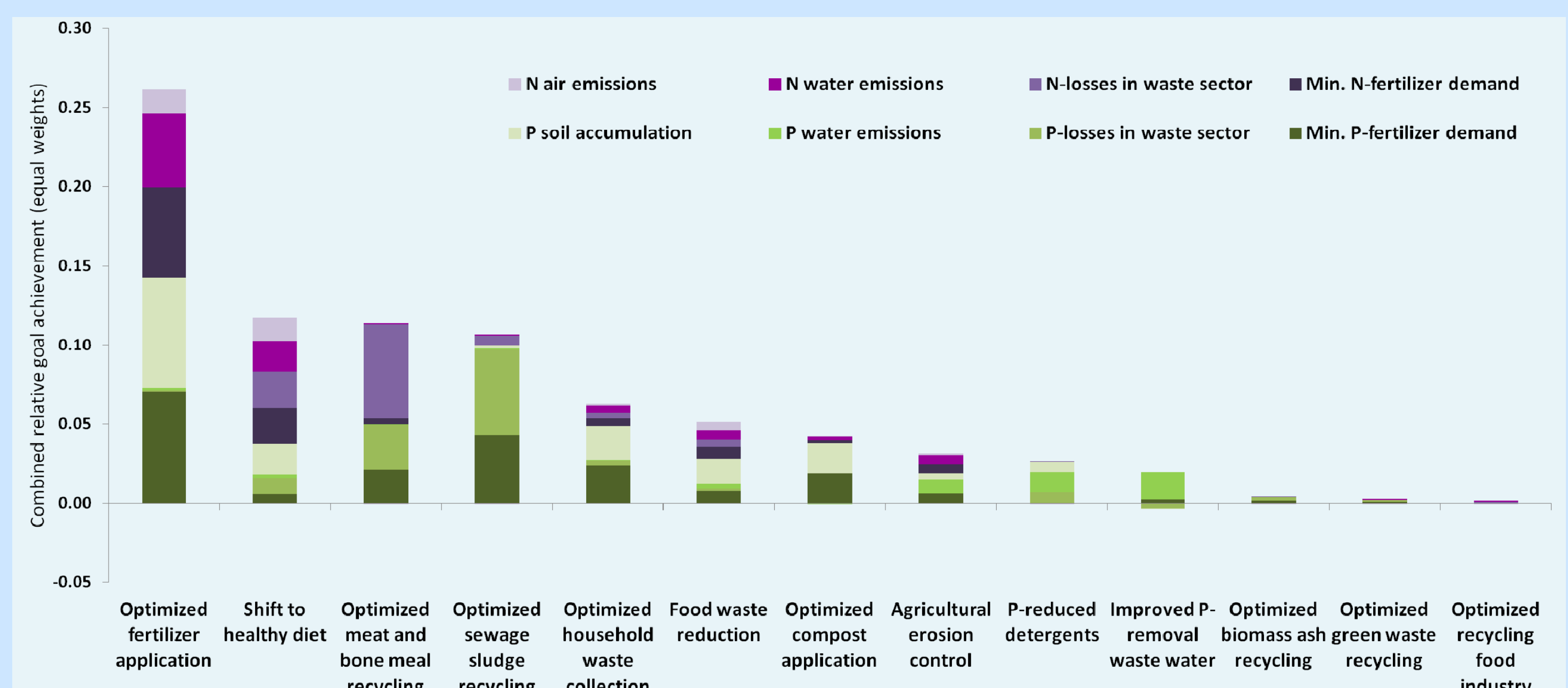
Current situation



Improved P-efficiency



Effectiveness of individual measures



In a scenario, where all measures to improve phosphorus management are applied simultaneously, losses to soil and waste sector, as well as net-imports of P can be reduced by 70-90%, whereas optimization potential for water emissions is less pronounced. Measures to improve phosphorus management are overall beneficial for the nitrogen cycle.

Looking at individual measures, improved agricultural fertilizer use and increased recycling of meat and bone meal as fertilizer prove to be especially effective for both P and N. Increasing recycling of sewage sludge can furthermore significantly reduce mineral P-fertilizer demand and P-losses in the waste sector, while a shift towards a healthy, less meat-reliant diet could yield considerable improvements for the nitrogen cycle.