



Urban nitrogen cycles: new economy thinking to master the challenges of climate change

The research project "Urban nitrogen cycles: new economy thinking to master the challenges of climate change" (UNCNET) is coordinated by the International Institute for Applied Systems Analysis (IIASA). Project partners are the University of Zielona Góra (Poland), the Chinese Academy of Sciences, Peking University, brainbows informationsmanagement in Vienna and E.C.O. Institute for Ecology in Klagenfurt. The project started in March 2019 and will end in February 2022.

Background

Nitrogen is an ubiquitous building block of nature. Almost the entire nitrogen stock forms the major component of the air we breathe, in the form of elementary nitrogen, but as such is not available to most living beings. Nitrogen can only be used by organisms as so-called reactive nitrogen, a term that encompasses a wide range of organic and inorganic compounds. All forms of life need this reactive nitrogen as a building block for proteins, which serve as the engines of the metabolism, and for DNA, the hereditary substance. Only a few natural processes convert elemental nitrogen from the atmosphere into "reactive" forms. Under natural conditions, there is a lack of reactive nitrogen.

But the global nitrogen cycle is out of balance. Every year, more than 200 million tonnes of reactive nitrogen are released into the environment as a result of human activities - such as the production and use of artificial fertilizers or the combustion of fossil and renewable fuels. This doubling of the natural rate leads to considerable problems: It affects ecosystems and their functions, threatens biodiversity in water and land, damages human health and accelerates climate change.

55 percent of the world's population live and work in urban areas, and by 2050 this figure is expected to increase to 68 percent. Cities need energy, food, water and are hotspots of productivity - around 80 percent of global GDP is generated in cities. It is obvious that nitrogen compounds accumulate especially in cities and their surroundings and lead to drastic burdens and environmental problems due to the high population density.

Especially in cities where causes and effects are closely related, it makes sense to develop strategies and measures to deal with the negative effects of the nitrogen imbalance. However, this requires an understanding of the interrelationships, material flows and the diverse pools to store nitrogen. For example, nitrogen compounds easily transform chemically (keyword: nitrogen cascade), which needs to be accounted for. This is because mitigation measures in one environmental area can, under certain circumstances, lead to problems being shifted to other areas. It is therefore necessary to consider the entire nitrogen cycle in an urban context.



Urban nitrogen balances

In order to better understand causes, interrelations and effects, the consortium of Austrian, Polish and Chinese researchers is developing nitrogen balances of selected urban areas. These include Vienna and Zielona Góra in Poland, Shijiazhuang and Beijing in China.

Nitrogen balances provide a detailed picture of a city's nitrogen situation and offer the following possibilities, among others:

- To record and evaluate quantities and sizes of stocks and flows of reactive nitrogen based on established methods
- To establish comparability of different urban situations in order to exchange solution competence
- To break down the (known) environmental and climate impacts of reactive nitrogen to the urban (planning) level
- To develop new modelling approaches and planning bases
- To support developing measures and programs to close cycles and minimize (greenhouse gas) emissions.
- To contribute to national and international climate protection targets (#mission2030, EU Green Deal, Paris Agreement, SDGs etc.)
- To provide a foundation and to extend Climate Change Adaptation Strategies and Measures
- To contribute to improving the health and living conditions of the local population

Focus on stakeholder involvement

One important aspect of the project is the applicability of the results in practice. For this reason, stakeholders and potential users need to be involved at an early stage in the process in order to jointly develop practical approaches. Above all, the results of the (scientific) project can be adapted in this way already during the elaboration phase and trimmed to "practical suitability".

The relevant stakeholders will be involved with an Austrian focus on the capital city Vienna and the smaller city of Klagenfurt in Carinthia. In both cities / regions, a dialogue process will be started with the respective stakeholders and the results will then be brought together. The comparison of the nitrogen balances of these cities with those of Zielona Góra in Poland and the megacities of Shijiazhuang and Beijing in China also promises interesting findings. Within the framework of an international workshop in Vienna, the results, but also approaches and implemented projects of the different regions will be compared and analysed. Here, it is possible to exchange experiences, learn from the success stories of other partners, develop ideas and forge possible new collaborations.

For further information please visit the following Links:

- <https://www.uncnet.org/>
- <https://jpi-urbaneurope.eu/project/uncnet/>