From Urban Nitrogen Budgets to Sustainable Development Goals: N Governance in Urban Context

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Overview

- The nitrogen cycle: why urban aspects

- UNBs and SDGs - Framework

- Urban SDG Index

- Outlook

Urban metabolism of N
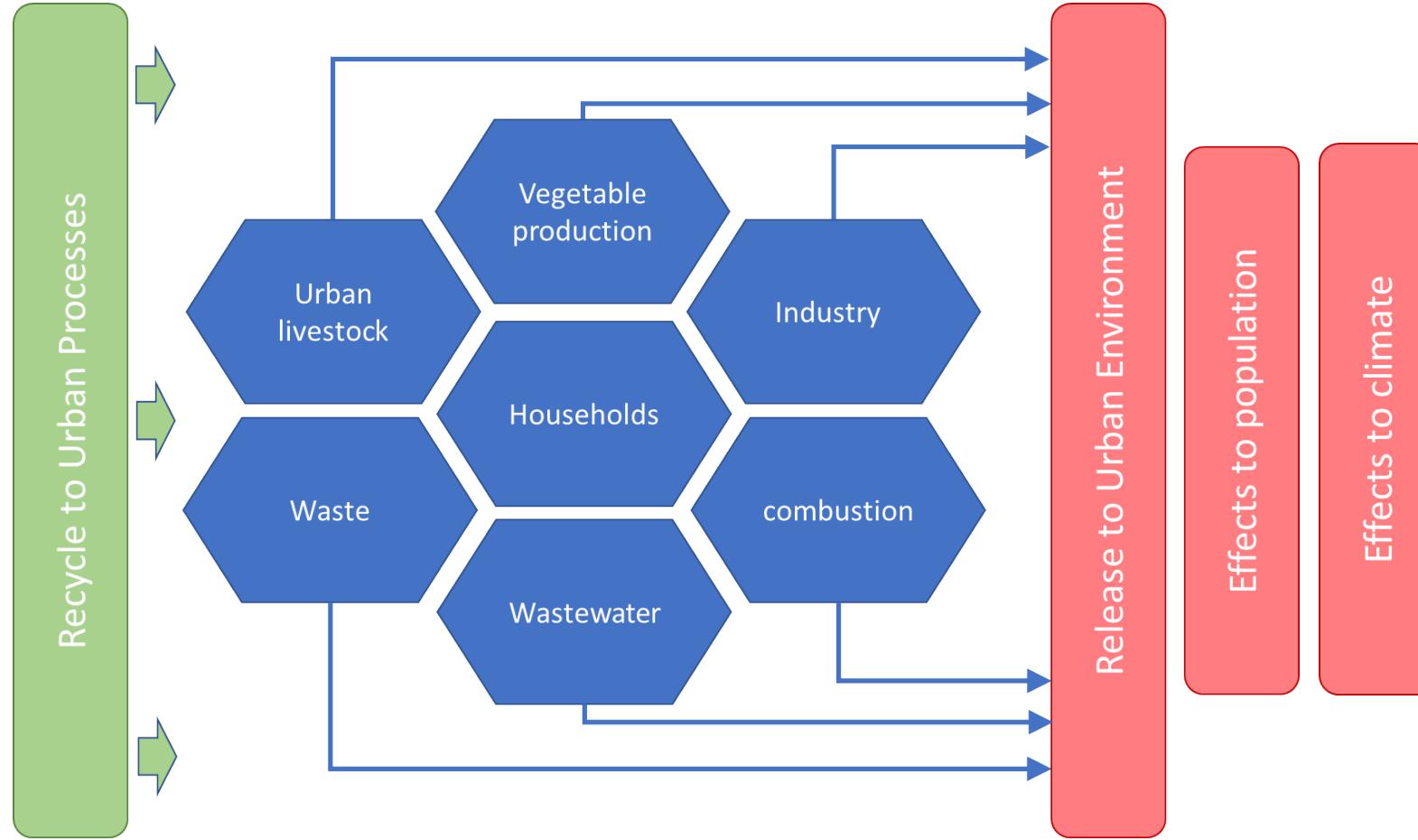
Urban Nitrogen Budgets - Methodology

Adapted from Winiwarter et al., 2020
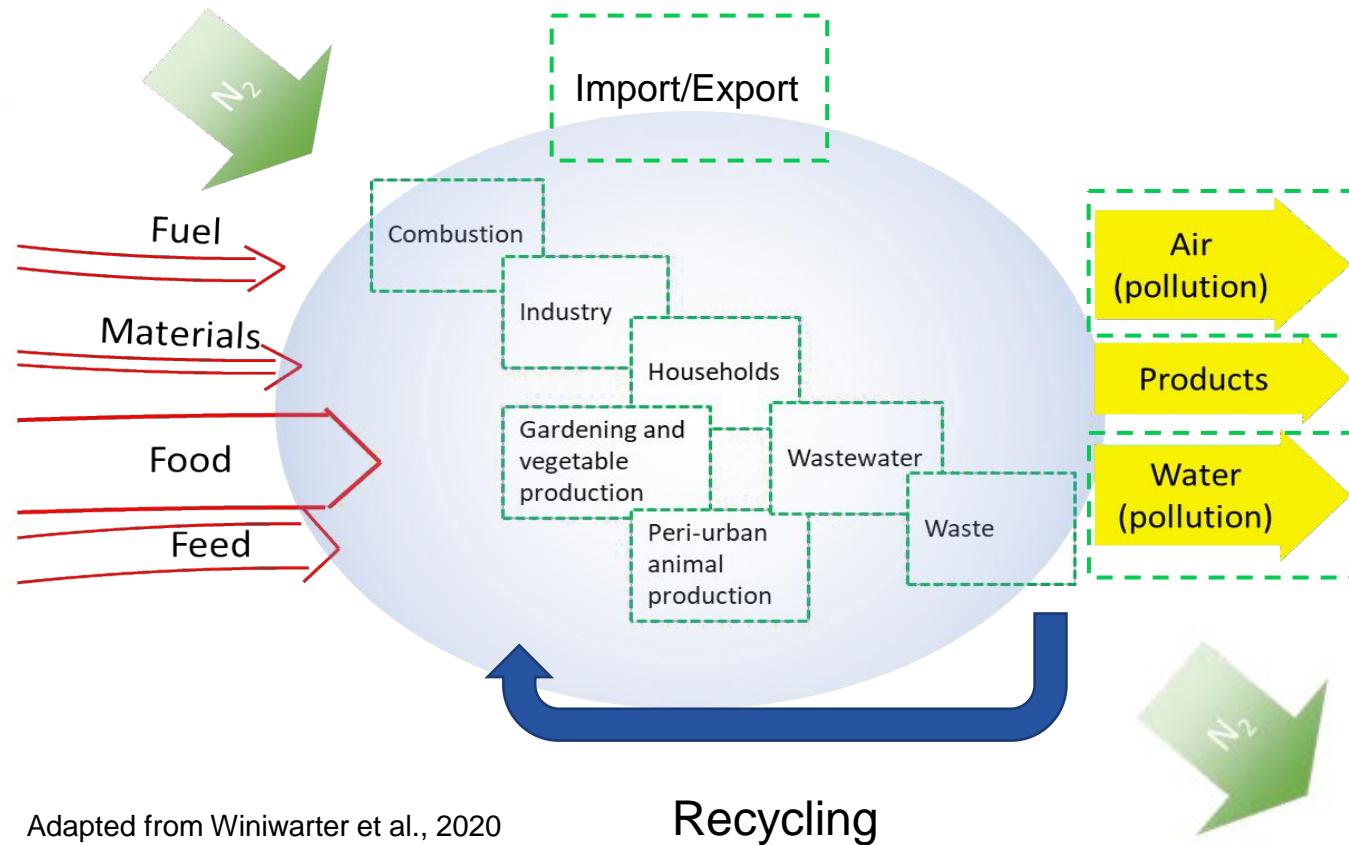
- Material Flow Analysis (STAN)

- 2015 Baseyear

- 10 Pools

- Core and Periurban

Vienna (Austria)   Zielona Góra (Poland)

Shijiazhuang & Beijing (China)

8 UNBs

SDG: N Indicator mapping

- Single-goal mapping
- Literature-based
- 8 N indicators

SNMI

NUE

N surplus

NH_3 emissions from agriculture

N_2O emissions from agriculture

Production-based N emissions

[NO_3^-] in groundwater

Recycling rate

Sutton et al., 2019

Score calculation framework (I)

Score

$$y_1 = 100 * \frac{x - min(x)}{max(x) - min(x)}$$

100 —

SDG achievement y_1

66 —

In progress

33 —

SDG not
achieved

Lower   Red   Green   Optimum
bound

Raw value
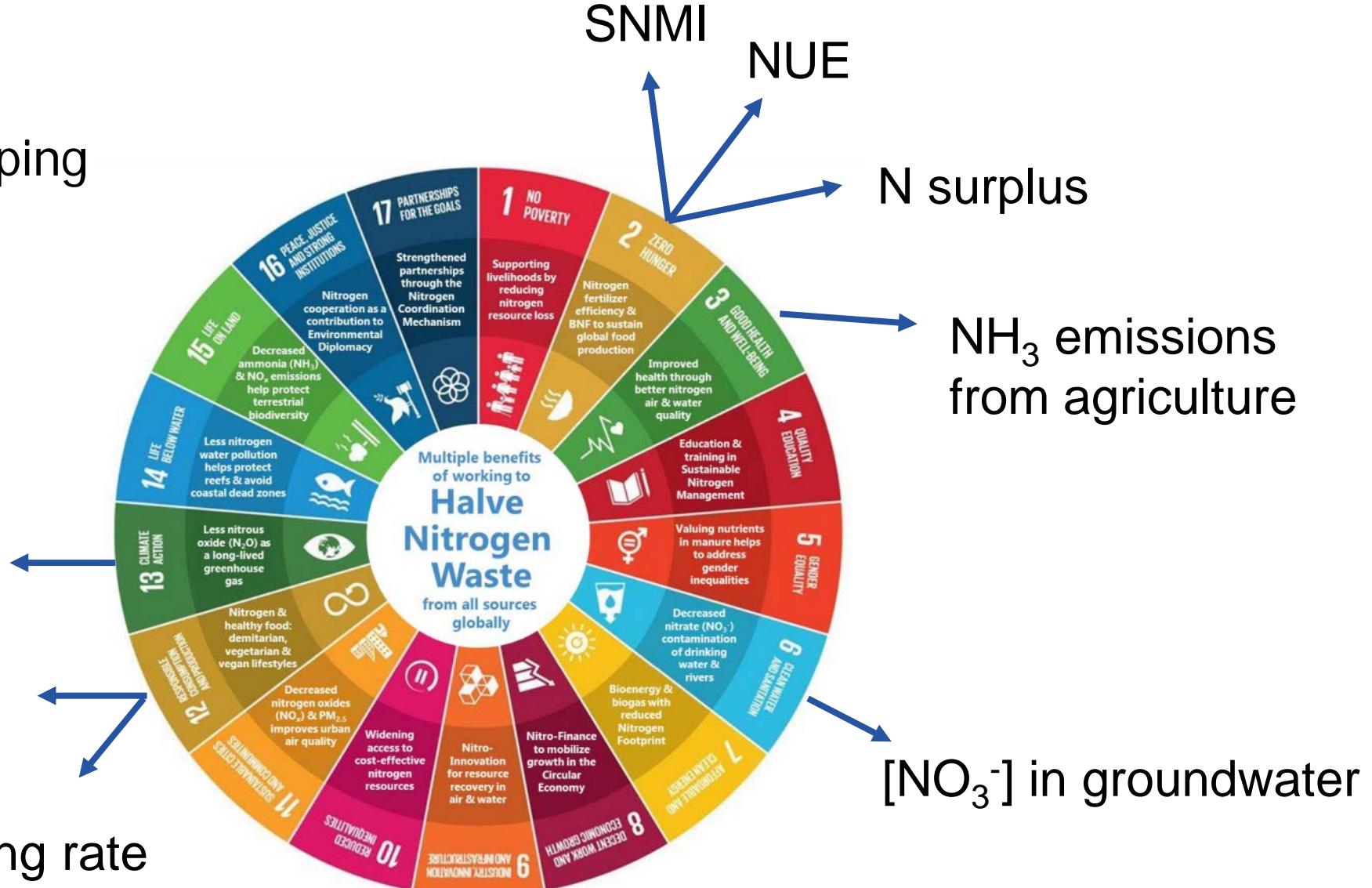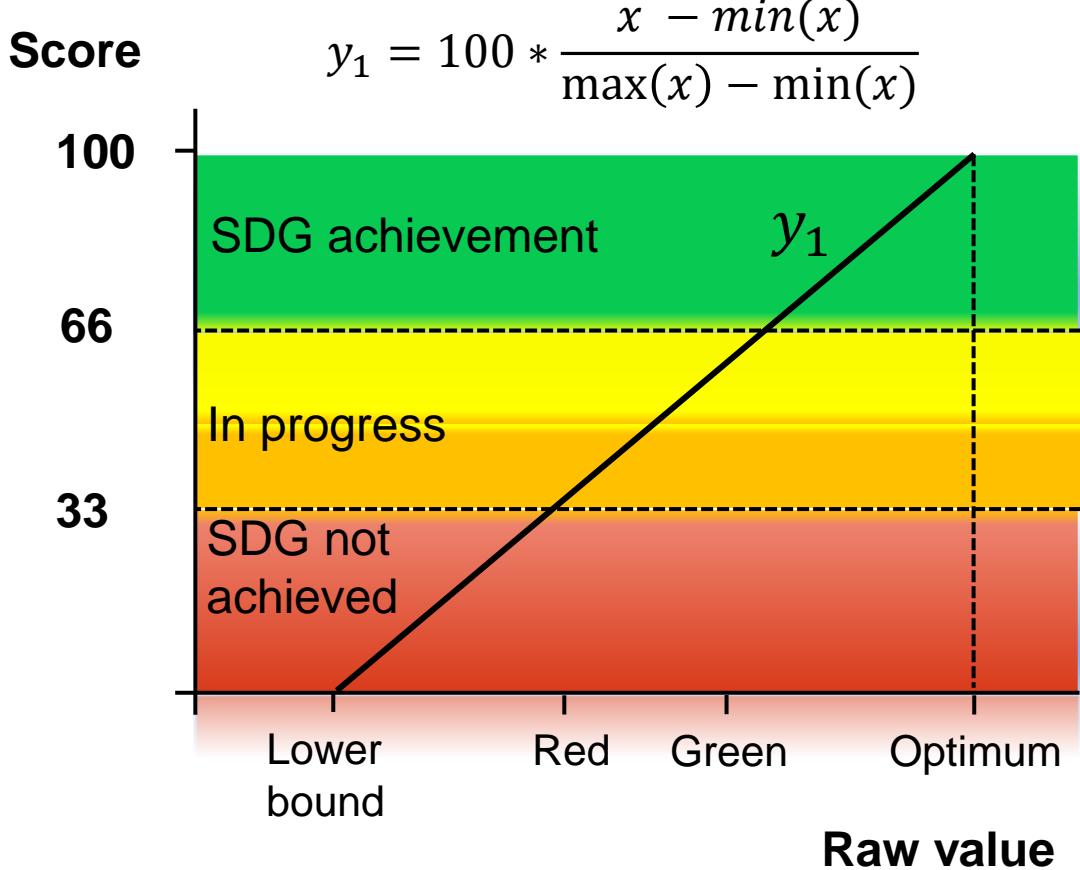
N Indicators	Lower Bound	Red	Green	Optimum	Source
SNMI	1.2	0.7	0.3	0	Sachs et al., 2022 (SDR)
N Surplus (kg N/ha)	200	100	50	10	Lafortune et al., 2021 (ESDR)
NH_3 emissions (kg NH3/ha)	60	45	20	8	Lafortune et al., 2021 (ESDR)
$[NO_3^-]$ in groundwater (mg NO3/L)	60	50	25	10	Lafortune et al., 2021 (ESDR)

Score calculation framework (II)

$$y_1 = 100 * \frac{x - min(x)}{\max(x) - \min(x)}$$

Score

100 —

SDG achievement

y_1

66 —

In progress

33 —

SDG not achieved

y_2

Lower bound   Red   Green   Optimum

Raw value
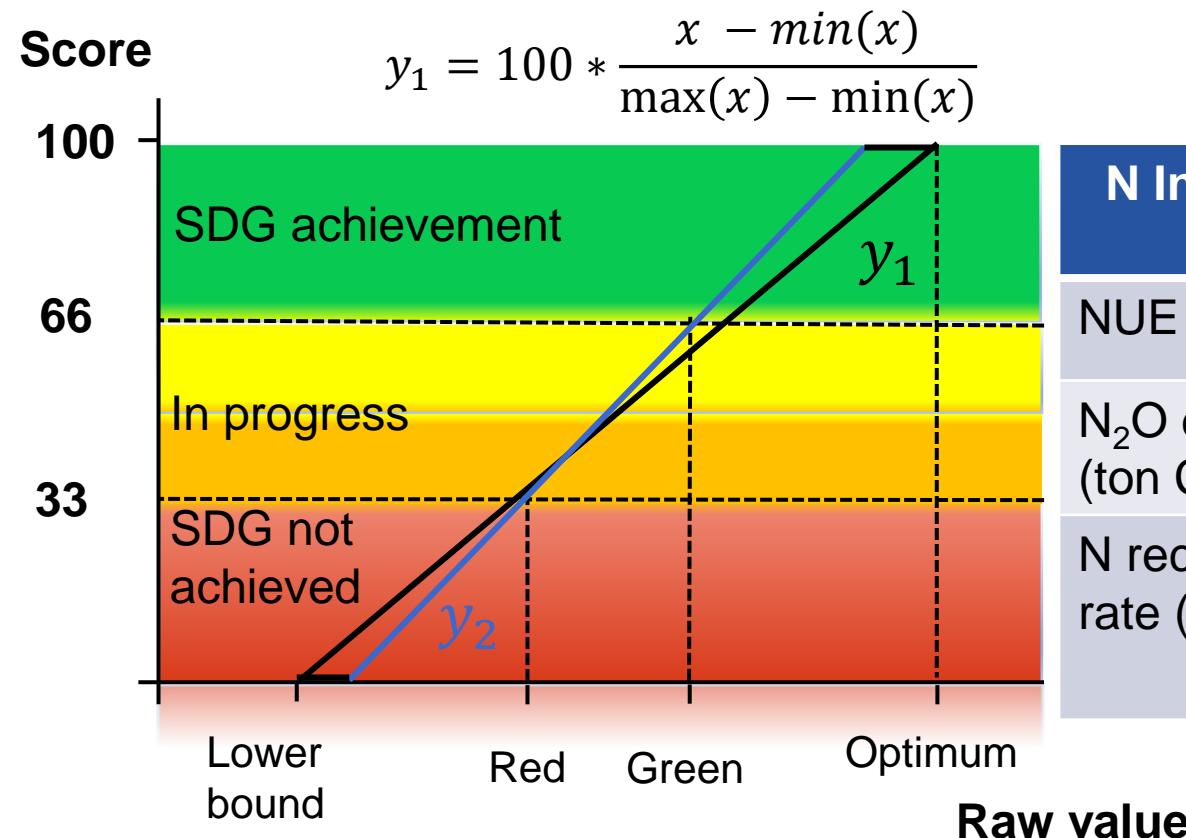
N Indicators	Lower Bound	Red	Green	Optimum	Source
NUE (%)		42	68		Zhang et al., 2015
N$_2$O emissions (ton CO2eq/ha)		0.51	0.41		Zhang et al., 2021 + GAINS
N recycling rate (%)		7	20		Winiwarter et al., 2020

$$y_2 = 33 * \frac{x - Red(x)}{Green(x) - Red(x)} + 33$$

Urban vs Global SDG Index

Vienna — with score **53**

Indicators around Vienna chart:
- SNMI
- NUE
- N Surplus
- N_2O Emissions from Agriculture
- Recycling Rate
- Production-based N emissions
- $[NO_3^-]$ in Groundwater
- NH_3 Emissions from Agriculture

SDG icons:
- 3 GOOD HEALTH AND WELL-BEING
- 6 CLEAN WATER AND SANITATION
- 12 RESPONSIBLE CONSUMPTION AND PRODUCTION
- 13 CLIMATE ACTION
- 2 ZERO HUNGER

Score: 100 / 75 / 50 / 25 / 0
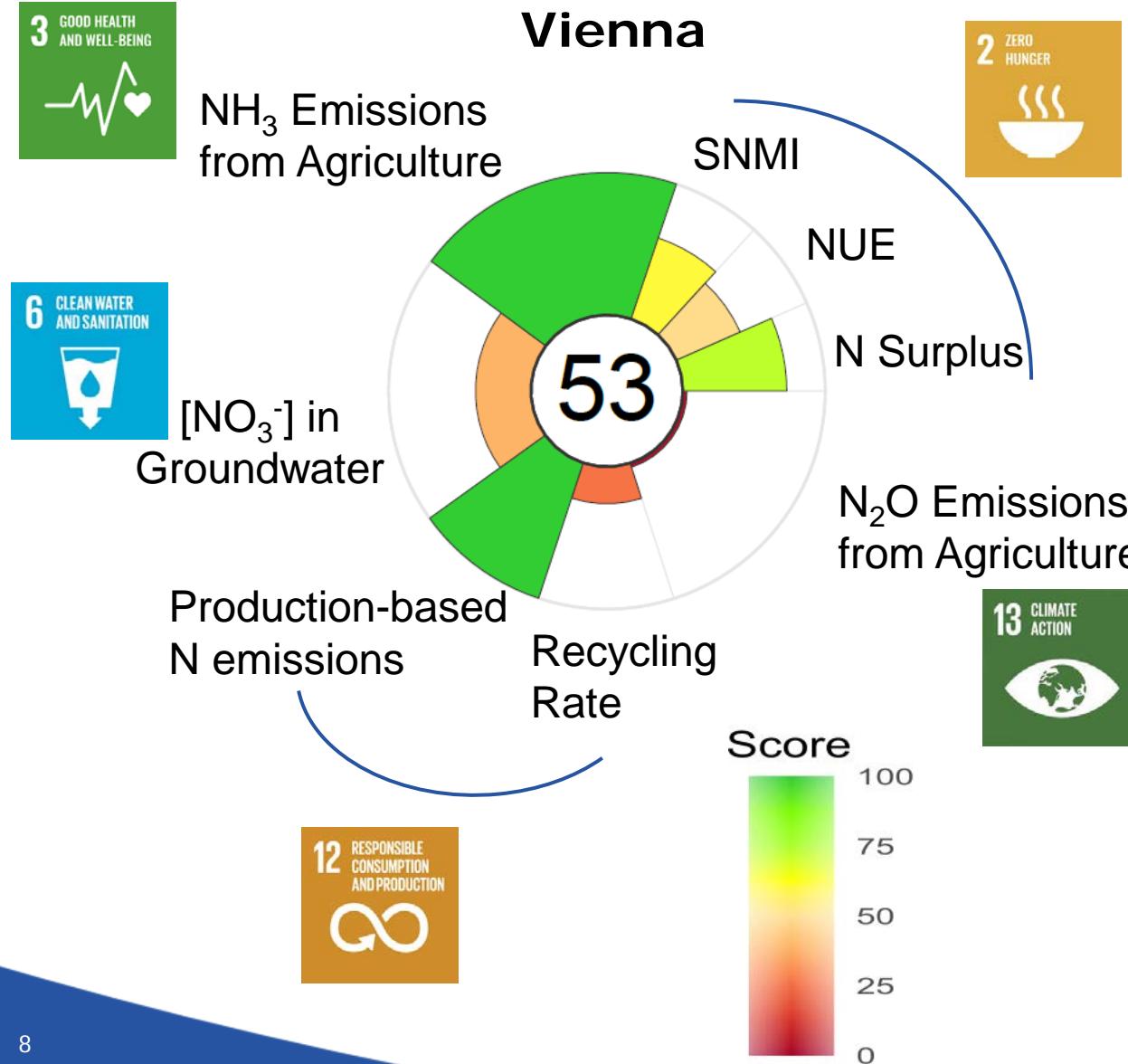
- Visual comparison tool

- Averaged across indicators and goals

- Consistent with global SDG Index

Austria
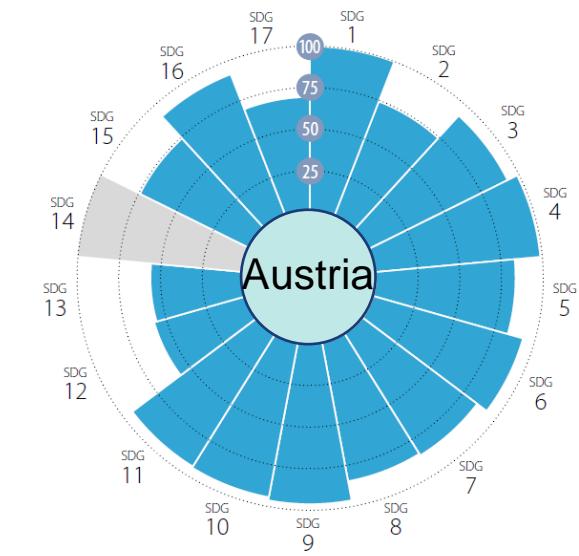
Sachs et al., Sustainable Development Report 2022

8
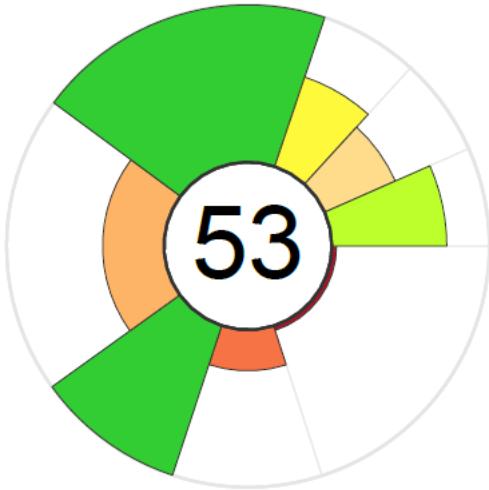
Vienna — 53

Vienna Periurban — 51
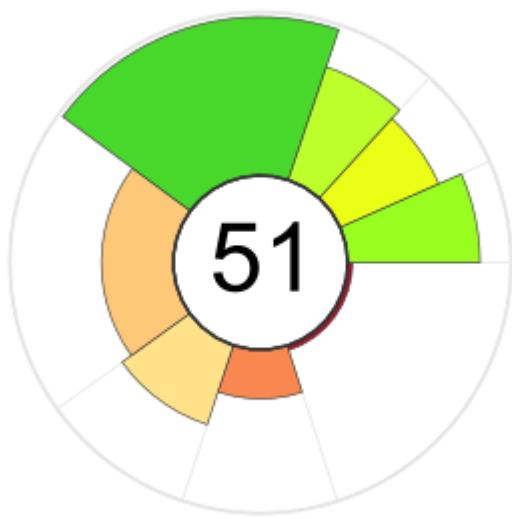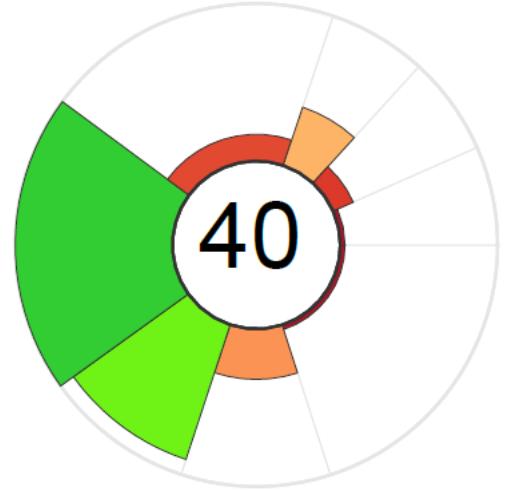
Shijiazhuang — 40

Shijiazhuang Periurban — 29
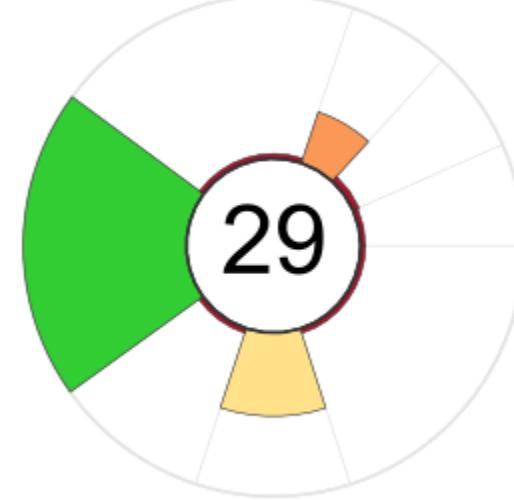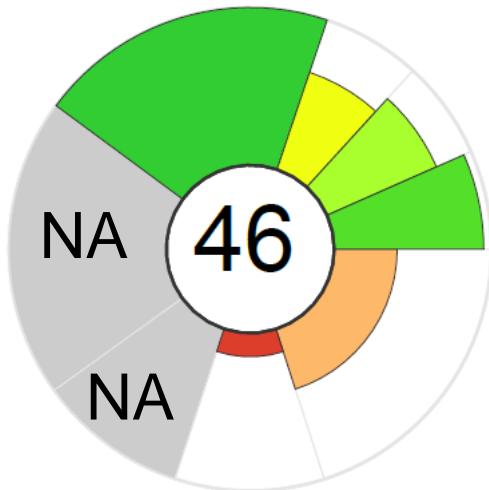
Zielona Gora — 46

Zielona Gora Periurban — 68
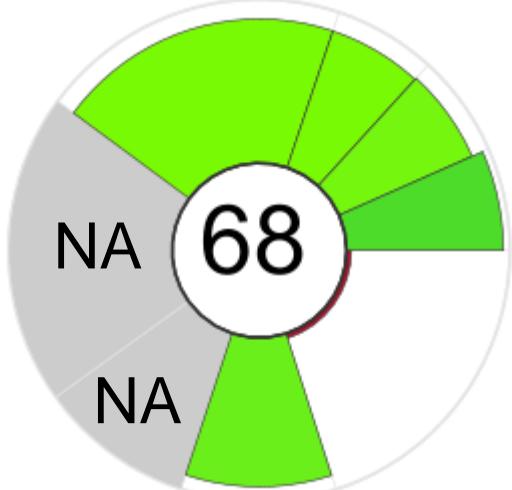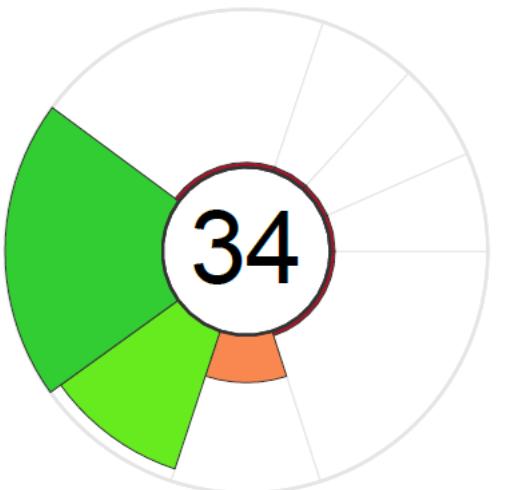
Beijing — 34

Beijing Periurban — 27

Score
100
75
50
25
0

Outlook

- Benchmark tool for urban N governance & policy

- Urban SDG Dashboard and Trends with timeseries

- Refine indicator framework

  o Account for multi-goal mapping?

  o Improve thresholds robustness

  o Devise new/more adequate indicators?
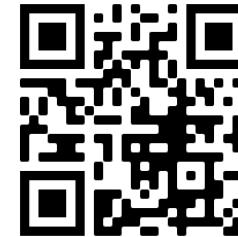
UNCNET - Urban Nitrogen Cycles:
New Economy Thinking to master the challenges of climate change

Europe – China joint call on Sustainable Urbanisation in the Context of Economic Transformation and Climate Change: Sustainable and Liveable Cities and Urban Areas

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