

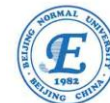


Food-Energy-Water Nexus for Urban Sustainability: Conceptual Framework and Real Challenges

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Beijing Normal University

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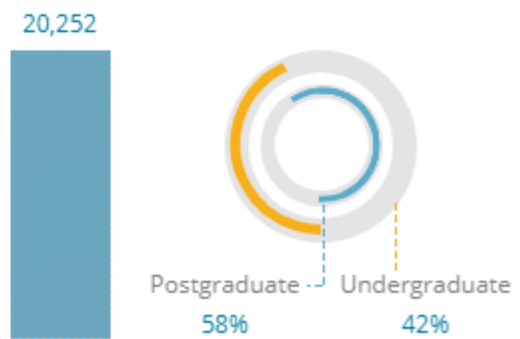
About BNU



Number of academic faculty staff



Number of students



- The university's predecessor, the Normal College of the Imperial University of Peking, was founded in 1902.
- The campus has 1 education faculty, 22 schools and colleges, 2 departments and 36 research institutes (centers)



About Me

Education

MSc in Environmental Sciences (Peking University)

PhD in Environmental Sciences (Peking University)

Career

1 years BOKU University of Austria (2004-2005)

12 years BNU (2005-Now)

Interest

Urban ecology---Urban metabolism

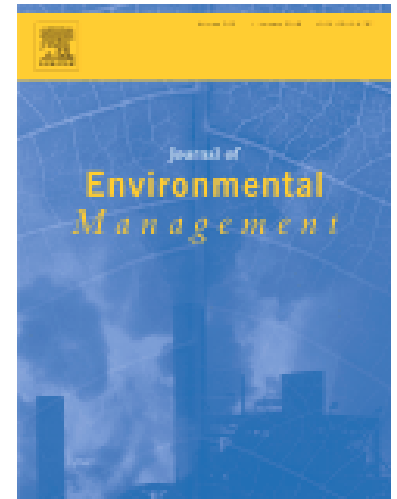
Industrial ecology---Sustainable energy

Service

Associate editor of *Journal of Environmental Management*

Deputy dean of School of Environment

General secretary of environmental geoscience, CSFES



Outline

- China-USA nexus project
- Consensus on nexus perspective
- Overview of nexus research
- Conceptual framework of urban nexus
- Real challenges facing with nexus transition

China-US nexus project

 National Natural Science Foundation of China: International Cooperation



Integrated Systems Modeling of Food-Energy-Water (FEW) Nexus for Urban Sustainability

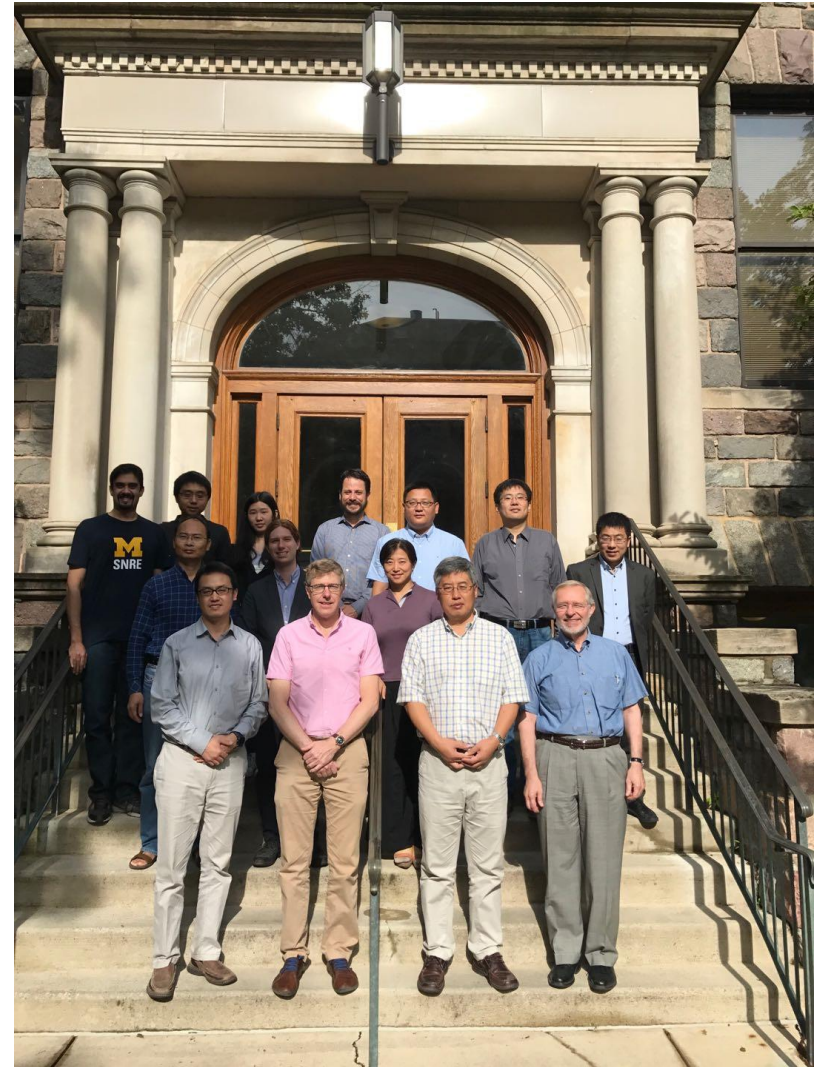


- Beijing Normal University and University of Michigan
- Project time 2016.01-2019.12
- Research objective :
 - In theory : uncover the mechanism of urban food-energy-water nexus
 - In application : take Beijing and Detroit as examples, evaluating policy and technology scenarios for efficiency improvement of urban FEW systems

Workshops on China-US project

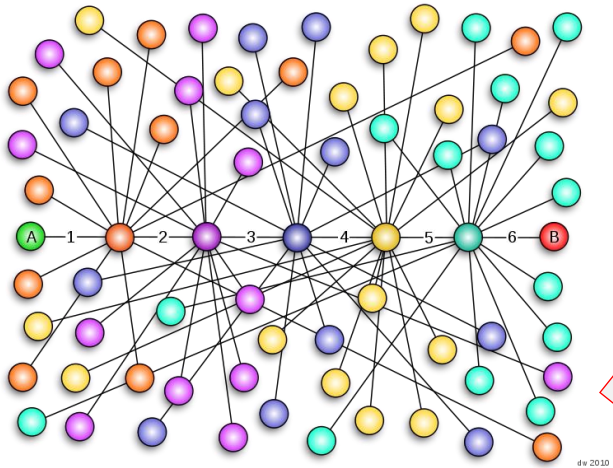


2016 Beijing



2017 Ann Arbor

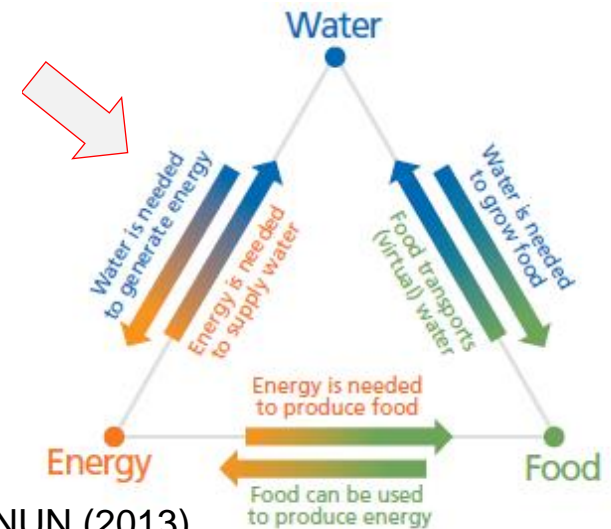
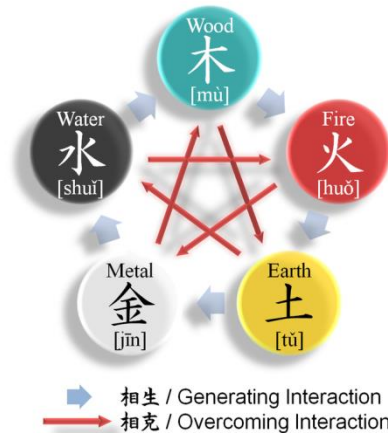
Consensus on nexus perspective



The system of five phases was used for describing interactions and relationships between phenomena

All things in the universe are closely interrelated with one another.

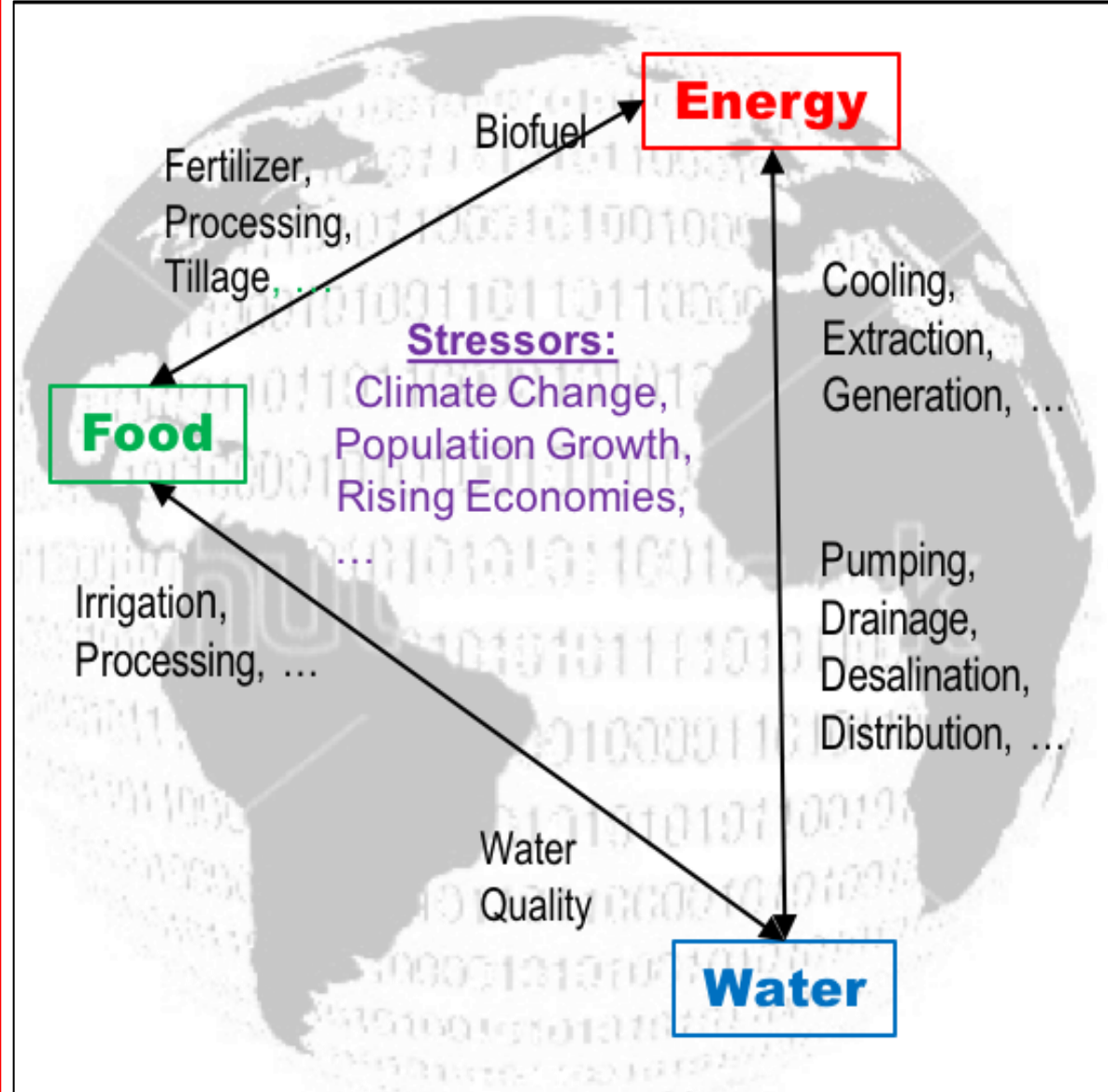
Six degrees of separation, originally set out by [Frigyes Karinthy](#) in 1929



NUN (2013)

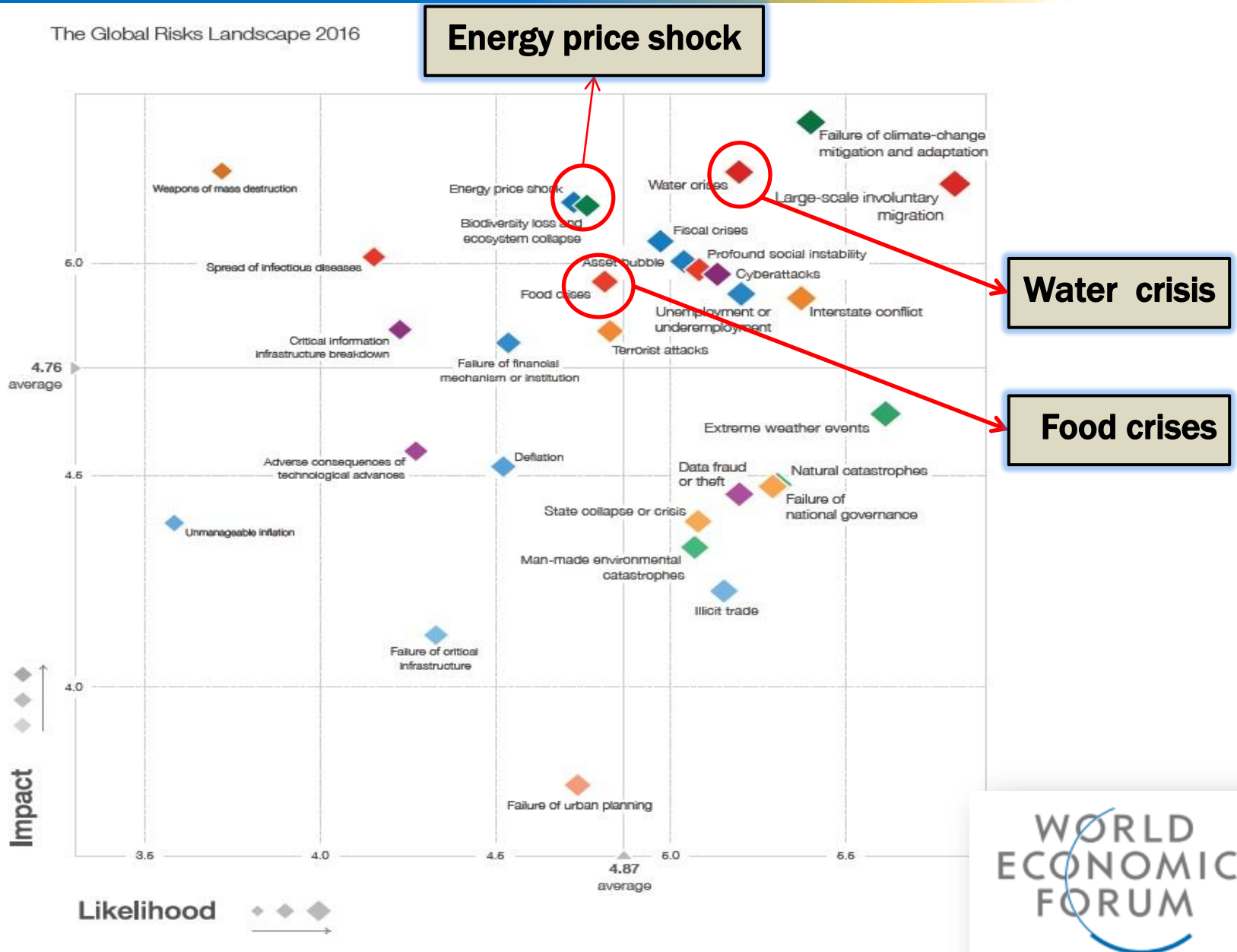
Interactions among food, energy and water systems

- Piecemeal decisions in one affect the other
- **Utility—Scarcity -- Replaceability**
- **Stressors:**
 - Urbanization
 - Climate change
 - Rising Economy



Global Nexus Risks

The Global Risks Landscape 2016



2050 – The Challenge

**9
Billion
People**

**60%
More
Food**

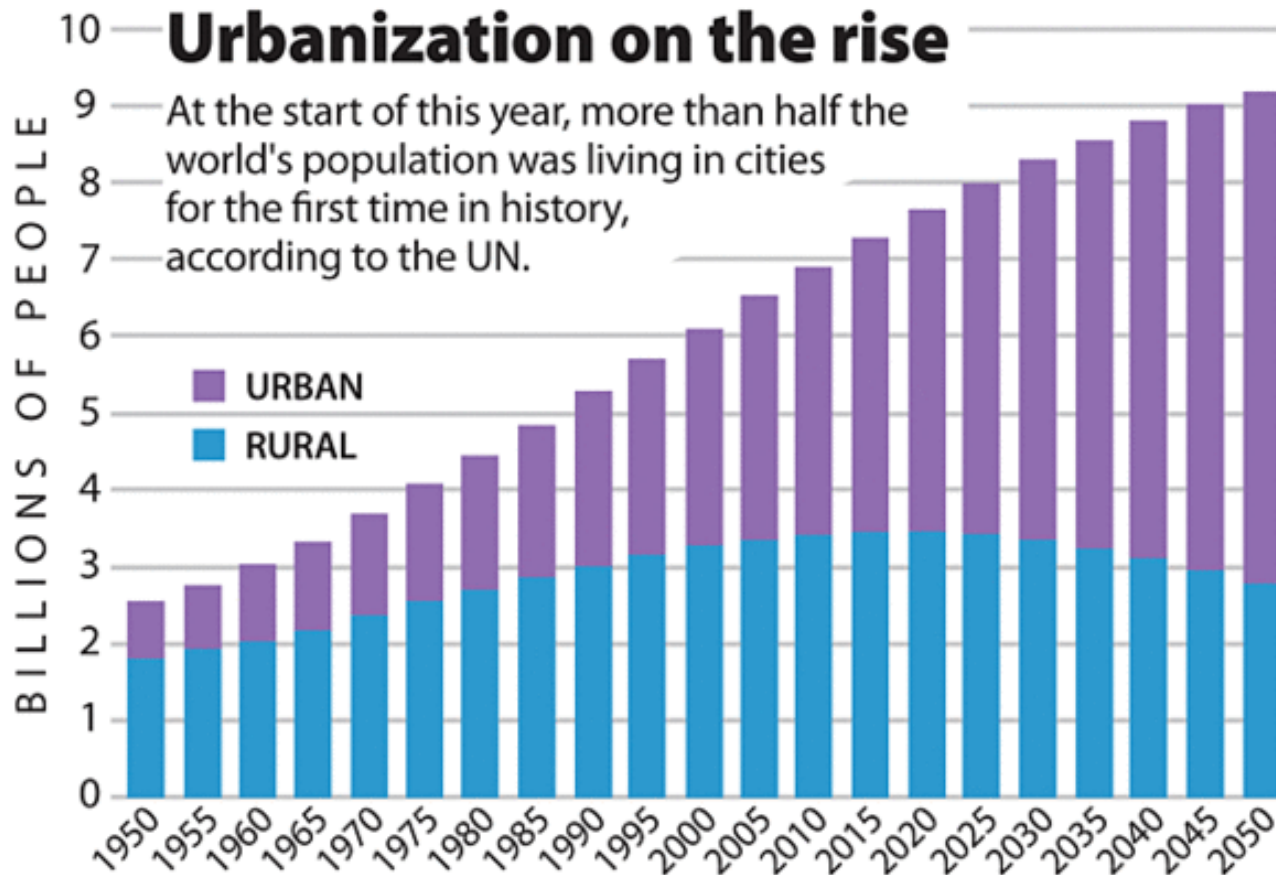
**55%
More
Water**

**80%
More
Energy**



Why FEW in urban systems?

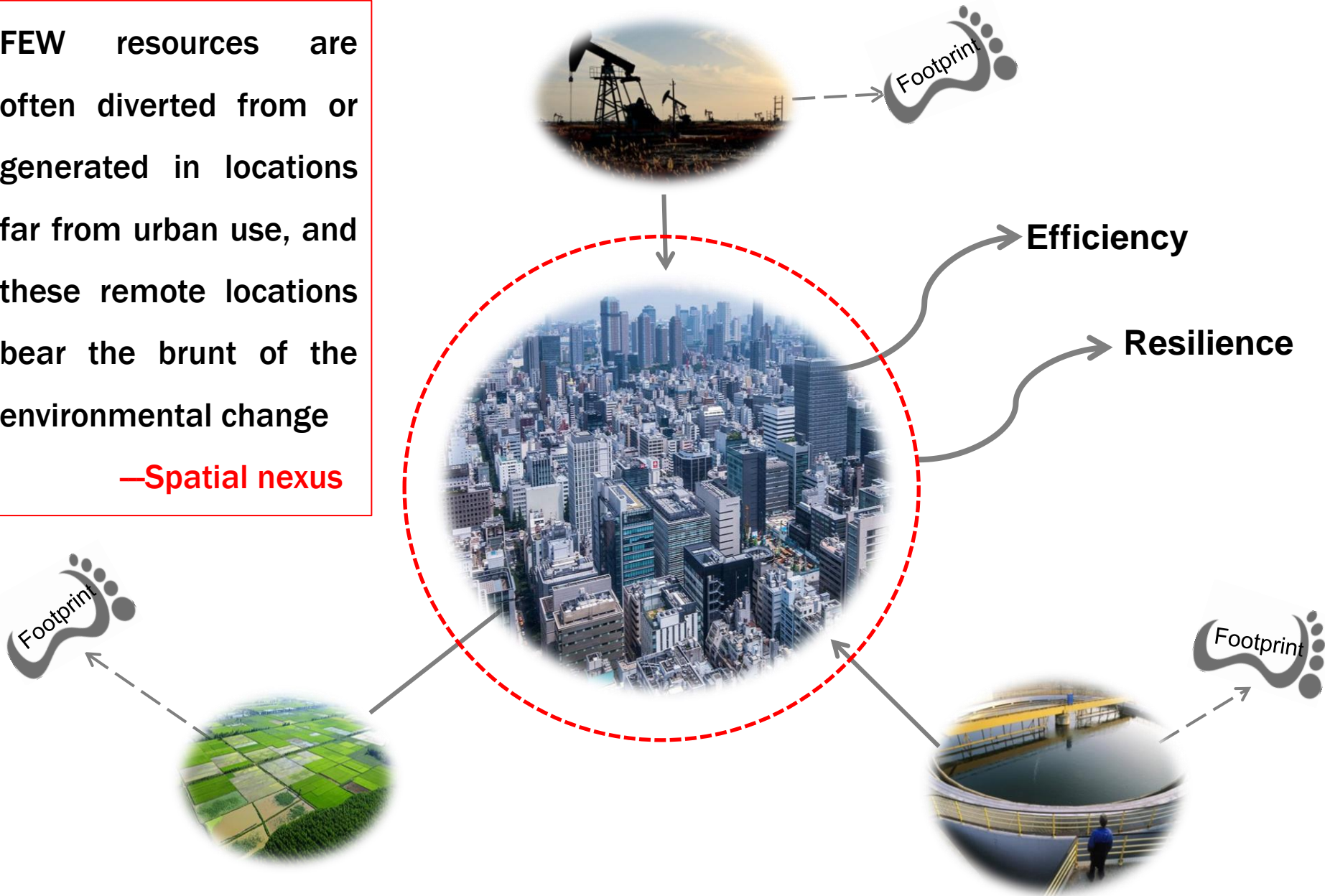
- Over half of the population lives in urban areas
- Urbanization shows an increasing trend



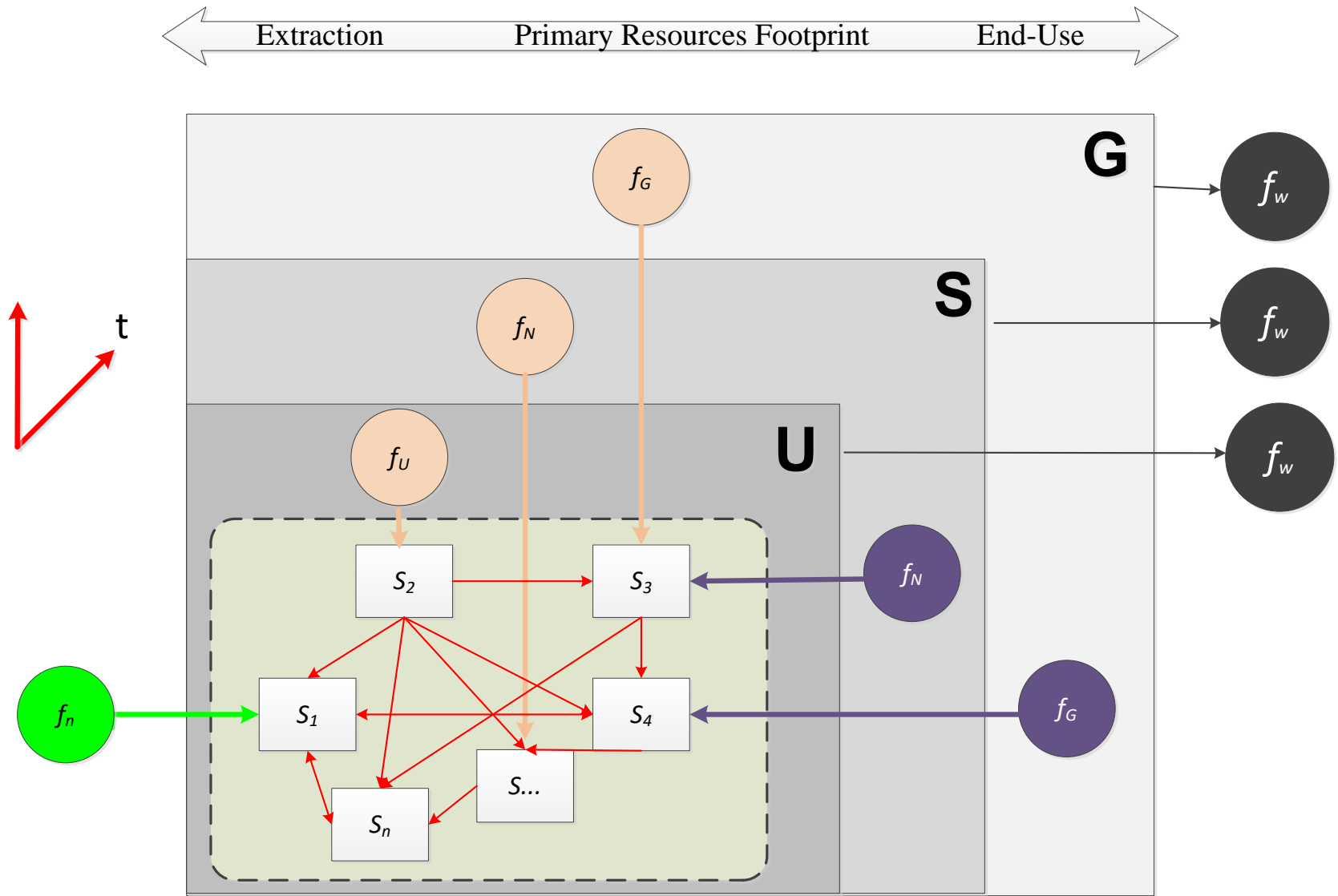
Why FEW in urban systems?

FEW resources are often diverted from or generated in locations far from urban use, and these remote locations bear the brunt of the environmental change

—Spatial nexus

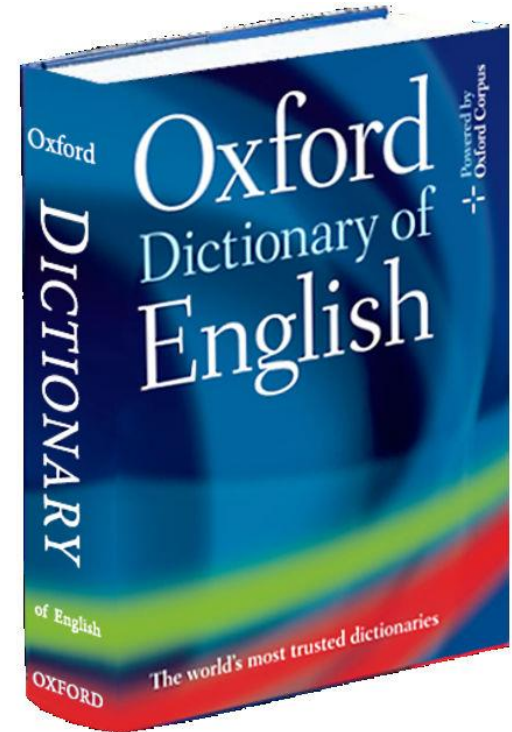


Urban system



What is Nexus?

- A connection or series of connections linking two or more things
- A central or focal point



We are all talking about nexus of FEW

Let's drink something?



Let's nexus?

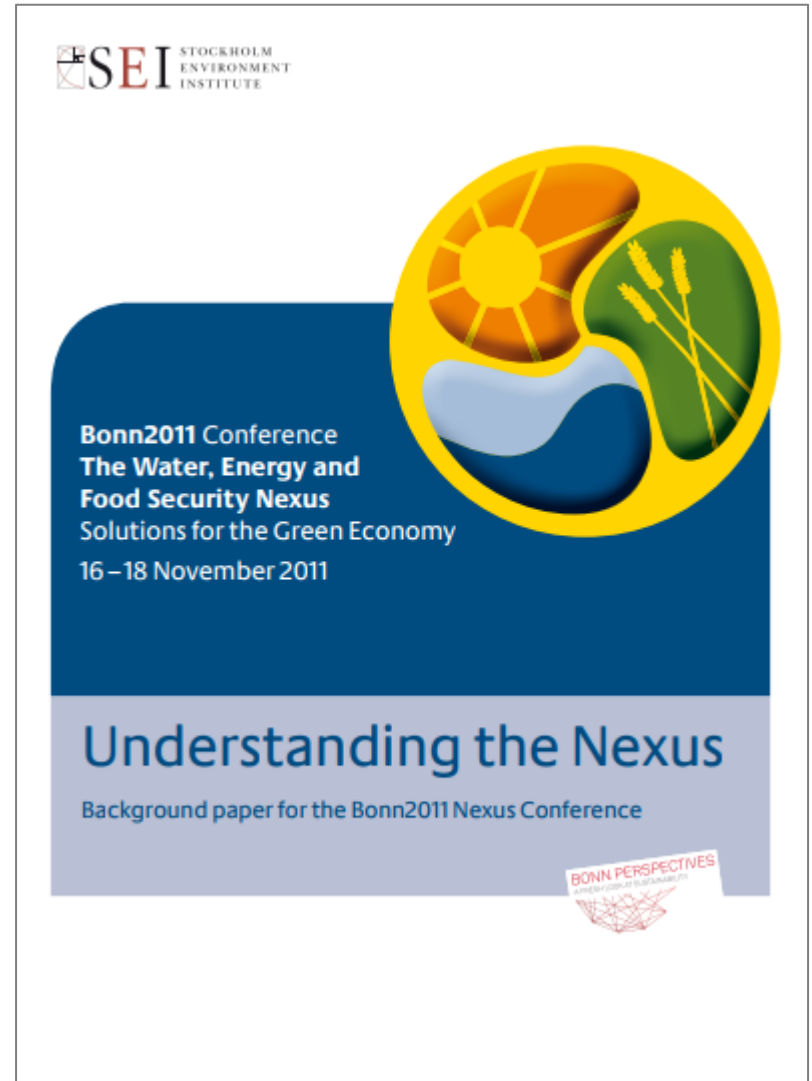


Various diagram of FEW nexus in Google

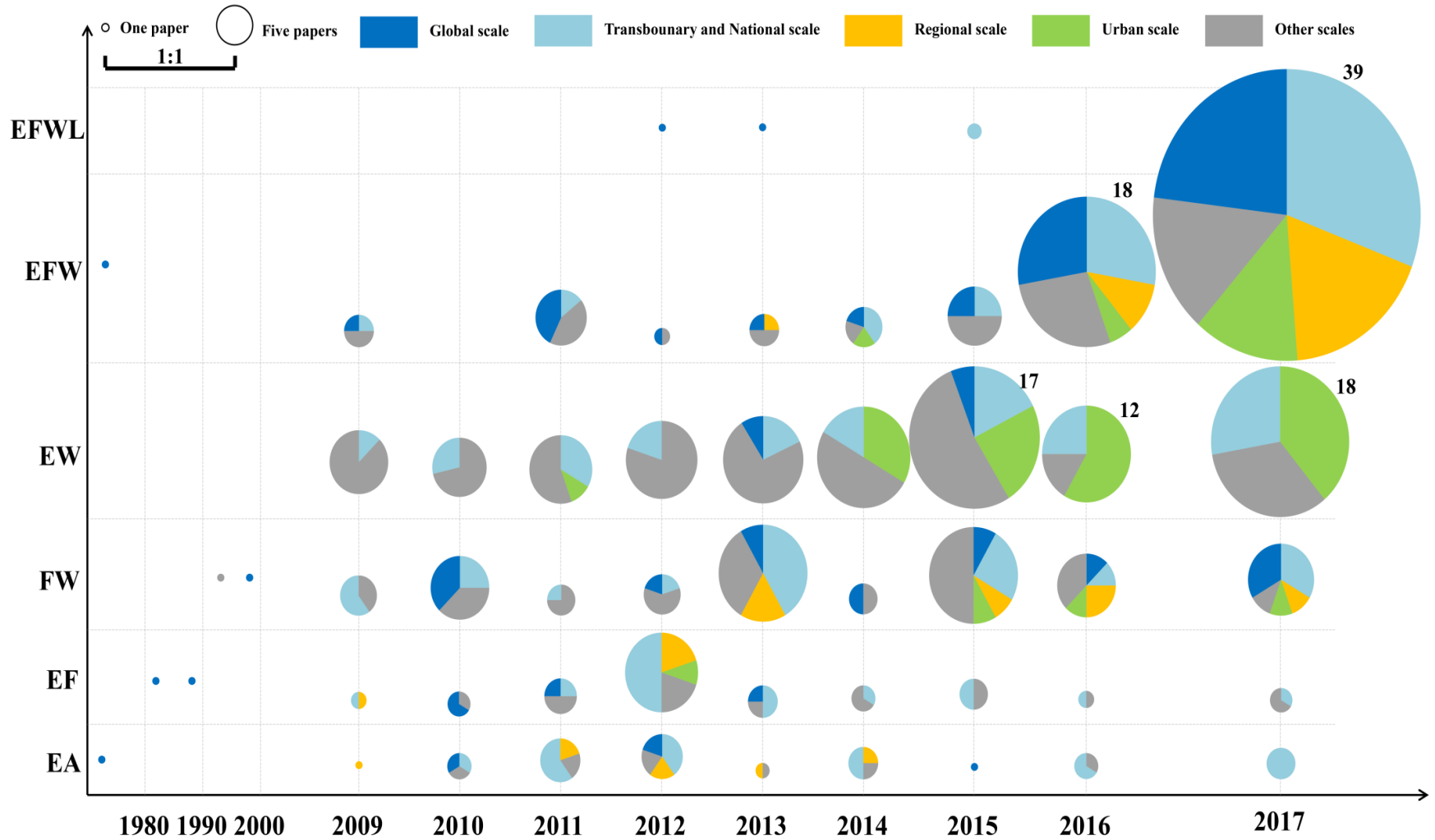


Overview of nexus research

Bonn report explains the Nexus and presents initial evidence for how a nexus approach can enhance water, energy and food security in a green economy by **increasing efficiency, reducing trade-offs, and building synergies** across sectors.

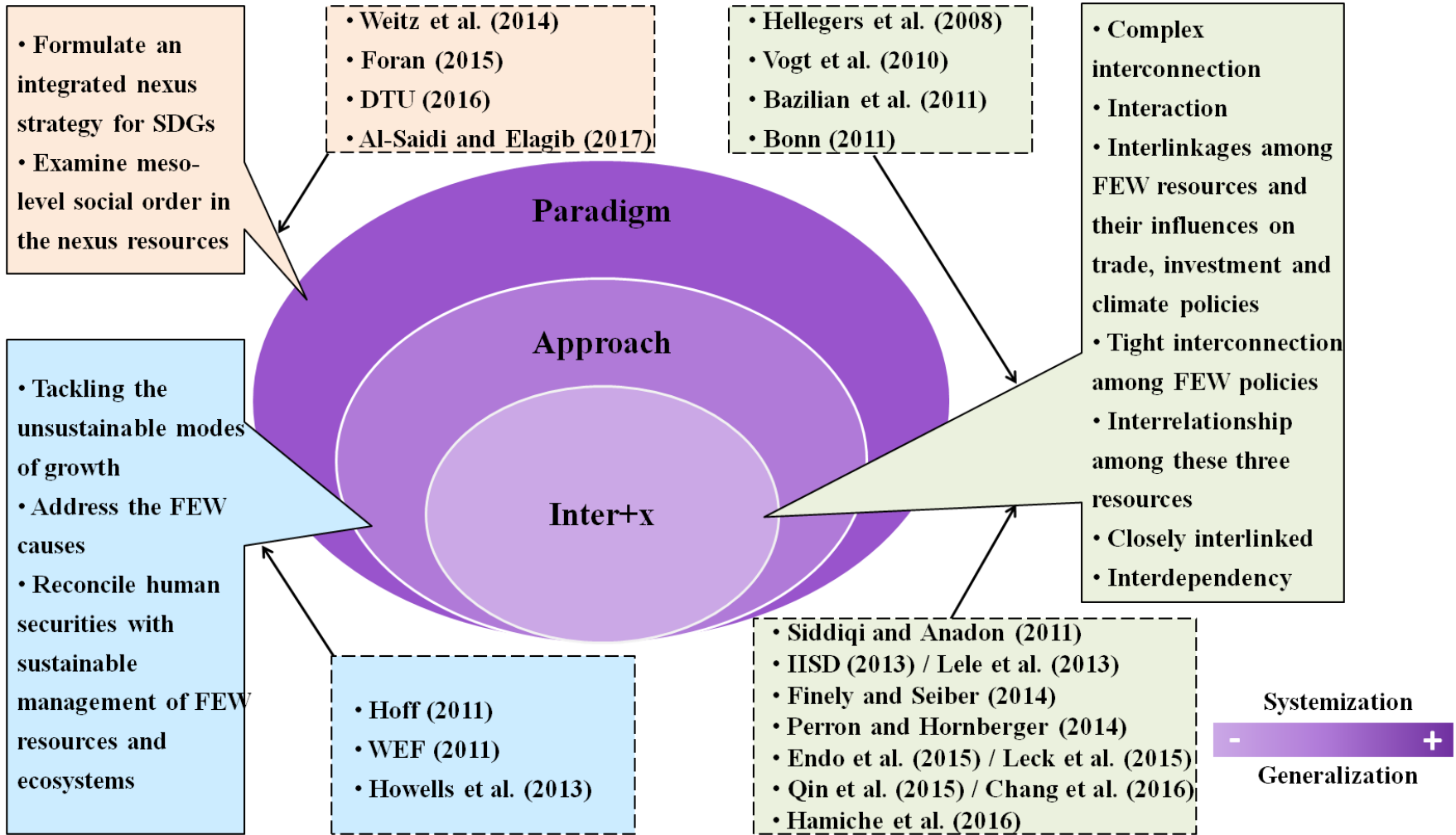


Overview of nexus research

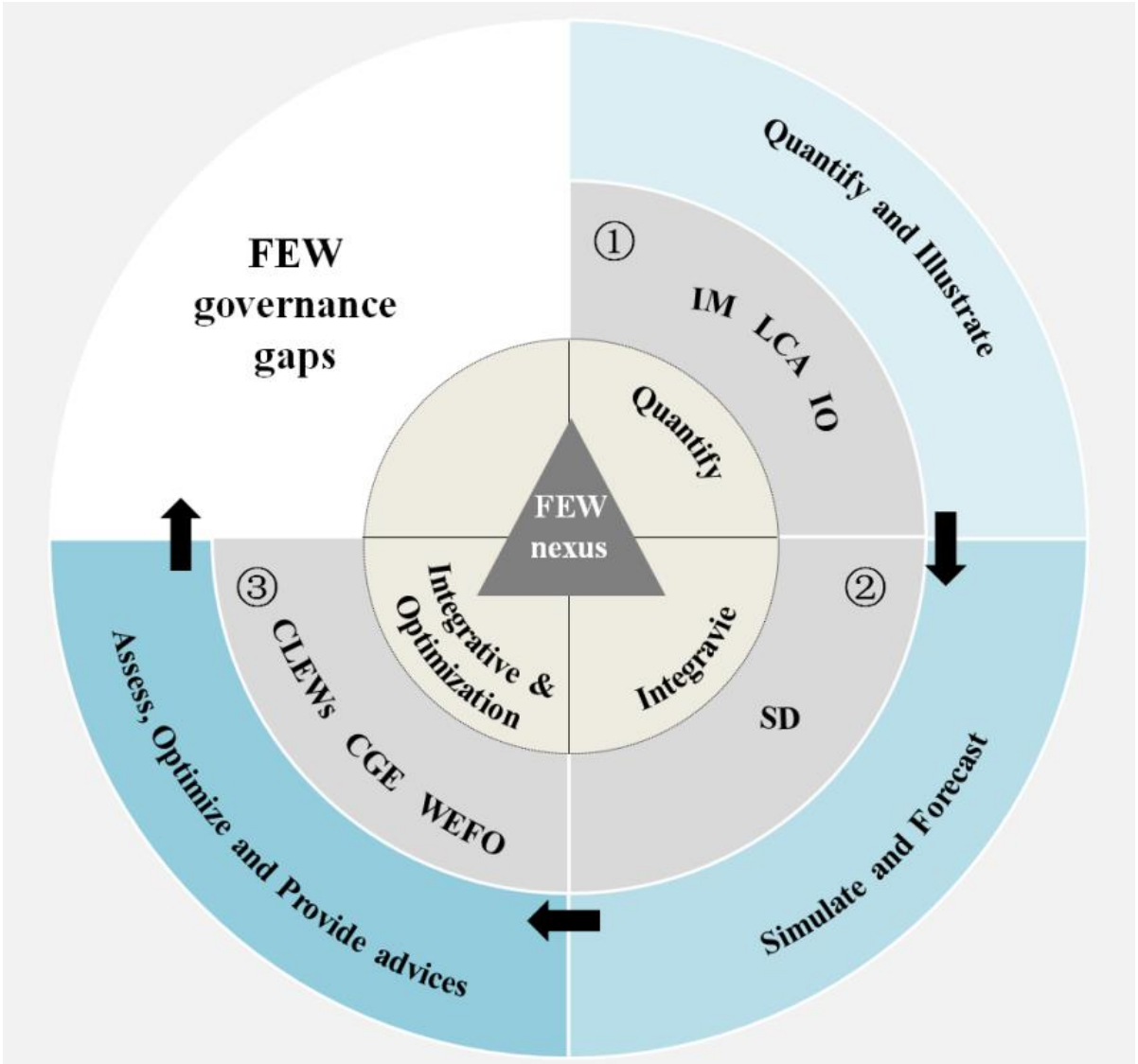


From 2011 to 2015, 291 organizations from policy, business and academic circles were involved in FEW nexus security activities and several hundred papers get published

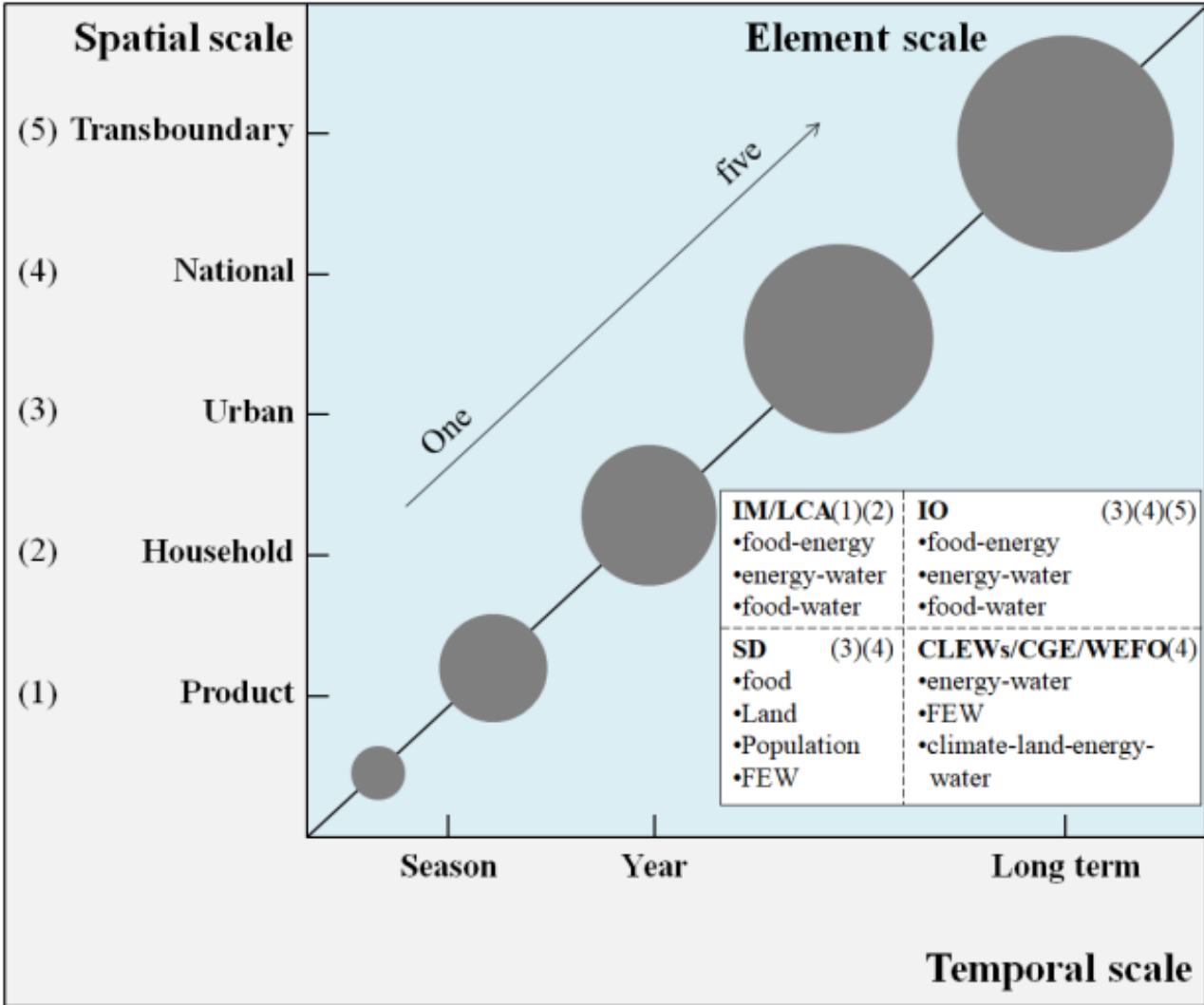
Conceptual description



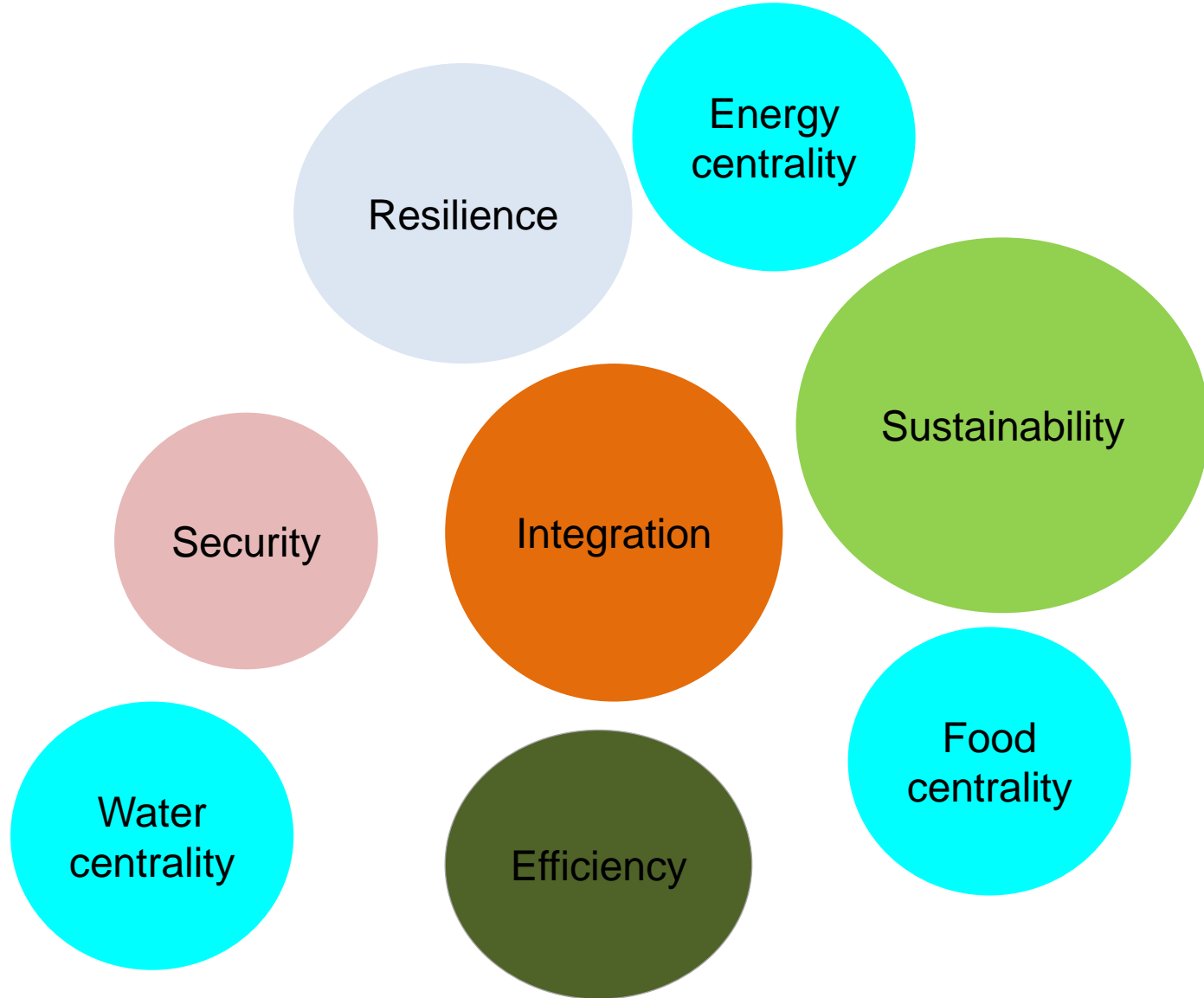
Comparison of methods



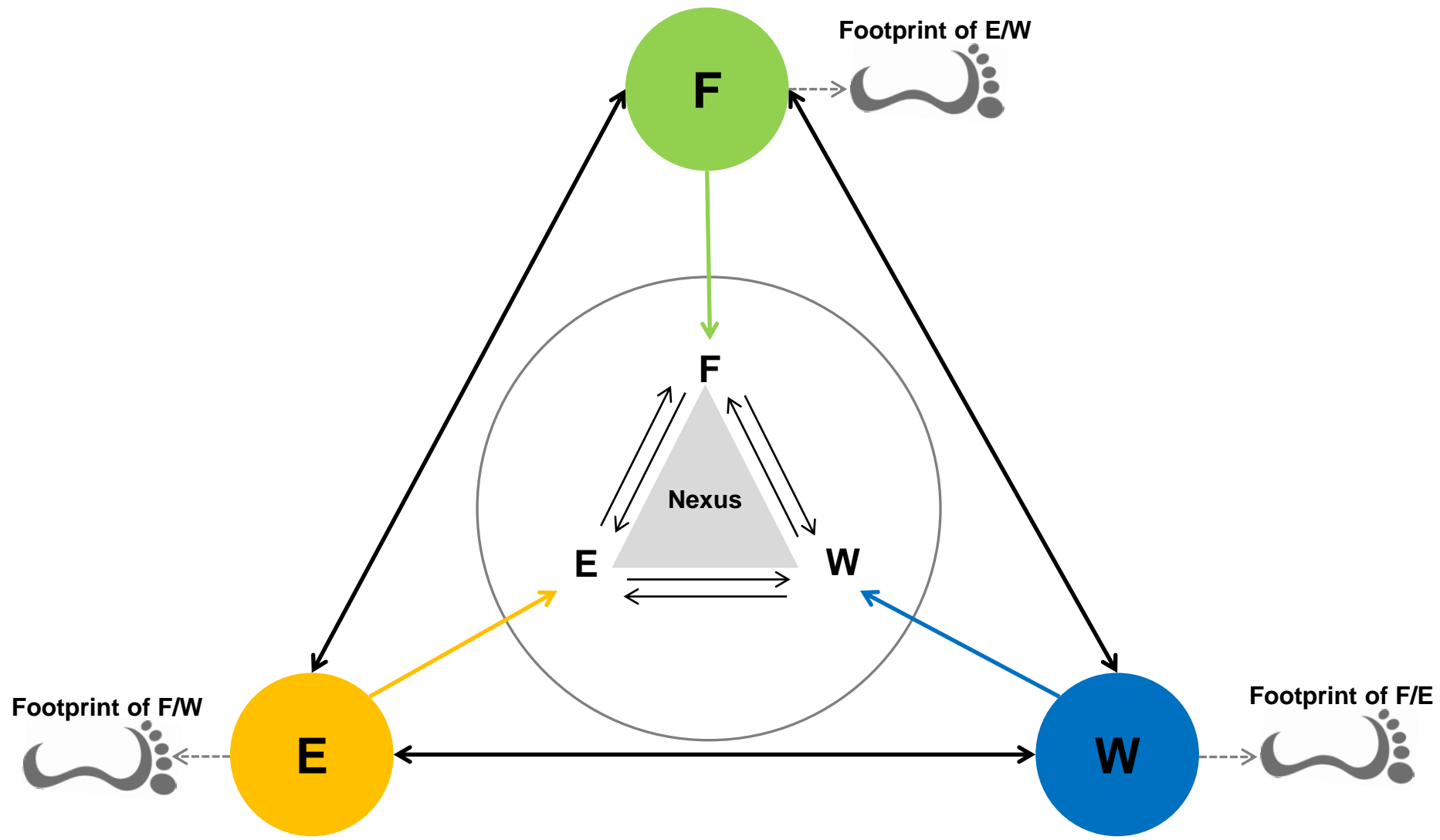
Existing case studies



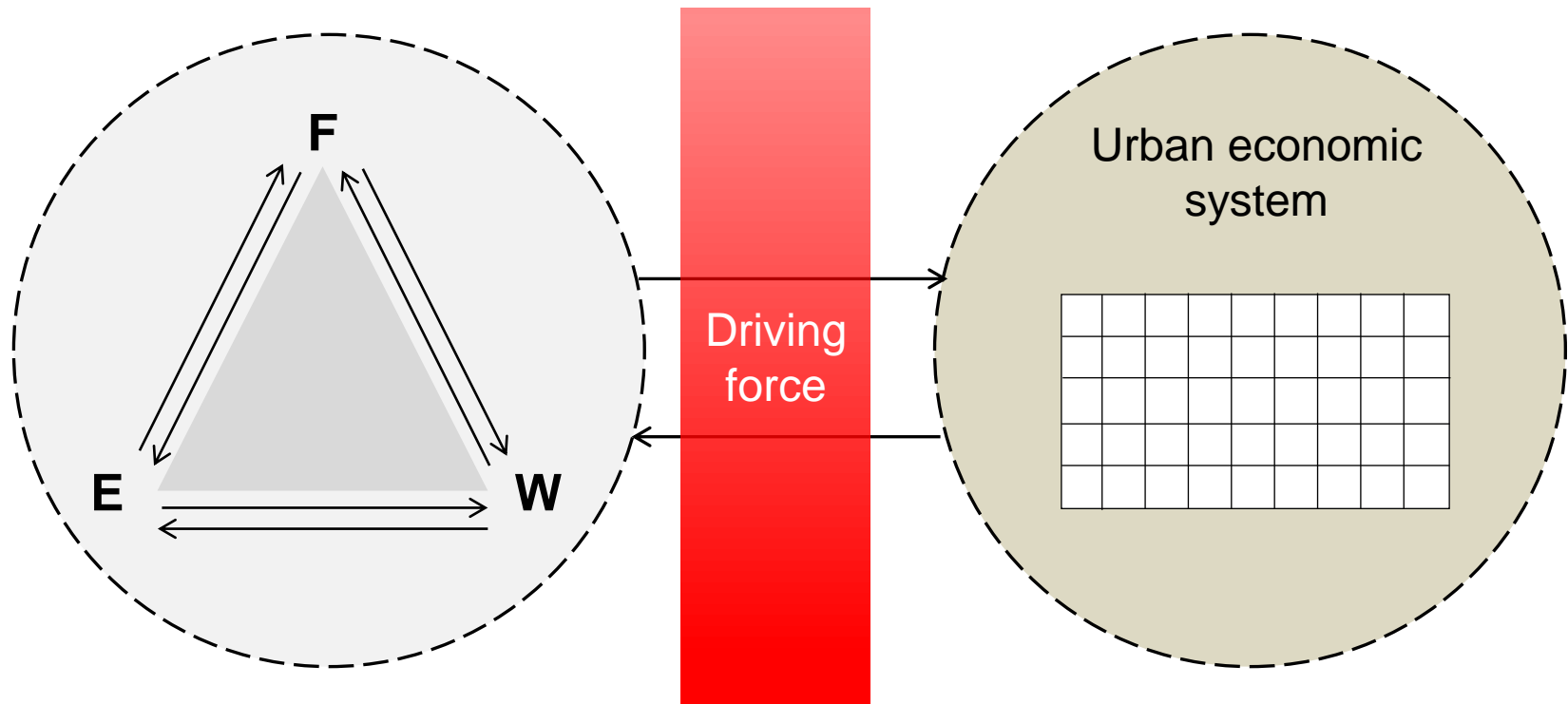
Conceptual framework of urban nexus



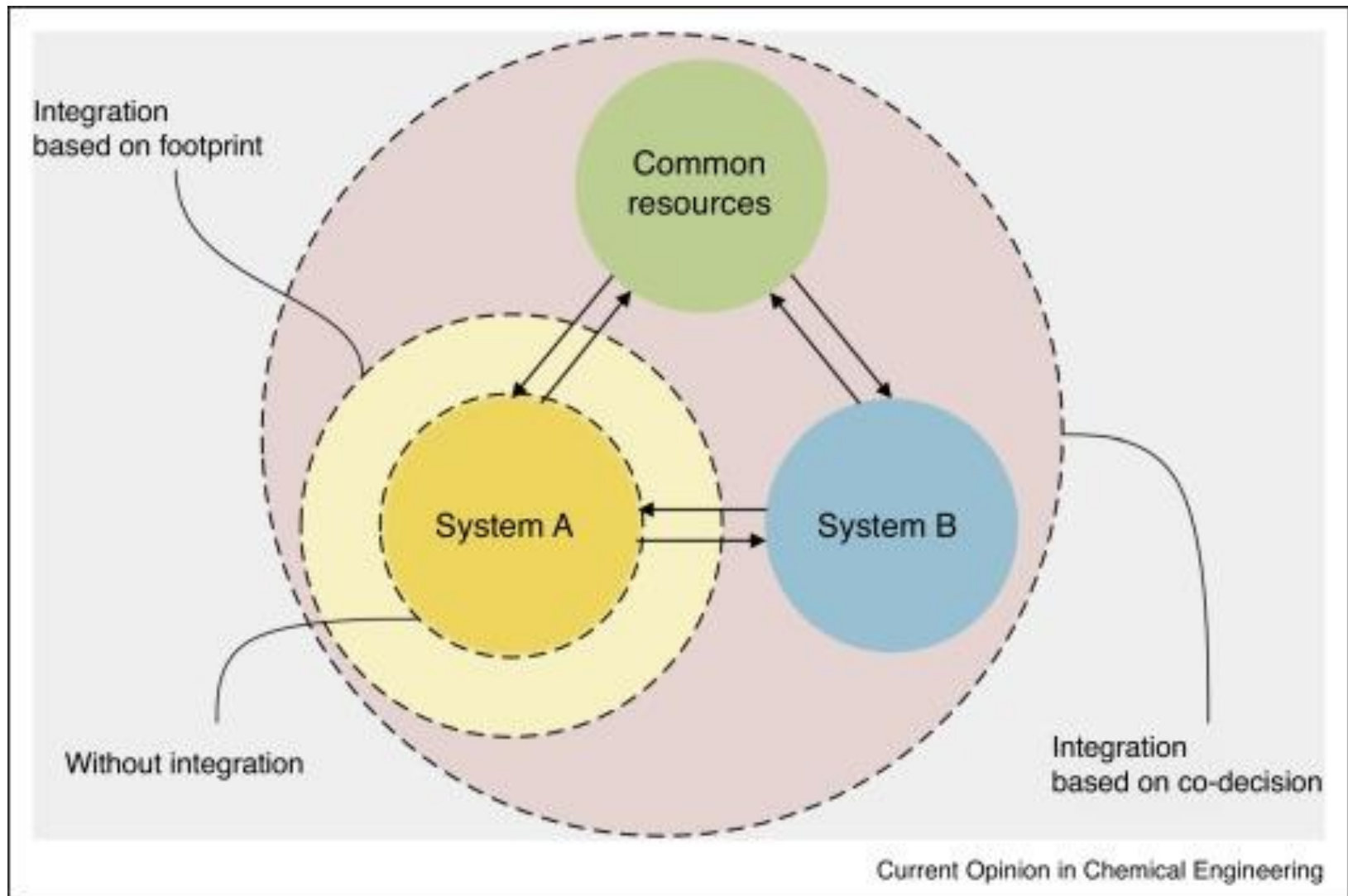
Conceptual framework—Efficiency Perspective



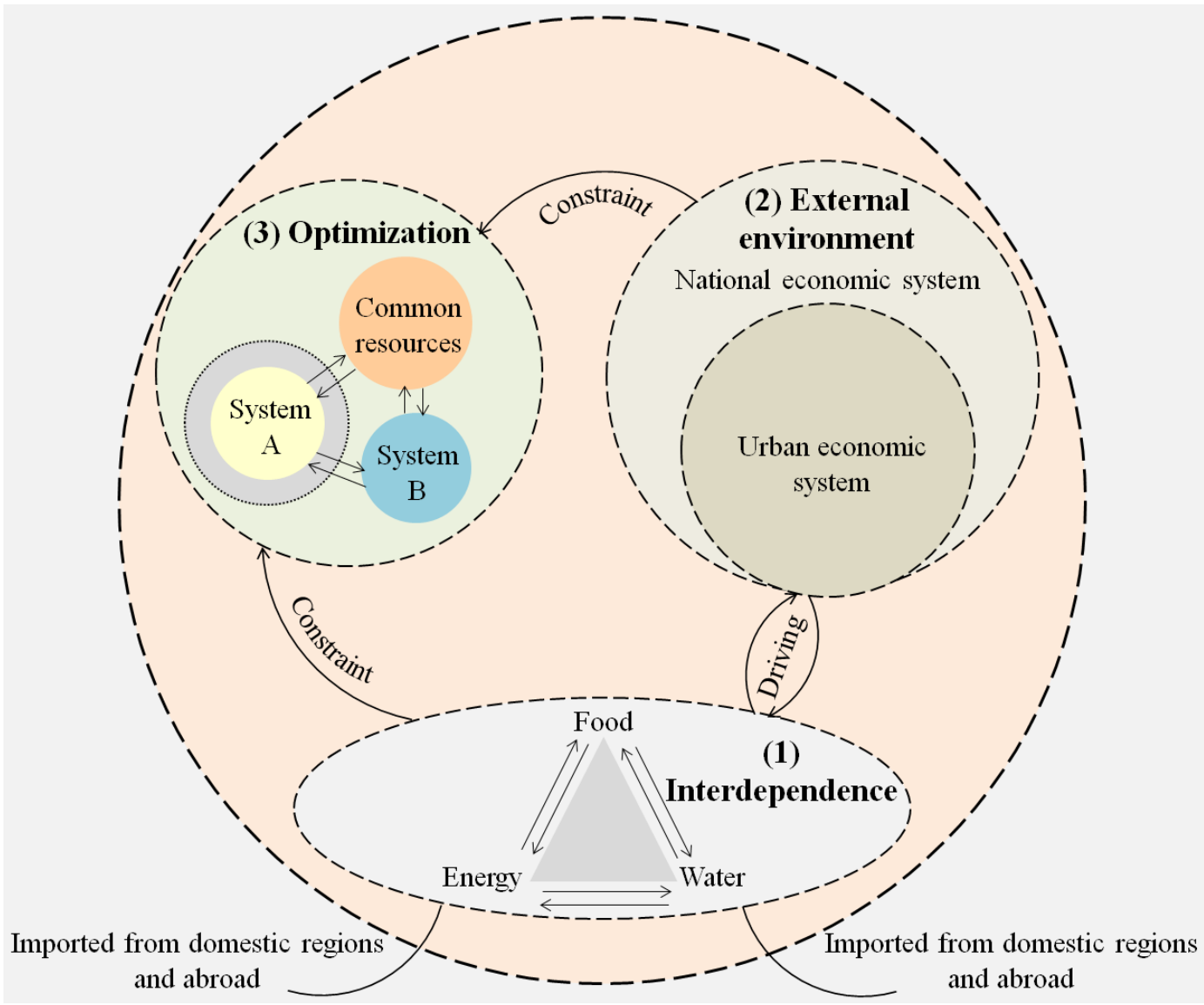
Conceptual framework—Security Perspective



Conceptual framework- Optimization Perspective

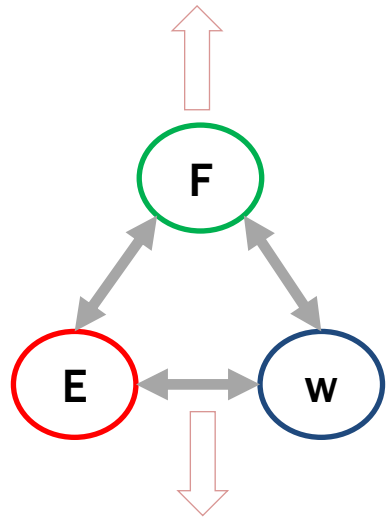


Conceptual framework-Integration Perspective



Ultimate objective

Reducing trade-offs



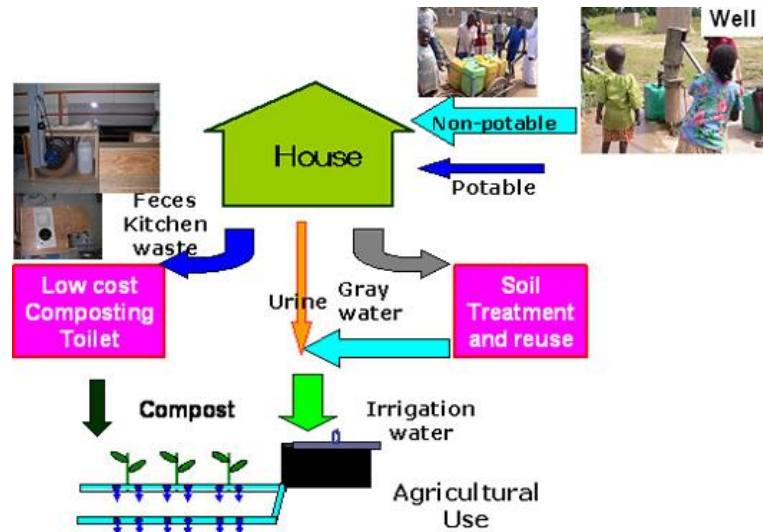
De-nexus



Increasing efficiency

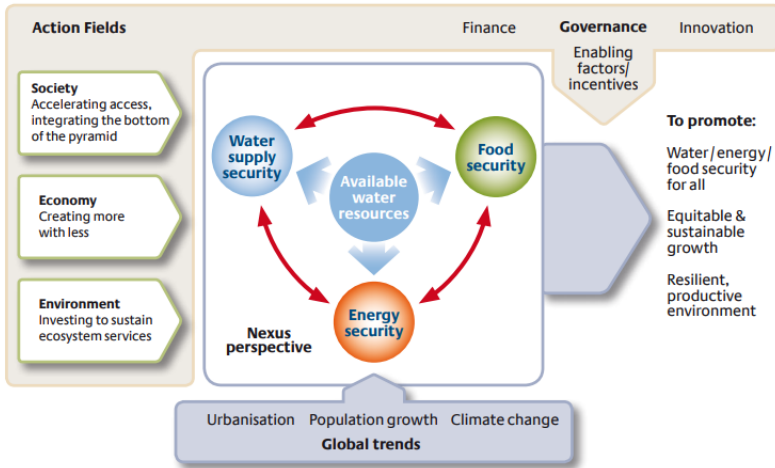
Production/Consumption

Building synergies



A framework for action

Figure 2: The water, energy and food security nexus



Uncovering the Nexus

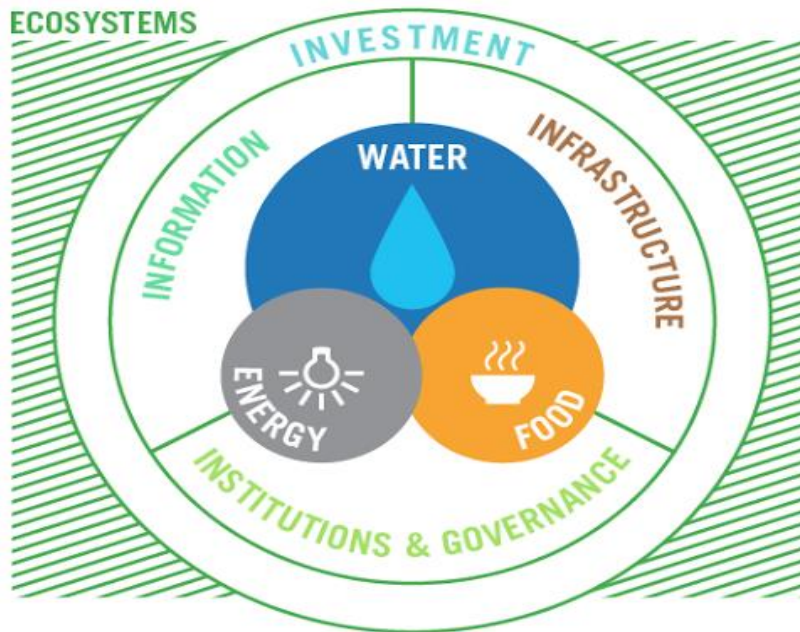
-Calculating basic data to demonstrate linkages and identify key problem, risks or opportunity areas

Governing the Nexus

-Guiding an institutional or policy response

Implementing the Nexus

- Guiding a technical intervention to improve efficiency/ effectiveness of resource use



Real challenges facing with nexus transition

COMMENTARY:

The food-energy-water nexus and urban complexity

Patricia Romero-Lankao, Timon McPhearson and Debra J. Davidson

While tackling interdependencies among food, energy, and water security is promising, three fundamental challenges to effective operationalization need addressing: the feasibility of science-policy integration, cross-scale inequalities, and path-dependencies in infrastructure and socio-institutional practices.

In 2015, the US National Science Foundation issued a battle cry with a call to fund US\$50 million for the advancement of research on the nexus (interactions) of food, energy, and water (FEW). This heightened level of research interest has now been matched by multiple international research calls, demonstrating that the nexus

has become a powerful metaphor used to convey the interdependencies between society and the natural systems on which it depends. Key to nexus thinking are the interactions between FEW security¹. From 2011 to 2015, 291 organizations from policy, business, and academic circles were involved in FEW nexus security activities².

The world's FEW systems are significantly stressed and already experiencing shortfalls due to their interactions with global anthropogenic processes such as urbanization and climate change³. FEW systems are so interconnected that actions in one frequently have impacts on the others. Therefore, in order to reduce trade-offs and

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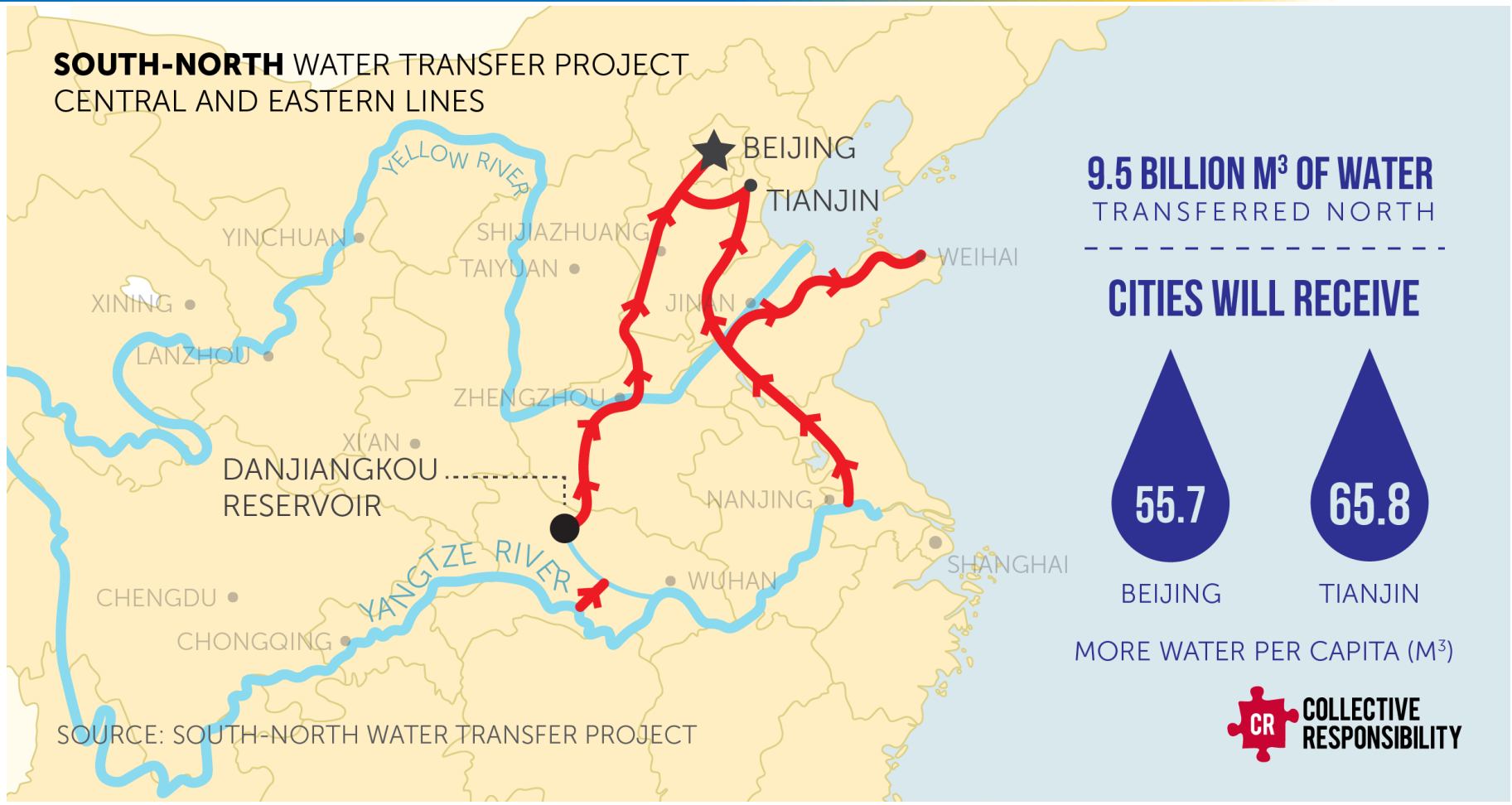
- Feasibility of science-policy integration
- Cross-scale inequalities
- Path-dependency

Feasibility of science-policy integration

- Science-policy integration faced with the challenge of moving decision-makers beyond their accustomed ways of framing and managing
- Science-policy integration involves a collective engagement of disparate interests, values, and power relations.
- There is also frequently a mismatch between geographical and topical areas of concern and the jurisdiction or knowledge necessary to manage FEW security.



Cross-scale inequalities



By and for whom are FEW system being secured?

Path-dependence



Once adopted, very enduring and costly to change



Infrastructural and governance regimes shaping urban FEW security may be dynamically stable, with a high degree of path-dependency that makes them difficult to change

**At worst, we will run the risk of perpetuating the
very dysfunction we are try to repair!**

—Romero-Lanko et al.,2017

2018 International Conference on Resource Sustainability (icRS 2018)



International Conference on Resource Sustainability

June 27-29, 2018

Beijing, China

- <http://www.icrsconf.com>
- Abstract due on January 15, 2018
- Conference topics:
 - Efficiency and environmental impacts of resource utilization
 - Sustainable supply chain
 - Waste reduction, reuse, recycling and recovery
 - Environmental behavior for sustainable consumption
 - Resource and waste management
 - Circular economy
 - Emissions, effects and management of air pollutants and greenhouse gases

Thanks for your attention!

Prof. Lixiao Zhang
zhanglixiao@bnu.edu.cn

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