

HOW SECURE IS EUROPE'S ENERGY SECTOR AND HOW IT INTERACTS WITH WATER AND FOOD SECURITY?

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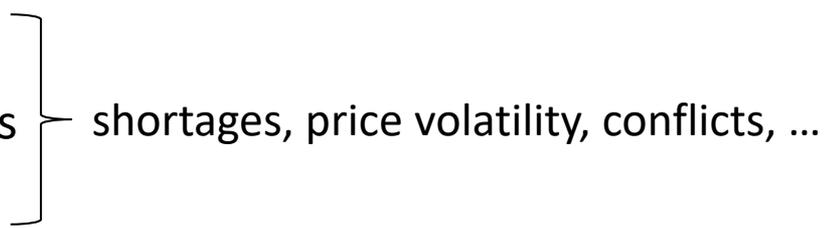
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University of Technology Sydney**

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MOTIVATION

- Importance of energy
 - critical for human well-being
 - vital for socioeconomic development
 - provision of energy → top priority in development agendas (SDGs)
- Energy security challenge
 - rapidly increasing demand
 - limited, and fast depleting, resources
 - growing climate change threats

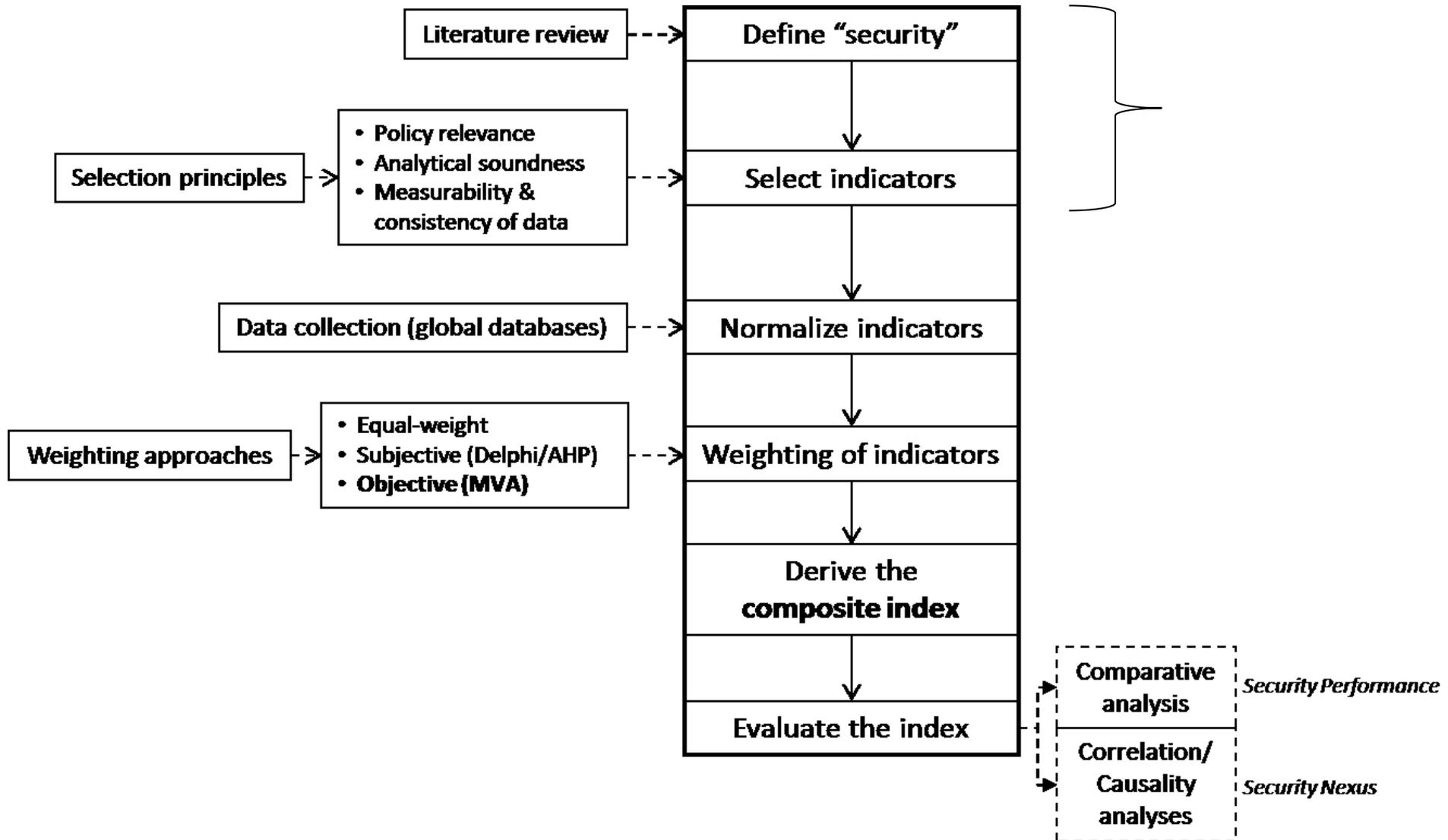
shortages, price volatility, conflicts, ...
- Policy to redress this challenge is not easy to formalized

- Reasons:
 - Concept of “security” is complex
 - multidimensional
 - dynamics
 - Interacts with security from other domains (energy-water-food nexus; Hoff 2011)
- Designing effective energy policy requires holistic/quantitative measures to enable a better understanding of “security”
- Yet, no consensus on interpretation/measurement of EWF security

OBJECTIVES

1. Develop composite indices to enable assessment of energy security across countries
 - emphasis on select European countries
2. Examine the nature of interactions between energy, water and food securities

METHODOLOGY



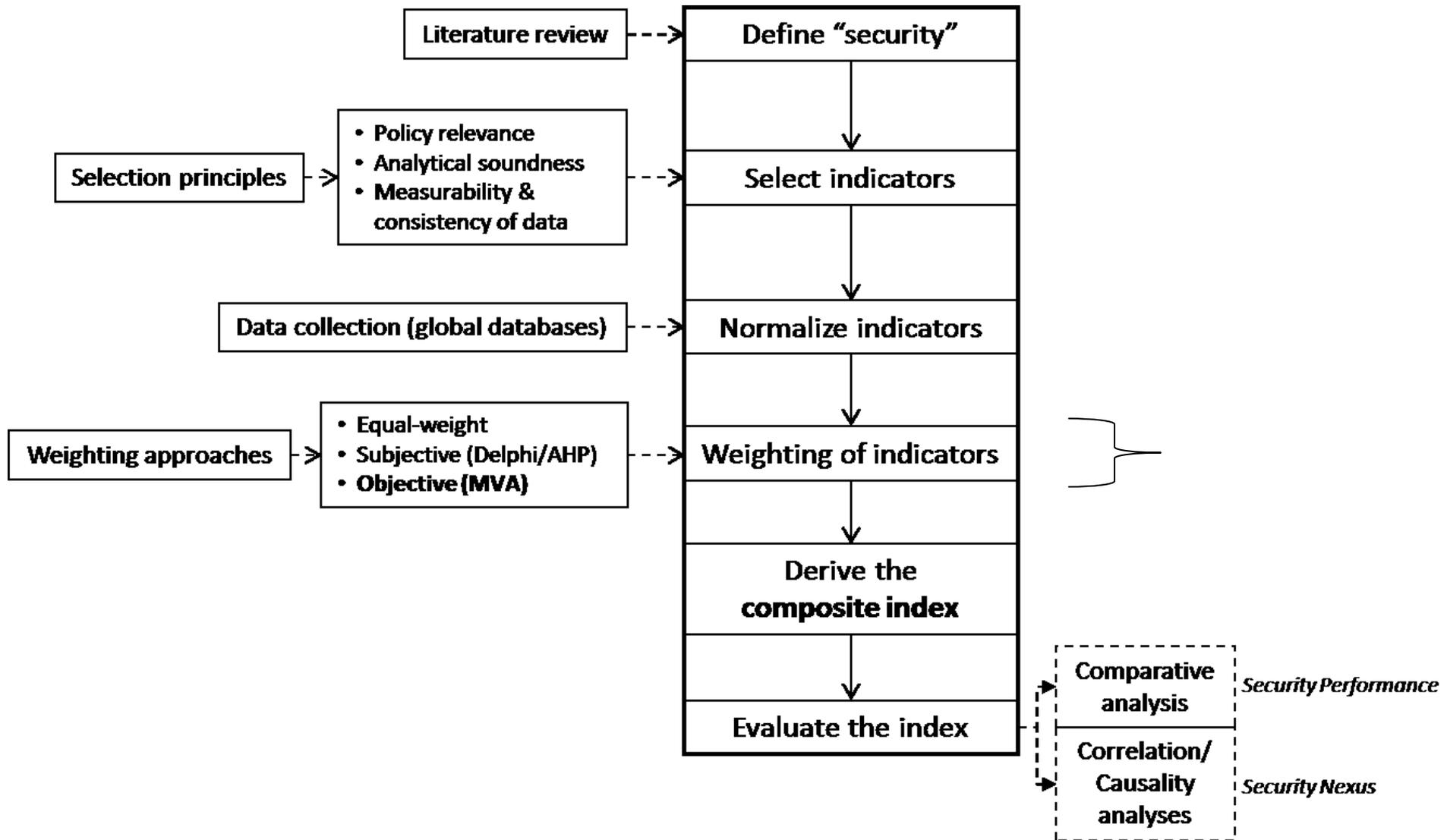
Security definition

- Early definitions focus on *availability* of resources → emphases given to the existence and diversification of resources, and sovereignty associated with resources
 - energy security ↔ avoid energy supply disruptions (Yergin 2006)
 - water security ↔ sufficient clean water to avoid conflicts (Gleick 1993)
 - food security ↔ avoid food shortages (UN 1974)
- Increasingly being recognized that ‘security’ is a *multidimensional* concept → physical availability, economic accessibility, efficiency in utilizing resources, environmental sustainability, and social acceptability (UN-Energy 2010, UN-Water 2014, FAO 2002)

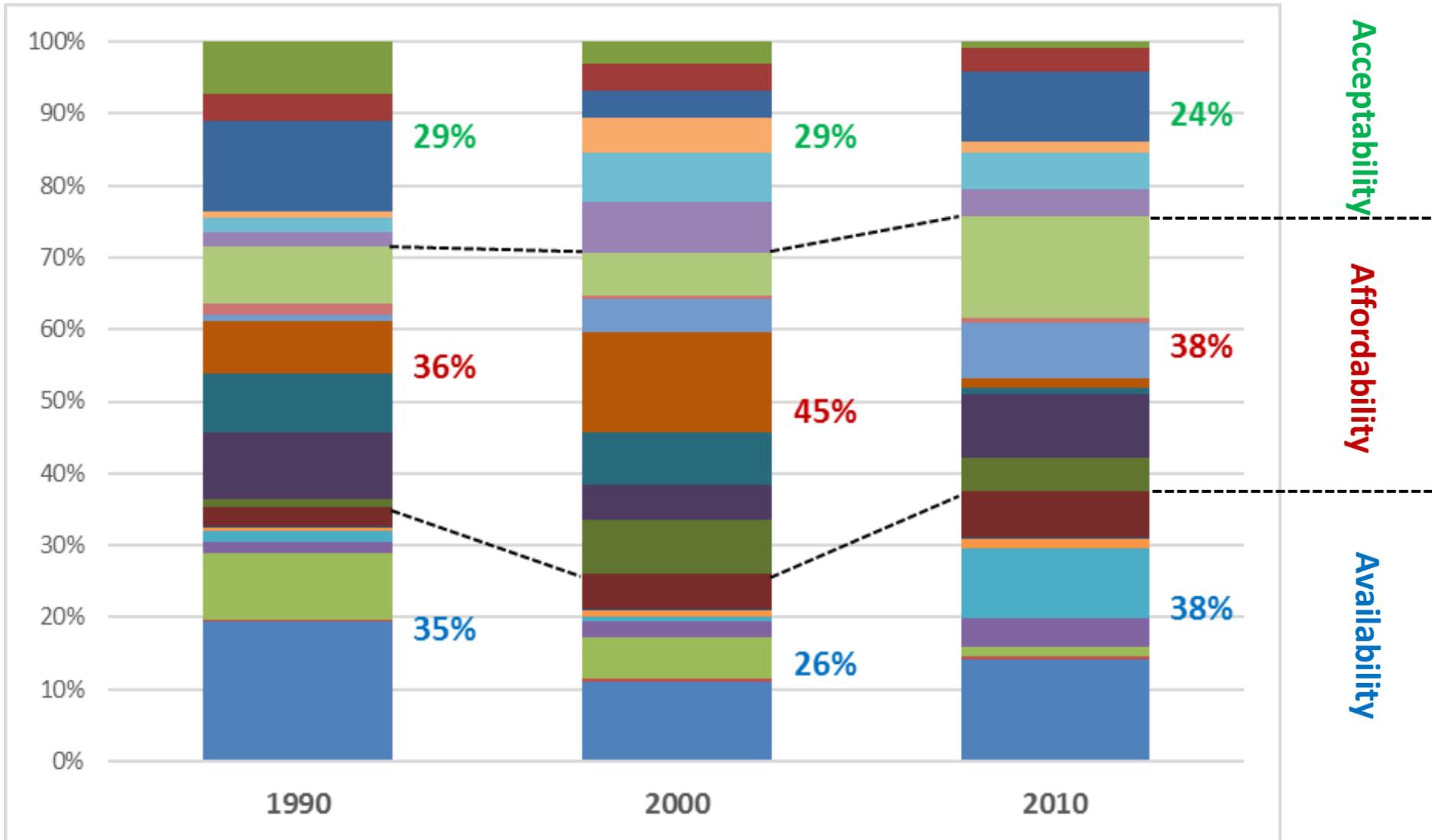
- Based on definitions by UN agencies, we classify ‘security’ into three broad dimensions:
 - **Availability:** refers to the *physical availability and access* to energy, water and food, and is determined by the level of domestic production and reserves, and physical capability to obtain these resources.
 - **Affordability:** refers to the *economic access* to energy, water and food, and is determined by the level of prices, and efficiency in utilizing resources.
 - **Acceptability:** refers to both *environmental sustainability* (e.g., cleanliness) and *social acceptability* (e.g., fair and safe) in the way energy, water and food are used and produced in an economy.

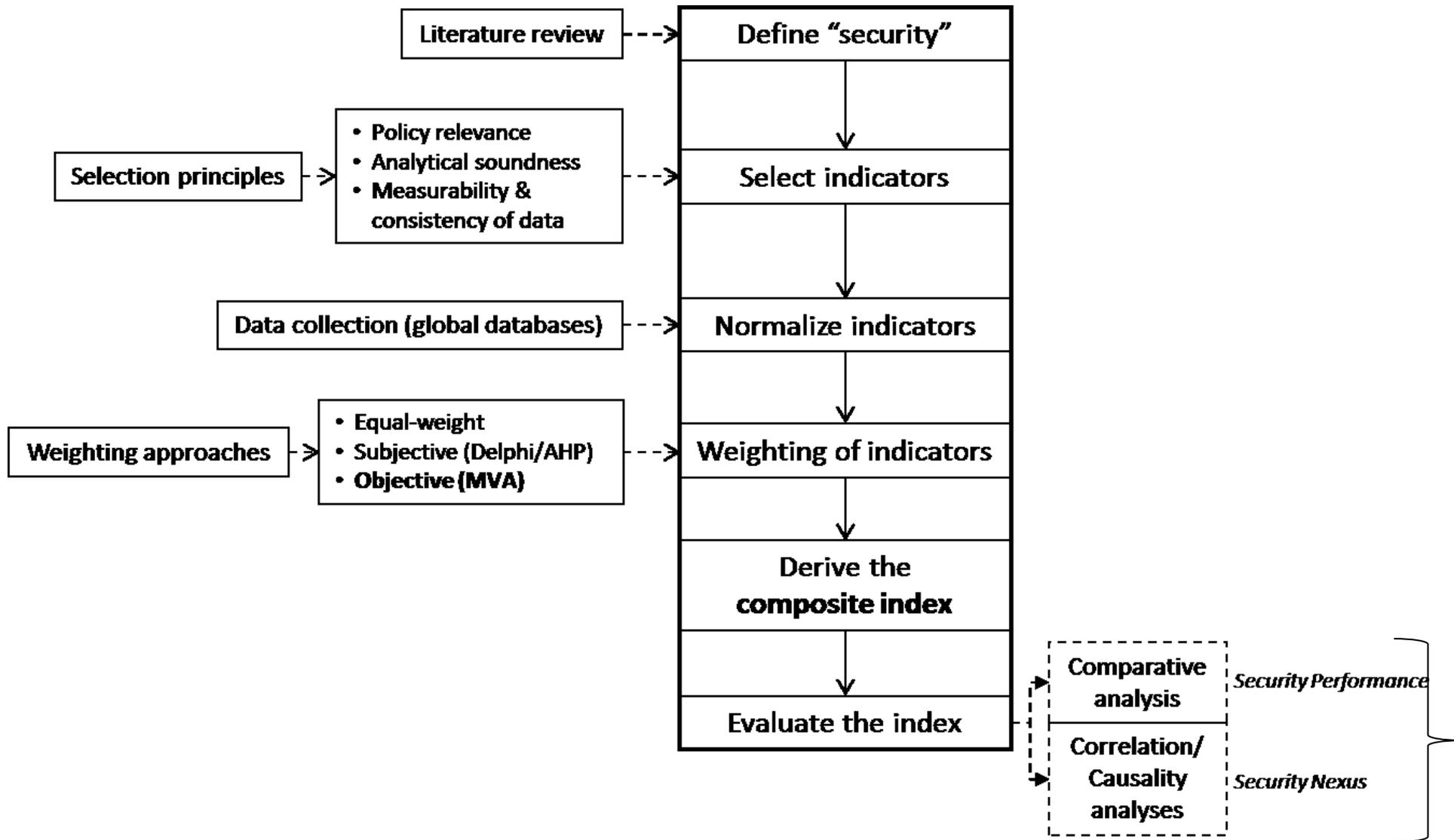
Security indicators

	AVAILABILITY (19)	AFFORDABILITY (14)	ACCEPTABILITY (14)
ENERGY SECURITY (21)	<ul style="list-style-type: none"> - Access to electricity - Diversity of electricity supply - Dependent on traditional energy - Diversity of primary energy supply - Energy import dependency - Diversity of end-use energy consumption - Value of energy reserves - Domestic energy production 	<ul style="list-style-type: none"> - Energy prices - Primary energy intensity - Economy-wide energy efficiency - Network losses - Value of energy imports - End-use energy intensity - Thermal efficiency 	<ul style="list-style-type: none"> - Greenhouse gas emissions - Renewable-based electricity production - Indoor air pollution - Carbon intensity of GDP - Renewable energy consumption - Carbon intensity of fuel
WATER SECURITY (12)	<ul style="list-style-type: none"> - Water stress ratio - Access to clean drinking water - Sectoral water withdrawals - Access to improved sanitation facilities - Internal freshwater resources 	<ul style="list-style-type: none"> - Irrigated agricultural water productivity - Industrial water productivity - Economy-wide water productivity 	<ul style="list-style-type: none"> - Vulnerability of water-flow due to dam - Inequality in access to sanitation facilities - Inequality in access to clean drinking water - Discharges of hot cooling water
FOOD SECURITY (14)	<ul style="list-style-type: none"> - Depth of food deficit - Irrigated land area - Value of food production - Cereal production - Arable land - Aquaculture production 	<ul style="list-style-type: none"> - Value of food imports - Food prices - Agricultural productivity - Cereal yield 	<ul style="list-style-type: none"> - Agricultural nitrous-oxide emissions - Agricultural methane emissions - Use of chemical fertilizer - Diversification of food consumption



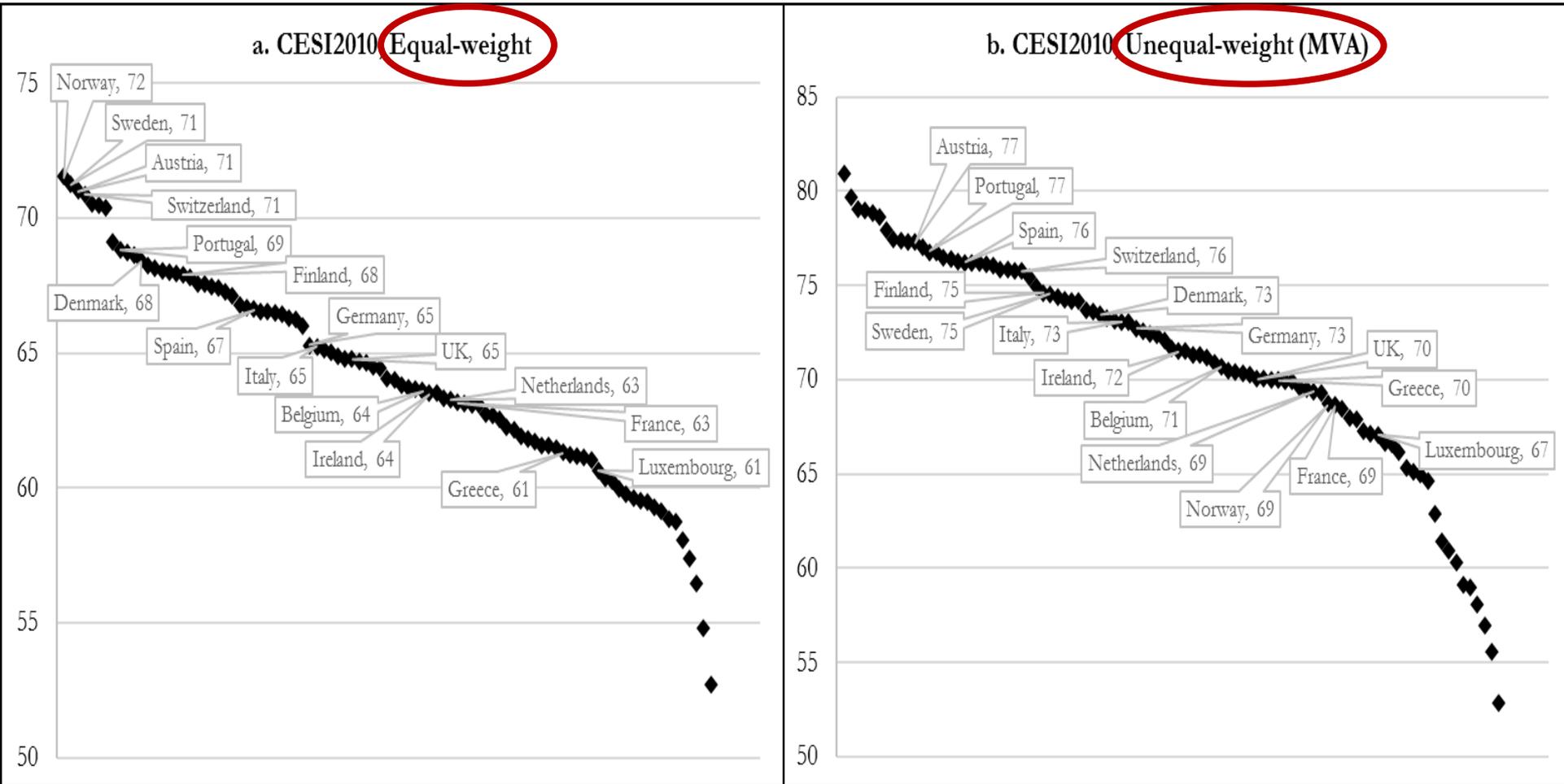
MVA-based weights of energy security indicators





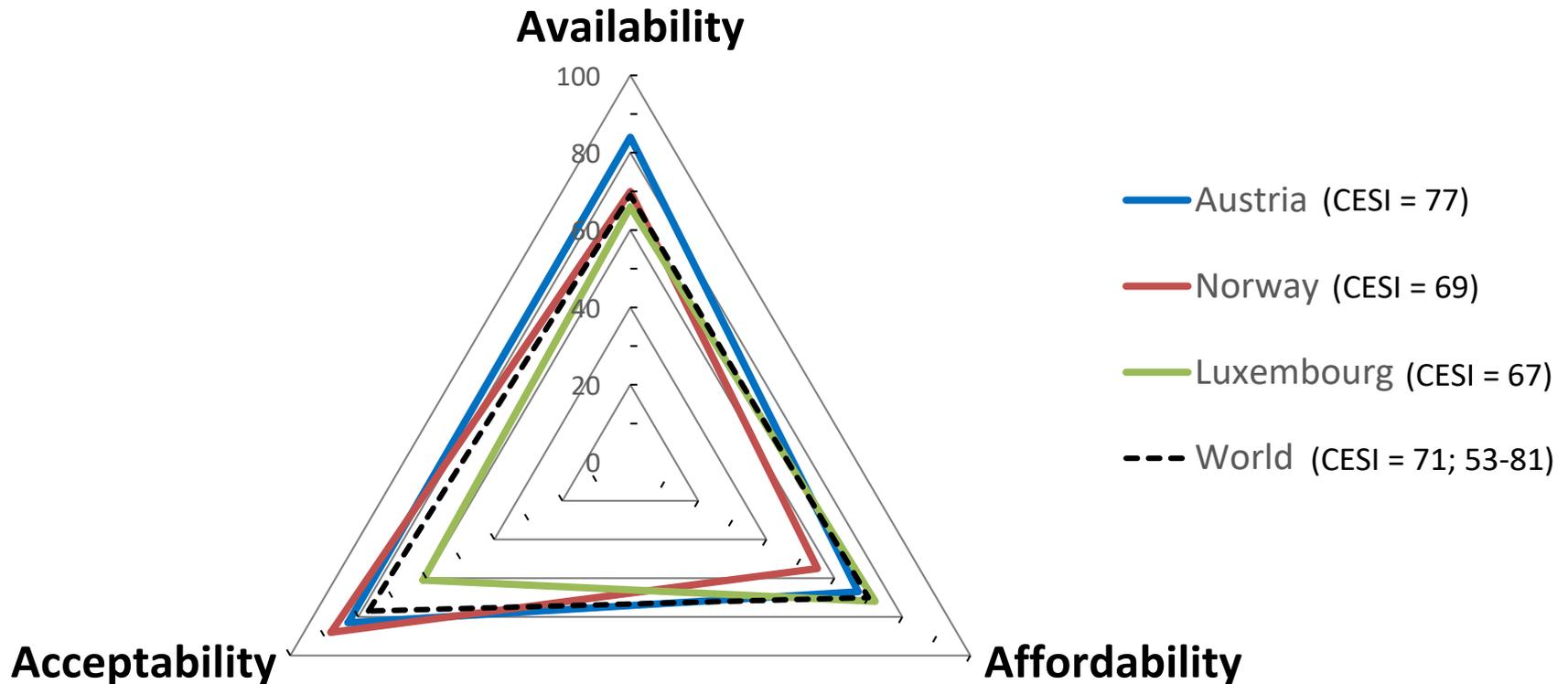
SOME OBSERVATIONS

Energy Security Performance



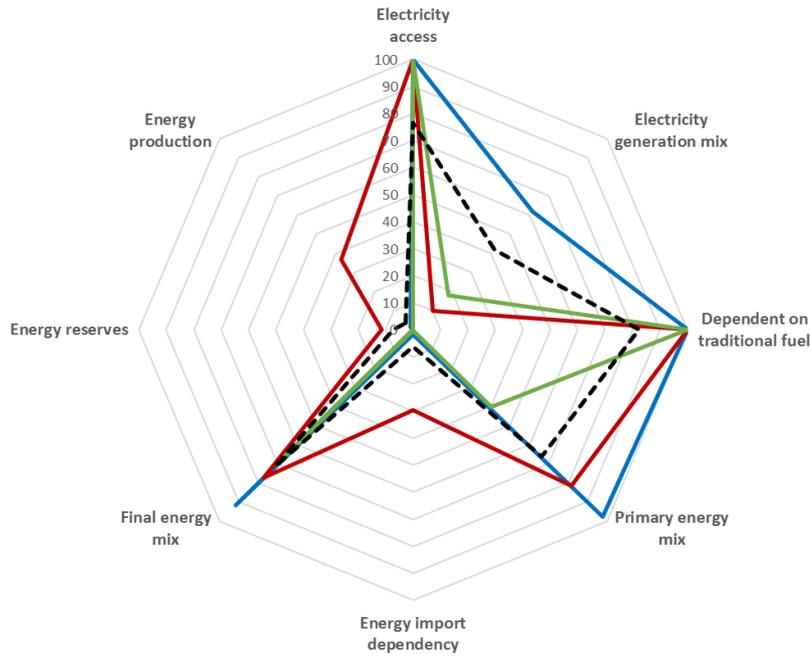
→ ranking of energy security changes, depending on the weight used

Energy Security, 2010

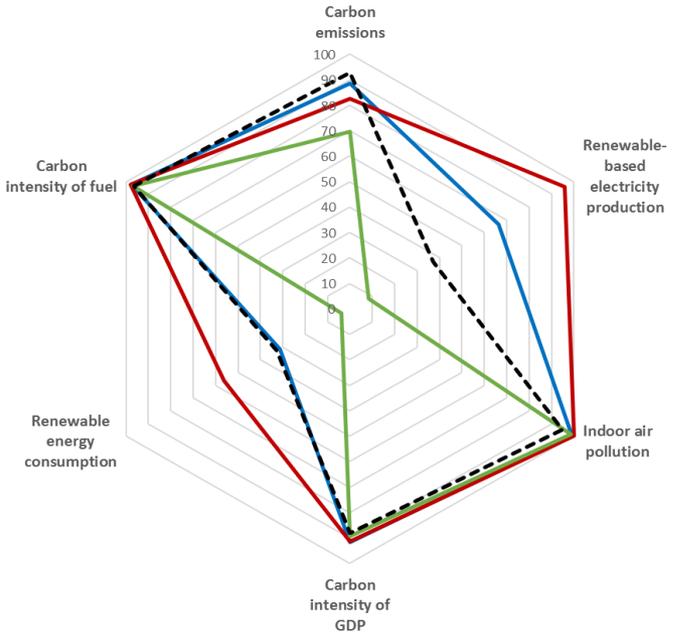


→ sources of (in)security vary across countries, implying a need for differences in policy prescriptions

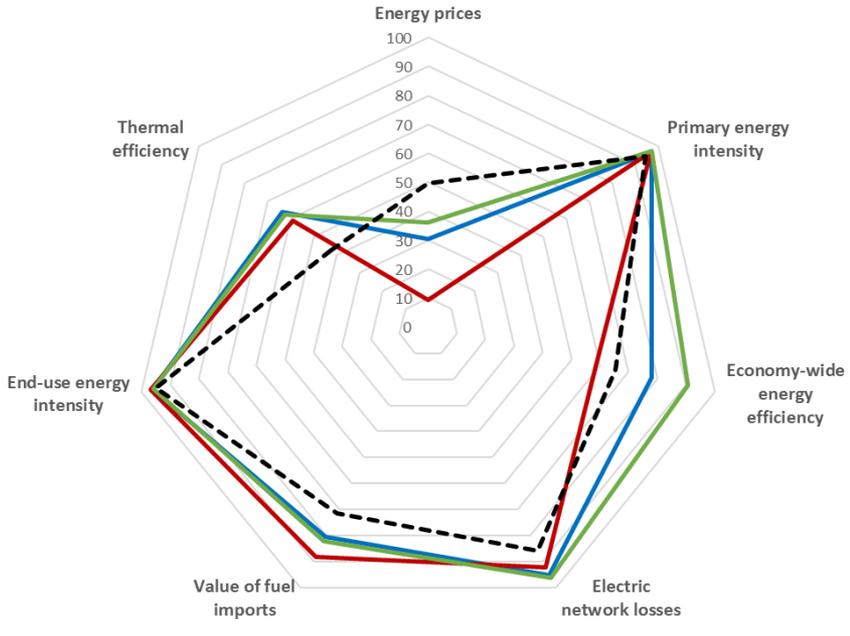
Availability



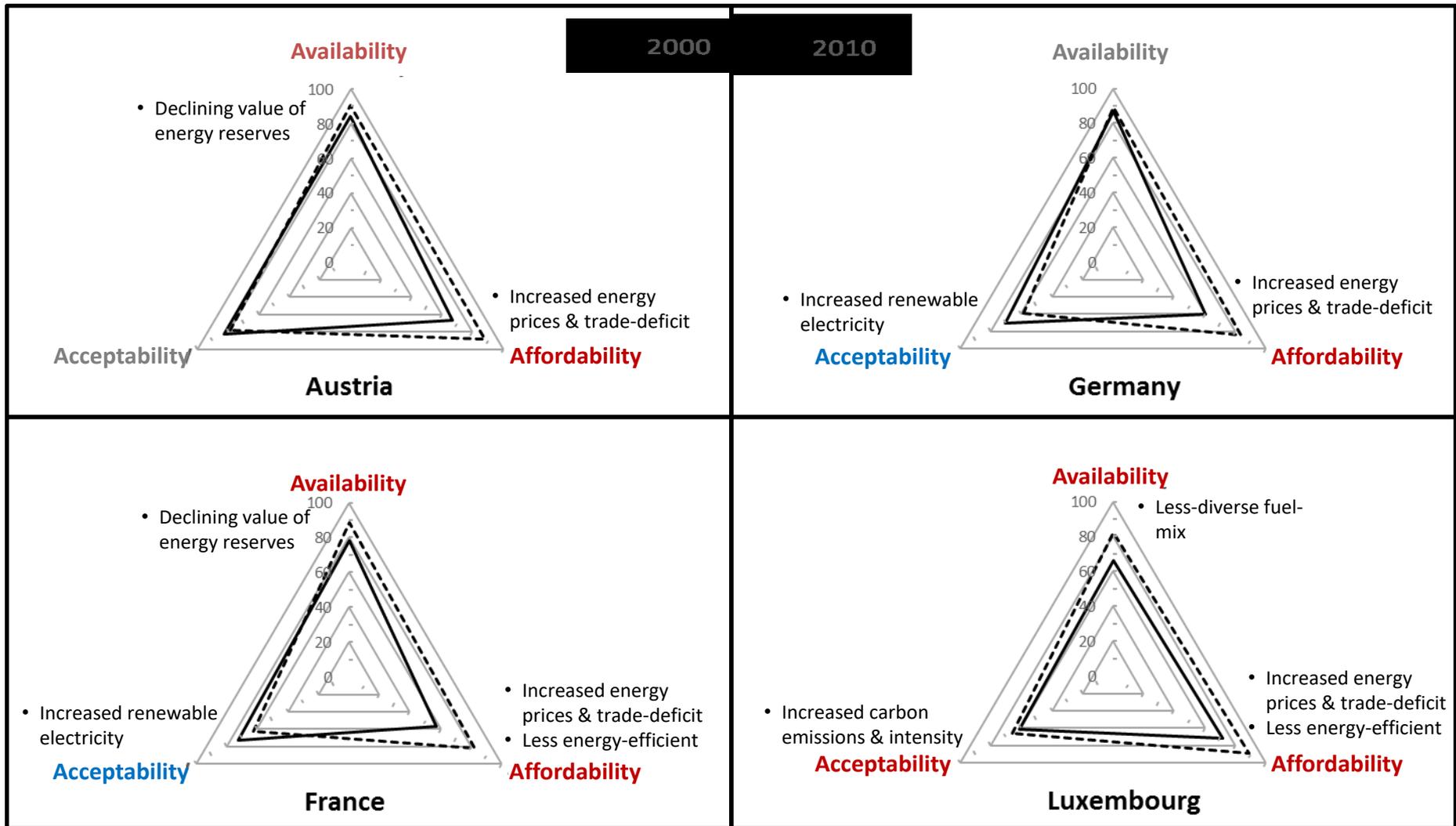
Acceptability



Affordability

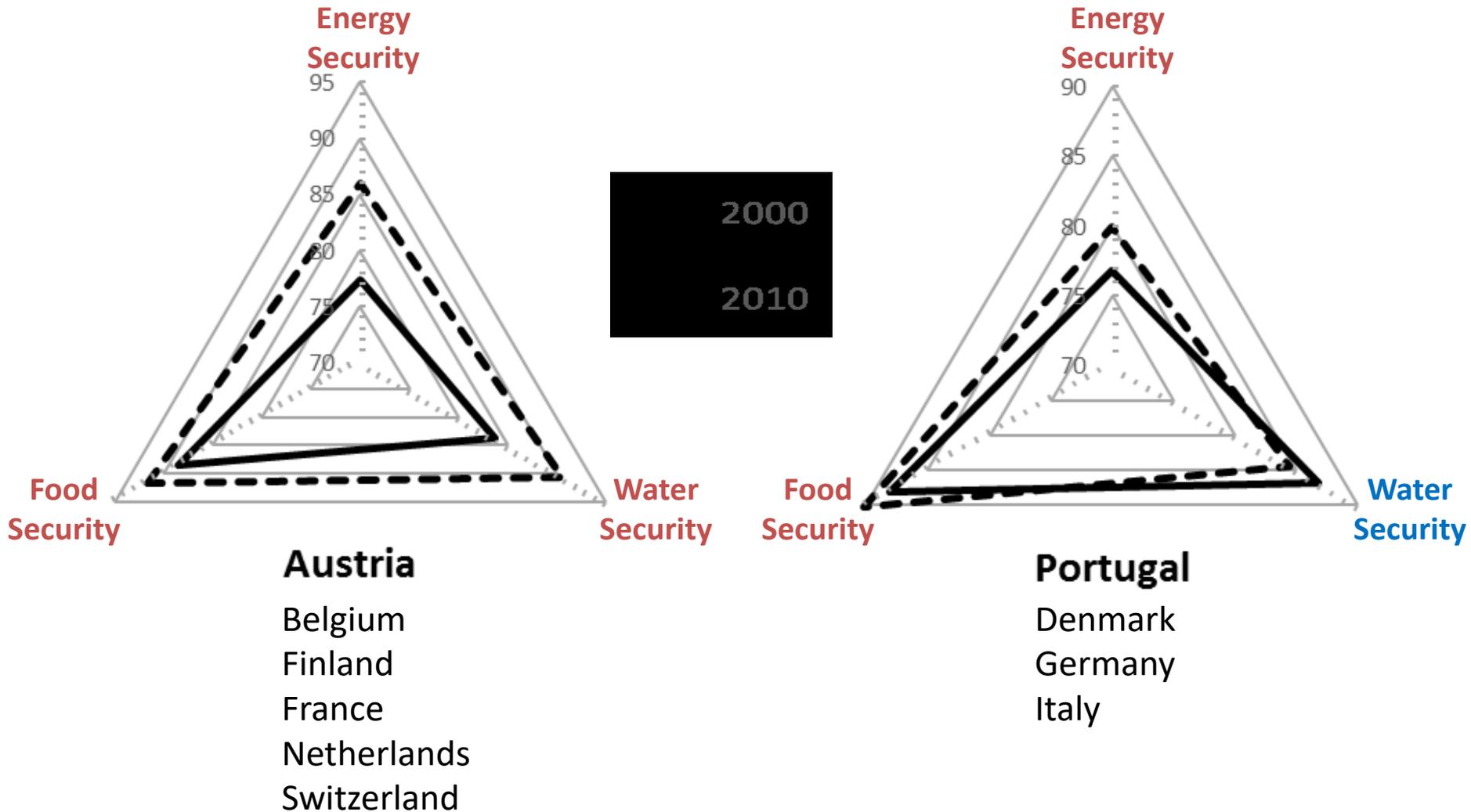


Energy Security, 2000 & 2010



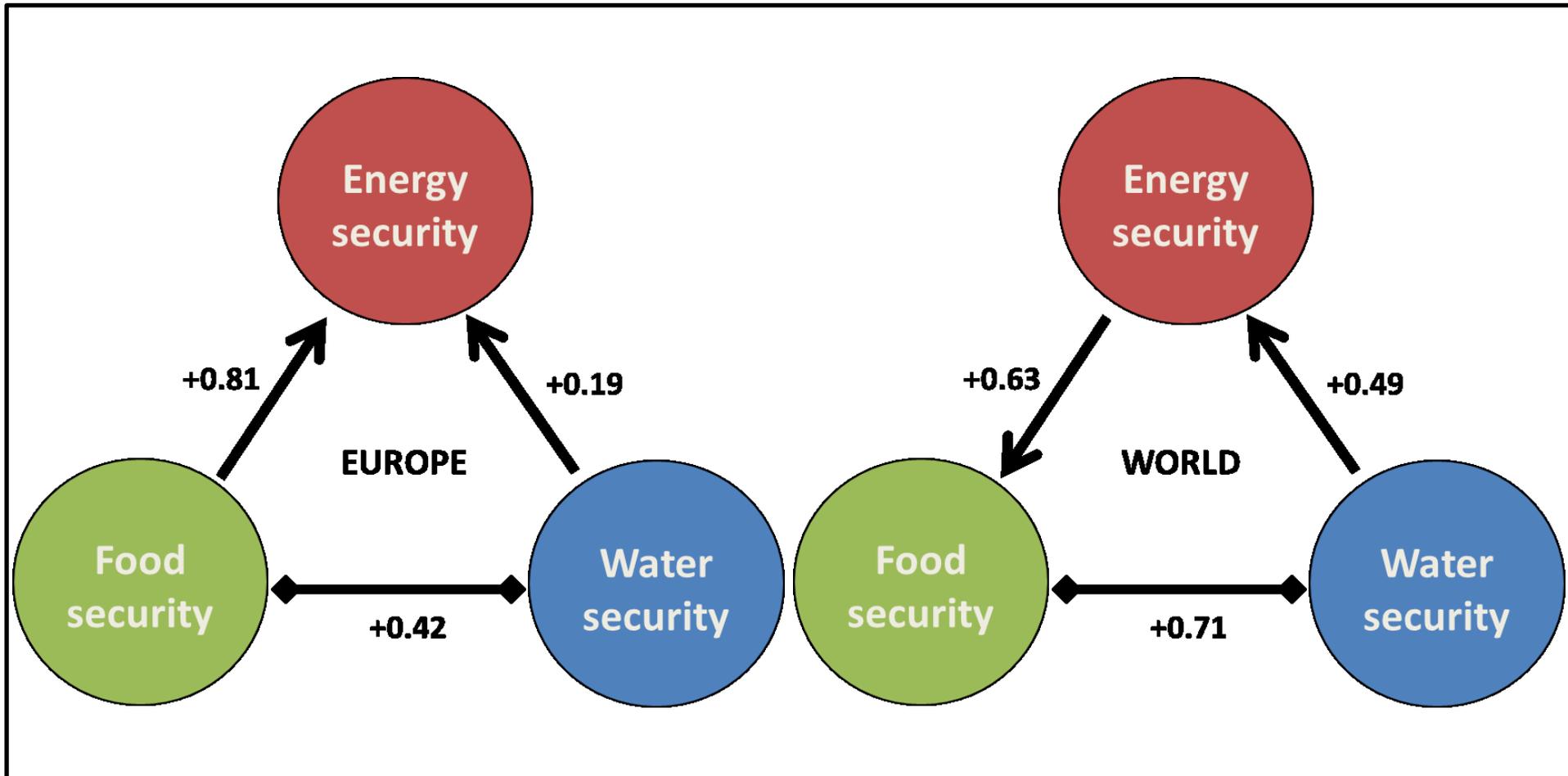
→ focus of security shifts over time, suggesting the existence of tradeoff between different security dimensions, and the nature of tradeoff differs across countries

Energy-Water-Food Security Nexus



→ results suggest some interactions between energy security, water security and food security ... potential tradeoffs in some countries

EWF Security Nexus: broad generalisation (preliminary)



The values are pairwise-correlation coefficients. Directions of causality are determined at $p < 0.05$ level.

- positive correlation coefficients across all security domains imply that improving security in one area is likely to be associated with improved security in other areas
- direction of causality differs by region (country)

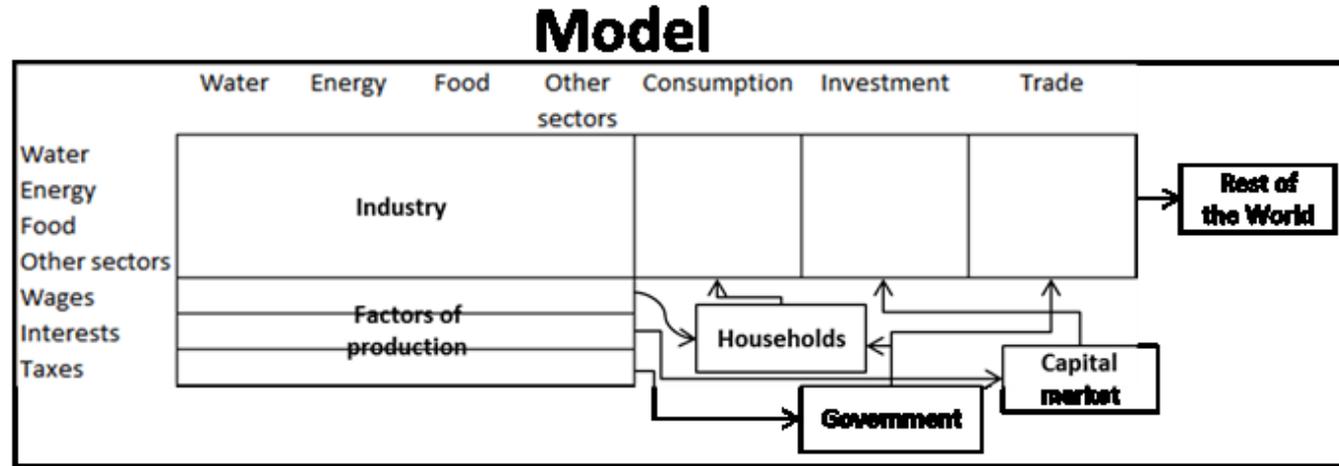
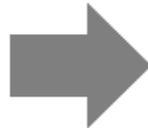
KEY MESSAGE

- Tackling EWF security challenges require an understanding of the state of EWF security, and the linkages between them
- A framework to quantify 'security' in a comprehensive and integrated manner, which can be used to:
 - provide insights into the *state of* energy, water, food *security* across countries
 - provide insights into the *sources of insecurity*
 - enable *monitoring* of countries' *security performance* over time
 - *convey policy messages* that can help policy-makers to prioritise security concerns that are specific to their countries
 - *support political dialogue* aiming to improve energy-water-food security

FURTHER RESEARCH

Scenarios

- Resources
- Technology
- Policies



Drivers

- Population growth
- Urbanization
- Economic growth
- Climate Change

Impacts

- EWF Security
- Economy
- Social
- Environment
- Polity

THANK YOU