

A Framework for Multi- and Systemic-Risk Analysis: Focusing on Indirect Risks Based on Dependencies

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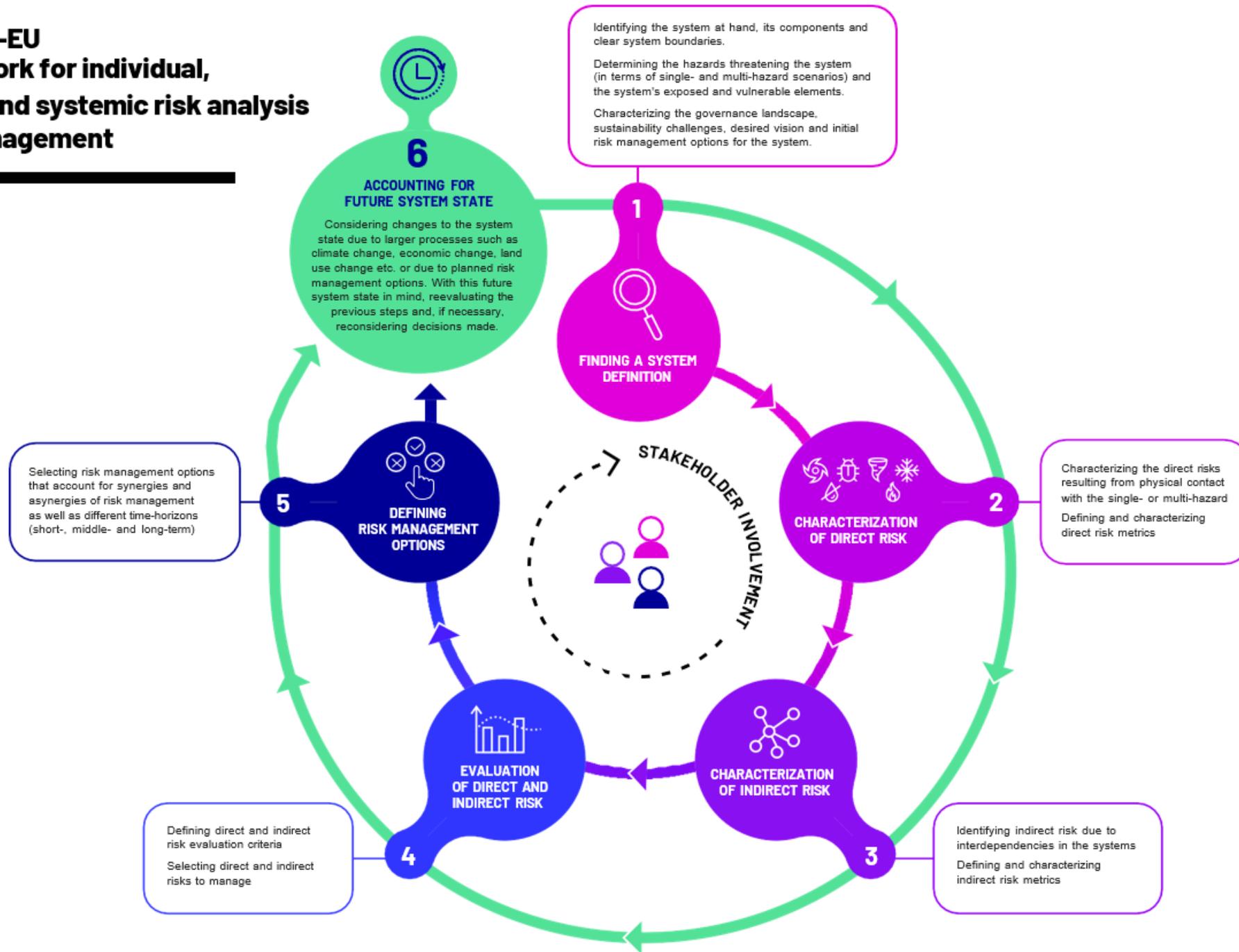
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Background

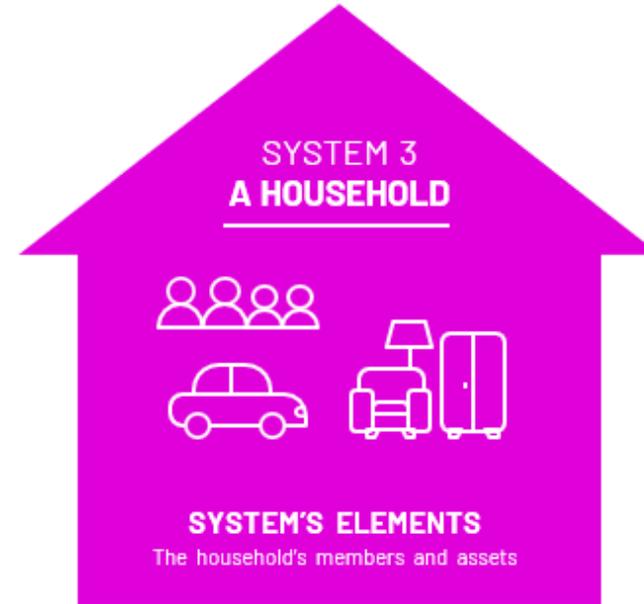
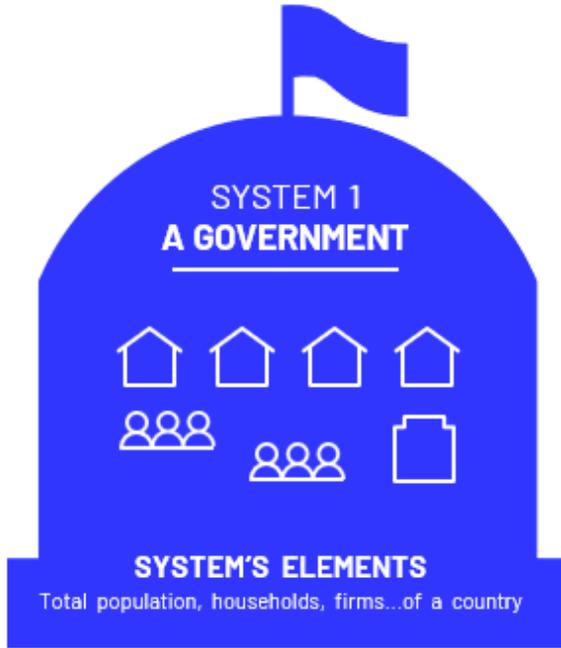
- Importance of considering **multiple hazards and their interactions** (independent, triggering, amplifying, compound, consecutive):
 - *Impacts greater than the sum of its parts*
 - *Distorted management priorities and options*
- We live in an **interconnected world** with natural hazards having **ripple effects across boundaries** (e.g., 2011 Thailand floods, 2010 heatwave in Russia and floods in Pakistan) resulting in **systemic risk**
 - *System as a set of (partly) interconnected elements with clear boundaries, and systemic risk as a risk emerging due to interdependencies between elements of the system*
- **Lack of clear framework** for multi and systemic-risk assessment and management (Ward et al., 2022; UNDRR, 2021, Sillman et al. 2022)
- MYRIAD-EU proposes **a framework for multi-hazard, multi-sectoral, systemic risk analysis and management** to be implemented and co-developed in five pilots (Danube, North Sea, Scandinavia, Veneto, and Canary islands)

MYRIAD-EU framework for individual, multi-, and systemic risk analysis and management



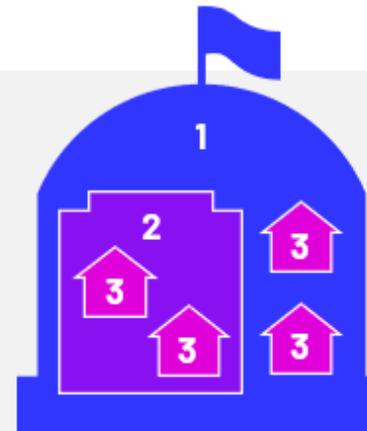
KEY CONCEPT

What is a **system** and what are **system elements** ?



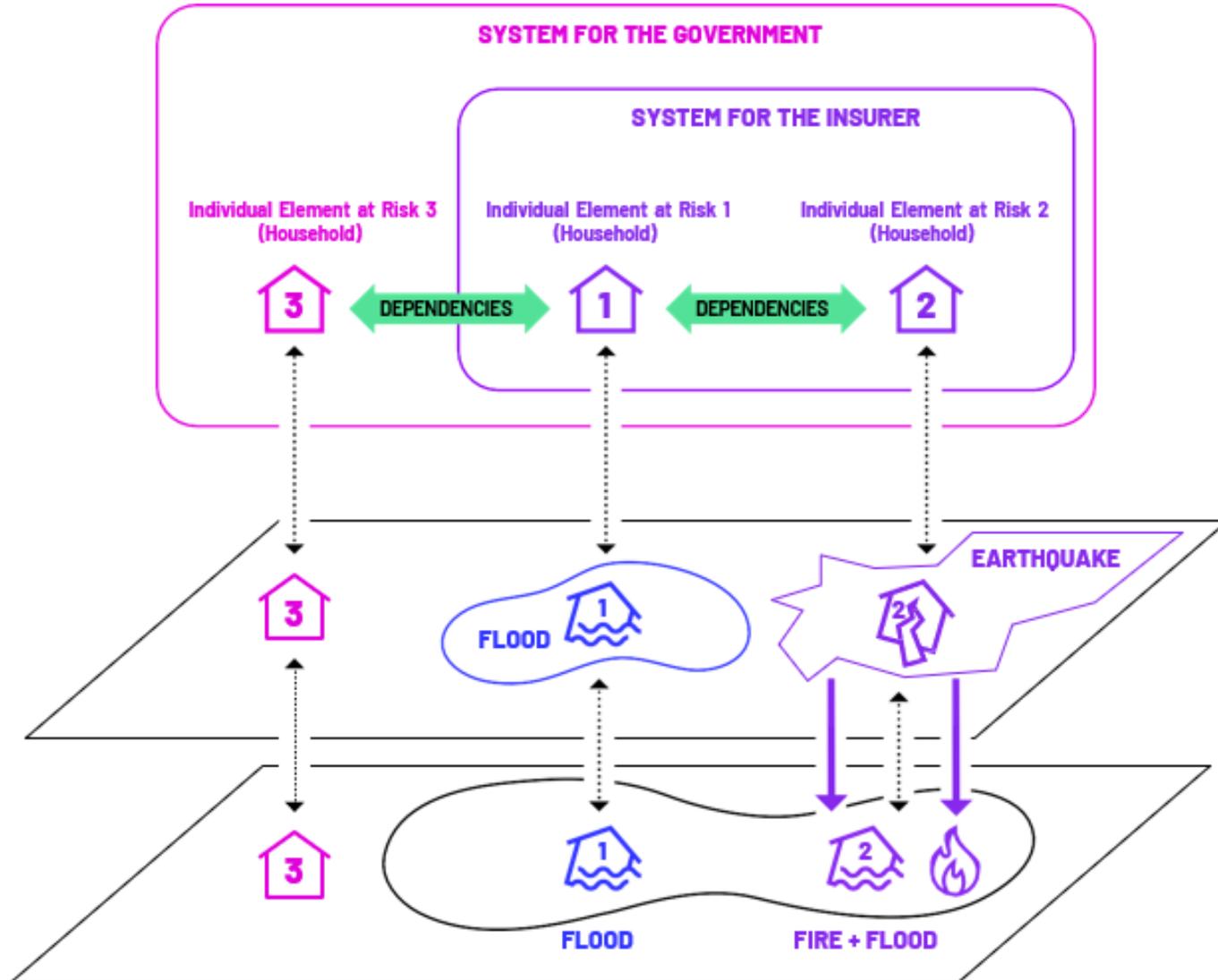
What are **systems of systems** ?

The **Government is a system (1)** which includes **all households (system 3)** as well as the **insurance company (system 2)** which, in turn, includes a part of **all households (system 3)**



KEY CONCEPT

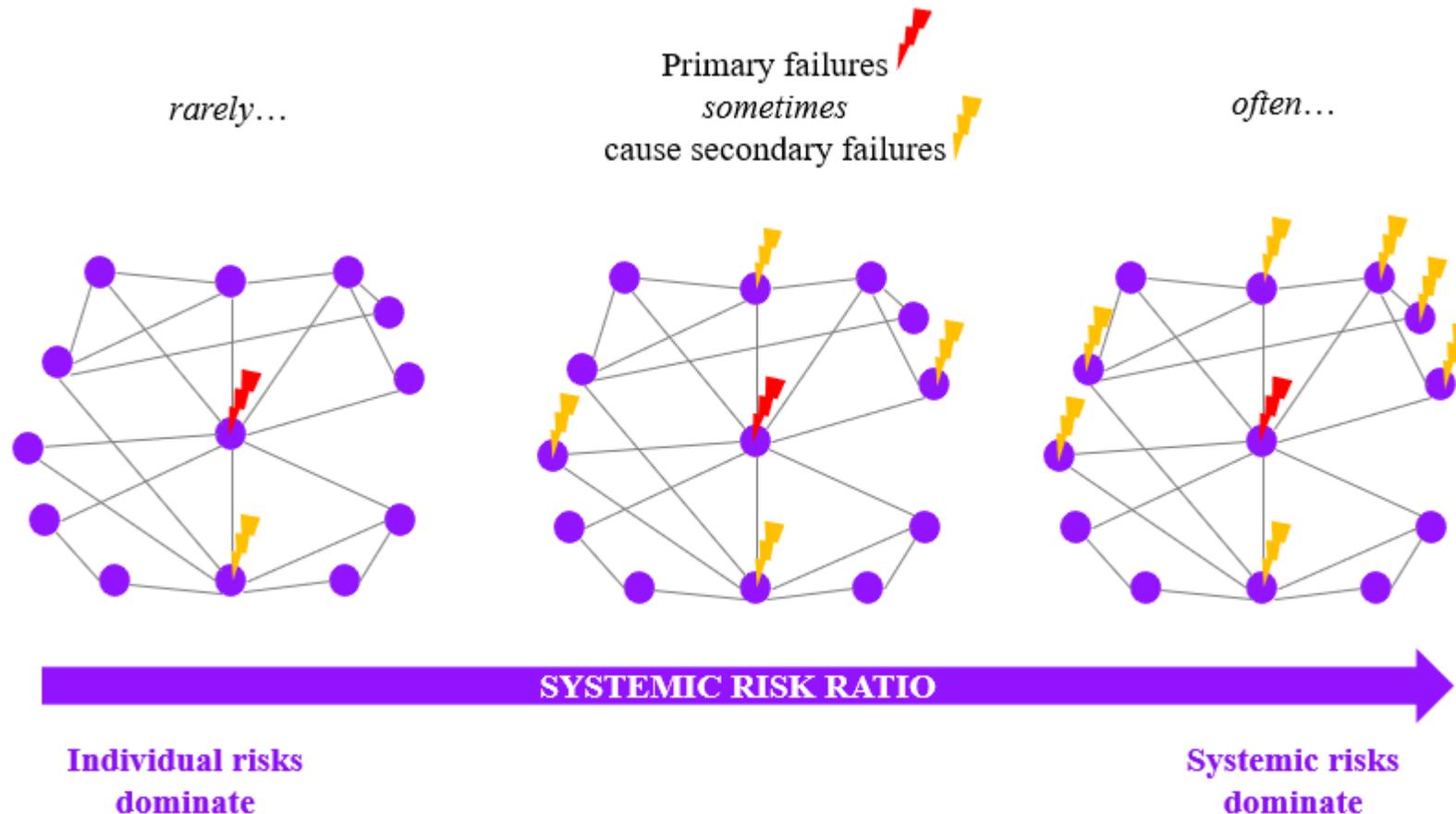
What do we mean by dependencies ?



- In the example, **Household 3** not directly affected by natural hazards
- However, due to **dependencies** (e.g., economic dependencies) to Household 1, **indirect impact** occurs
- Indirect risk arises **due to dependencies between system elements**

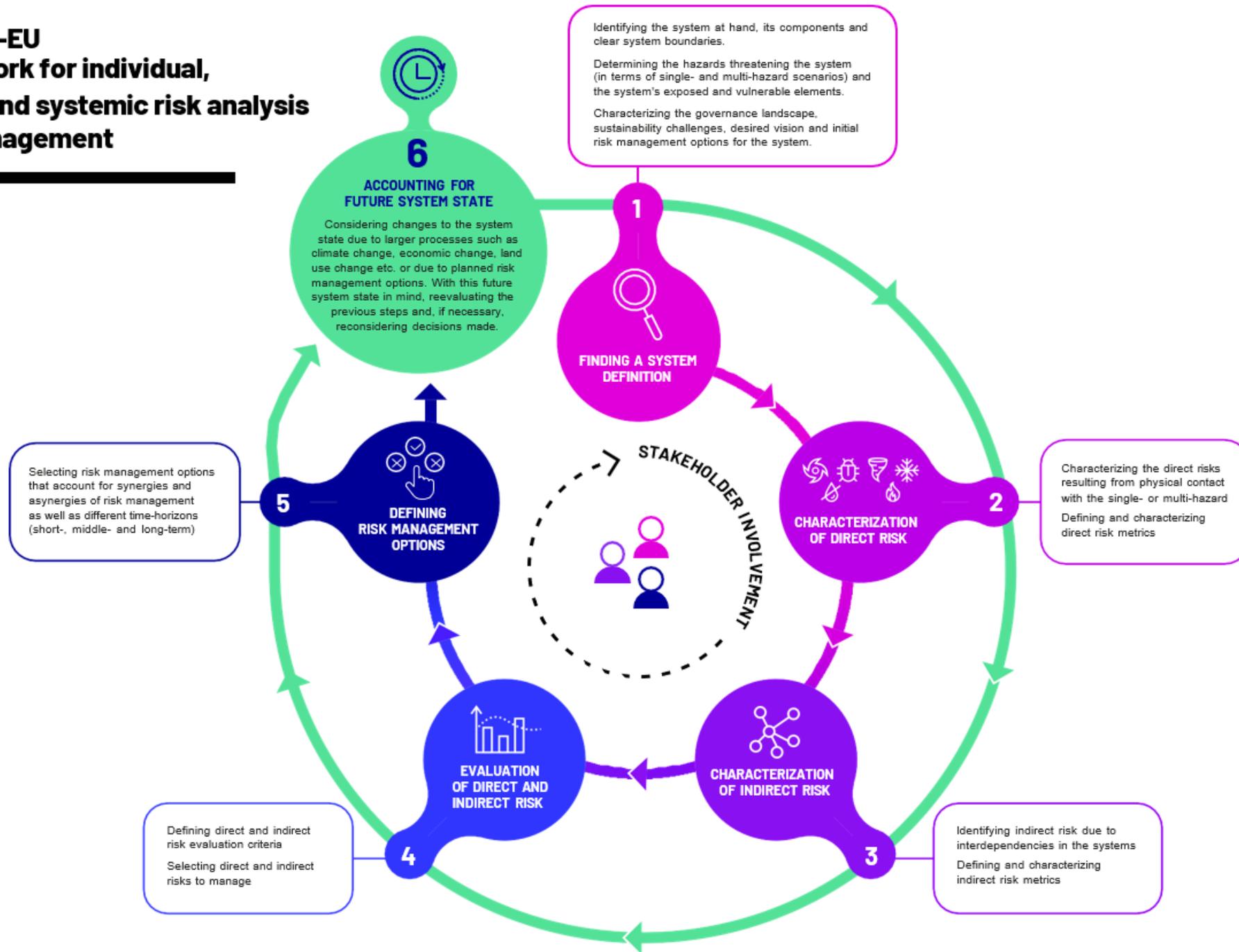
KEY CONCEPT

What do we mean by dependencies ?



- **Without any dependencies** between hazards or system elements, a multi-hazard and multi-risk perspective can be handled by **single hazards and single risk assessment frameworks**.
- **In case of dependencies**, a multi-risk framework is needed, and options can be considered based on the **systemic perspective**.

MYRIAD-EU framework for individual, multi-, and systemic risk analysis and management



Framework benefits and limitations

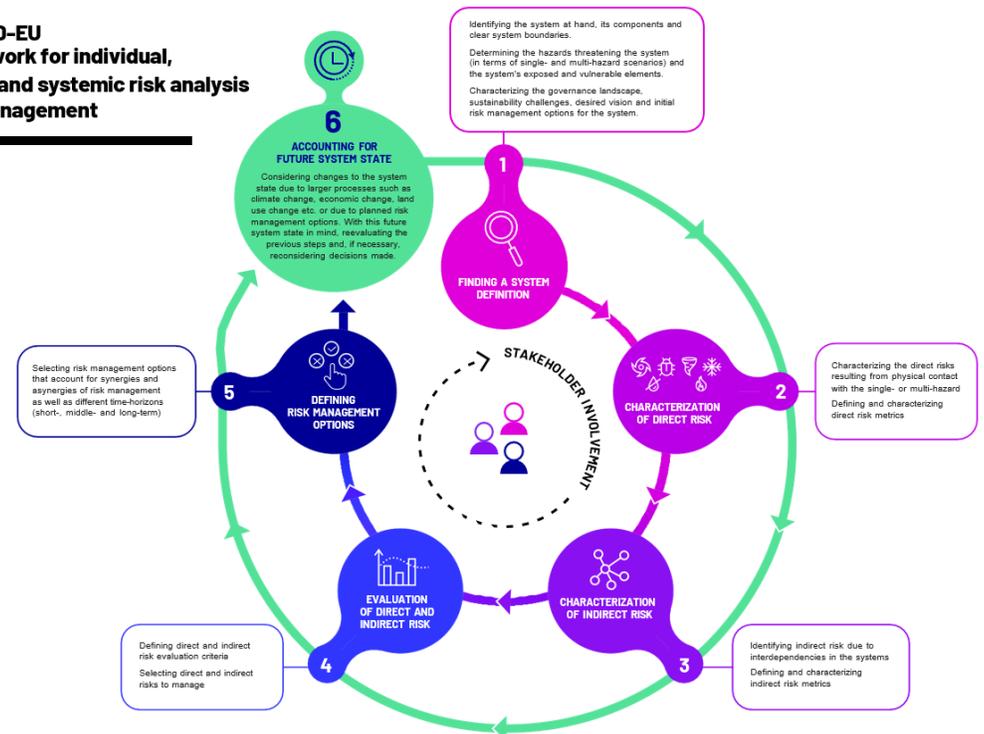
Benefits

- **Flexibility** to address single- to multi- and systemic risks
- Accounts for **risk dynamics**
- Explicit focus on **indirect risk**
- **Multiple lines** of evidence approach
- **System of systems** perspective allowing for risk analysis and management across scales
- Strong emphasis on **stakeholder engagement** and co-production
- **Forward-looking** and embedded in larger **sustainability issues**

Limitations

- Framework **complex**
- **Data** requirements

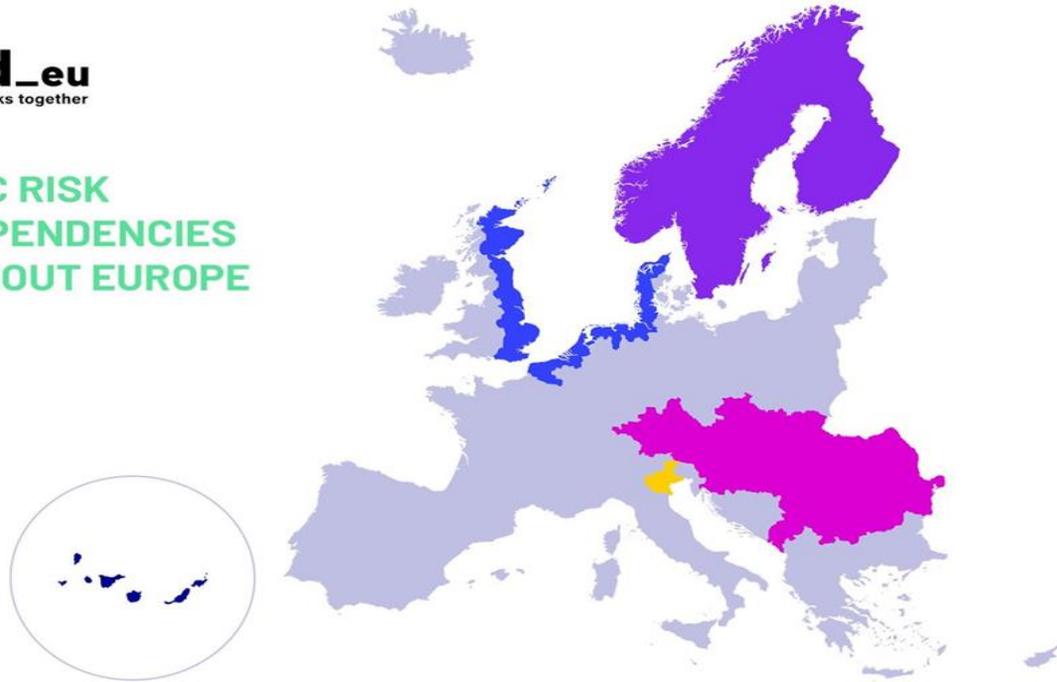
MYRIAD-EU framework for individual, multi-, and systemic risk analysis and management



Framework implementation in practice



SYSTEMIC RISK INTERDEPENDENCIES THROUGHOUT EUROPE



CANARY ISLANDS

CHALLENGE

How can island regions with a strong dependence on tourism become more resilient to multi-hazard risk?

SECTOR	HAZARDS
ENERGY	Earthquake, Flood, Landslide
FOOD & AGRICULTURE	Storm, Tsunami, Volcano
TOURISM	

VENETO

CHALLENGE

How can diverse natural landscapes from the mountains to the sea achieve a forward-looking perspective conducive to multi-risk planning?

SECTOR	HAZARDS
ECOSYSTEMS & FORESTRY	Biological hazard, Drought, Fire
FINANCE	Flood, Landslide, Snow
TOURISM	

NORTH SEA

CHALLENGE

How can spatial planning at the interface of the land and sea environments be optimised in the face of increasing and interrelated risk?

SECTOR	HAZARDS
ECOSYSTEMS & FORESTRY	Biological hazard, Extreme wind, Flood
ENERGY	Heat, Storm, Thunder and hail
INFRASTRUCTURE & TRANSPORT	

SCANDINAVIA

CHALLENGE

How can we maintain healthy ecosystems under climate-related risks while meeting increasing demands for energy, food, and other ecosystem services, and what is the role of nature-based solutions?

SECTOR	HAZARDS
ECOSYSTEMS & FORESTRY	Biological hazard, Drought, Fire
ENERGY	Flood, Heat, Snow
FOOD & AGRICULTURE	

DANUBE

CHALLENGE

How can we increase resilience to multiple disasters that impact several interconnected countries with strong macro-economic relations?

SECTOR	HAZARDS
FINANCE	Drought, Earthquake, Flood
FOOD & AGRICULTURE	Heat, Landslide, Thunder and hail
INFRASTRUCTURE & TRANSPORT	

Concluding remarks on six steps

- We propose a framework for **multi-hazard, multi-risk, systemic risk assessment and management**
- The framework is iterative, and flexible to operate across **single to multi-risk spectrum**
- The framework is based on two core aspects: **system boundaries and dependencies between elements of the system**
- We will develop a **set of guidance protocols** for the implementation of the framework and **a wide range of tools** for the implementation of various steps of the framework

THANK YOU FOR THE ATTENTION

Please do reach out to troglic@iiasa.ac.at

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