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Extreme weather events and their impacts on transportation networks

EWENT & WEATHER Project - Summary of Relevant Findings

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BCRRE

Transport and climate change - Challenges

- Rising damages caused by extreme weather events
- Current focus on carbon emissions
- Limited research on vulnerability of transport sector due to climate driven effects
- Less focus and interest on the economic costs
  - Even less evidence on the options, costs and benefits of adaptation measures

What is our focus on ?

- Need for European studies to address local conditions
- Analysis of economic costs of more frequent and more extreme weather events on transport and on the wider economy
- Exploration of the benefits and costs of suitable adaptation and emergency management strategies

Scope of EWENT and WEATHER projects

- Assess the impacts of extreme weather events on transport system
- Identify the hazardous phenomena, their probability and consequences
- Assessment of expected economic losses
- Evaluate the efficiency, applicability and finance needs for adaptation and mitigation measures

Geographical scope & transport markets

- Impact of weather extremes across the entire European region
- More than 29 countries covered, reaching from the North Pole to the Mediterranean, comprising islands, coastal regions, mountain areas and continental zones
- All transport modes with a focus on inter-regional services
- Cost assessments for road, rail, aviation, maritime shipping, inland navigation and combined road-rail transport

Economy-wide losses

Weather Extremes

(Heat, fires, precipitation, storms, floods…)

Impacts and damages to:

- Transport sector
- Economic sectors
- Society

Adaptation measures

Emergency management

Governance structures

Social costs

Extreme weather and threshold values

- Threshold values for winter conditions for most parts of Europe in the present climate

Phenomena	Threshold 1 harmful impacts possible, 0.33	Threshold 2 harmful impacts likely, 0.66	Threshold 3 harmful impacts certain, 0.99
Wind (gust speed)	≥17 m/s	≥25 m/s	≥32 m/s
Snowfall	≥1 cm/d	≥10 cm/d	≥20 cm/d
Rain	≥30 mm/d	≥100 mm/d	≥150 mm/d
Cold (mean temperature of the day)	<0°C	<-7°C	<-20°C
Heat (mean temperature of the day)	≥+25°C	≥+32°C	≥+43°C
Blizzard	Blizzard is considered to occur when Threshold 1 values of Wind, Snowfall and Cold are realised simultaneously		

Leviäkangas et al., 2011: "Extreme weather impacts on transport systems" EWENT Project Deliverable 1.
Available at: http://virtual.vtt.fi/virtual/ewent/Deliverables/D1/W168.pdf

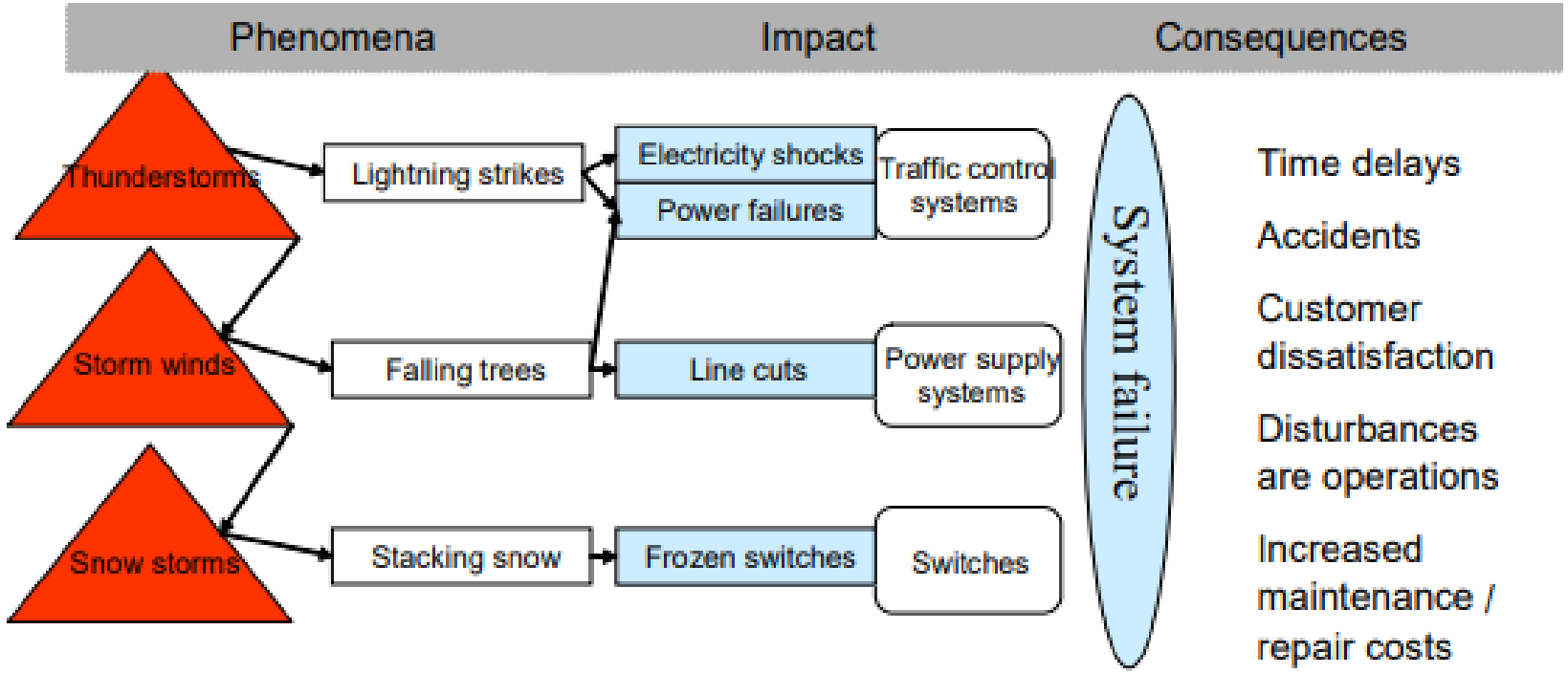
Probabilities

Based on analysis of the present climate according to observational data obtained on a European-wide level (Copernicus, EWENT, WEATHER projects):

- High frequency of winter extremes in Northern Europe and Alpine regions
- Decline in the probability of frost days and cold spells
- Extreme heat waves (25°C and 32°C) are most common in Southern Europe
- Increase in heat waves, especially in the Mediterranean region.
- Moderate increases in heavy precipitation over the Alps and sporadically over the western part of the continent
- Extreme wind events and blizzards mostly over the Atlantic, shores and sea areas

Consequences – Impact analysis

- Thresholds, recovery time and accident numbers for each weather differ for each traffic mode
- Weather can affect operations directly or damage infrastructure, affecting operations indirectly



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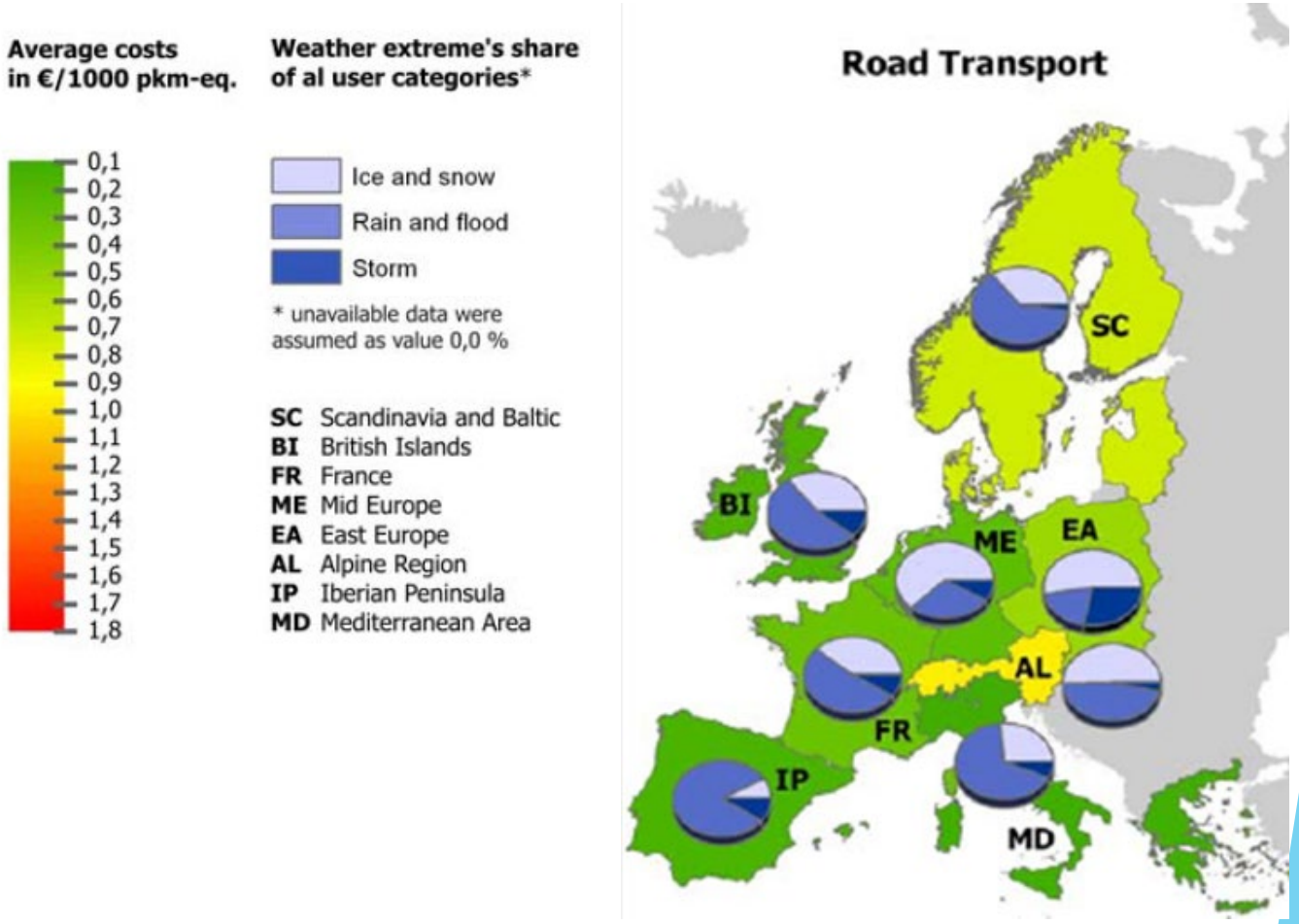
Average costs due to weather extremes - Road

Present costs due to extreme weather (2010)

Accidents		> 10 bill. €/a
Time costs		0.5 - 1 bill. €/a
Infrastructure	Physical	ca. 1 bill. €/a
	Maintenance	ca. 0.2 bill. €/a
Freight & logistics		1-6 bill. €/a

Leviäkangas et al., 2011: "Extreme weather impacts on European networks of transport" EWENT Project Deliverable 6. Available at: http://virtual.vtt.fi/virtual/ewent/Deliverables/D6/Ewent_D6_SummaryReport_V07.pdf



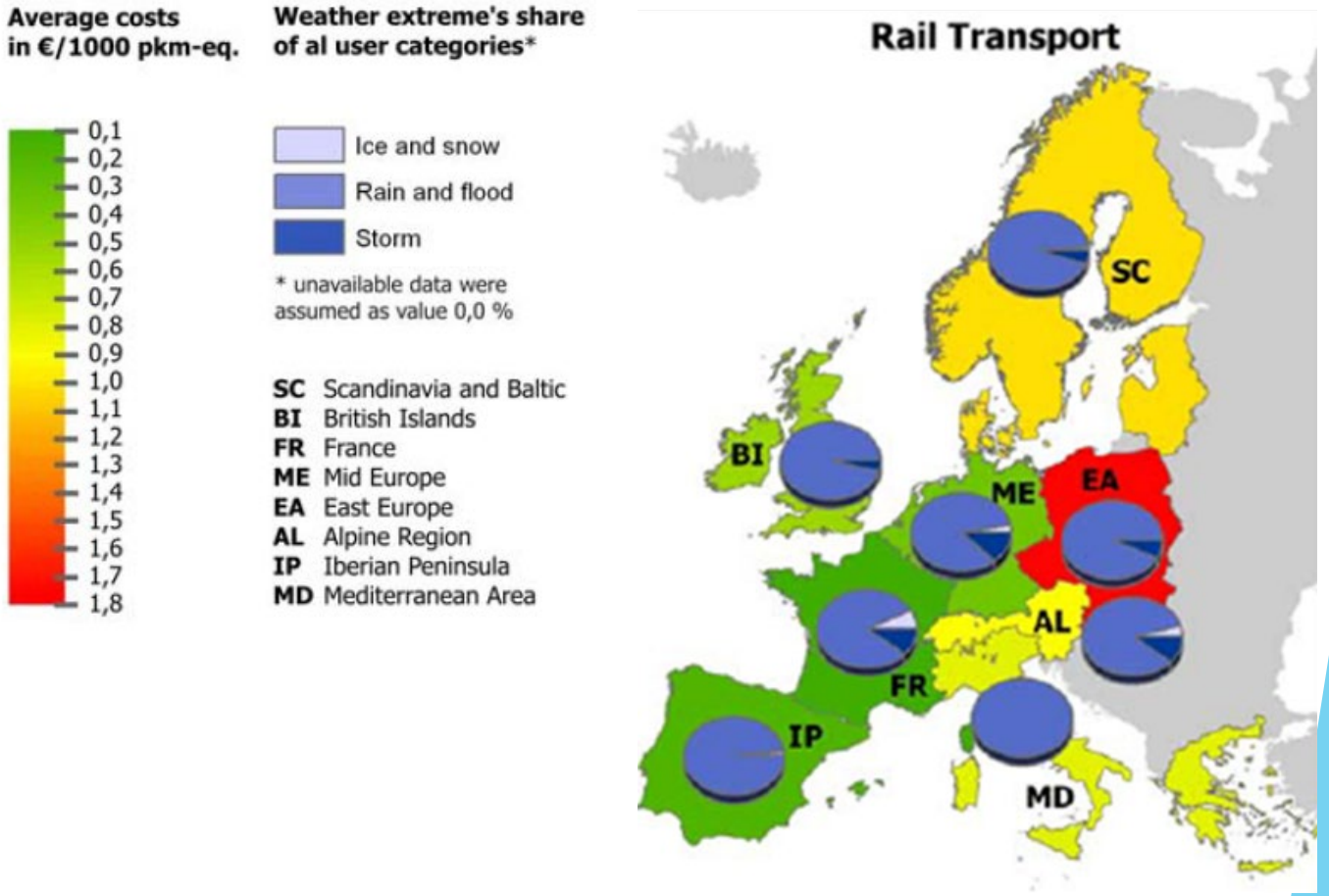
Doll et al., 2012: "WEATHER Project Summary and Policy Conclusions" Deliverable 7 of the research project WEATHER (Weather Extremes: Impacts on Transport Systems and Hazards for European Regions). Available at: http://www.weather-project.eu/weather/downloads/Deliverables/WEATHER-D7_fin.pdf

Average costs due to weather extremes - Rail

Present costs due to extreme weather (2010)

Accidents		> 0.1 bill. €/a
Time costs		10 mill. €/a
Infrastructure	Physical	> 0.1 bill. €/a
	Maintenance	
Freight & logistics		5-24 mill. €/a

Leviäkangas et al., 2011: "Extreme weather impacts on European networks of transport" EWENT Project Deliverable 6. Available at: http://virtual.vtt.fi/virtual/ewent/Deliverables/D6/Ewent_D6_SummaryReport_V07.pdf



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Average costs due to weather extremes - Aviation

Present costs due to extreme weather (2010)

Accidents		na
Time costs		> 0.7 bill. €/a
Infrastructure	Physical	na
	Maintenance	
Freight & logistics		na

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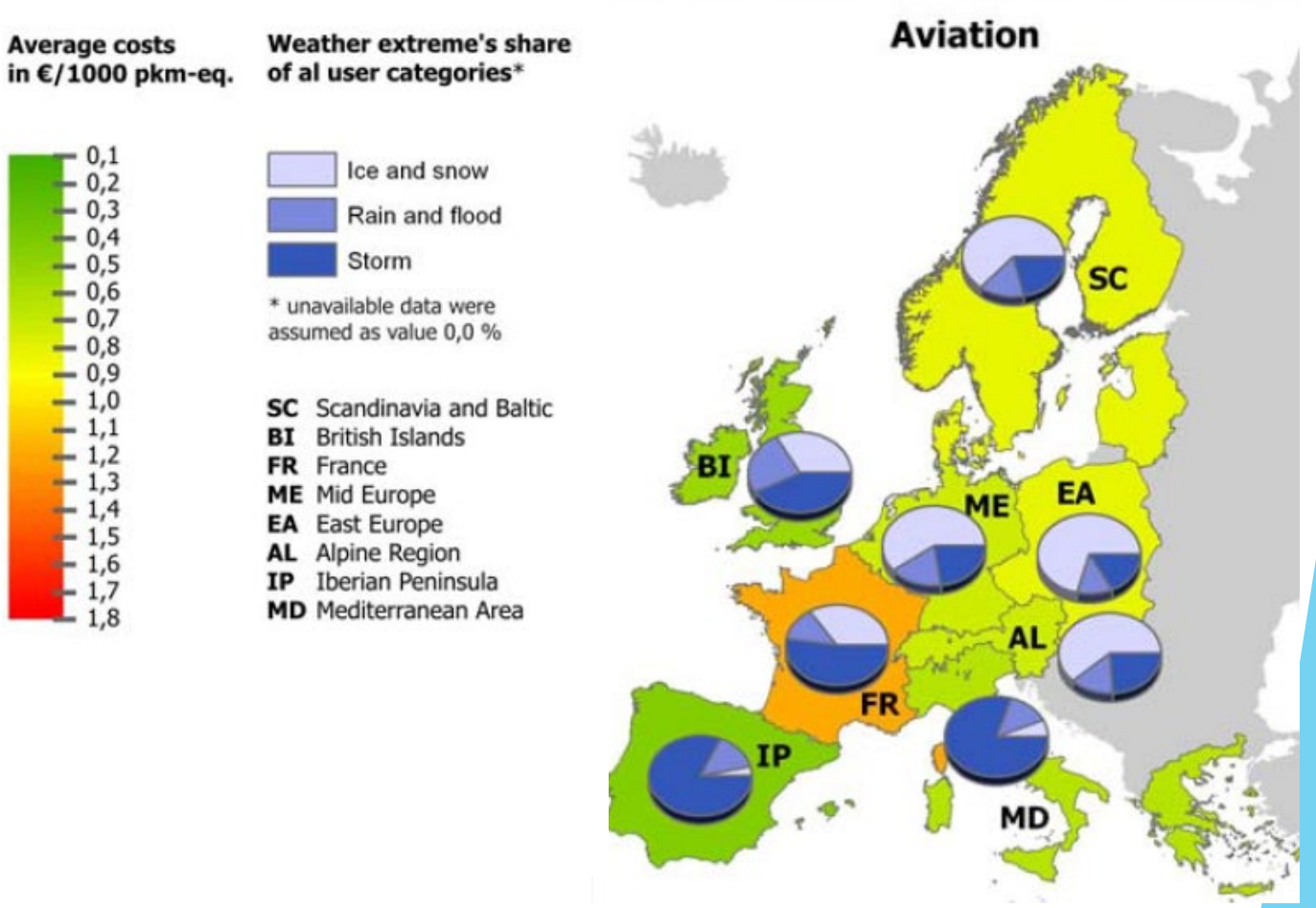

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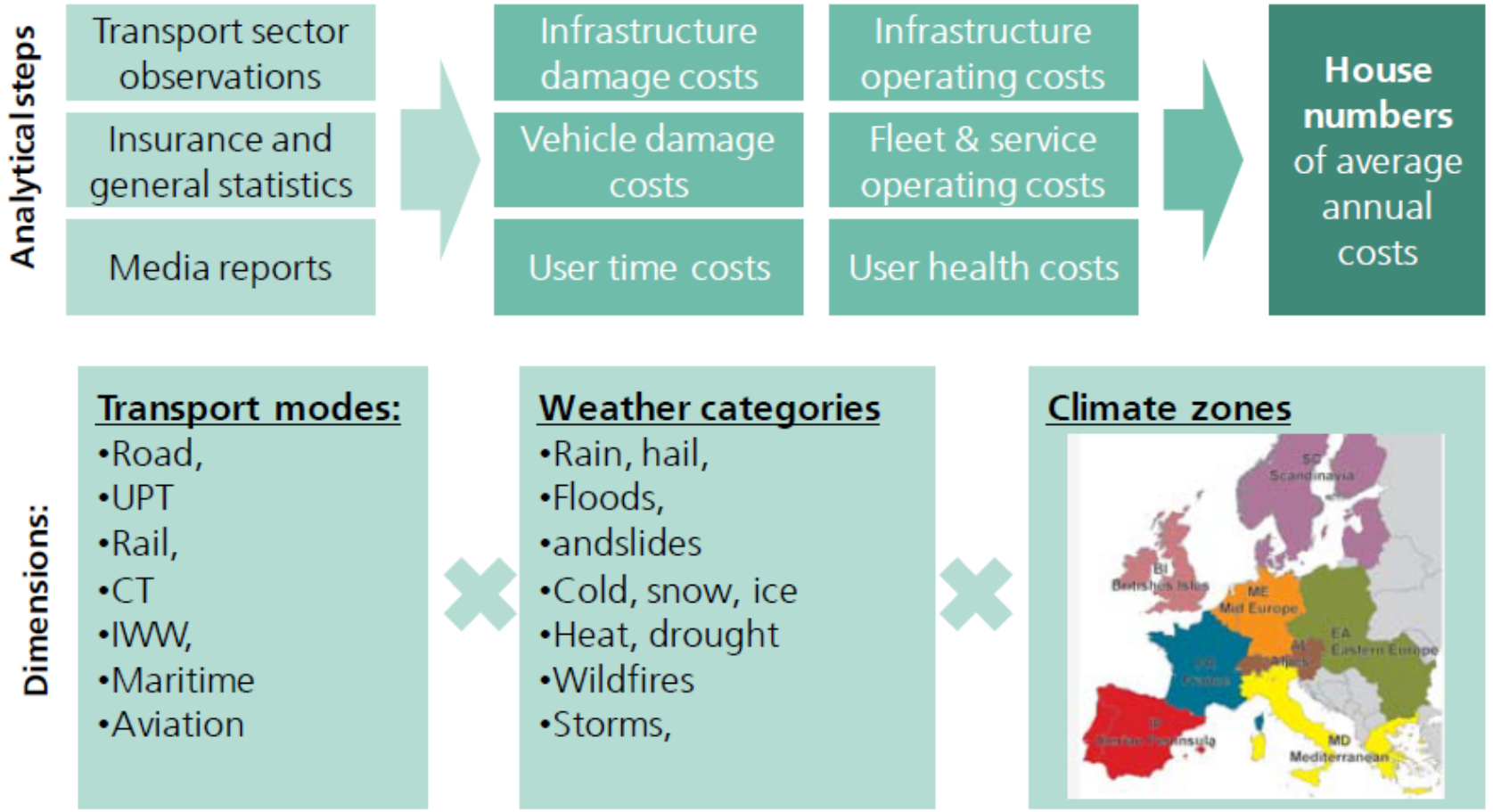
Overview of the vulnerability assessment



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Risk panorama

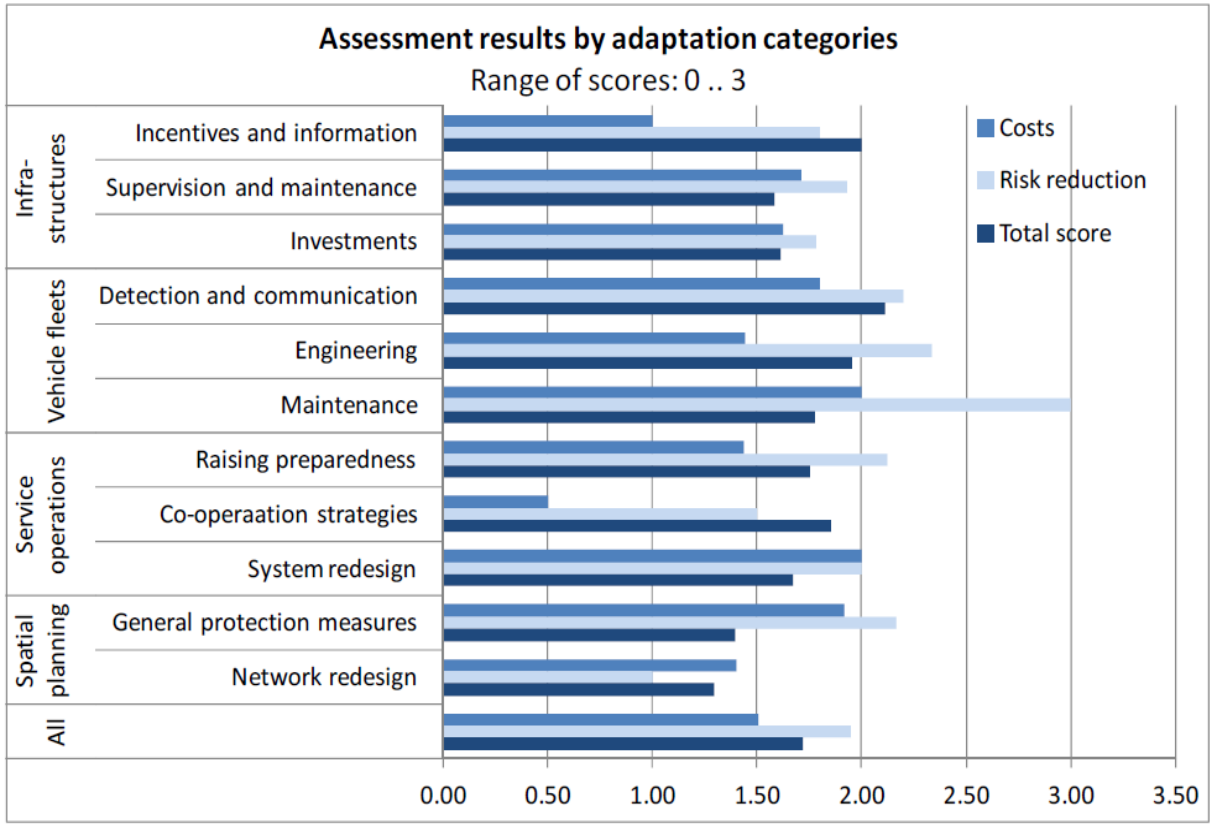
- Changing the engineering and operational decisions made

$$Risk = Hazard \times Vulnerability\ (\times Consequence)$$

- Factors that affect risk indicators for different European transport modes:
  - Probability of the most recurrent extreme weather
  - Events (hazard indicator)
  - Quality of infrastructure
  - Traffic density
  - Population density
  - Coping capacity

Adaptation strategies

- Values range from 0 (no impact or costs) to 3 (full risk reduction or very high costs)
- High scores reflect the impact due to adaptation measures
  - Internal measures generate smaller side effects
- Lowest scores are attributed to measures with low flexibility, long and complex implementation phase and mostly limited benefits



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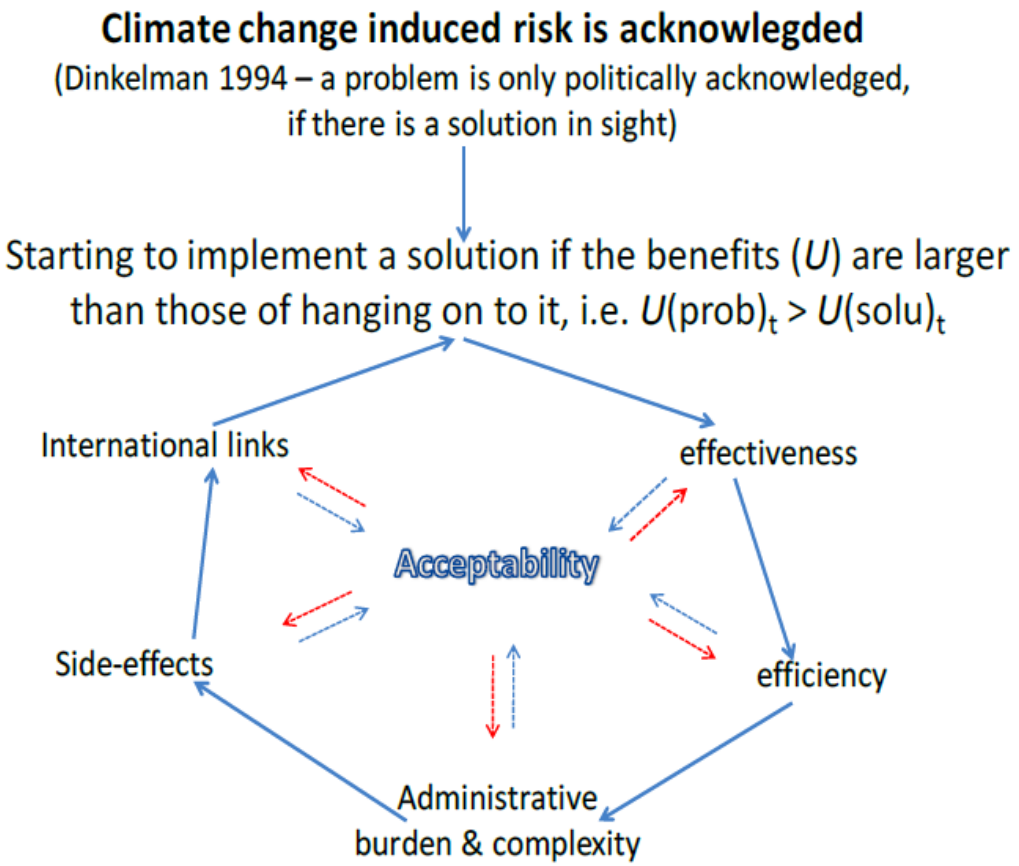
Interconnected links to adaptation strategies



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Conclusions from EWENT and WEATHER projects

- **Climatology and future scenarios of extreme weather**
  - Changes in extremes will likely have both positive and negative effects
  - Impacts need to be considered in maintenance and investment in preparedness
- **Summary of consequences**
  - Risks for delay and accidents are dependent on the expected climatic changes
  - Focus on other weather extremes (Wind gusts, Snowfall, and Heat and cold waves)
  - Accident rates will either reduce or stay low due to better technologies and safety standards
- **Present and future costs**
  - Road sector costs dominate; roads are still today relatively unsafe and vulnerability is high
  - Apparent trend in declining accident costs
  - Winter maintenance operations costs are also expected to decrease
  - Considerable improvements expected in vehicle technologies
- **Adaptation**
  - First priority: staff training, information systems co-operations and contingency planning
  - Vehicle technology of second order
  - Expensive infrastructure investments needed in mountain and coastal areas
  - Public transport can serve as first mover preparing for climate change

Final recommendations and discussions

- Learning from past events is essential for implementing effective crises preparation and adaptation policies
- Deepen the knowledge of local climate and weather pattern changes
- Improve damage cost estimates
- Global exchange of information on good practices
- Broaden the scope on transport sector challenges
- Explore the co-benefits of new or improved systems
- Foster the development of reliable detection and warning systems
- European industries to set worldwide technology standards

THANK YOU FOR YOUR ATTENTION