



# Analysis of the vulnerability of the existing transport infrastructure

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# Analysis of the vulnerability of the existing transport infrastructure

- **PT Framework for Climate Change Adaptation**
- **Climate Vulnerabilities on transport networks:**
  - What we know and what we need to know
  - Assessing transport networks vulnerabilities
- **Adapting Transport Authorities**
  - From vulnerabilities to adaptation policies

CLIMATE CHANGE ADAPTATION IN THE TRANSPORT SECTOR  
EXPERIENCE FROM PROJECT PREPARATION AND NETWORK MANAGEMENT  
Session 1 – Analysis of Climate Vulnerabilities on Transport Networks



PLANNING AND  
INFRASTRUCTURE

ENVIRONMENT

SEA

INTERNAL AFFAIRS



INSTITUTO DA  
MOBILIDADE E DOS  
TRANSPORTES, I.P.

Public  
Institute

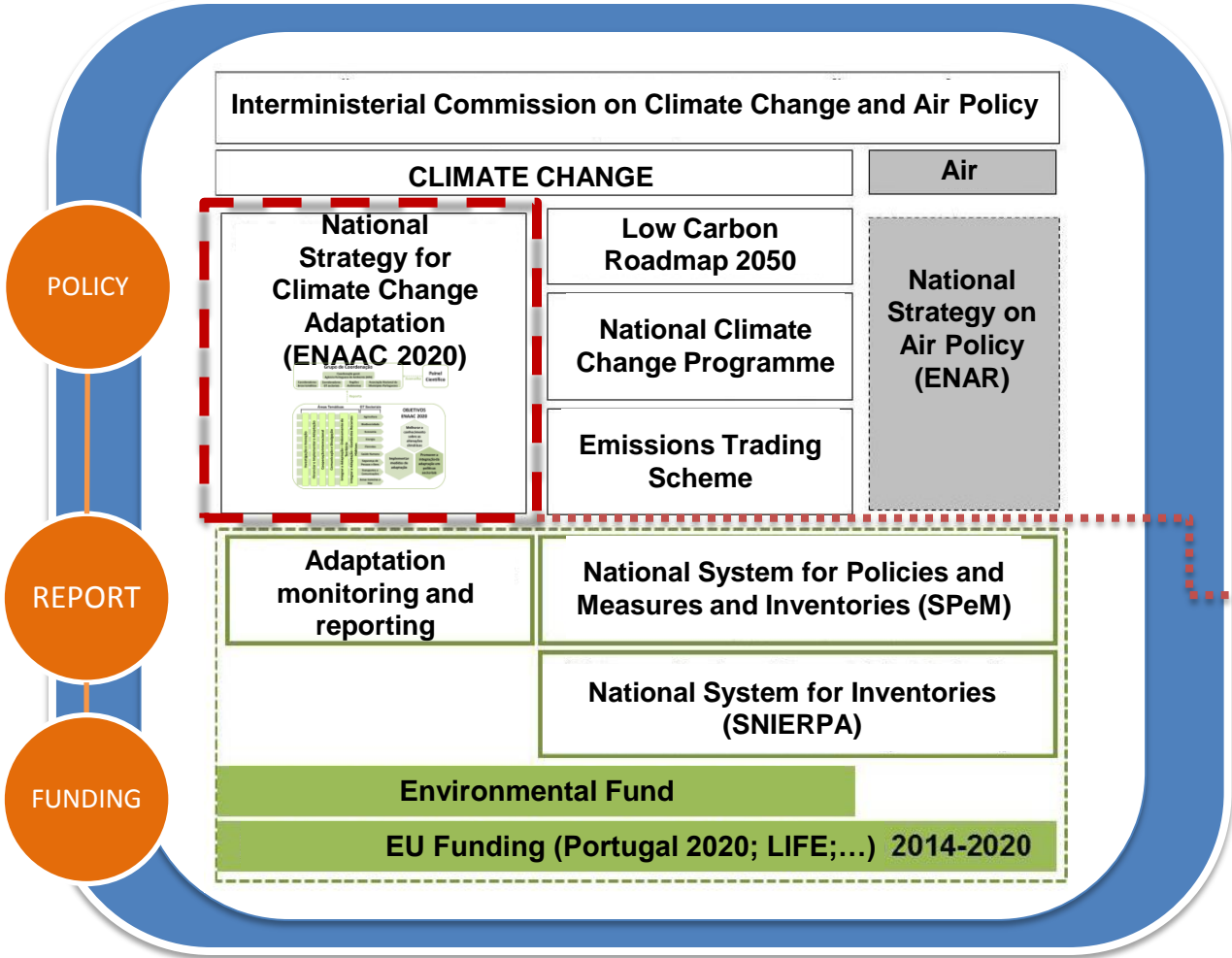
Indirect  
State  
Administration

Financial and  
Administrative  
Autonomy



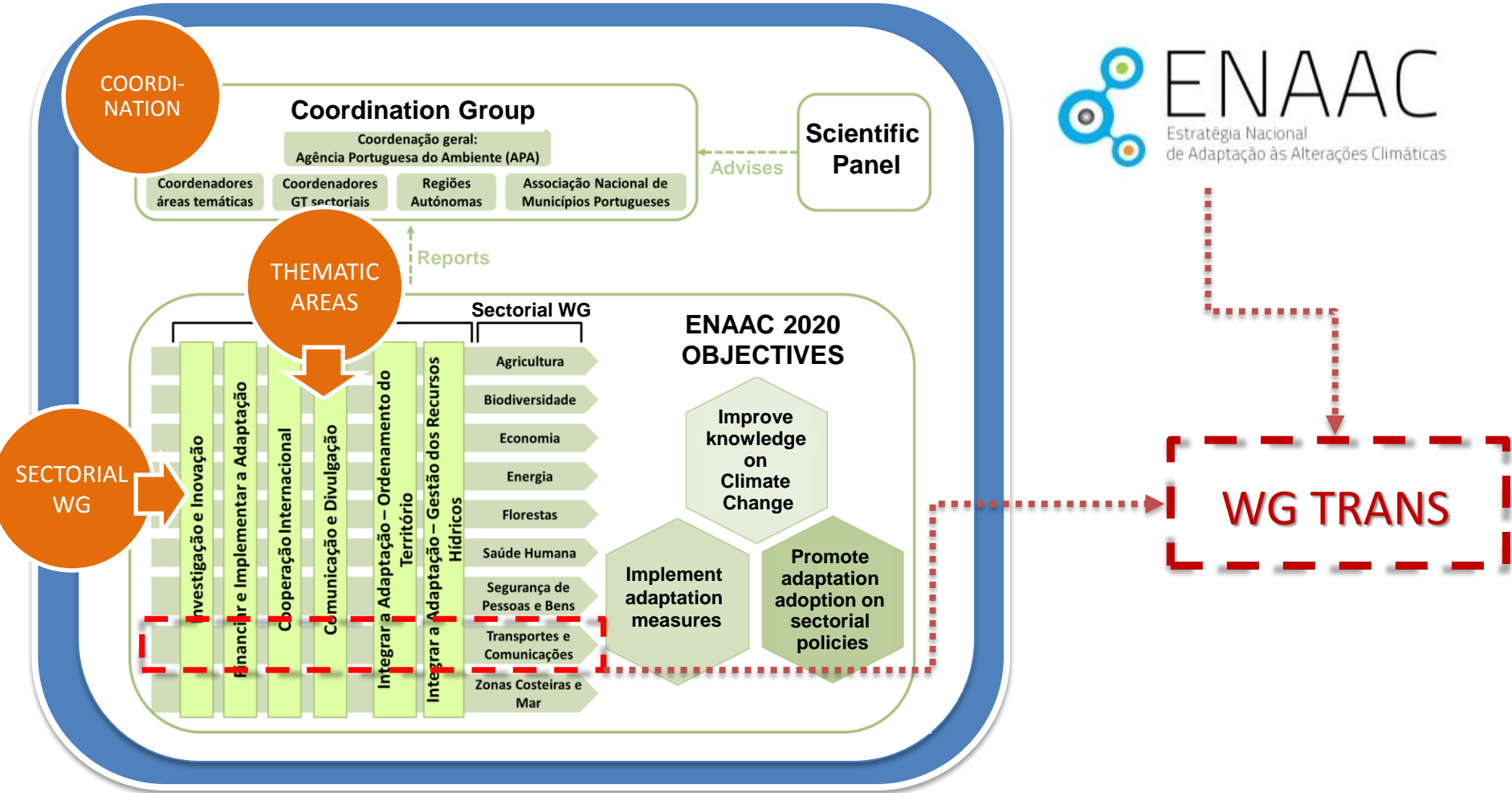
# PT Framework for Climate Change Adaptation

# Strategic Framework for Climate Policy



**NATIONAL STRATEGY FOR CLIMATE CHANGE ADAPTATION (ENAAC 2020)**

# National Strategy for Climate Change Adaptation



## WG TRANS

- **Coordination:**  
Instituto da Mobilidade e dos Transportes (IMT) and Autoridade Nacional de Comunicações (ANACOM);
- **Structure:**  
Divided in two subgroups, that work independently (Transport/Communications);
- **Competences:**  
Study, monitor and propose measures to safeguard transport infrastructures and services, which present a vulnerability to climate change impacts worthy of concern.
- **Members:**  
Autoridade Nacional de Aviação Civil (ANAC), Associação Nacional dos Transportadores Rodoviários de Pesados de Mercadorias (ANTRAM), Associação Nacional dos Transportadores Rodoviários de Pesados de Passageiros (ANTROP), Associação das Sociedades Concessionárias de Auto-estradas ou Pontes com Portagens (APCAP), Comboios de Portugal (CP), Instituto da Mobilidade e dos Transportes (IMT) and Infraestruturas de Portugal (IP).



Road  
Infrastructure  
Operators



Road  
Transport  
Operators  
(Freight )



Road  
Transport  
Operators  
(Passenger)



Rail  
Infrastructure  
Operators



Rail  
Transport  
Operators

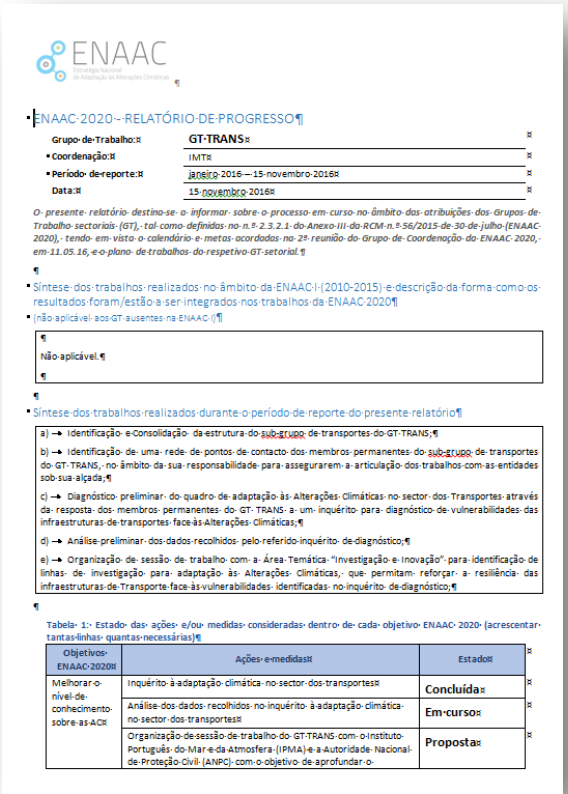


Air  
Authority

# WG TRANS – Progress so far:

## HIGHLIGHTS:

- WG TRANS - Established on May 2016
- Working procedures and proposed action plan for 2016-17
- 5 Working Sessions (2016-17)
  - R&D Funding for Transport:
    - Life
    - H2020
  - Civil Protection Emergency Response to extreme weather events:
    - Civil Protection Services
  - Climate Change Related Requirements for Major Transport Projects in the 2014-2020 Programming Period
    - JASPERS
- Survey on Climate Change Impacts and Adaptation for transport networks and nodes
  - UNECE
- Set Priorities for Climate Change Adaptation Funding



**ENAAAC 2020 – RELATÓRIO DE PROGRESSO**

Grupo de Trabalho: **GT-TRANS**

Coordenação: **IMTR**

Período de reporte: **junho 2016 – 15 novembro 2016**

Data: **15 novembro 2016**

O presente relatório destina-se a informar sobre o processo em curso no âmbito das atribuições dos Grupos de Trabalho sectoriais (GT), tal como definidas no n.º 2.3.2.1. do Anexo-III do RCM n.º 56/2015 de 30 de julho (ENAAAC 2020), tendo em vista o calendário e metas acordadas no 2º reunião do Grupo de Coordenação da ENAAAC 2020, em 11.05.16, e o plano de trabalhos do respetivo GT setorial.

Síntese dos trabalhos realizados no âmbito da ENAAAC-I (2010-2015) e descrição da forma como os resultados foram/estão a ser integrados nos trabalhos da ENAAAC 2020.

(Não aplicável) aos GT ausentes na ENAAAC I.

Não aplicável.

Síntese dos trabalhos realizados durante o período de reporte do presente relatório:

a) → Identificação e Consolidação da estrutura do sub-grupo de transportes do GT-TRANS.

b) → Identificação de uma rede de pontos de contacto dos membros permanentes do sub-grupo de transportes do GT-TRANS, no âmbito da sua responsabilidade para assegurarem a articulação dos trabalhos com as entidades sob sua alçada.

c) → Diagnóstico preliminar do quadro de adaptação às Alterações Climáticas no sector dos Transportes através da resposta dos membros permanentes do GT-TRANS a um inquérito para diagnóstico de vulnerabilidades das infraestruturas de transportes face às Alterações Climáticas.

d) → Análise preliminar dos dados recolhidos pelo referido inquérito de diagnóstico.

e) → Organização de sessão de trabalho com a Área Temática "Investigação e Inovação" para identificação de linhas de investigação para adaptação às Alterações Climáticas, que permitam reforçar a resiliência das infraestruturas de Transporte face às vulnerabilidades identificadas no inquérito de diagnóstico.

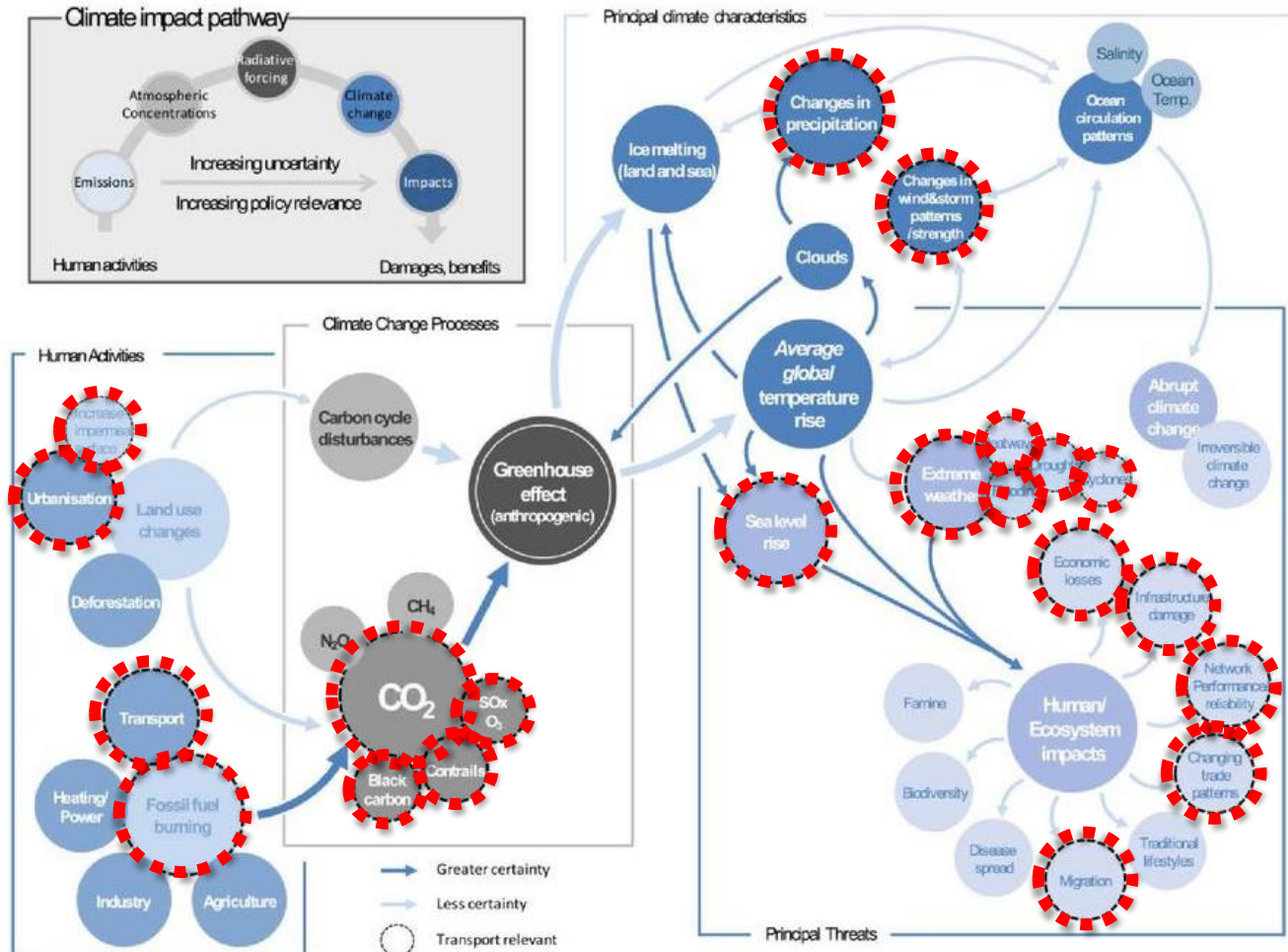
Tabela 1: Estado das ações e/ou medidas consideradas dentro de cada objetivo ENAAAC 2020 (acrescentar tantas linhas quantas necessárias)

Objetivos ENAAAC 2020	Ações e medidas	Estado
Melhorar o nível de conhecimento sobre as ACC	Inquérito à adaptação climática no sector dos transportes	Concluída
	Análise dos dados recolhidos no inquérito à adaptação climática no sector dos transportes	Em cursos
	Organização de sessão de trabalho do GT-TRANS com o Instituto Português do Mar e da Atmosfera (IPMA) e a Autoridade Nacional de Proteção Civil (ANPC) com o objetivo de aprofundar o	Propostas



# Climate Vulnerabilities: What we know and what we need to know

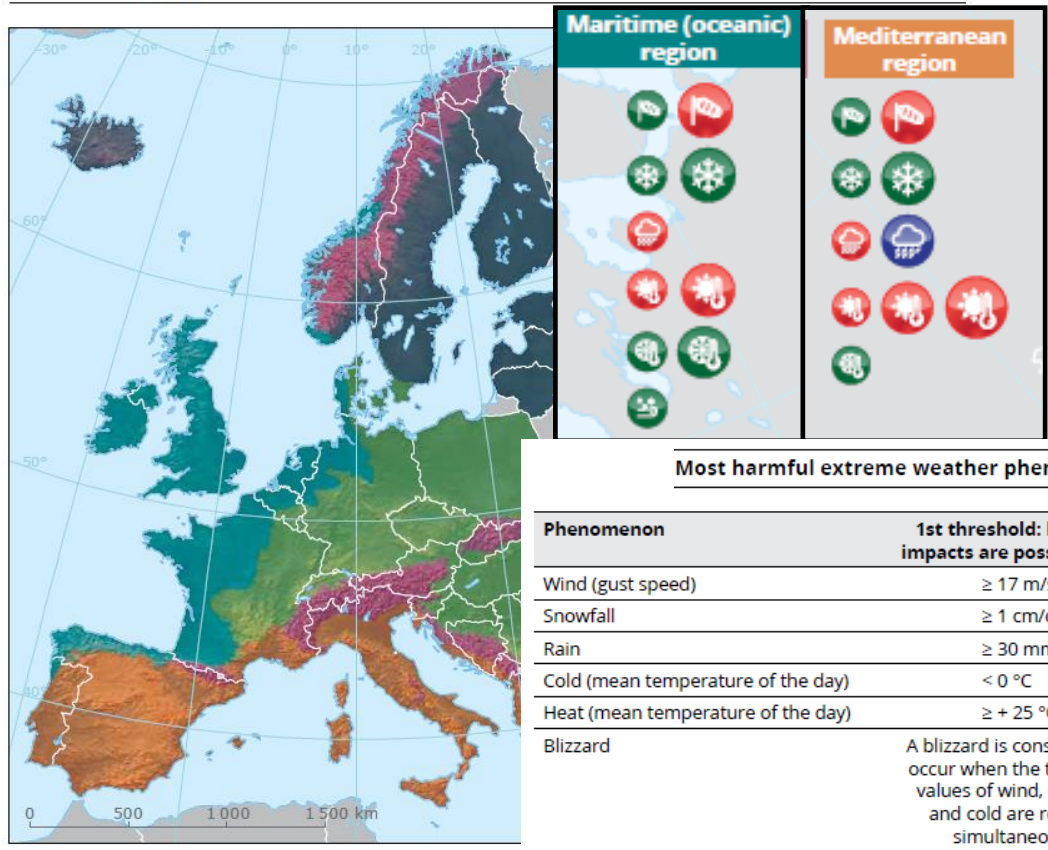
# We know Transport role on the Anthropogenic climate change impact pathway



Source: Adapted from UNEP-GRIDA, and den Elzen et al. (2005).

# We know the projected climate change scenarios

Map 5.20 Projected changes in the frequency of adverse weather events relevant for transport across Europe



**Maritime region:**  
 Heat Increase (2<sup>nd</sup> threshold)  
 Wind Increase (2<sup>nd</sup> threshold)

**Mediterranean region:**  
 Heat Increase (3<sup>rd</sup> threshold)  
 Wind Increase (2<sup>nd</sup> threshold)  
 Rain (1<sup>st</sup> threshold)

Most harmful extreme weather phenomena and their threshold values

Phenomenon	1st threshold: harmful impacts are possible, 0.33	2nd threshold: harmful impacts are likely, 0.66	3rd threshold: harmful impacts are certain, 0.99
Wind (gust speed)	≥ 17 m/s	≥ 25 m/s	≥ 32 m/s
Snowfall	≥ 1 cm/day	≥ 10 cm/day	≥ 20 cm/day
Rain	≥ 30 mm/day	≥ 100 mm/day	≥ 150 mm/day
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	A blizzard is considered to occur when the threshold values of wind, snowfall and cold are realised simultaneously		

Projected changes in the frequency of adverse weather events relevant for transport across Europe

Expected mean changes by the 2050s

- Increasing (Red circle)
- Decreasing (Green circle)
- No trend (Blue circle)

Ranking

- 1st threshold (Small circle)
- 2nd threshold (Medium circle)
- 3rd threshold (Large circle)

Phenomena

- Wind (Wind icon)
- Heavy precipitation (Rain icon)
- Heat waves (Heat waves icon)
- Cold spells (Cold spells icon)
- Snow (Snow icon)
- Blizzards (Blizzards icon)

# And the climate change scenarios are often regionalized according to our needs (<http://portaldoclima.pt>)



Alterações Climáticas em Portugal

DADOS

O PROJETO

NOTÍCIAS

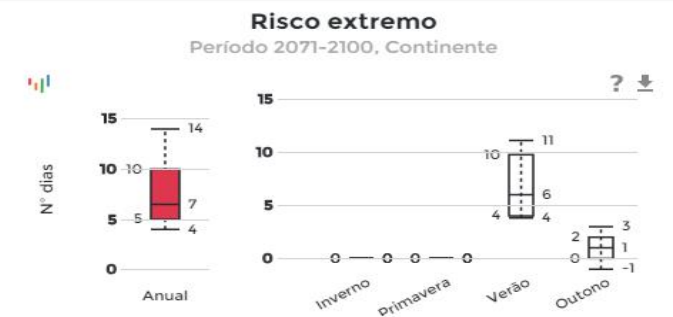
PT

**CLIMA** | COMPARAÇÃO | DOWNLOAD | ESTAÇÕES | AJUDA

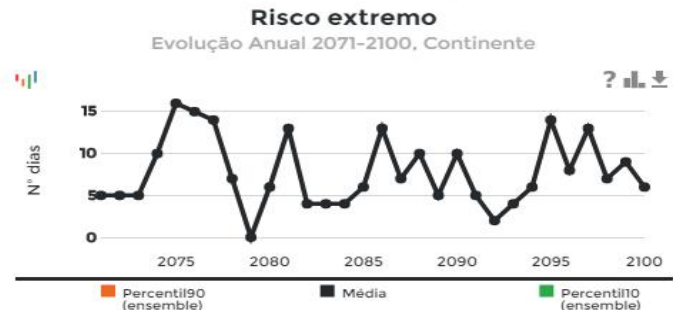
- Normais climatológicas  
 Cenário RCP4.5  
 2071-2100
- Média temporal  
 Anual
- Áreas geográficas  
 Continente
- Variável  
 Índice risco de incêndio  
 Risco extremo
- Estatística  
 Anomalia referência: 71-00
- Modelo Global  
 Ensemble
- Modelo Regional  
 Ensemble

Legenda: 20, 10, 0, -10, -20

50 km | Leaflet | Data | ipema | Tiles © Esri



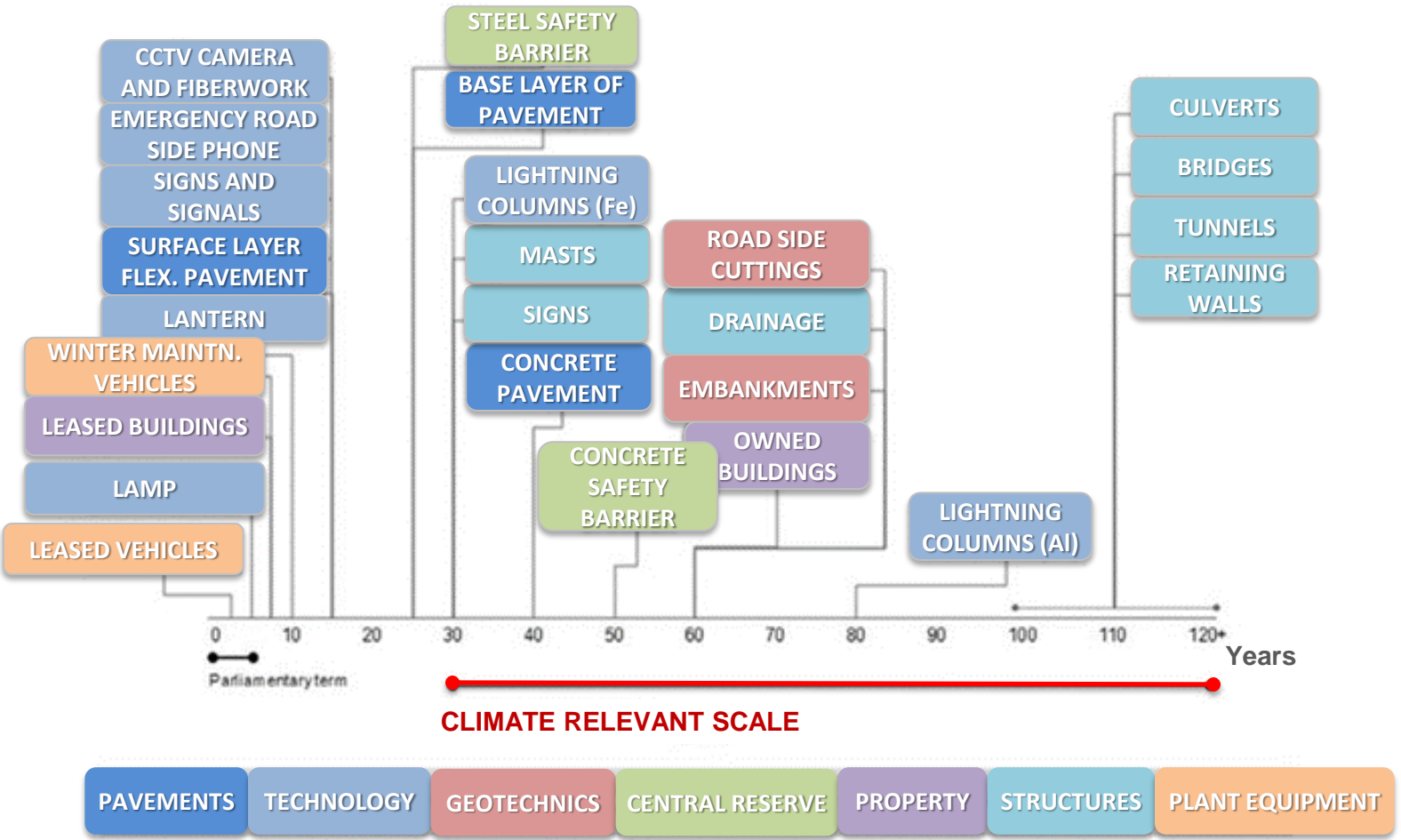
Normais climatológicas: Cenário RCP4.5 - 2071-2100, Estatística: Anomalia referência: 71-00, Modelo Global: Ensemble, Modelo Regional: Ensemble



Normais climatológicas: Cenário RCP4.5 - 2071-2100, Média temporal: Anual, Estatística: Anomalia referência: 71-00, Modelo Regional: Ensemble, Modelo Global: Ensemble

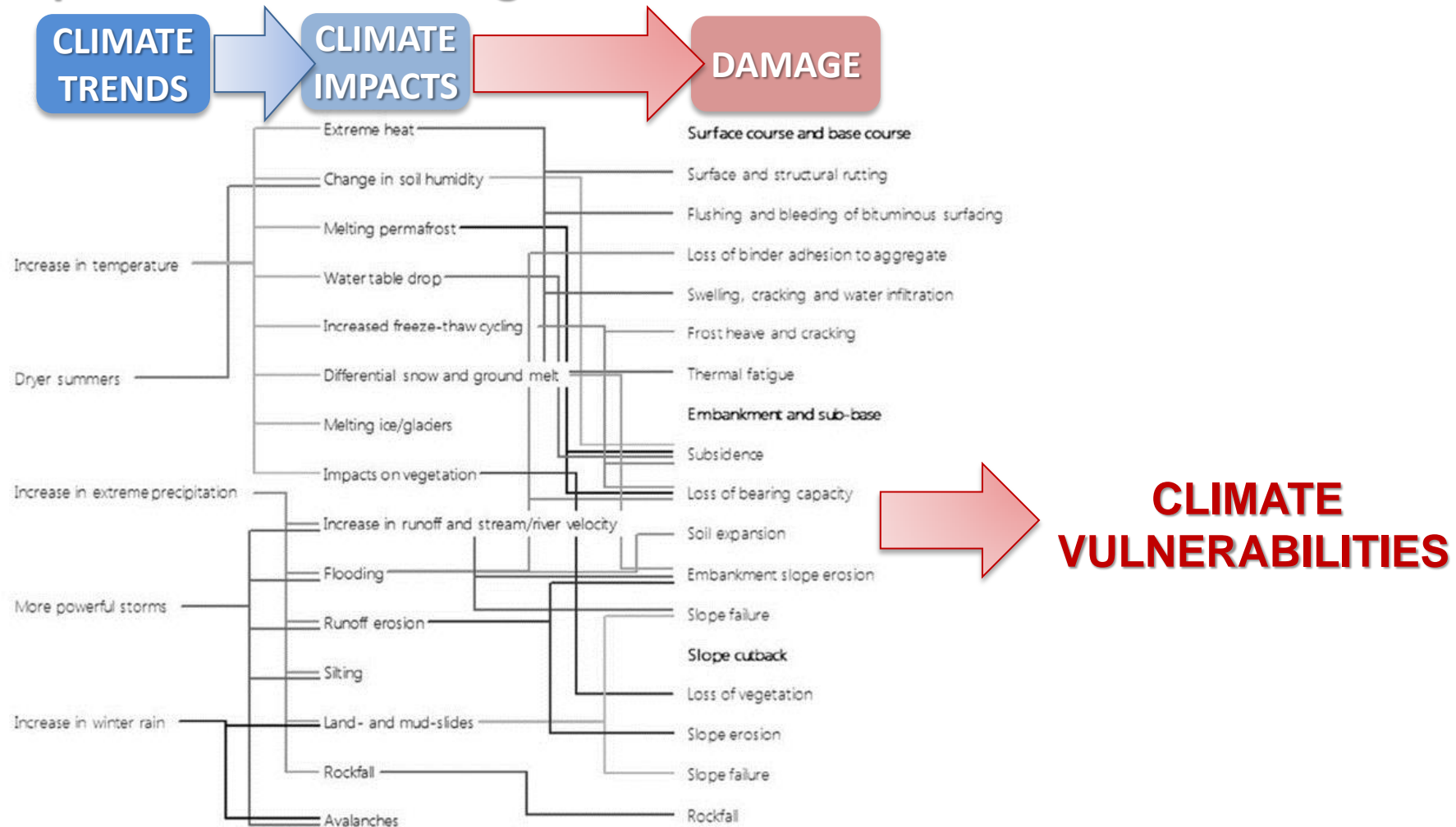
Download de dados | Download de mapa | Bookmark

**We also know that the lifespan of the transport newtwork assets will extend long enough to have to cope with climate change effects**



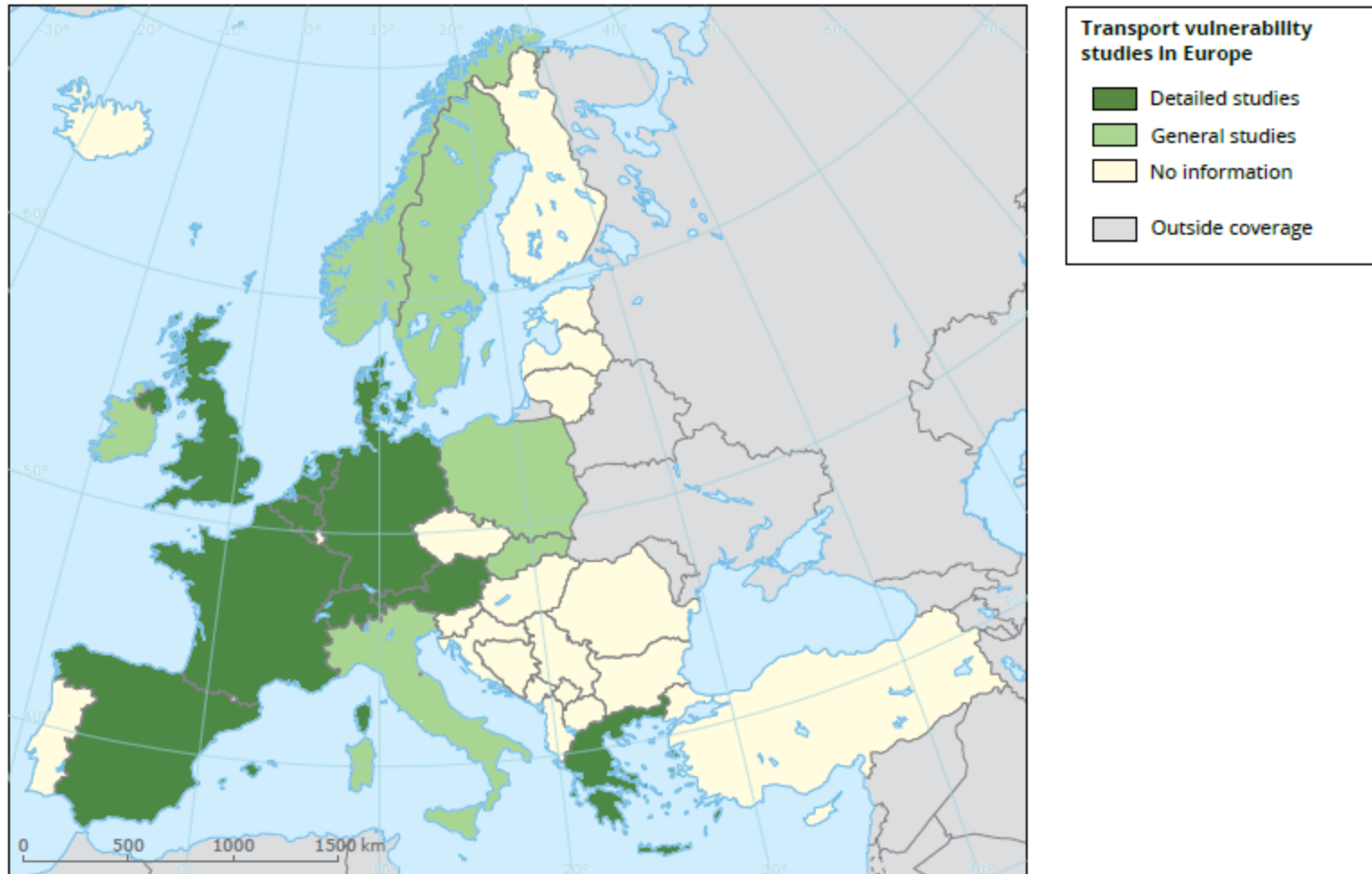
Source: UK Highways Agency, 2011.

## But we often lack the connection between climate trends, transport networks damage and climate vulnerabilities:



## Starting Point for WG TRANS:

### No information on transport vulnerability studies in PT

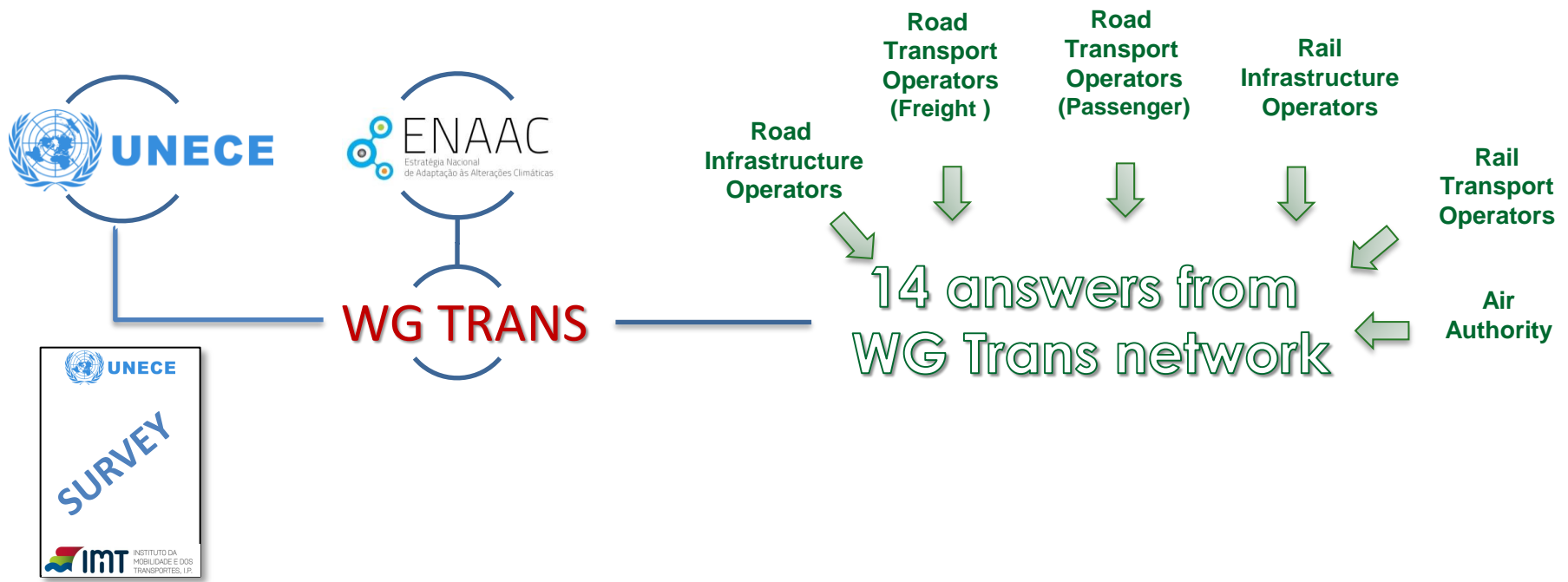


Source: Climate Change, impacts and vulnerability in Europe 2016

# Climate Vulnerabilities: Assessing transport networks vulnerabilities

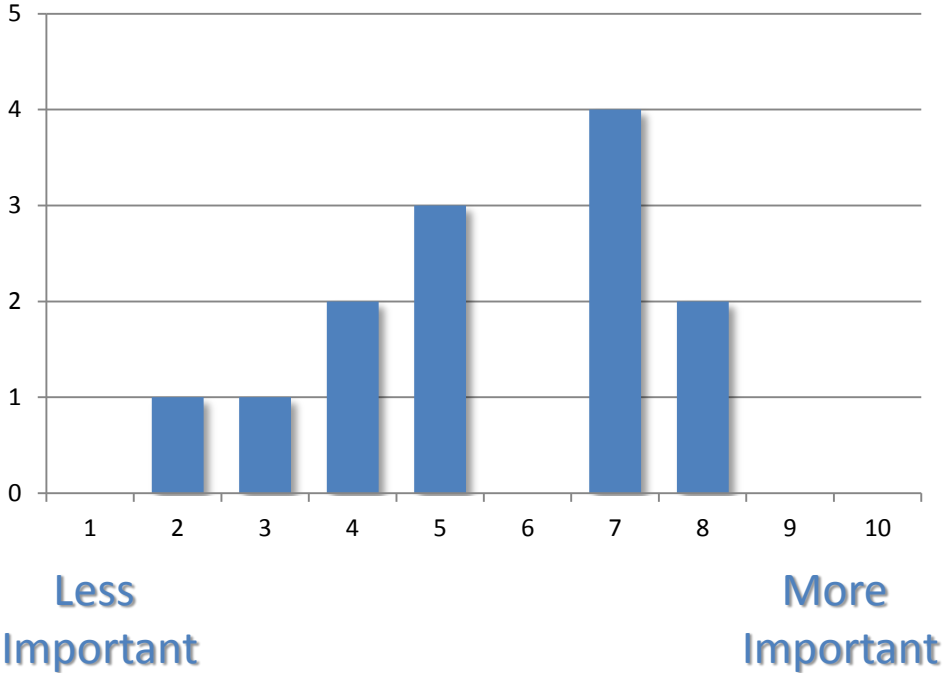


• Survey on Climate Change Impacts and Adaptation for transport networks and nodes:



**QUESTION 1**

To which extent do you consider climate change and/or extreme weather events to be a problem for transport in your country/region (on a scale of 1–10)



- **PERCEPTION THAT CLIMATE CHANGE HAS IMPACTS ON TRANSPORT INFRASTRUCTURE**
- **HIGH VARIATION OF OPINIONS REGARDING THE DIMENSION OF THE CHALLENGE.**

**Average value: 5,3**

**QUESTION 2**

Critical transport infrastructure: Please list below the transport arteries (road, rail, inland water transport) and nodes (ports, airports, freight villages/ logistics centers/ intermodal centers) considered as critical in your country/region/orgzanization and specify their criticality.

**FIRST PROBLEM**

- **DEFINE CRITICAL INFRASTRUCTURES ON A CLIMATE CHANGE CONTEXT**

**ADOPTED SOLUTION**

- **MAJOR INFRASTRUCTURES THAT ALLOW INTERNATIONAL AND NATIONAL CONNECTIONS AND/OR WITH A RELEVANT HISTORY OF EXPOSURE TO EXTREME WEATHER EVENTS AFFECTING THE INFRASTRUCTURE NORMAL CAPACITY.**
- **TEN-T Network + Nodes**
- **UNECE E-Roads + National main roads (IP's)**
- **National main rail tracks (Metropolitan Areas + Corredor Atlântico)**
- **Roads+Rail with relevant history of weather related disturbances**

**Analyzed infrastructure:**

- **30 roads**
- **17 railroads**
- **7 ports (lacking data)**
- **3 airports (lacking data)**



**QUESTION 3**

Do your Government / organization plan any investments in the next 5 years in the above mentioned critical infrastructure? If yes, please specify the investment and indicate its total value (in million €).  
Do planned investments in the above indicated critical infrastructure consider impacts of extreme weather and/or other climate related factors? If yes, please specify for each investment.



€237 Million



€400 Million

**Estimated Investment  
(over 5 Years)**

€637 Million

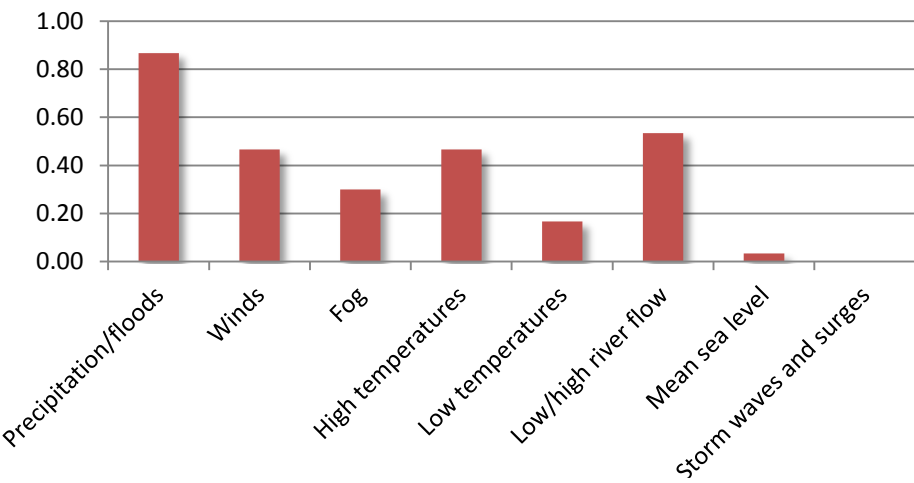
- **REGULAR EIA ASSESSMENT**

- **NO CLIMATE CHANGE SPECIFIC EVALUATION**
- **NO CLIMATE CHANGE ADAPTATIONS INCLUDED TO INCREASE RESILIENCE OF INFRASTRUCTURES**

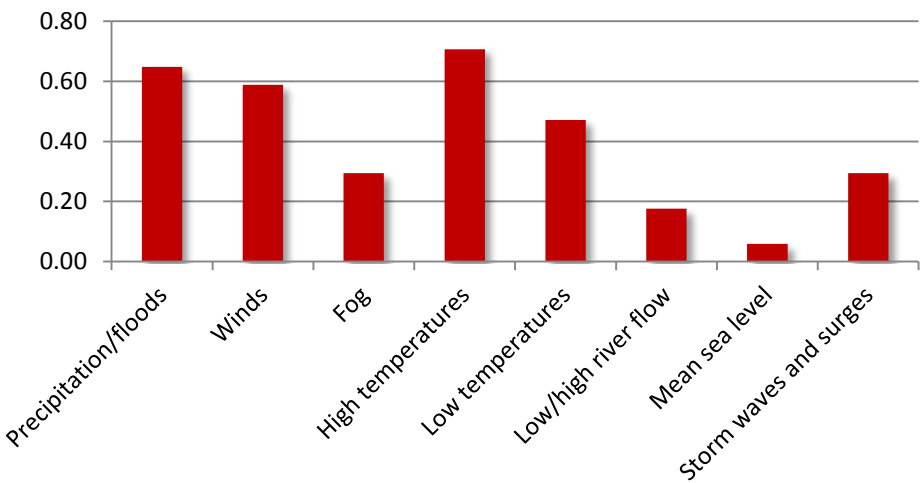
**QUESTION 4**

Which of the following weather or climate related factors have impacted your critical infrastructure mentioned above (check all that apply)

**Road (%)**



**Rail(%)**



**WEATHER OR CLIMATE FACTORS WITH LARGER HISTORICAL IMPACT**

- **VARIABLE ACCORDING TRANSPORT MODE**
- **PRECIPITATION/FLOODS, HIGH TEMPERATURES AND WIND ARE THE FACTORS WITH LARGER IMPACT**
- **MEAN SEA LEVEL AND STORM WAVES AND SURGES ARE THE FACTORS WITH LESS IMPACT**

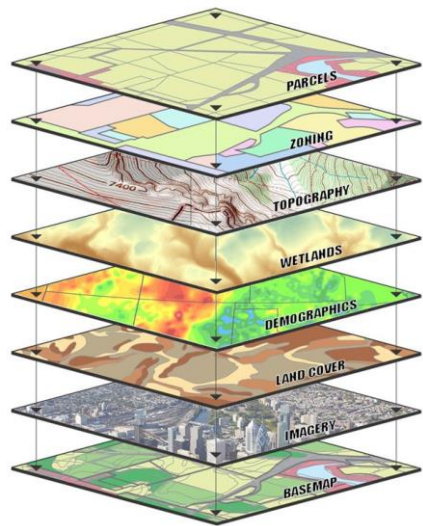
**QUESTION 4**

Which of the following weather or climate related factors have impacted your critical infrastructure mentioned above (check all that apply)

**LOCATION**

- FOR EACH CRITICAL INFRASTRUCTURE WE IDENTIFIED THE MAJOR WEATHER OR CLIMATE RELATED FACTORS THAT HAVE IMPACTS AND THE ASSETS THAT ARE DAMAGED**

THIS DATA WILL ALLOW FUTURE GIS INTEGRATION



*ASSETS: A – Toll Operations; B – Sliding slope; C- Underground drainage; D - Road side telematics equipment; E - Drainage; F - Crossroads; G – Connections; H – Signs and signals; I – Lightning; J - Bridges; K - Road Pavement L - Non specified infrastructure*

ID	Designação	Origem	Destino	P/I	V	N	AT	BT	S/D	NMM	SM
1	IP 1	Valença	Porto (VCI)	A, B, C, D	H, I		A, J, K		J		
2	IP 1	Carvalhos	Aveiro (Albergaria)	A, B, C, D	H, I		A, J, K		J		
3	IP 1	Aveiro (Albergaria)	Lisboa (Sacavém)	A, B, C, D	H, I		A, J, K		J		
4	IP 1	Lisboa	Montijo	E	H, I		A, J, K				
5	IP 1	Montijo (A2)	Setúbal (Nó A2/A12)	A, B, C, D	H, I		A, J, K				
6	IP 1	Nó A2/A6/A13	Nó A2/A22	A, B, C, D	H, I		A, J, K		J		
7	IP 1	Nó A2/A22	Castro Marim	A, B, C, D	H, I		A, J, K		J		
9	CRIP	Carvalhos	Francos	F, G, L	F, G, L	F, G, L	L	L			
10	IP 2/ E 802	Portelo	Faro	L							
11	IP3/E801	Vila Verde da Raia	Figueira da Foz	A, B, C, D, L	H, I, J	L	A, J, K, L	L	J		
12	IP 4/ E82	Porto	Quintanilha	A, B, C, D, L	H, I, J, L	L	A, J, K, L	L	J		
13	IP 5	Aveiro	Vilar Formoso	L		L					
14	IP 6	Peniche	Castelo Branco	B, E	H, L						
15	IP 7	Lisboa	Caia	A, B, C, D			A, J, K		J		

Precipitation/floods  
 Winds  
 Fog  
 High temperatures  
 Low temperatures  
 Low/high river flow  
 Mean sea level  
 Storm waves and surges

## QUESTION 5

Over time, has the magnitude of damage and/or disruption caused by weather or climate related events:

### HISTORICAL VARIATION OF WEATHER OR CLIMATE EVENTS

- MOST ANSWERS REFER THAT LACK OF HISTORICAL DATA DETERS THE ANSWER TO THIS QUESTION
- ALL ENTITIES THAT EVALUATED THE HISTORICAL VARIATION POINTED THAT THE MAGNITUDE OF DAMAGE FROM WEATHER OR CLIMATE EVENTS HAS REMAINED MORE OR LESS THE SAME

## QUESTION 6

Have users of the critical infrastructure requested implementation of effective response measures?

- **Yes. After extreme weather events the users usually request implementation of corrections to the infrastructure resiliency.**
- **Some transport infrastructure operators report having received user requests to increase vegetation cutting area, improve road pavement, slope stabilization and road runoff water control.**

## QUESTION 7

Please provide any other comments/information you would like to submit regarding the above questions

- **The historic experience of operating transport infrastructure built in the recent decades does not provide a knowledge base wide enough to provide a correct evaluation on the changing weather condition.**
- **Other operators stressed that a correct adaptation of the transport infrastructure to climate change effects also has effects on lowering GHG emissions.**



## QUESTION 8

Is there information available on the following climate change impacts that have affected or will potentially affect critical infrastructure in your country/region/organization?

### DATA AVAILABILITY

- **AVAILABILITY OF DATA FOR MAJOR ROAD AND RAIL INFRASTRUCTURES ON PRECIPITATION, TEMPERATURE AND WINDS**

### DATA GAPS

- **LACK OF DATA REGARDING RIVER WATER LEVELS AND COASTAL SEA LEVELS AND STORM WAVES/SURGES**
- **LACK OF PRECIPITATION, TEMPERATURE AND WINDS DATA FOR ROADS+RAIL WITH RELEVANT HISTORY OF WEATHER RELATED DISTURBANCES**

## QUESTION 9

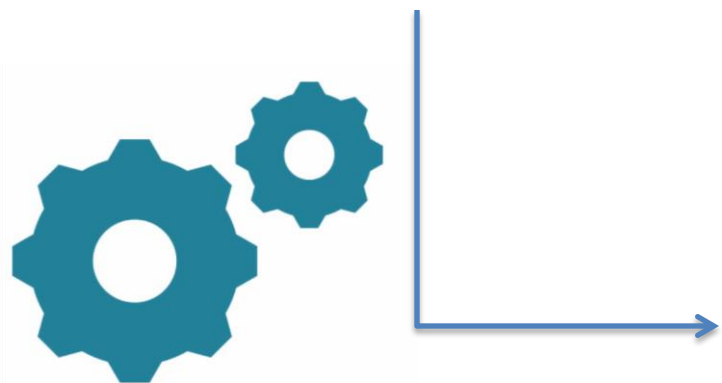
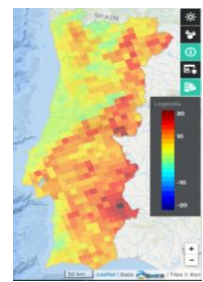
If yes, have the observed trends already necessitated or will require adaptation responses?

- **FEW ANSWERS AND NO SIGNIFICATIVE TRENDS IDENTIFIED**

**QUESTION 10**

Please indicate the basis for weather/climate information used in the estimation of impacts and the design of response measures regarding your critical infrastructure (check all that apply)

Observations	x
Modelling	x
Modelling validated by long term observations	x



- CIVIL PROTECTION SERVICES 
- PORTUGUESE SEA AND ATMOSPHERE INSTITUTE 



**QUESTION 11**

Are downscaled forecasts or assessments available for your critical infrastructure regarding the following climate forcing and factors? If so, at which time scale? (Check all that apply)

<i>Factor/forcing</i>	<i>10 years</i>	<i>30 years</i>	<i>50 years</i>	<i>&gt; 50 years</i>	<i>Not available</i>
Precipitation (average/extreme precipitation) and floods	X	IPMA	X	X	
Temperature (averages and extremes)	X	IPMA	X	X	
Winds (e.g. average and extremes, number of days of high winds)	X	IPMA	X	X	
River water levels	X	IPMA	X	X	
Coastal sea levels and storm waves/surges	X	IPMA	X	X	

**FORECASTS AVAILABILITY**

- **AVAILABILITY OF FORECASTS FOR ALL FACTORS FOR ALL TIME RANGES**
- **STRONG AVAILABILITY OF 30 YEARS FORECASTS (IPMA)**

**INCONSISTENT ANSWER?**

- **RIVER WATER LEVELS AND COASTAL SEA LEVEL AND STORM WAVE/SURGES FORECASTS BUT LACK OF DATA REPORTED ON CLIMATE CHANGE IMPACTS?**



**QUESTION 12**

At which thresholds do you expect that the integrity and functionality of the critical infrastructure of your country/region/organization will be significantly impaired?

**THRESHOLDS**

- FEW KNOW THRESHOLDS

**THRESHOLDS**

- KNOW THRESHOLDS FOR MAJOR INFRASTRUCTURES
- KNOW THRESHOLDS FOR SOME RELEVANT HISTORICAL EVENTS

i.d	Line name (European level i.e. E-Roads)	From	To	Extreme temperatures (high, in C0]	Extreme temperatures (low, in C0]	Exrtreme wind speed [in km/hr]	Extreme river water level (high in metres)	Extreme river water level (low in metres)	Extreme coastal water levels/storm surges (in metres)
1	Autoestrada do Norte /IP 1	Lisboa /Valença	Porto / Castro-marim (37.230910 ; -7.448240)	NO DATA	NO DATA	<b>200Km/h (bridge)</b>	NO DATA	NO DATA	NO DATA
3	CRIP Circular Regional Interior do Porto (Provavelmente IP1)	Carvalhos	Francos	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
4	EN 125 (ER)	Faro	Olhão	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
5	IP 2/ E 802	Portelo	Faro	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
6	E801 /IP3	Vila Verde da Raia	Figueira da Foz	NO DATA	NO DATA	NO DATA	<b>5 m</b>	NO DATA	NO DATA
7	IP 4/ E82	Porto	Quintanilha	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
8	IP 5	Aveiro	Vilar Formoso	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
9	IP 6	Peniche	Castelo Branco	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
10	IP 7	Lisboa	Caia	NO DATA	NO DATA	<b>200Km/h (bridge)</b>	NO DATA	NO DATA	NO DATA



# • Survey on Climate Change Impacts and Adaptation for transport networks and nodes



Evaluation

## WEAK POINTS

- LACK OF OPERATORS DATA TO ALLOW A MORE DETAILED RESPONSE TO THE SURVEY
- LACK OF ANSWERS FROM AIRPORTS AND PORTS

## STRONG POINTS

- RAISED THE AWARENESS TO CLIMATE CHANGE ADAPTATION
- RAISED THE AWARENESS ON NEEDED DATA BY TRANSPORT SERVICES AND INFRASTRUCTURE OPERATORS
- CREATED A NETWORK OF PEOPLE THAT DEAL WITH CLIMATE CHANGE ADAPTATION WITHIN TRANSPORT SECTOR
- VULNERABILITY DATA PROVIDES FRAMEWORK FOR ADAPTION EFFORTS FOCUS

# Adapting Transport Authorities: From vulnerabilities to adaptation policies

# How to use this survey data?

Example 1: Crosscheck transport vulnerabilities to extreme weather events identified for wider regions

Summary of transport vulnerabilities to extreme weather events

Extreme weather event	Impacts on transport modes			
	Road	Rail	Water-borne	Aviation
Heat waves	Damage to pavements Vehicle failure (tyres) Forest fires Fatigue of drivers	Rail buckling Material fatigue Increased instability of embankments Overheating of equipment Forest fires causing damage to infrastructure	Low river flow (due to drought), imposing restrictions on loading capacity, navigation problems and speed reduction	Damage to runway pavement Forest fires reducing visibility Take-off weight limitations
Cold spells	Reduced surface friction Road maintenance Technical failure of vehicles and infrastructure Deterioration of pavement	Ice on trains and catenary	Warm and early winters followed by a rapid decrease in air temperature may result in rougher ice cover formation and lead to ice jams and damage to navigation signs and infrastructure	Reduced runway friction Runway maintenance Deterioration of pavement Technical failure of vehicles and infrastructure Icing of aircraft
Heavy precipitation (large-scale systems)	Reduced visibility and surface friction Floods and landslides	Flooding and landslides damaging infrastructure Scour to structures Increased instability of embankments	High river flows, resulting in problems for passage of bridges, dike instability (speed limitations) and restrictions to the height of vessels	Reduced visibility and runway friction Floods Reduction in airport throughput Runway clearance

# How to use this survey data?

Example 2: Identify Transport adaptation policies that can help coping the identified vulnerabilities

## SNCF (France)

- Climate vulnerability cartography;
- Update of constructions and maintenance regulations for infrastructures;
- Strategic reflection on climate change crisis with other transport entities;
- Climate change indirect impacts evaluation: changes in passengers O-D, energetic crisis during long drought periods...

## Norwegian Public Roads Administration

- Revision of road transport regulations integrating climate change risks such as floods, ice and landslides, extreme rain events and sea level rise;
- Mandatory inspections on road drainage according to expected extreme weather events rise.

## AdapteCCa Platform (Spain)

- Platform for sharing experiences on climate change adaptation (PT has also implemented a similar platform); Dissemination of the study on “Necesidades de adaptación al cambio climático de la red troncal de infraestructuras de transporte en España”.

## Deutsche Bahn (Germany)

- Revision of the protocols and operational plans for climate extreme events;
- Colaboration with the Standardization Institute to define the necessary standards updates to cope with climate change;
- Research on climate change adaptation strategies.



# How to use this survey data?

Example 3: Identify new transport technologies that can help coping the identified vulnerabilities

## Real time Information and Communication Technologies

smartphones, computers, satellites, sensors ...

### Intelligent Transport Systems-ITS



Dynamic Traffic Management



Real Time Traffic Information



Satellite Navigation - Track & Trace



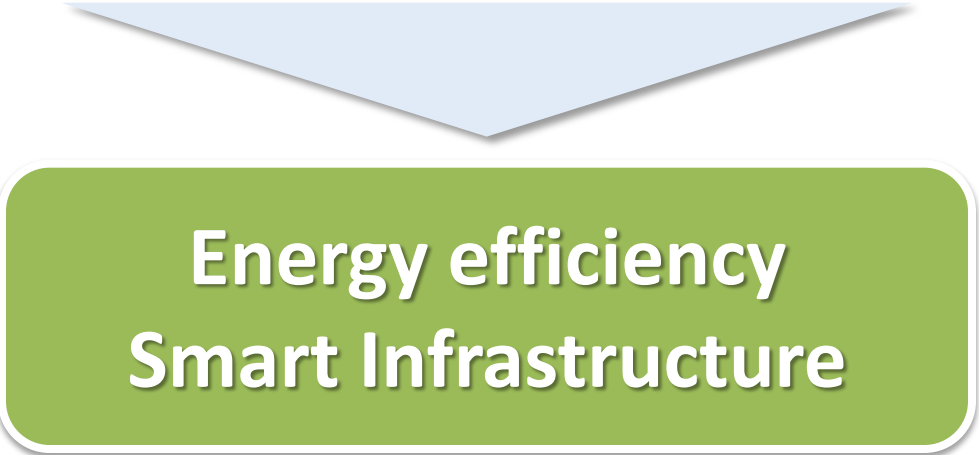
Multi-modal journey planner



Electronic tolling fee collection



Onboard safety systems



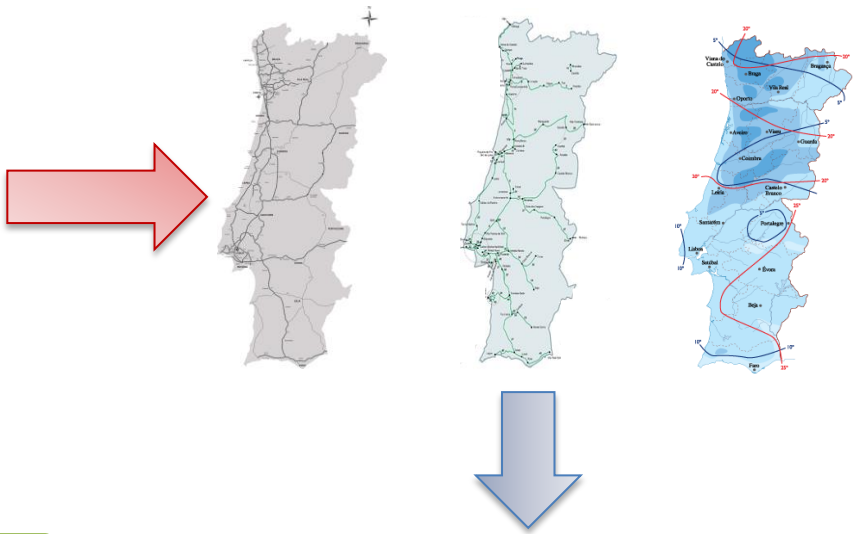
Source: Pedro Barradas; IMT

# How to use this survey data?

Example 4: Integrate it on operational management centers through GIS

ROAD NETWORK				Periódico de observações (precipitação e vento)		Zonas de risco (tempestades e ventos)		Número de acidentes	
Ld	Estimativa (Segmento km e E-Road)	From	To	Passing through	SE1	SE2	SE3	SE4	SE5
1	140 (pavim.)	Naves (Ld)	Naves (Ld)	Naves (Ld)					
2	Autobstrada do Norte (IP1)	Valença	Carvalhos	Santarém-Lousã-Castrolim-Albergaria-a-Velha	x	x			x
3	CRP Circular Regional Exterior de Lisboa	Alameda	Carvalhos	Caralis (Estádio Nacional) Cascais-Odivelas-Lousã-Alverca	SEM	DADOS	SEM	DADOS	SEM
4	CRP Circular Regional Interior do Tejo (Procedimento 1º)	Francos	Francos	Freixo	SEM	DADOS	SEM	DADOS	SEM
5	EN 125 (1º)	Fam	Odivelas	O	SEM	DADOS	SEM	DADOS	SEM
6	IP 2/ E 802	Portugal	Fam	Castelo Branco-Portugal-e-Coora		x		x	
7	IP 4/ E 802	Vila Verde	Porto	Vila Verde-Castelo Branco	x	x	x	x	
8	IP 5	Aveiro	Castelo Branco	Guarda		x		x	
9	IP 6	Peniche	Castelo Branco	Santarém-Lousã		x		x	
10	IP 7	Lisboa	Cala	Lisboa	x	x	x	x	
11	IP 8	Sines	Vila Verde do Tejo	Baja-Sertulal		x		x	
12	EN 2	Vila Rica	Vila Rica	Vila Rica - P-46,00		x		x	
13	EN 101	Méguas	Méguas	Vila Rica, Mourão Antas de Valdevez					

ID	Designação	Origem	Destino	PA	V	N	AT	BT	L/D	MM	MM	MM
1	IP 1	Valença	Porto (VOC)	A,B,C,D	H,1		A,L,K		J			
2	IP 1	Carvalhos	Aveiro	A,B,C,D	H,1		A,L,K		J			
3	IP 1	Alameda	Lisboa	A,B,C,D	H,1		A,L,K		J			
4	IP 1	Lisboa	Montijo	E	H,1		A,L,K					
5	IP 1	Montijo	Sertulal (N0 A2/A12)	A,B,C,D	H,1		A,L,K					
6	IP 1	N0	N0 A2/A12	A,B,C,D	H,1		A,L,K		J			
7	IP 1	N0 A2/A12	Castro Marim	A,B,C,D	H,1		A,L,K		J			
8	IC18/OREL	Caxias	Alverca	L	L	L	L	L				
9	CRP	Carvalhos	Francos	F,G,L	F,G,L	F,G,L	L	L				
10	IP 2/ E 802	Portugal	Fam	L								
11	IP3/IB01	Vila Verde da Raia	Figueira da Foz	A,B,C,D,L	H,L,1	L	A,L,K	L	J			
12	IP 4/ E 802	Porto	Quintanilha	A,B,C,D,L	H,L,1	L	A,L,K	L	J			
13	IP 5	Aveiro	Vilar Formoso	L	L	L	L	L				
14	IP 6	Peniche	Castelo Branco	B,E	H,L							
15	IP 7	Lisboa	Cala	A,B,C,D			A,L,K		J			



## TRAFFIC MANAGEMENT

- Create common operational picture for extreme weather events
- Increase coordination between infrastructure and transport service operators
- Basis for integrated ITS systems



# How to use this survey data?

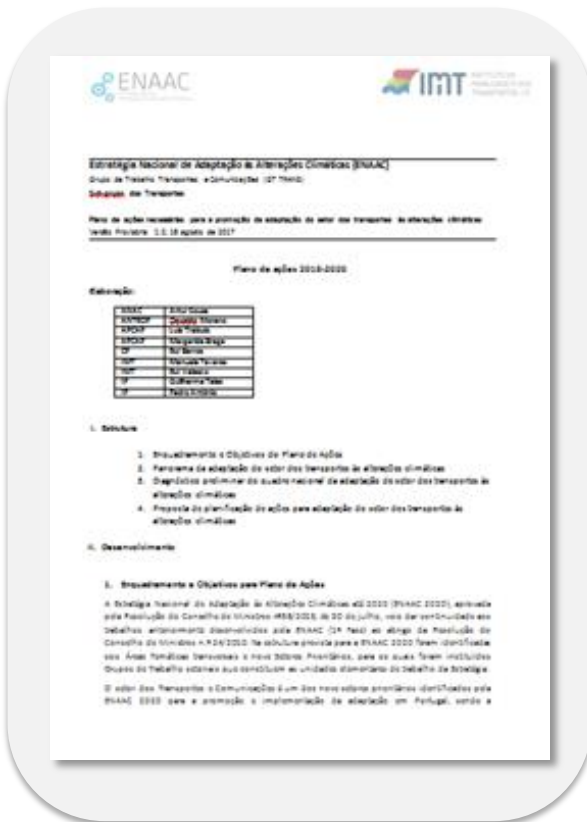
Example 5: Propose priorities for transport investment funds

- **Vulnerability studies for transport systems, namely threshold identification within foreseen climate change scenarios**
- **Infrastructure Climate Proofing**
- **Prevention plans for extreme weather events**
- **Emergency Plans for extreme weather events**
- **Studies for adapting transport planning to foreseen climate change scenarios**
- **Innovative traffic management systems that increase extreme weather events resilience**
- **Definition and development of new construction techniques that increase climate change resilience**
- **Climate risk cartography**
- **ITS systems for emergency communications during extreme weather events**
- **Adaptation of transport operators equipment**
- **Adaptation of coastal infrastructures to increase climate change resilience**

# How to use this survey data?

Example 6: Prepare an action programme for transport adaptation

1. **MONITOR CLIMATE RELATED VARIABLES**
2. **IDENTIFY CLIMATE CHANGE IMPACTS (AIRPORTS AND PORTS)**
3. **IDENTIFY CLIMATE CHANGE VULNERABILITIES (AIRPORTS AND PORTS)**
4. **INTEGRATE CLIMATE ADAPTATION ON TRANSPORT PLANNING**
5. **MONITOR CLIMATE CHANGE ADAPTATION ON TRANSPORT SECTOR**



----- Possible Actions -----

OBTAIN WEATHER DATA FOR SITES WITH KNOW WEATHER ISSUES

SURVEY PORTS AND AIRPORTS

SURVEY PORTS AND AIRPORTS

INTEGRATE CLIMATE CHANGE ADAPTATION ON EIA

DEFINE INDICATORS TO REPORT ADAPTATION PROGRESS

# CLIMATE CHANGE ADAPTATION IN THE TRANSPORT SECTOR EXPERIENCE FROM PROJECT PREPARATION AND NETWORK MANAGEMENT

- Session 1 – Analysis of Climate Vulnerabilities on Transport Networks -



Transport Authorities Need to  
Adapt to Climate Change



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Brussels, 6 December 2017



# More Information

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**For info or further questions on this seminar and the activities of the JASPERS Networking Platform, please contact the JASPERS Networking and Competence Centre at the following email:**

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**JASPERS Website:**

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**JASPERS Networking Platform:**

**[www.jaspersnetwork.org](http://www.jaspersnetwork.org)**

