

Excessive heat at the workplace: the EU case

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Joint Research Centre, European Commission

ILO's International Conference on Occupational Heat Stress: "Implementation of Practices, Sharing of Experiences"

Doha, 10 May 2023

Climate Risks in the EU

- EU Climate Target Plan:
 - By 2030: Reduce GHG emissions to at least 55%
 - By 2050: EU to become climate neutral
- Joint Research Centre (DG JRC):
 - To provide independent, evidence-based knowledge and science, supporting EU policies
 - JRC PESETA Report (since 2009)
 - EU-wide climate change risk assessment
 - Bottom-up, multisector approach
 - IPCC's risk notion = Hazard x Exposure x Vulnerability

PESETA-IV

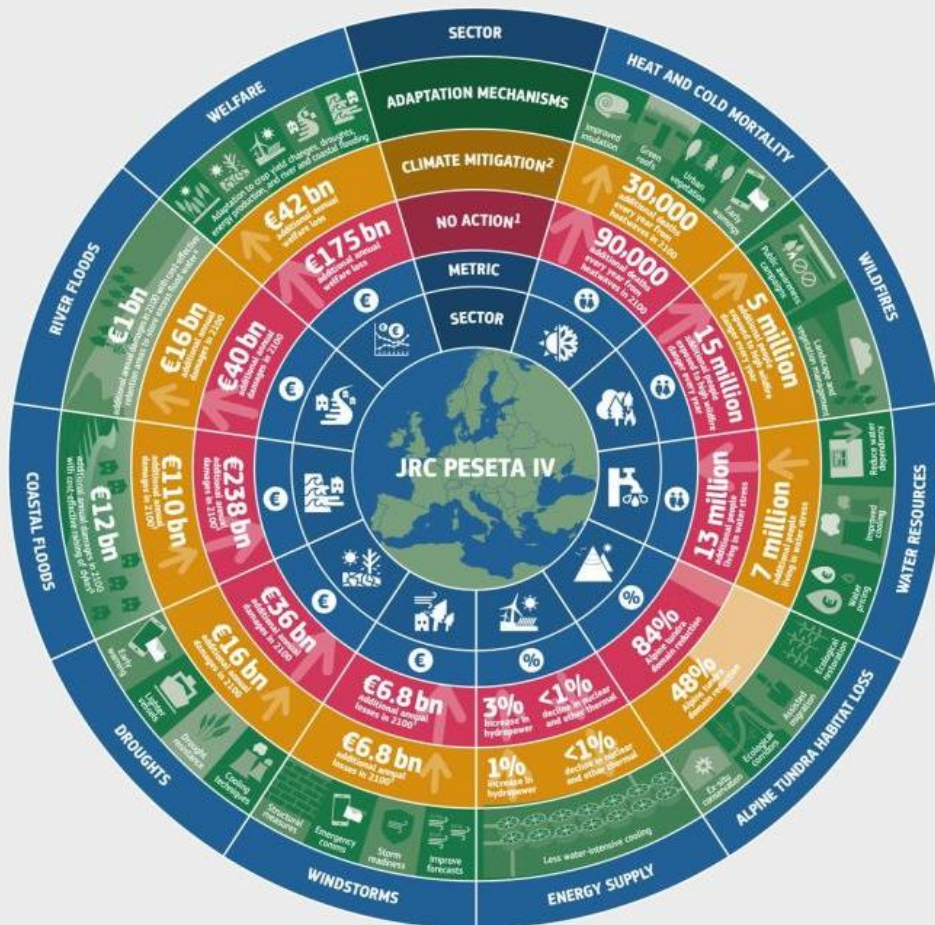
- Published in 2020
- 10 sectors analysed
- EU-wide GDP impacts

Link to Report:

https://joint-research-centre.ec.europa.eu/peseta-projects/jrc-peseta-iv_en

JRC PESETA IV study: climate change impacts and adaptation in Europe

Climate mitigation can considerably lower the impacts of future climate change in Europe. But not all the impacts will be avoided by mitigation. Adaptation can further reduce climate change impacts in a cost-efficient way.



NO ACTION 3°C¹
CLIMATE MITIGATION 1.5°C²
ADAPTATION MECHANISMS

¹ Impacts under a 3°C global warming scenario (relative to pre-industrial) unless otherwise stated. Assumes the population and economy does not change from present, unless a particular year is specified (e.g. 2100). Impacts are estimated in additional terms, i.e. relative to the effects of climate on nowadays. Impacts are for Europe. ² Impacts under a 1.5°C global warming scenario (relative to pre-industrial) unless otherwise stated. Assumes the population and economy does not change from present, unless a particular year is specified (e.g. 2100). Impacts are estimated in additional terms, i.e. relative to the effects of climate on nowadays. Impacts are for Europe. ³ Impacts are for a moderate mitigation emissions scenario in 2100 (RCM4.5). ⁴ Impacts are for a high emissions scenario in 2100 (RCR8.5). ⁵ Droughts are largely due to increasing future asset values, as windstorm intensity and frequency do not change significantly. ⁶ Combined with mitigation.

PESETA-V (aka TRACE)

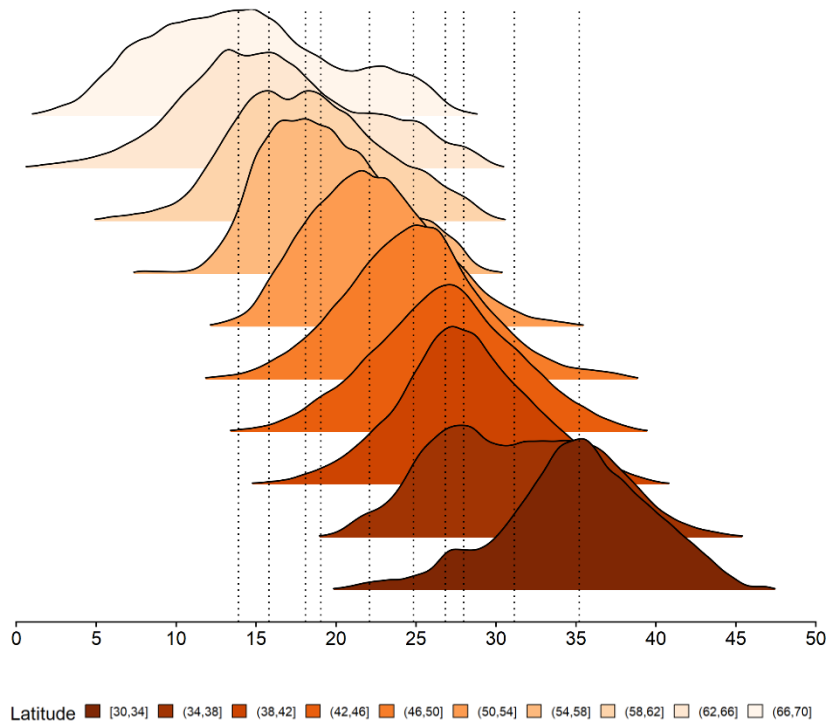
“Territorial Risk Assessment of Climate in Regions of Europe”

- **Understand unequal impacts of climate change in regions of Europe**
 - Regionalise PESETA IV impacts
 - Add some key climate impact areas
 - Regional economic modelling
 - Map impacts on people, ecosystems and economy in regions of Europe
 - Relevant for EU Cohesion Policy to reduce social, economic and environmental disparities within European regions

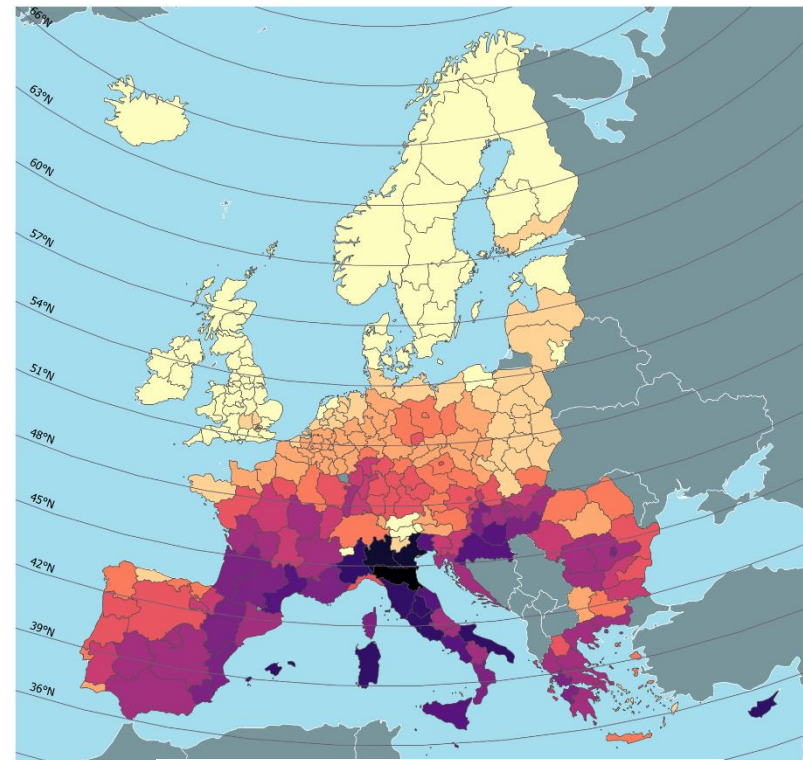
1. What we do know

1.1 Hazard: Greatly heterogeneous

North–south gradient of temperatures...

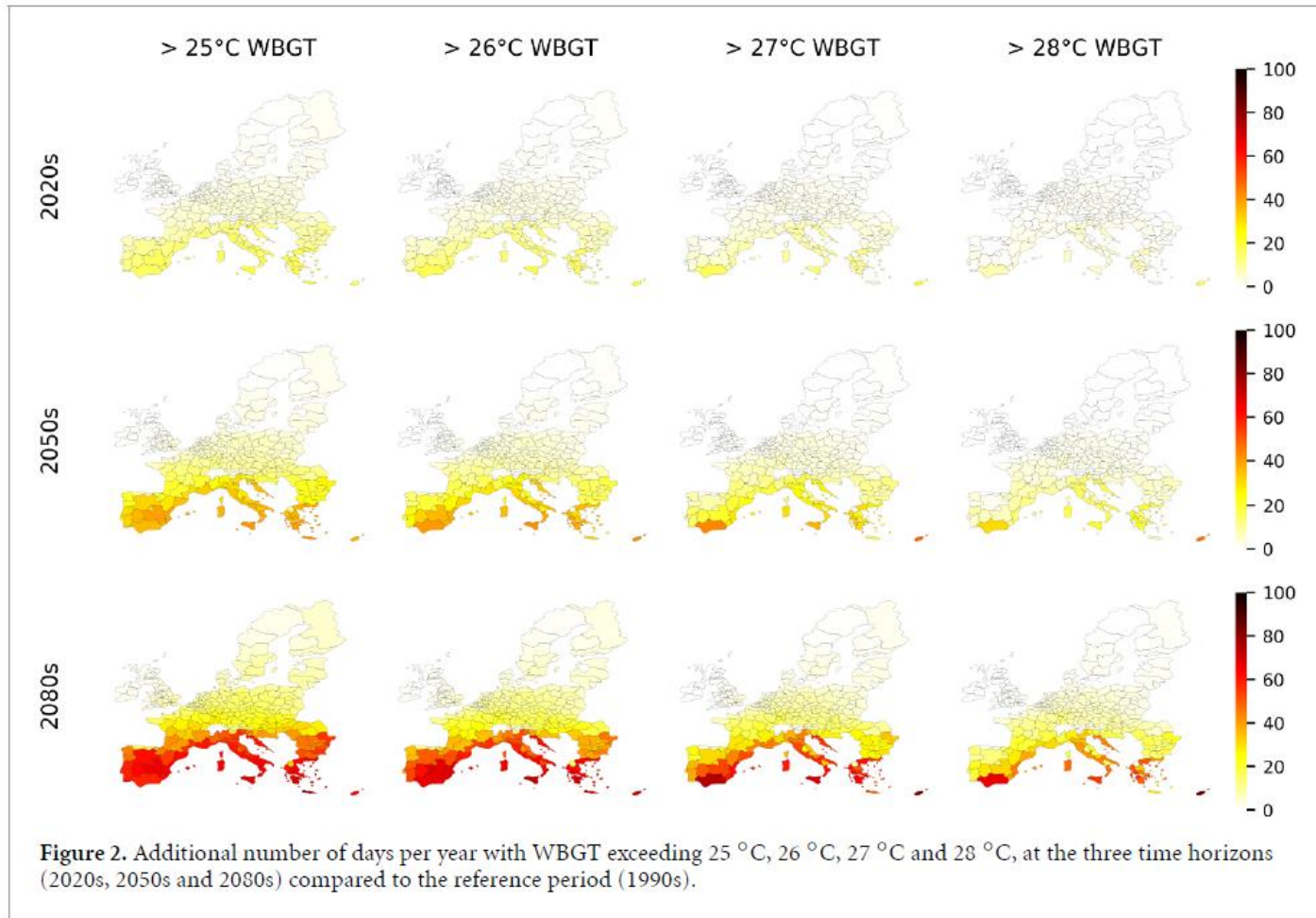


...and thermal comfort

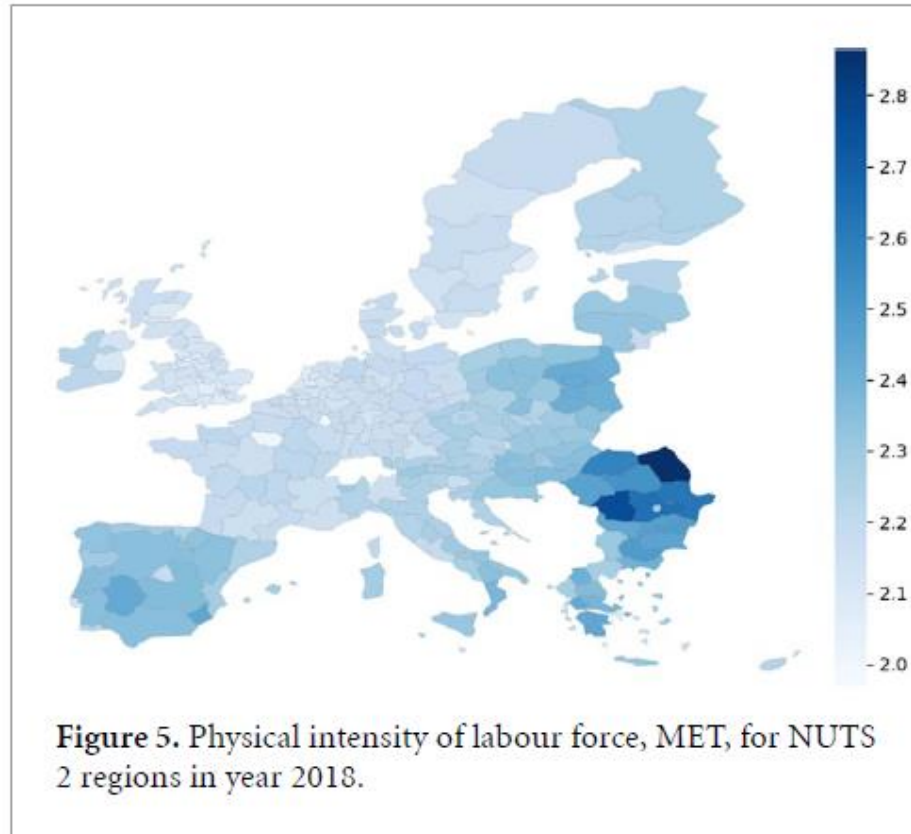


WBDD (°C) 0° 100° 200° 300° 400° 500°

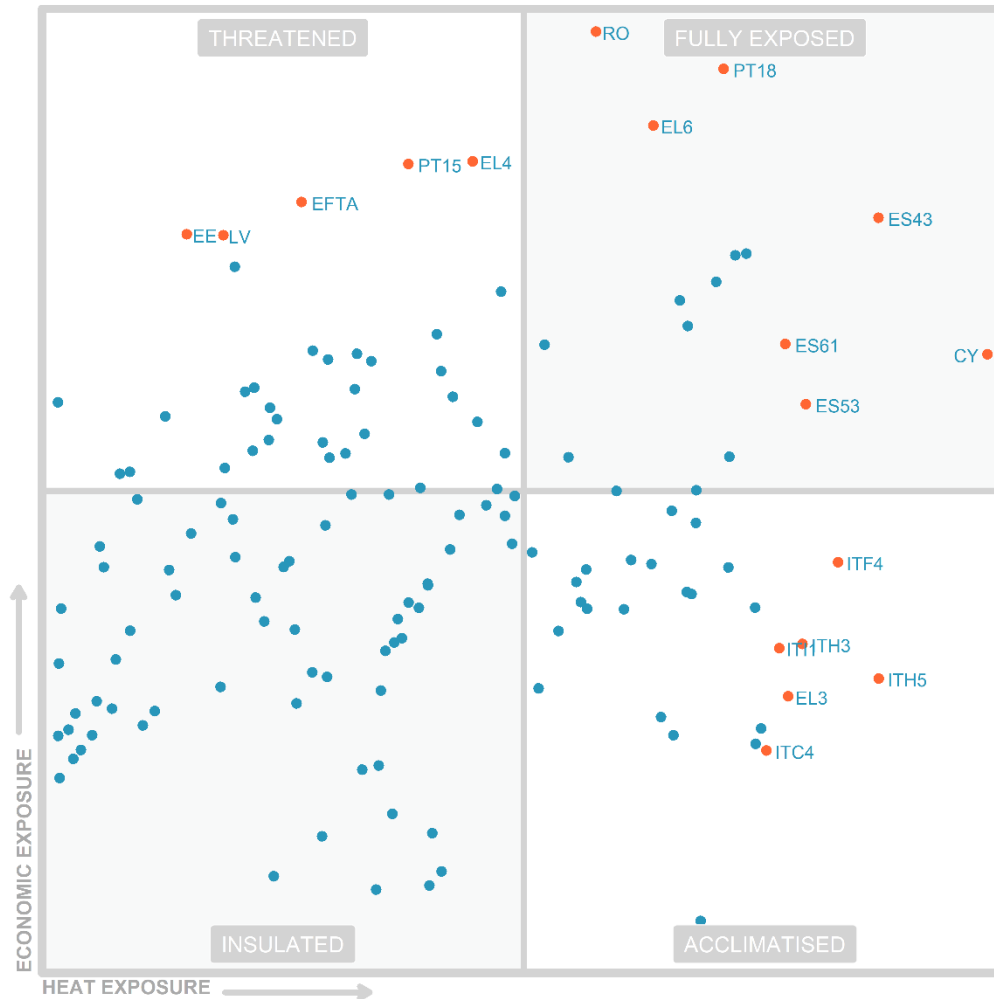
1.1 Hazard: Future projections



1.2 Exposure & Vulnerability



1.2 Exposure & Vulnerability



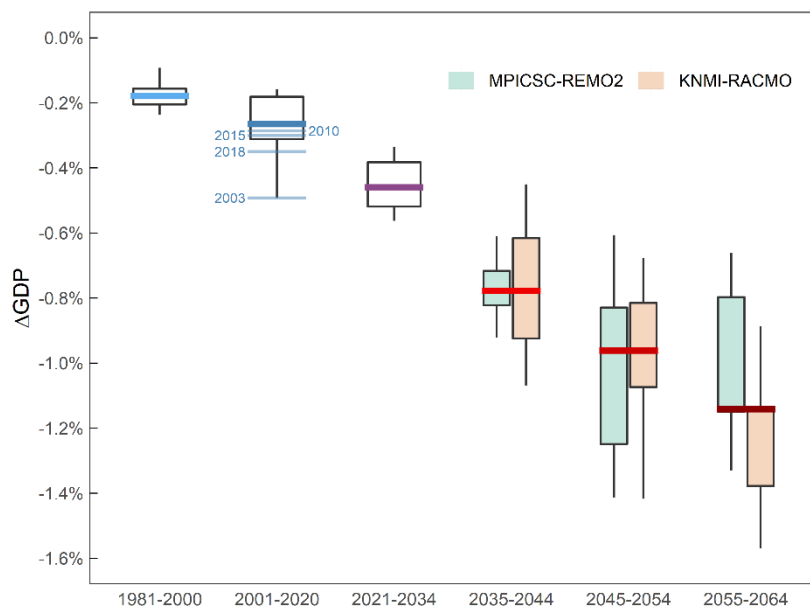
García-León et al. (Nature Comms)

1.3 Impacts

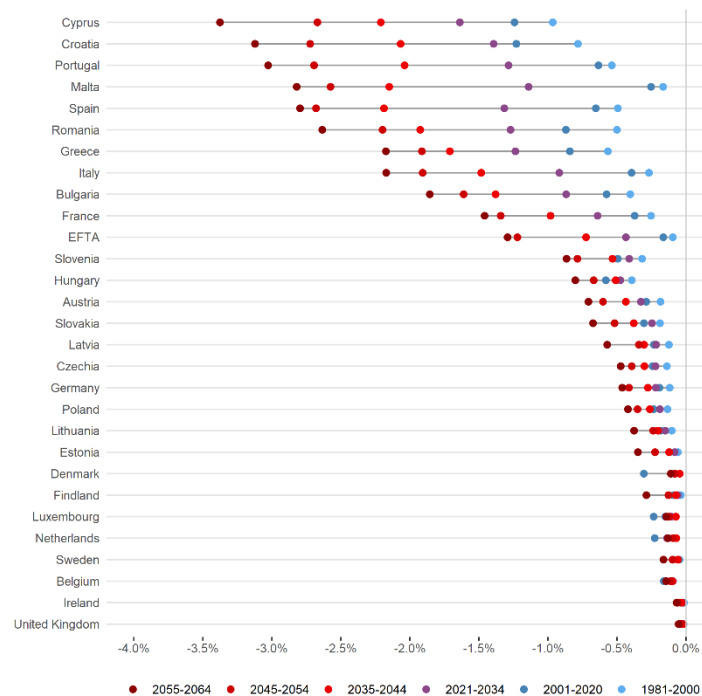
- Spatial correlation between variability in heat stress and exposure
- Productivity losses can range from less than 0.5% in the north to more than 8% losses in Southern European regions
- EU-wide GDP annual growth damages in the range 0.35-0.5%
- Outdoor sectors more impacted, but also indoor if no air conditioning effectively implemented
- Losses are expected to increase notably if no mitigation/adaptation action
- More vulnerable regions will be relatively more affected

1.3 Impacts

Economic costs to grow by a factor of five



Great disparities between countries/regions



2. What we want to know

2. Planned research and work in progress

1. Investigate impacts accounting for **occupational diversity** (LABPROD)

2.1 LABPROD

Table SM 4: Classification of 43 sub-major ISCO occupations to four occupational groups by country

ISCO 08 sub-major groups description	ISCO08 code	Countries																											
		AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Chief Executives, Senior Officials and Legislators	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Administrative and Commercial Managers	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Production and Specialized Services Managers	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Hospitality, Retail and Other Services Managers	14	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Science and Engineering Professionals	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Health Professionals	22	3	3	3	3	3	2	3	3	3	2	2	3	3	2	3	2	3	2	3	3	3	3	3	3	3	3	2	3
Teaching Professionals	23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Business and Administration Professionals	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Information and Communications Technology Professionals	25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Legal, Social and Cultural Professionals	26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Science and Engineering Associate Professionals	31	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Health Associate Professionals	32	2	3	2	2	3	2	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	
Business and Administration Associate Professionals	33	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Legal, Social, Cultural and Related Associate Professionals	34	3	2	3	3	3	2	3	3	3	3	2	3	2	3	3	3	2	3	3	3	2	2	3	3	3	3	3	
Information and Communications Technicians	35	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
General and Keyboard Clerks	41	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Customer Services Clerks	42	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Numerical and Material Recording Clerks	43	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Other Clerical Support Workers	44	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Personal Services Workers	51	2	2	3	2	3	2	3	3	3	2	3	2	2	2	2	3	2	3	2	2	2	3	3	3	2	2	2	
Sales Workers	52	3	2	3	2	2	3	2	2	2	2	2	2	3	3	3	3	3	2	2	3	2	3	2	2	2	3	3	
Personal Care Workers	53	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	
Protective Services Workers	54	3	3	3	4	4	3	4	3	4	3	4	3	4	3	4	3	4	3	3	3	3	3	3	3	4	4	3	
Market-oriented Skilled Agricultural Workers	61	3	4	3	3	4	4	3	4	3	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Market-oriented Skilled Forestry, Fishery and Hunting Workers	62	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Subsistence Farmers, Fishers, Hunters and Gatherers	63	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Building and Related Trades Workers (excluding Electricians)	71	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Metal, Machinery and Related Trades Workers	72	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Handicraft and Printing Workers	73	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Electrical and Electronic Trades Workers	74	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Food Processing, Woodworking, Garment and Other Craft	75	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	
Stationary Plant and Machine Operators	81	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Assemblers	82	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Drivers and Mobile Plant Operators	83	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Cleaners and Helpers	91	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Agricultural, Forestry and Fishery Labourers	92	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Labourers in Mining, Construction, Manufacturing and Transport	93	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Food Preparation Assistants	94	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Street and Related Sales and Services Workers	95	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Refuse Workers and Other Elementary Workers	96	3	4	4	3	4	3	3	3	3	3	4	3	3	4	3	4	3	4	3	4	3	3	3	3	3	3	4	3

Legend: 1 clerical 2 light physical 3 moderate physical 4 heavy physical

2. Planned research and work in progress

1. Investigate impacts accounting for **occupational diversity** (LABPROD)
2. Analyse the impact of EU Member State **policies** against excessive heat
 - Heat-Health Adaptation Plans (**HHAP**)
 - Heatwave Early Warning Systems (**HEWS**)

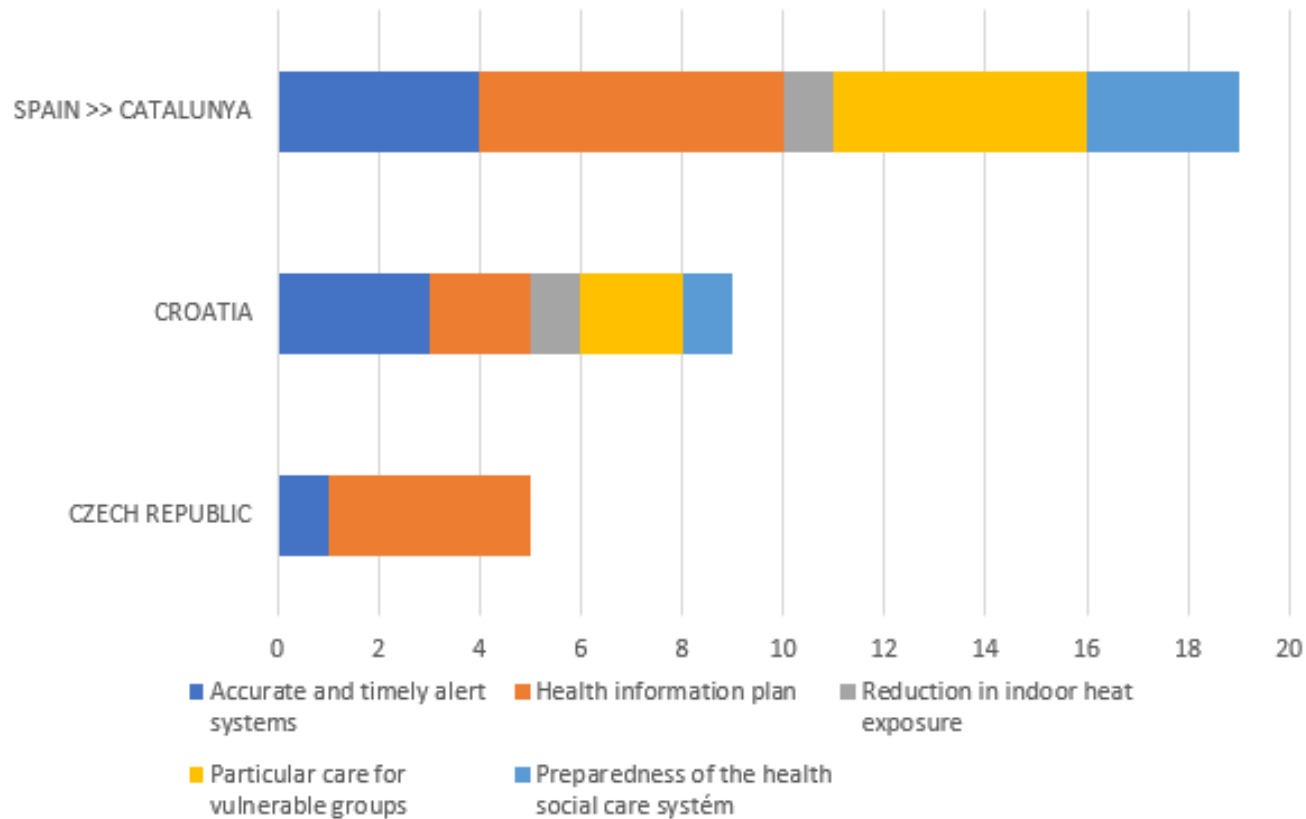
2.2 HHAP/HEWS

- Different year of implementation and different degree of sophistication

COUNTRY	N LOCATIONS	1969	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
Denmark	?															1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Estonia	4 cities and 1 region									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Finland	1 metropolitan area						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1		
Norway	1 city	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Sweden	3 cities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	
UK	10 cities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Czech Republic	3 cities						0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Moldova	4 cities													0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Romania	8 cities						0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Hungary	?													2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Poland	?												1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Serbia	?																			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Slovakia	?																								1	1	1	1	1	1	1	1	1	1	1
Belgium	1 city?																3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
France	18 cities												0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Germany	12 cities				0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
The Netherlands	5 regions						0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Switzerland	8 cities						0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Greece	1 city													0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Italy*	6 cities													0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Portugal	5 districts		0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Spain	12 cities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

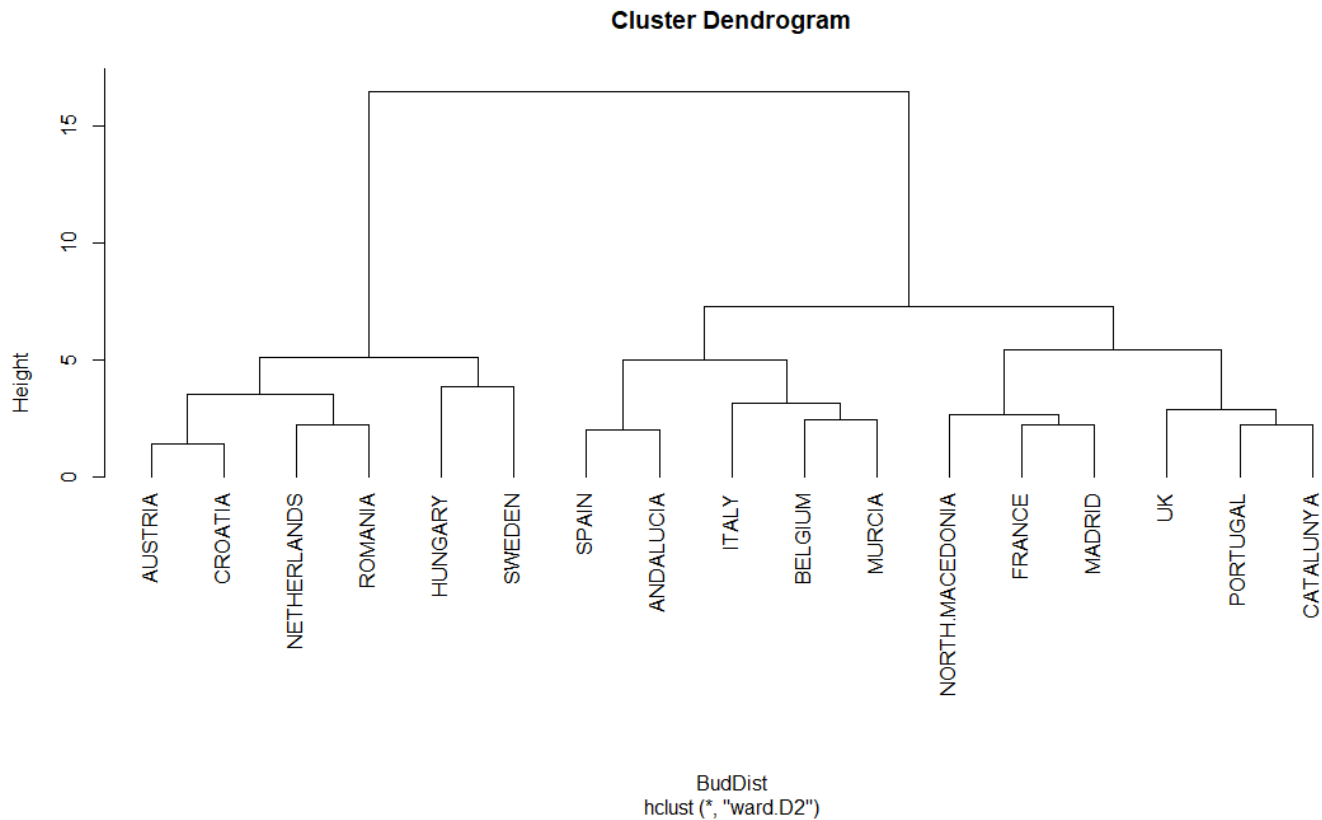
2.2 HHAP/HEWS

- Different year of implementation and different degree of sophistication



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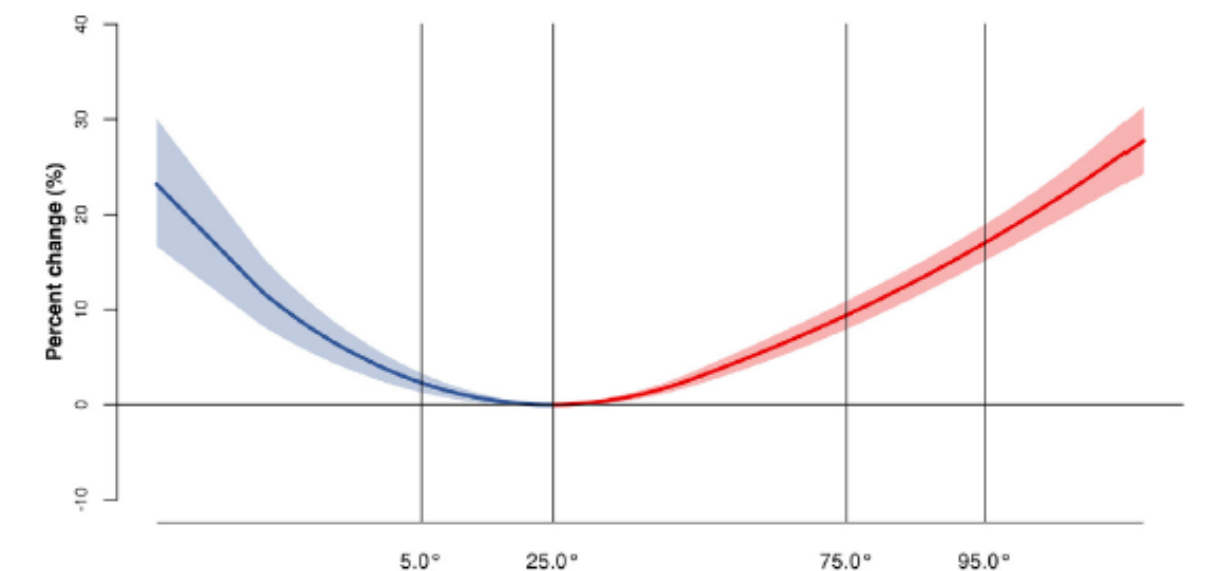


2. Planned research and work in progress

1. Investigate impacts accounting for **occupational diversity** (LABPROD)
2. Analyse the impact of EU Member State **policies** against excessive heat
 - Heat-Health Adaptation Plans (**HHAP**)
 - Heatwave Early Warning Systems (**HEWS**)
3. Extreme heat (and cold) have been linked to an increased risk of **occupational injuries** (Martínez-Solanas et al., 2018; Marinaccio et al., 2019)

2.3 Occupational Injuries

- Relative Risk of getting injured for various occupations, regional-level
- Occupational injuries temporary decrease labour force
- Mechanism acting on top of labour productivity impacts



Marinaccio et al. (Env Int)

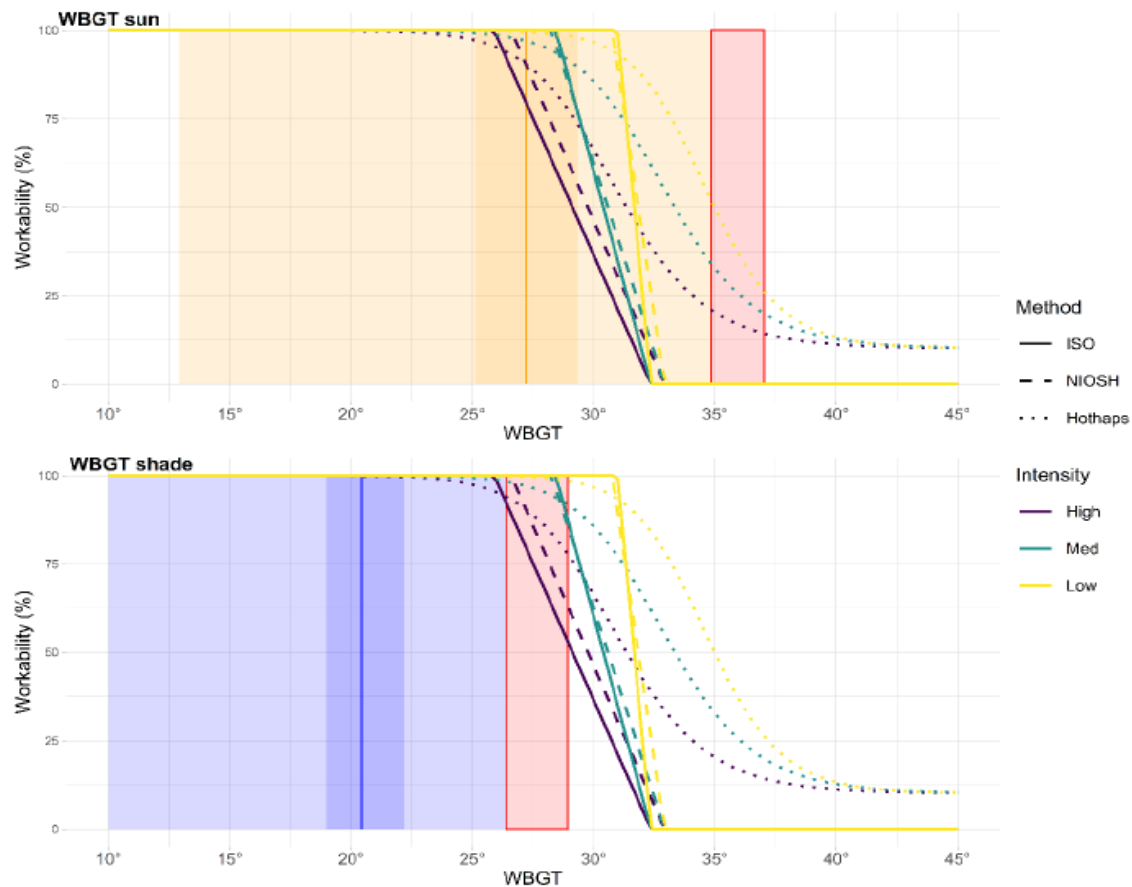
3. What we wish to know

3. Research gaps and avenues for future research

1. **Exposure-Response (E-R) function:** more precise (evidence-based) calibration

3.1 E-R precise calibration

- ISO/NIOSH (safety), Hothaps (empirical) not to be mixed.
- The first lower productivity more



3. Research gaps and avenues for future research

1. **Exposure-Response (E-R) function**: more precise (evidence-based) calibration
2. Impacts on **vulnerable groups**
 - Extended health impacts: mortality (Pradhan et al., 2019)
3. **Adaptation**:
 - Technological: Mechanisation/Robotisation (e.g. exo-skeletons, Szewczyk et al., 2021)
 - Regulatory: Shifting working hours, breaks (Takakura et al., 2017,2021)
 - Behavioural: Migration
4. Role of **sleep quality** (Lyons et al., 2022) and **tropical nights**

Thank you



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