2008 CTCI Foundation
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Mitigation and Adaptation to Climate Change
11 November 2008

ADAM
Adaptation and Mitigation Strategies: Supporting European Climate Policy

Adaptation in the EU:
Research Implications for Policy Makers

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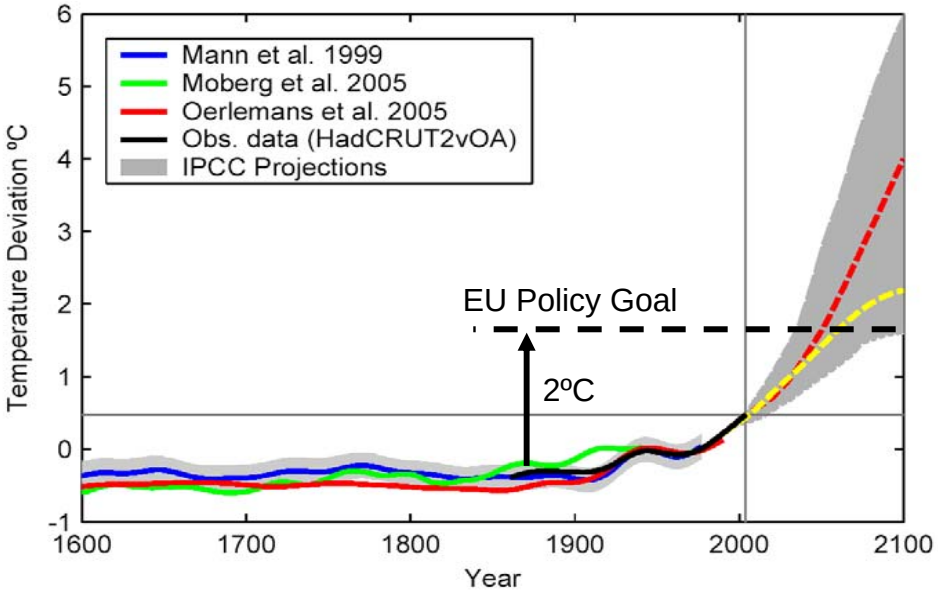
ADAM in Numbers

- 3 years lifetime
- 13m € funding
- 26 partner institutes from 15 countries
  (NL 5, DE 3, UK 3, CH 2, FR 2, IT 2, SE 2, AT, BE, ES, HU, NO, PL, CN, IN)
- 120 researchers
- www.adamproject.eu

ADAM Objectives

- **To assess whether existing mitigation and adaptation policies can achieve a tolerable transition to a world with a global climate no warmer than 2°C above pre-industrial levels;**
- **To develop and appraise a portfolio of policy options that could address shortfalls of existing adaptation and mitigation policies;**
- **To develop a novel Policy Appraisal Framework based on the appraisal of existing and evolving climate policy options and case studies.**

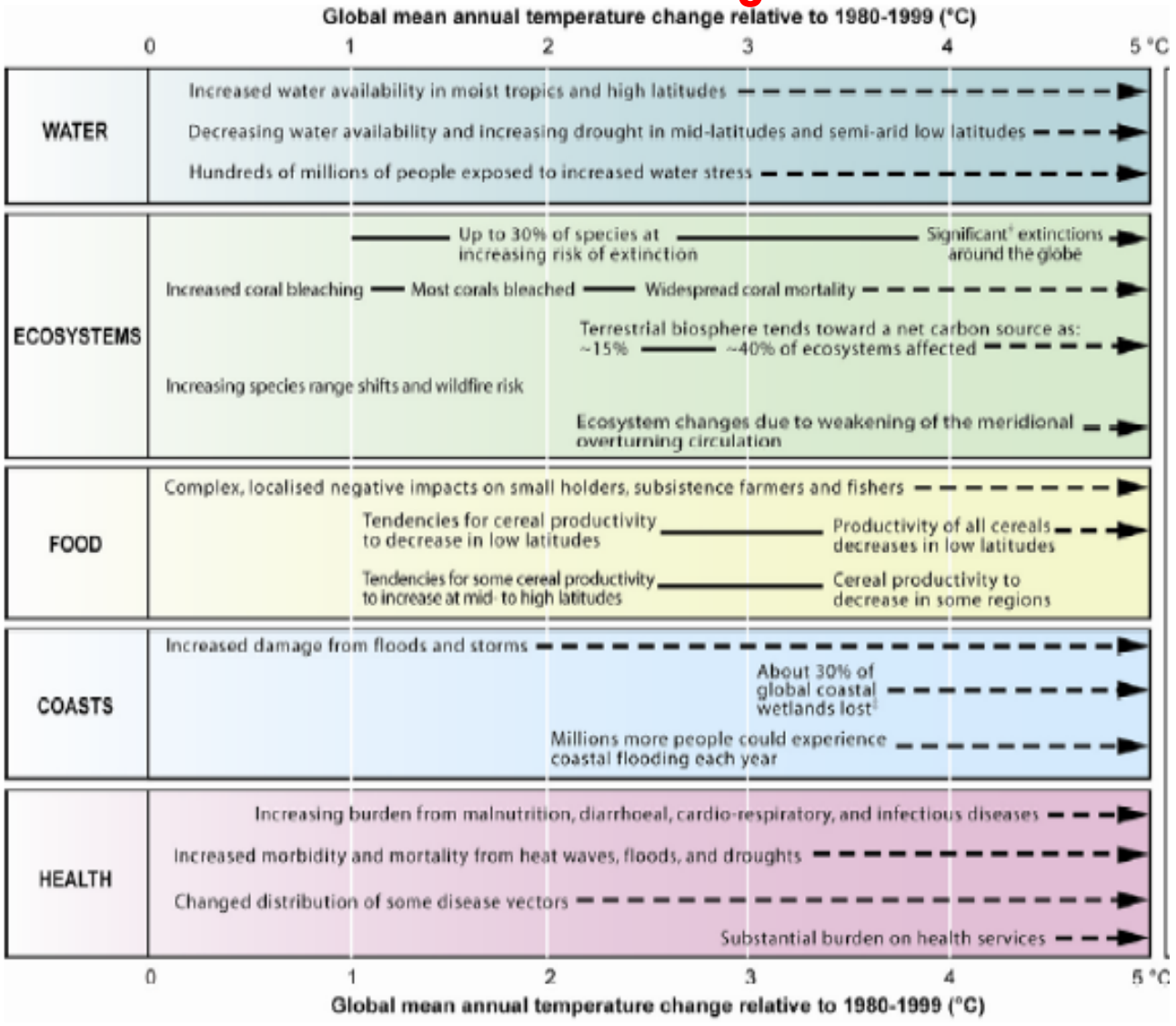
Avoiding the Unmanageable, Managing the Unavoidable



ADAM Work Domains

• Scenarios	Developing framing scenarios that guide the ADAM analyses
• Policy Appraisal	Analytical and deliberative appraisal of climate change policy options
• Adaptation	Analysis of impacts, vulnerabilities and adaptation options; coping with extremes
• Mitigation	Analysis of mitigation policy options; globally and for the EU
• Case Studies	•Post 2012 climate governance •International development assistance •EU electricity •Regional cases (Tisza, Guadiana, Inner Mongolia

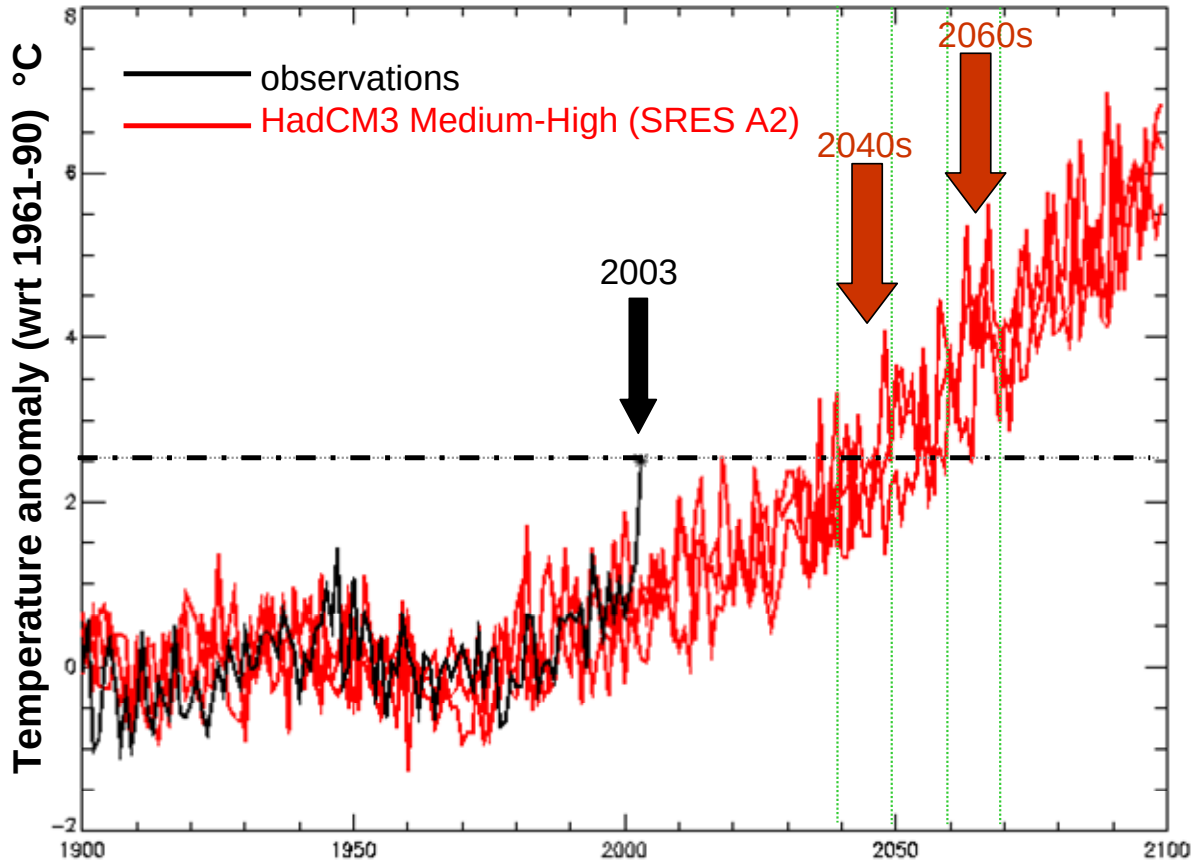
Climate change will affect us all …



(Source: IPCC AR4 WG2, 2007)

… so we will adapt to climate change

- **Changing means, variability and extreme events**
- **Direct and indirect signals of adaptation**
- **Single events and the accumulation of conditions**



Climate influences on social and ecological systems are many-faceted

Coping ranges are context-specific and variable (adaptation space)

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What is adaptation?

"*Adjustment in natural and human systems in response to actual or expected climatic stimuli or their effects, which moderates harms or exploits beneficial opportunities*" [IPCC, 2001]

- Adaptation can:
  - **be anticipatory or reactive (probably mostly reactive)**
  - **autonomous or policy driven (probably mostly autonomous)**
  - **focus on managing the impacts of the climate-related hazard, or reducing the vulnerability of elements at risk**
  - **involve a range of actors throughout society from Governments down to individuals**
  - **manifest itself in many forms**

- Distinguishing between process (building adaptive capacity) and outcome (delivery of adaptation measures) can be useful to operationalize the concept

- Relative to non-climate change decisions of similar type, adaptation poses no unusual cognitive, organizational or political problems (e.g. externalities, long time lags, principal agent, lock in)

Differences between adaptation and mitigation

	Adaptation	Mitigation
Scale	Local, hotspots	Global
Sectors	Agriculture, forestry, water, health, building and infrastructure, ecosystem preservation, energy, tourism, insurance	Energy, transport, agriculture and forestry, industry
Timing	Action needed where long-term planning is involved	Urgent action needed now
Benefits	Perceived quickly	Perceived in >50yr

Uncertainties surrounding adaption

- Basic science of the climate system and the responses of biological and social systems
- Predictions of the future climate are sensitive to the current state of the climate system
- Scale and ambition of future climate policies
- How adaptation policies will work and how to increase adaptive capacity

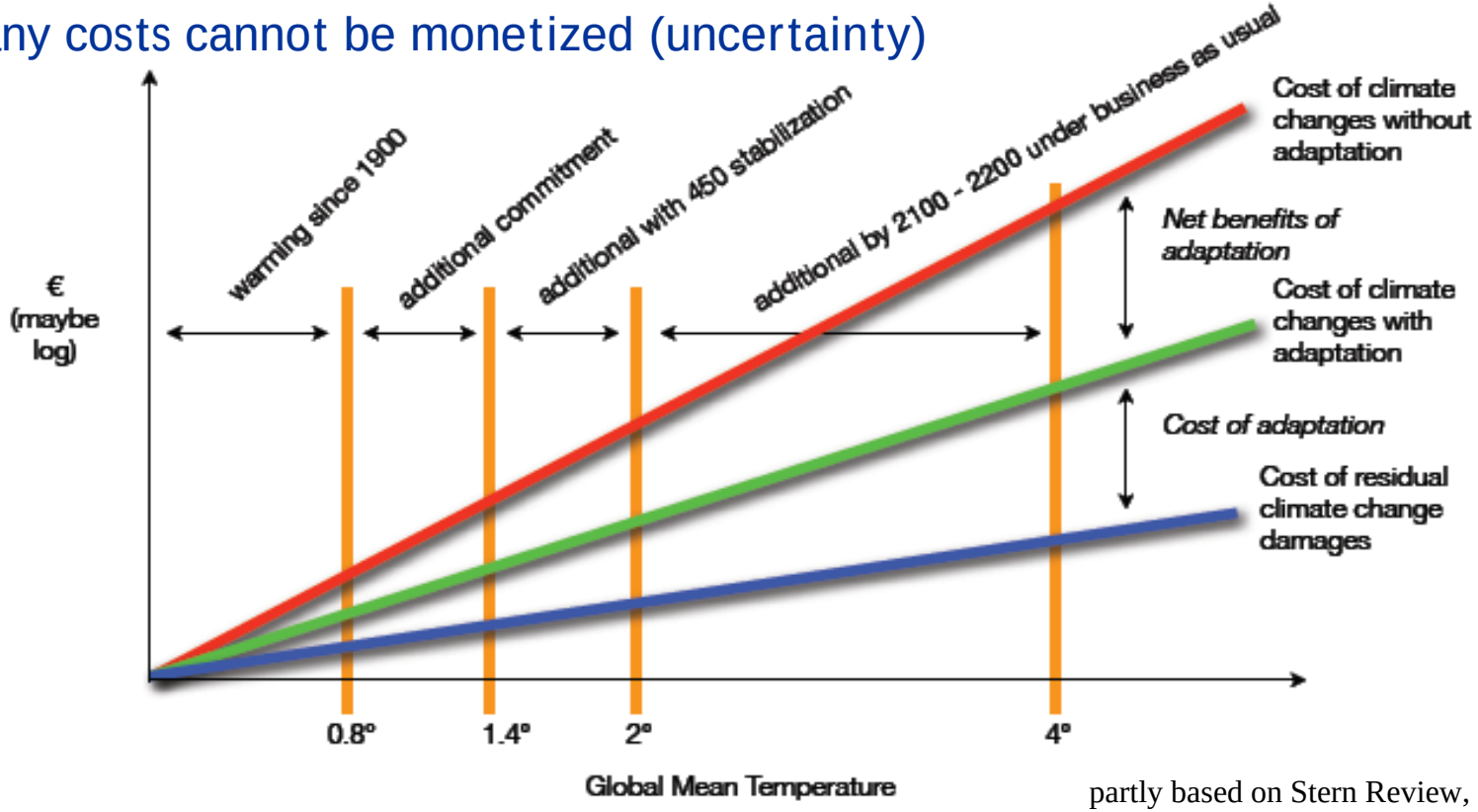
→ No good justification for delayed action (precautionary principle)

→ Effective adaptation measures are robust and flexible to allow for upscaling or downscaling when uncertainties are resolved

→ Flexibility is case specific and comes at different costs

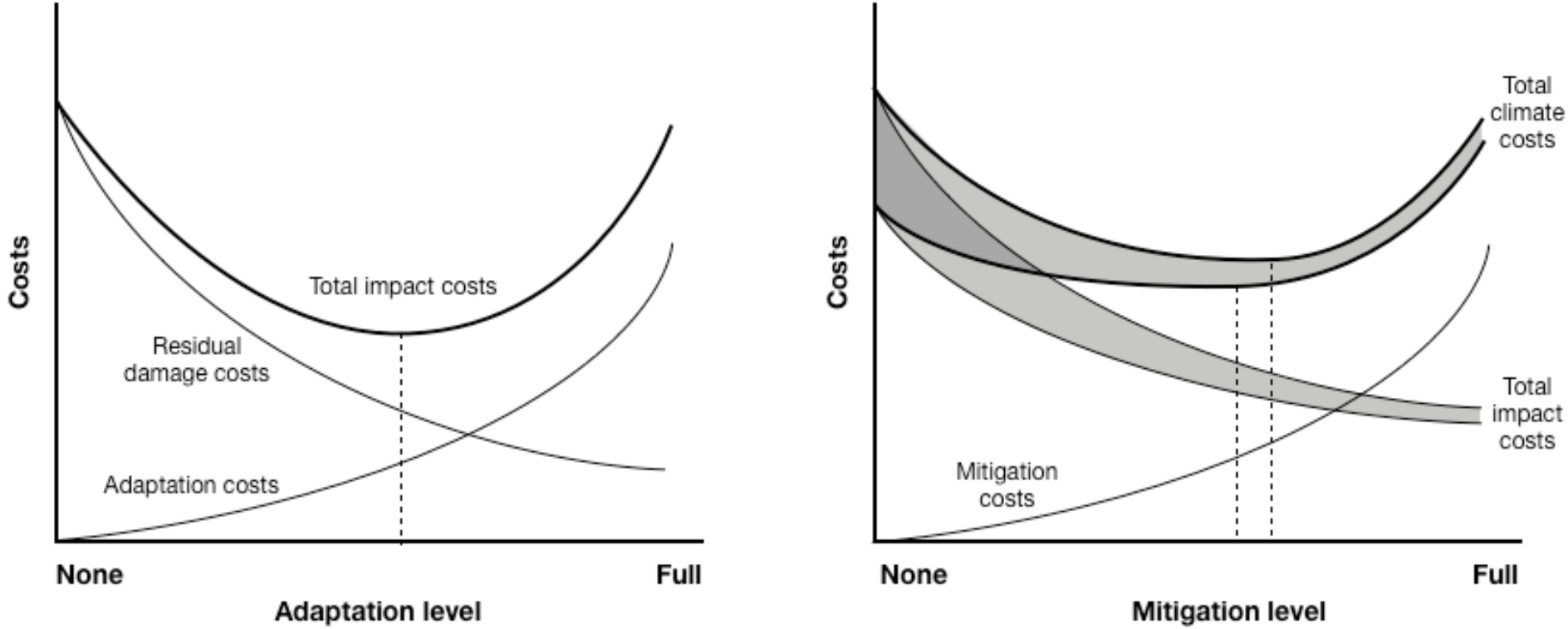
The costs and benefits of adaptation

- Adaptation is one way societies will experience the costs of climate change
- For the purposes of justifying mitigation, the costs of climate change are relevant. For the purposes of planning optimal adaptation, the net benefits are relevant.
- Many costs cannot be monetized (uncertainty)



partly based on Stern Review, 2006

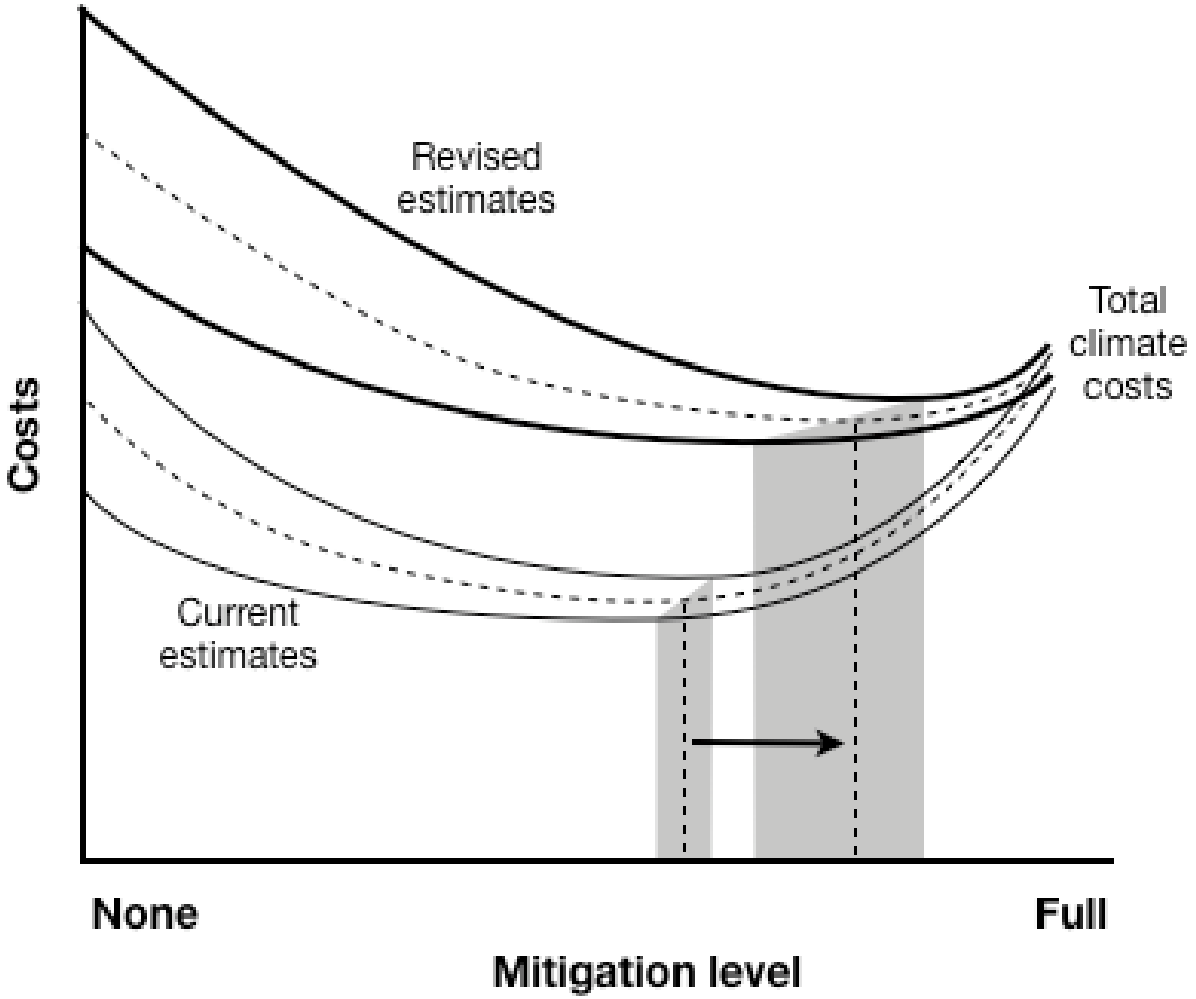
The costs and benefits of adaptation



Using the adaptation cost curve to identify optimal levels of adaptation and mitigation. For any level of warming, the optimal level of adaptation is that which minimizes the total impact costs, as shown on the left hand graph. The right hand graph then shows the range of total impact costs, and total climate costs, which is influenced by the level of adaptation. This in turn implies a range of optimal mitigation targets.

Source: Patt et al., submitted

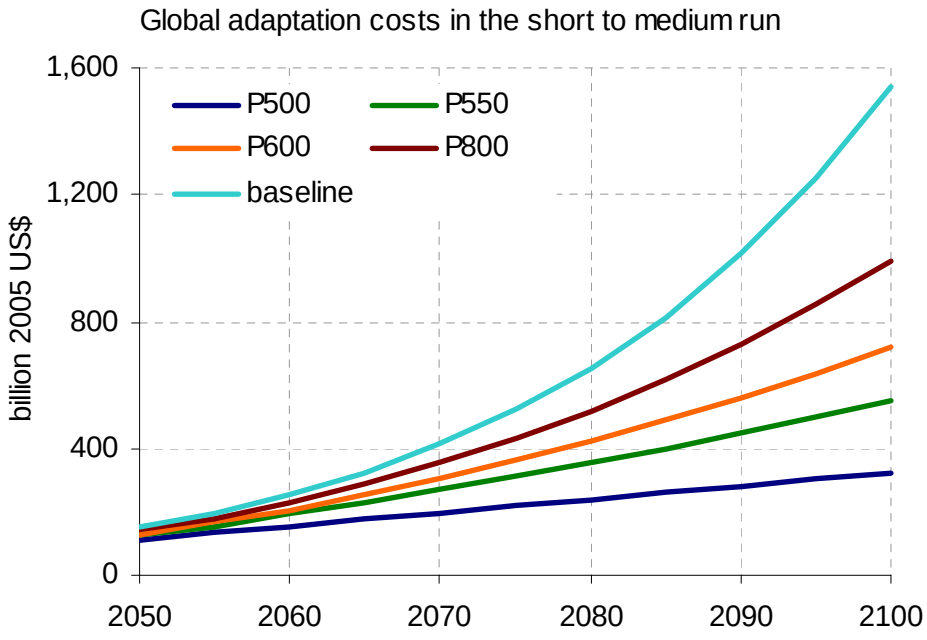
The costs and benefits of adaptation



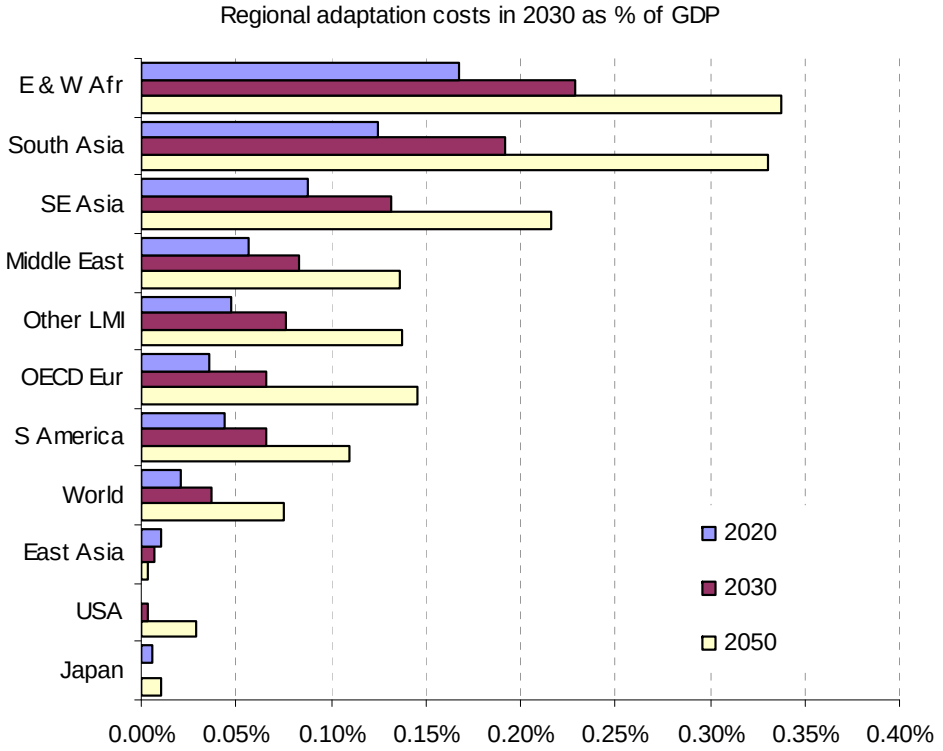
Sensitivity of mitigation target to adaptation and to different estimates of the magnitude of the entire climate problem. In this case, it becomes very important to estimate how much adaptation is actually possible, represented by the dashed lines, as this would suggest how the mitigation target ought to be changed.

Source: Patt et al., submitted

The costs and benefits of adaptation



Adaptation costs with concentration peak targets of 500, 550, 600 and 800 ppm CO_2-equivalent and without any mitigation efforts, from 2050 until 2100 according to a B2 baseline and a climate sensitivity of 3°C.



Adaptation costs as percentage of GDP for several world regions in B2 scenario with concentrations peaking at 550 ppm CO_2-equivalent.

Source: ADAM D-P3a, 2008

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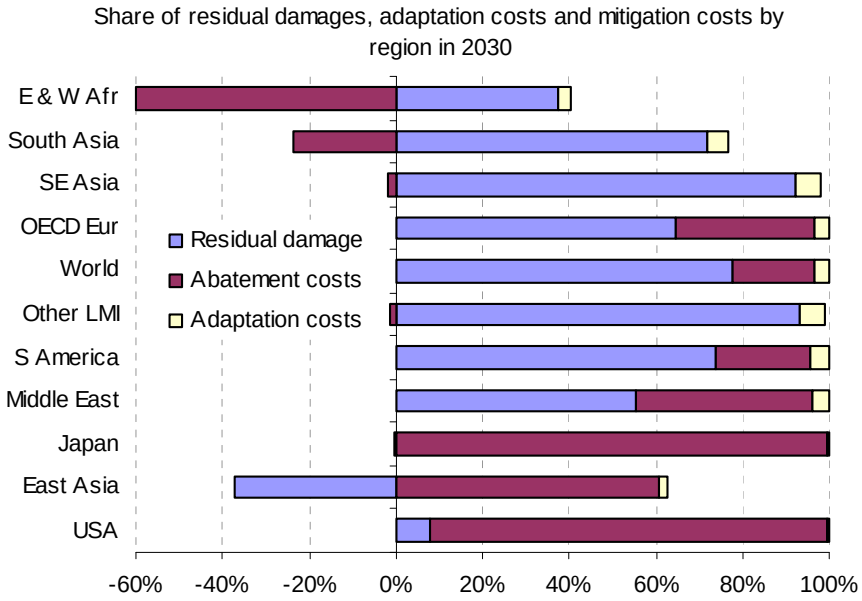
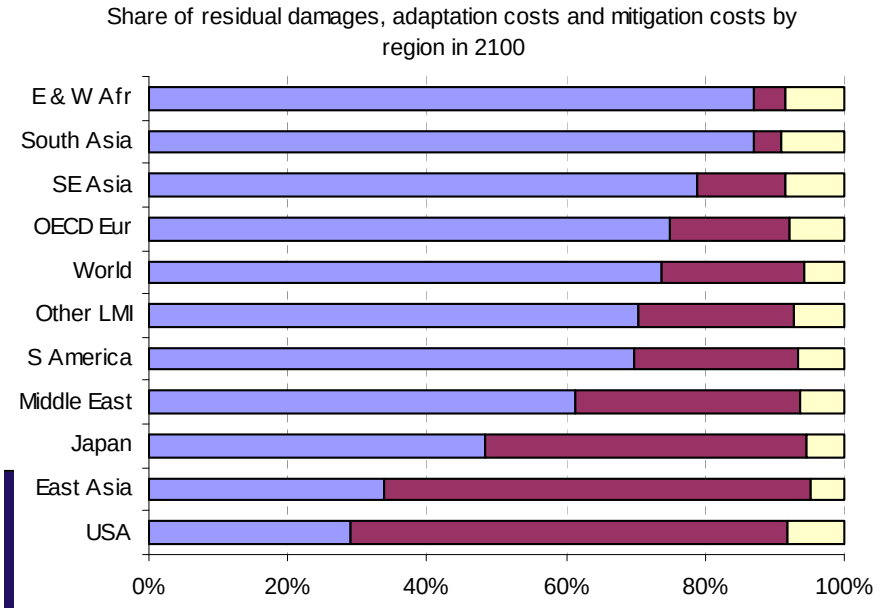
The costs and benefits of adaptation





Share of residual damages, adaptation costs, and mitigation costs in total costs for a 550 ppm CO_2-equivalent concentration peak scenario: 2030 (above) and 2100 (below).

Source: ADAM D-P3a, 2008

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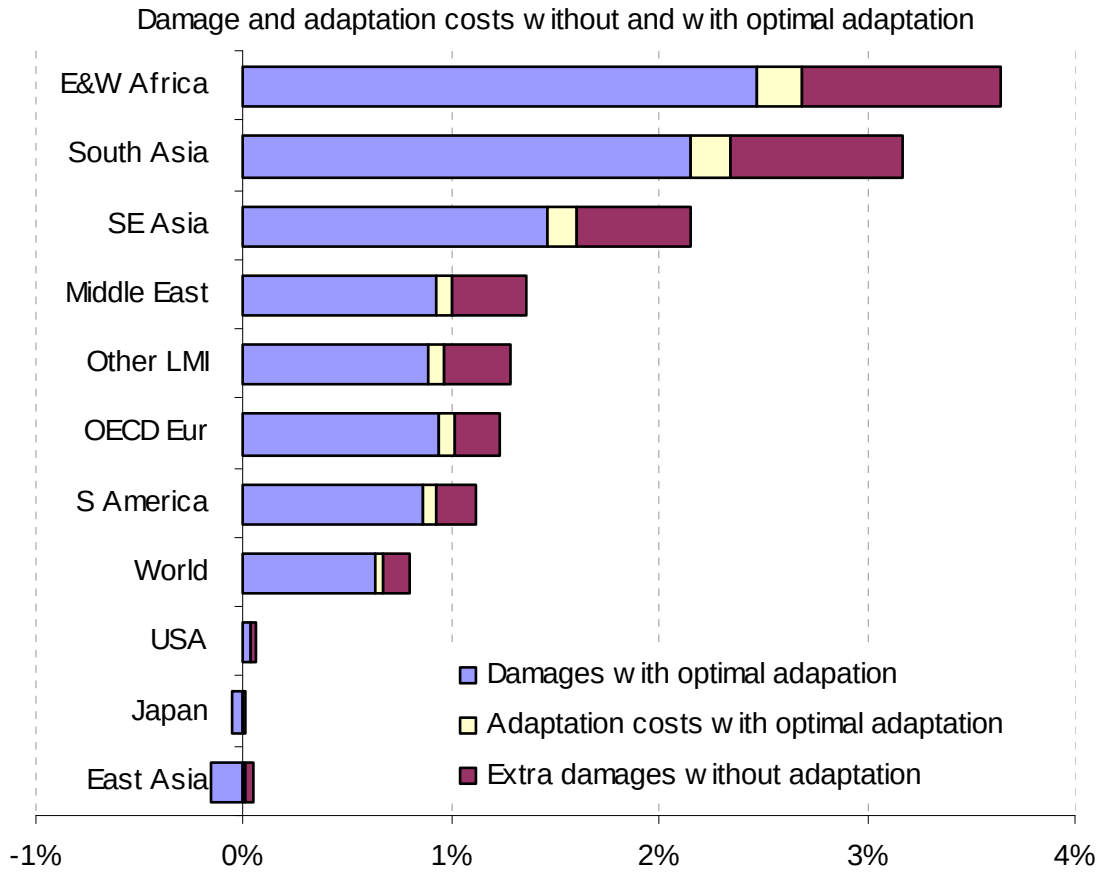
The costs and benefits of adaptation

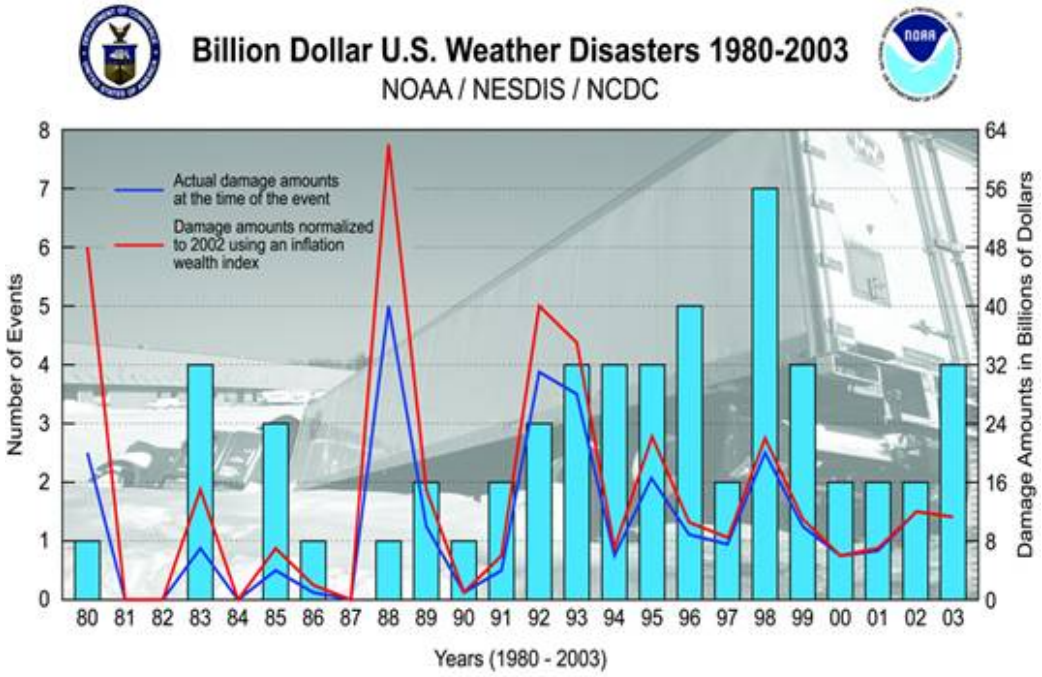


Residual damages as % of GDP by region in 2030 in a 550 ppm CO_2-equivalent concentration peak scenario with optimal adaptation vs. a 550 ppm CO_2-equivalent concentration peak scenario without any adaptation.

Source: ADAM D-P3a, 2008

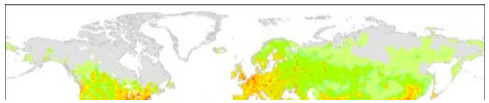
Extreme events

- Increasing evidence of rising economic losses due to extreme events
  - floods, drought, storms, sea surge
- Considerable rise of economic losses for projections of the future
- Knowledge gaps concerning assessment of monetary and wider socioeconomic risks to extreme events
  - map asset risks to flooding and drought in Europe with probabilistic approach
  - estimate economic vulnerabilities

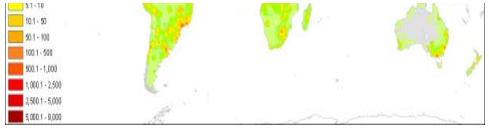


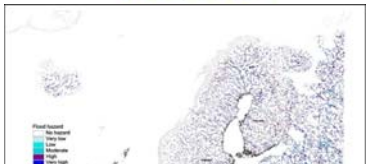
Risk triangle

- **Identify and assess drivers of risk and changes**



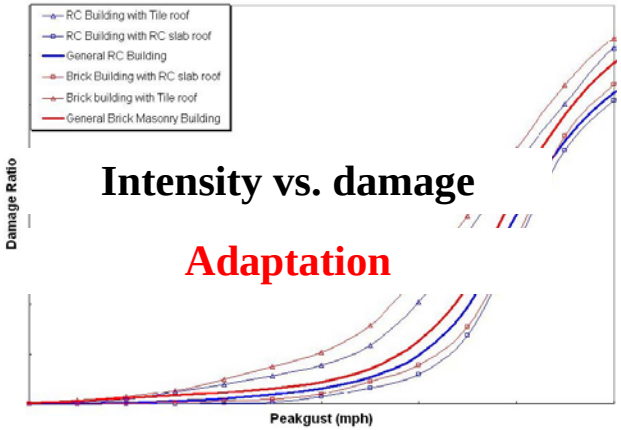
Exposure: population and capital stock exposed





Intensity and frequency

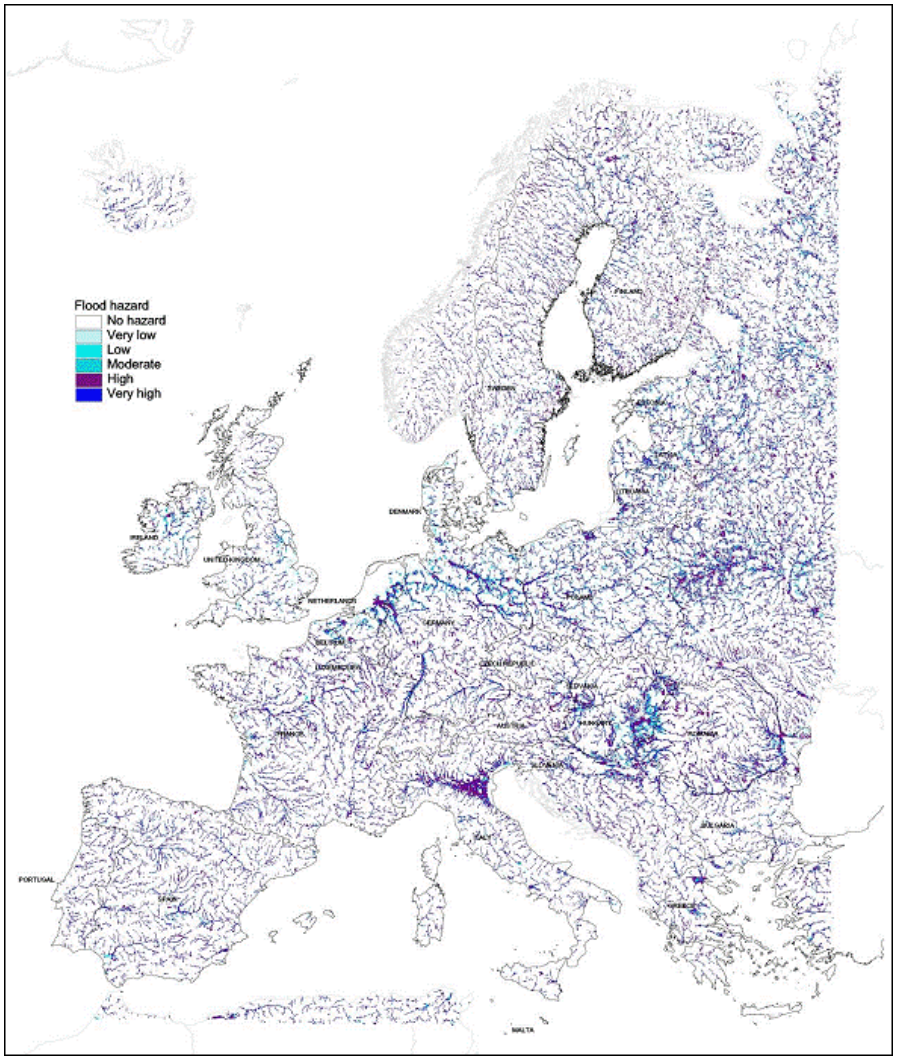
Climate change



Intensity vs. damage

Adaptation

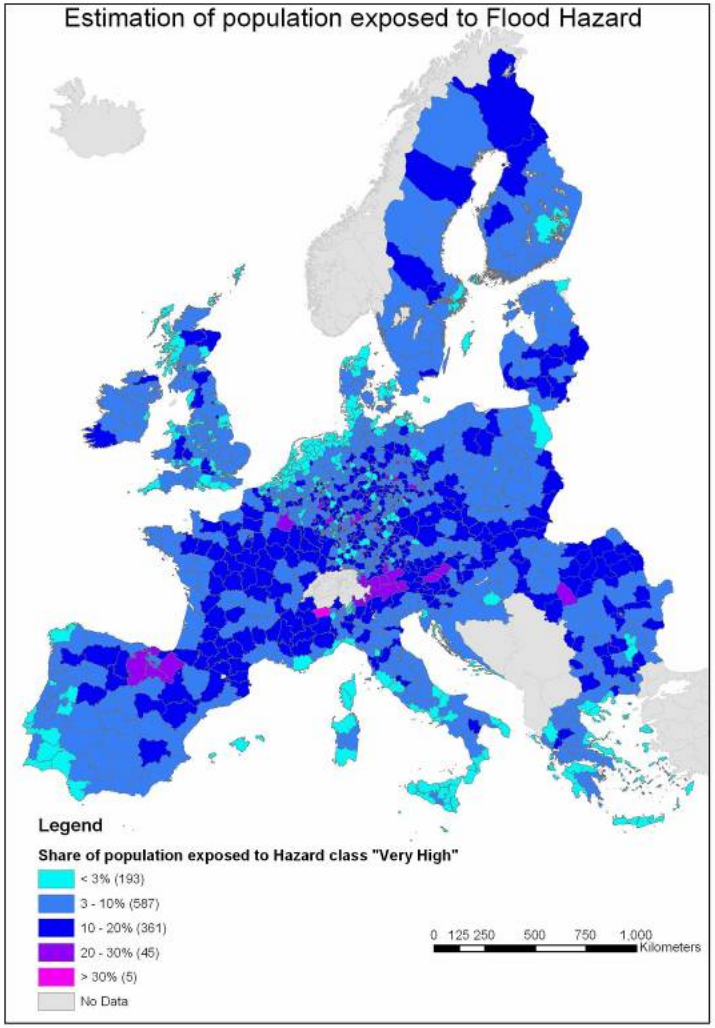
Floods: from hazard …



European Flood Hazard Map

Source: JRC, 2007

via exposure and vulnerability…

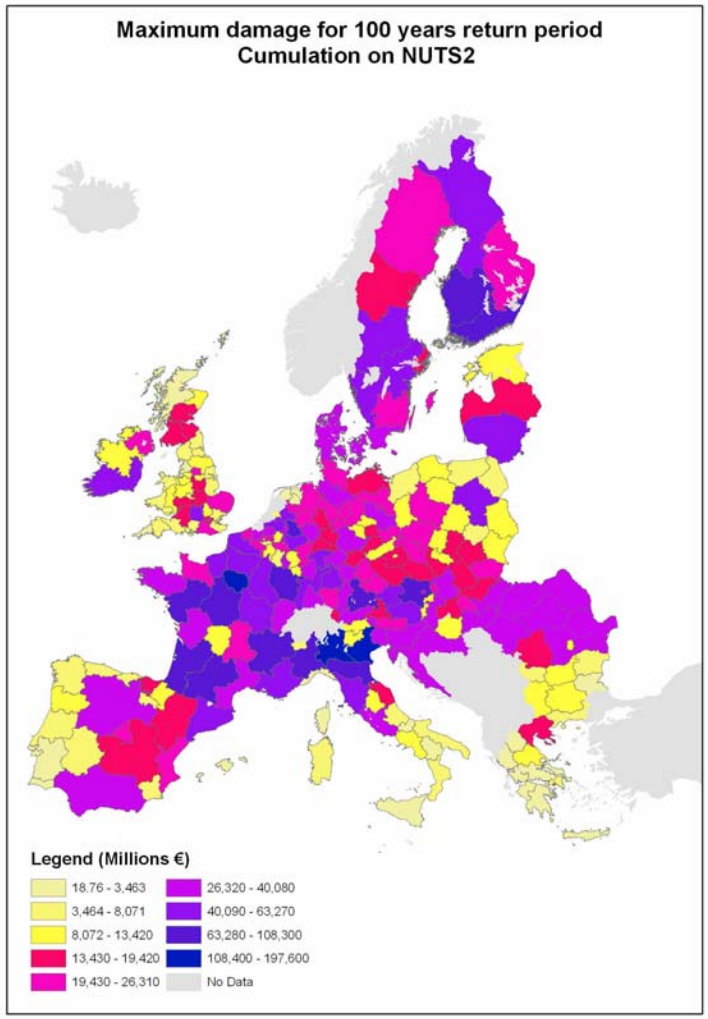


Population exposed to floods

Source: JRC, 2008

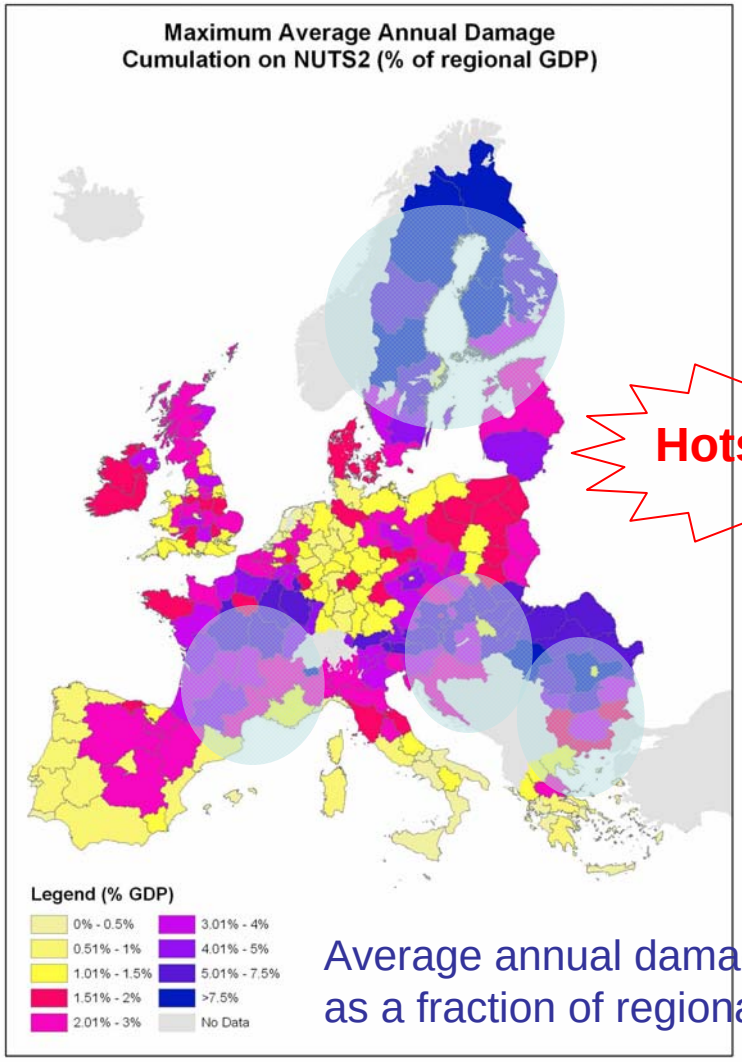
to risk: asset losses in monetary terms

Damages for 100 year flood events



Source: JRC, 2008

Risk hotspots



Average annual damage
as a fraction of regional GDP

Hotspots?

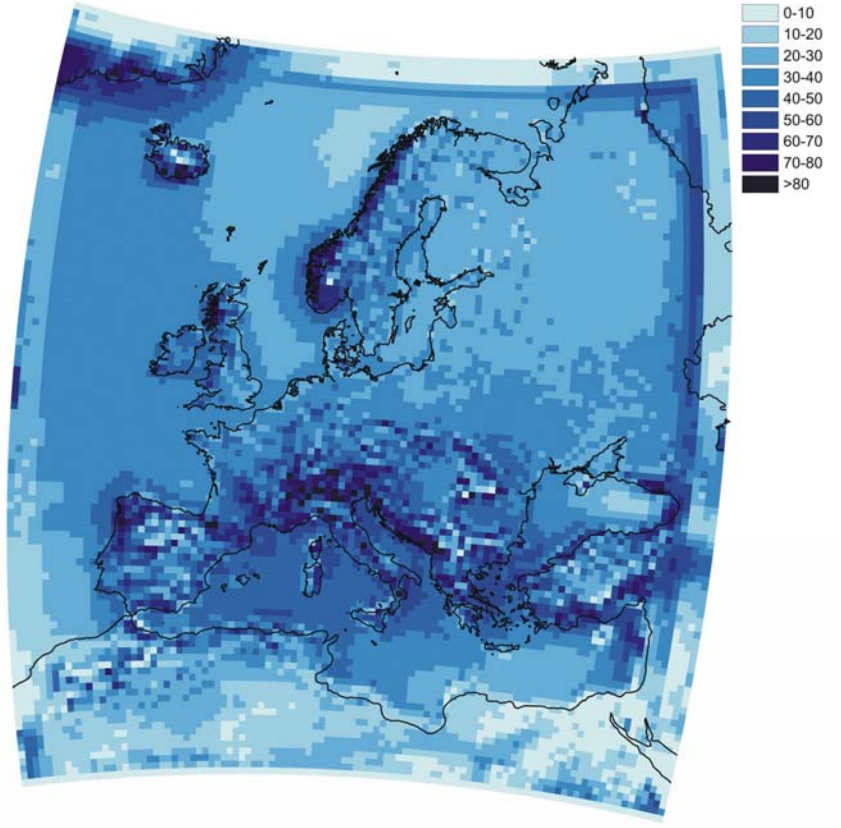
In 50 European NUTS-3 regions (i.e. provinces) the share of population potentially exposed to high flood risk is above 20%;

Almost all of the 12 newcomers to the EU with potential average annual damage due to floods higher than 1% of GDP

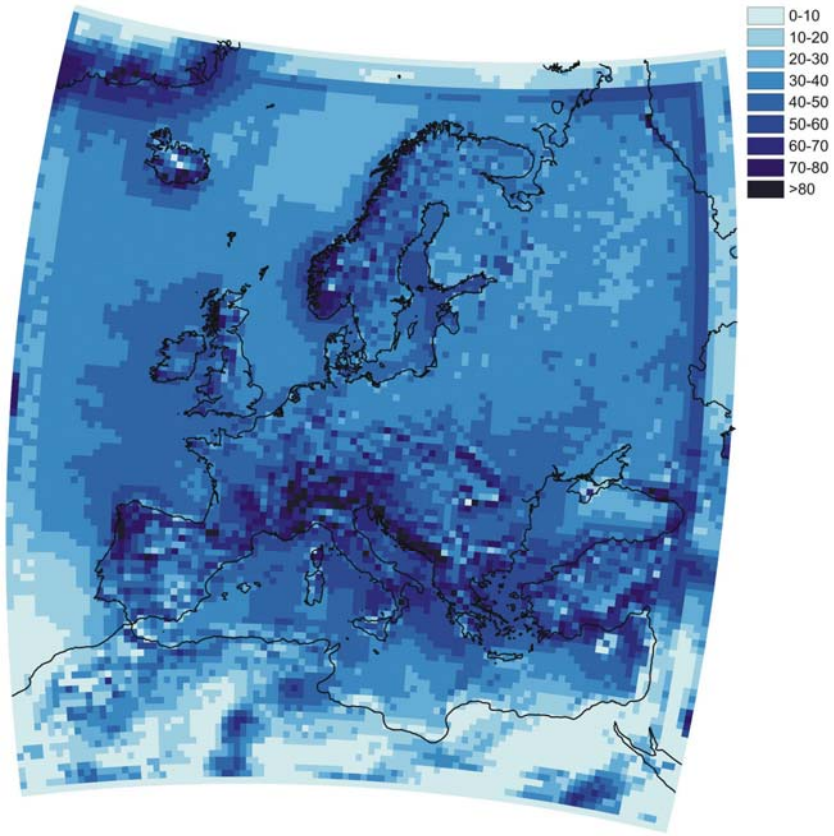
Source: JRC, 2008

Changes in hazard: heavy precipitation

Percentage share of heavy precipitation in total **annual** precipitation



Period 1961-1990



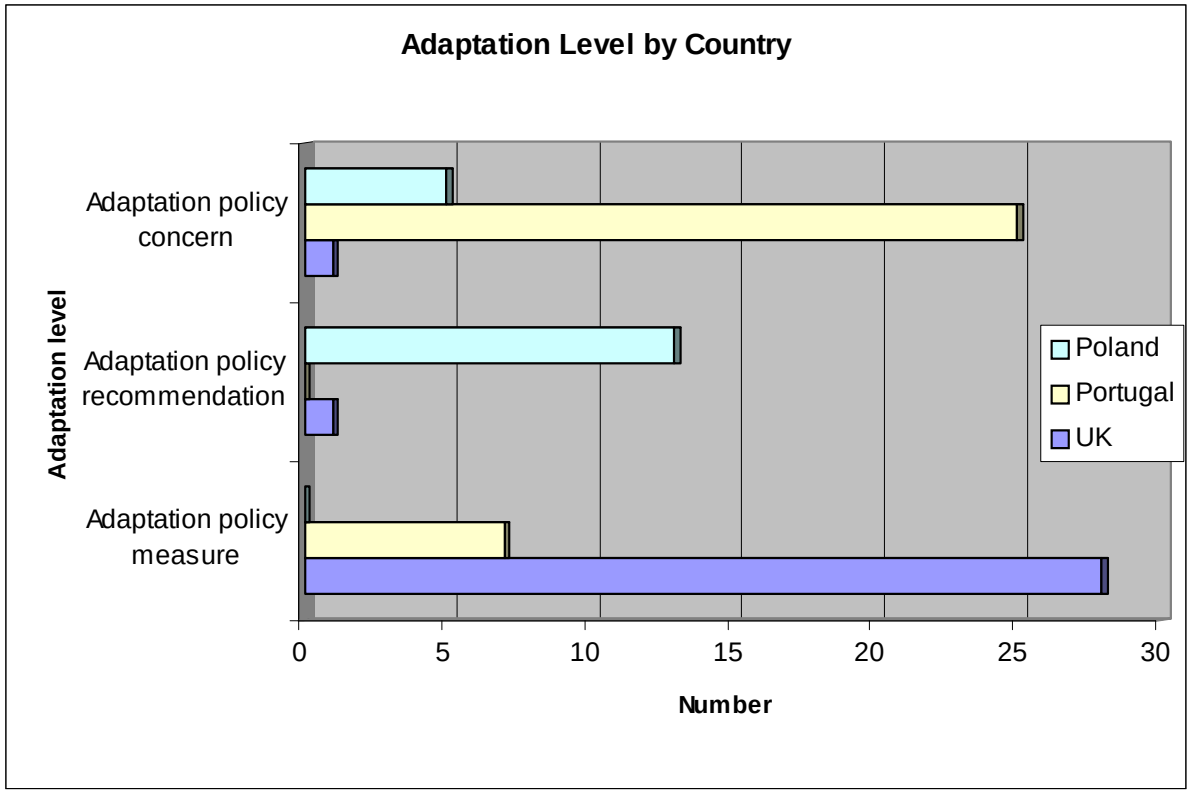
Projection for the 2090s (SRES A2 scenario)

Source: Kundezewicz et al., 2007

Analysis of the economics of adaptation

- Impacts of CC will be reduced by adaptation
  - primarily through autonomous (private) responses
  - major challenges are with planned (public) action
  - distinguish between direct and indirect effects (e.g. knock-on effects)
- Adaptive capacity of agents increases with both flexibility and economic growth
  - small and remote communities are more vulnerable because of restrictions of economic diversification and endowments
  - commodities and services dependent on natural resources are particularly vulnerable (agriculture, forestry, fisheries, transport, tourism)
- Adaptation is more difficult for extreme events
- Early anticipatory adaptation may be more cost-effective than reactive adaptation
- Transaction costs need to be accounted for
  - information deficit, set up policy, enforcement, public resistance
- Important to define what to adapt to → policy
  - mal-adaptation (ineffective, inefficient, lock-in, transfer vulnerability)
  - example: Norfolk sea-level rise

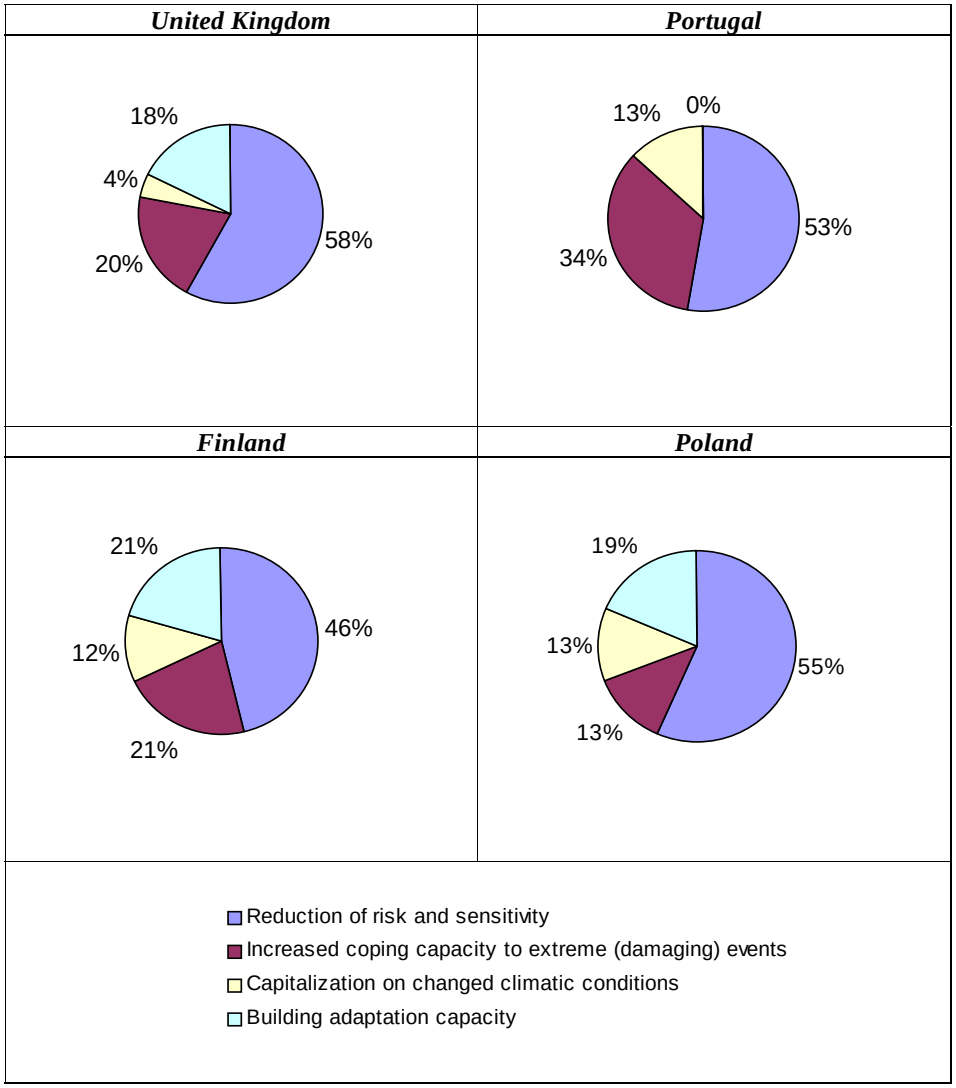
Adaptation: much policy experimentation



- **UK has the most implemented measures**
- **Portugal has some measures implemented plus a wide range of concerns**
- **Poland at lower "level" with only recommendations and concerns**
- **Finland not included- some 150 policy recommendations**

ADAM Climate Policy Inventory

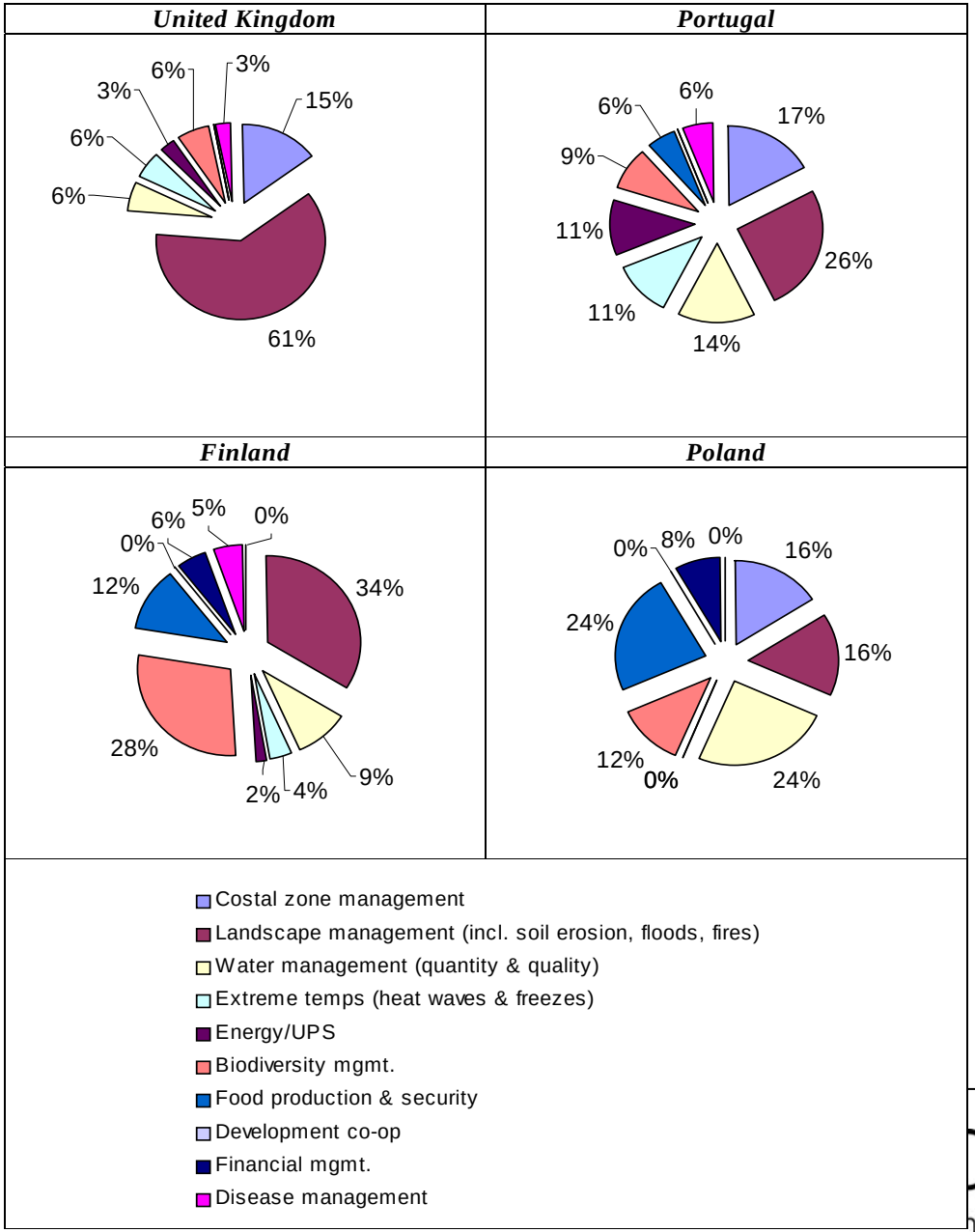
Adaptation objective



- All countries predominantly oriented towards reduction of risk and to a lesser extent extreme events
- Some recognition that benefits can flow from CC
- For 3 countries the notion of building adaptive capacity (i.e. communicating information) for adaptation to the public also appears important

ADAM Climate Policy Inventory

Adaptation sectors



- Adaptation sectors differ between countries
- UK heavily focused on landscape management (flooding)
- Finland apart from landscape has biodiversity (reindeer)
- Portugal & Poland fairly even spread
- No country addresses all 10 issues
- No country has development cooperation as part of their portfolio

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Key problems for adapting agents

- **Awareness of climate vulnerability**
  - **Uncertainty about climate impacts (broad and specific)**
  - **Signals are weak or ambiguous**
- **Uncertainty about adaptation strategies**
  - **Link between vulnerability and adaptation unclear**
  - **(Private) costs and benefits of adaptation hard to determine**
- **Constraints on adaptation**
  - **There may be institutional, economic or other constraints to adaptive behavior**

Public aspects of adaptation

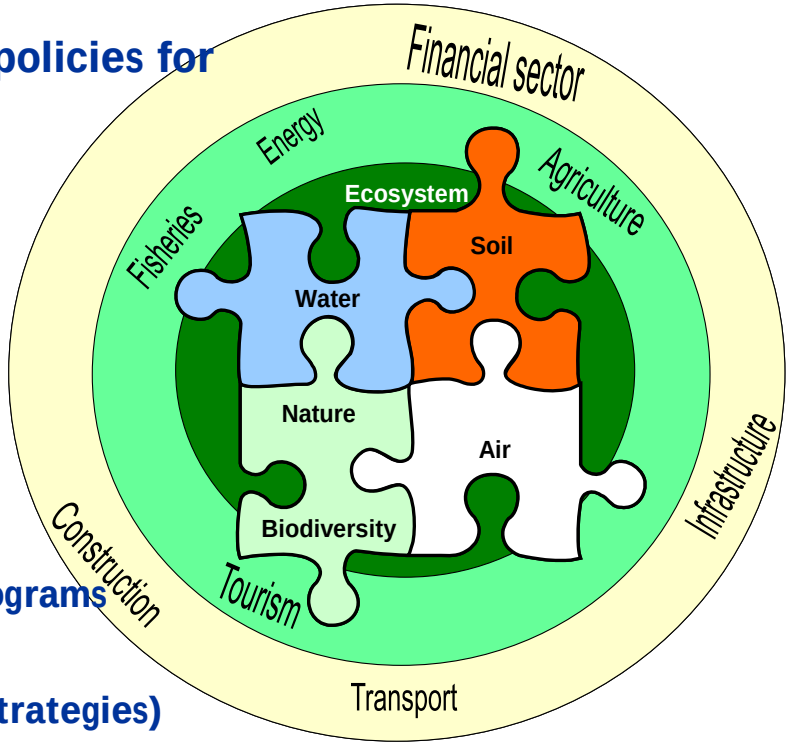
- **Role of the market in adaptation**
  - **Efficient adaptation (benefits > costs)**
  - **Differing role in traded, public or mixed goods**
- **Adaptation spillovers**
  - **There may be collective benefits to adaptation**
- **Distributional impacts of adaptation**
  - **Risk tends to flow towards the most vulnerable**
- **Unequal distribution of climate impacts**
  - **Liability for extra-EU damages**

7 Roles for policy in adaptation

- **Information, knowledge and learning**
  - **dissemination**
  - **research**
- **Early-warning, pro-active disaster management and disaster relief**
- **Facilitating adaptation**
  - **increase transparency, remove market distortions and barriers**
  - **invest in technology and incentives**
- **Mainstreaming and climate-proofing**
  - **for sectors with public good characters (e.g. nature conservation, water)**
- **Infrastructure planning and development**
  - **water, transport and energy infrastructure, settlements and spatial planning (e.g. building standards)**
- **Regulating adaptation spillovers**
- **Compensating for unequal distribution of climate impacts**
  - **ensure equitable distribution of burdens**
  - **define limits of compensation**

EU Adaptation Green Paper: Four Pillars of Action

- **Early action in the EU: mainstream and develop CC policies for relevant sectors**
  - agriculture, forestry + fisheries
  - water,
  - health
  - industry + services
  - energy,
  - ecosystems + biodiversity,
  - transport,
  - infrastructure,
  - cross-cutting + integration into Communtiy funding programs
- **Integrating adaptation into EU external actions**
  - different approach between DCs (e.g. MDGs) and ICs (strategies)
  - act through UNFCCC (e.g. NAPAs, Adaptation Fund) and European Neibourhood Policy
- **Expanding knowledge base through integrated climate research**
- **Involving EU society, business and public sector**



EU Adaptation Green Paper

- Multi-level approach
  - local to regional scale
  - principle of subsidiarity
- Stakeholder involvement
  - learning
  - barriers to adaptation
- Well-covered issues
  - Early warning and disaster relief (allocated to national policies)
  - Mainstreaming in areas of EU competence and external policies
  - Infrastructure
  - Science: information, knowledge and learning
- Less prominent issues
  - Facilitating adaptation in the market
  - Regulating spillovers and distributional consequences
  - Compensating unequal distribution of impacts
- Lack of understanding how to organise a consistent EU adaptation policy
- White Paper on Adaptation: early 2009

An actor based approach on adaptation and mainstreaming

- **Objective**
  - analyse institutional adaptive management and capacity
  - better understanding of barriers to adaptation
  - identify processes that allow best practice to occur
- **An actor based approach provides bottom-up input to**
  - determinants of adaptive capacity
  - the mechanisms necessary for delivering adaptation
- **Method**
  - several learning cycles: define research questions → plan stakeholder engagement process → engage with stakeholders → reflect on responses → new/better research questions → …
- **Stakeholder engagement through interviews, questionnaires and workshops**

Source: McEvoy et al. , 2007

ADAM learning examples

- Tourism (Guadiana basin in Spain and Portugal)
- Health / heat stress
- Urban planning and design (London, Manchester, Berlin)
- Insurance and investment banking
- Water scarcity (Guadiana and Southeast England)
- Flooding (Tisza basin in Hungary)
- Desertification (Inner Mongolia)

The main goal is to understand how successful adaptation is managed by different organisations and within different institutional settings

Source: McEvoy et al. , 2007

Early lessons learnt from interviews

- **CC is no longer questioned across sectors**
  - perception of risk defines response (insurance vs. 'traditional' sectors)
- **Access to information and best practice is key**
  - risk assessment tools
  - authoritative guidance tailored to needs (due to information overload)
  - potential adaptation options (and their costs and benefits)
  - databases and knowledge-transfer platforms (e.g. UKCIP)
- **Dealing with uncertainty**
  - robust and flexible solutions
  - lack of knowledge how to climate proof operations
- **Little action despite awareness of climate risks**
  - missing clear benefits
  - legal or political barriers
- **Learning to adapt and knowledge transfer**
  - cross-sectoral collaboration
  - other contexts (practitioners can provide valuable information)
  - closer interaction between policy makers, stakeholders and academia
  - training events

Source: McEvoy et al. , 2007

Early lessons learnt from interviews

- **Getting 'buy-in' to implement adaptation strategies**
  - support from key decision-makers
  - change of perspective from environmental (marginal) to corporate (central) risk
  - start with 'low-cost' wins
  - external factors (e.g. extreme events, IPCC AR4)
- **Overcoming barriers to change**
  - in addition to: risk perception, inadequacy of information, uncertainty, knowledge transfer (see above)
  - public and private actors have different timescales
  - ownership and liability need to be defined
  - path dependencies and technological lock-ins
  - long-term planning horizons (e.g. strategic framework)
- **Using existing policy instruments to induce change**
  - incentives and rebates
  - standards and regulations

Source: McEvoy et al. , 2007

Implications for policy

- **An EU adaptation strategy**
  - should stimulate and incentivise proactive adaptation responses
  - should be flexible and robust
  - leads on areas that require supra-national action (e.g. cross-border river basins)
  - focuses on sectors with high EU regulation (agriculture, fisheries, water, biodiversity, health, transport, energy) and hot spots (arctic, coasts, urban)
  - influences the way in which MS deal with adaptation
  - enables adaptive action at the local level
- **Mainstreaming**
  - horizontal integration (across sectors) of climate change issues
  - emphasis on existing (sectoral) policies rather than independent adaptation policies
  - implement and modify existing EU legislation for external policies (ODA)
  - ensure regional compensation (e.g. structural funds, regional development fund)

Source: McEvoy et al. , 2007

Electricity sector policy implications: cooling

- The current estimates of the total and marginal economic costs of climate change (e.g. IAM) show electricity (cooling) is one of the key sectors
  - Cooling is a significant part of the global marginal social cost (t/CO_2)
  - Estimated at several billion/year for domestic sector in UK by 2070s (without carbon price)
  - Will be much more significant in warmer parts of Europe,
  - Mitigation linkages (increased GHG) under certain responses (air conditioning)
- Cooling is important as associated with mean temperature change, not extremes (though heat extremes may exacerbate)
  - Therefore much higher confidence of increased burden (high certainty)
  - Associated with annual increases (continuous) unlike extremes, cumulative damages
- Lessons from Europe have important implications globally
  - Space cooling is already a major concern in tropical and subtropical cities, and there will be significant changes with climate change
  - Spillover effects from European policy (e.g. adaptation) could be important

Electricity sector policy implications: extremes

- Modern economies are extremely dependent on reliable power supply (computers)
- Blackouts have extremely high economic and political costs
  - E.g. California 2001 - $16,000 for each undelivered MWh, $1 Billion per hour of outage
  - Autonomous response was for companies to install back-up generation *
- But there is a need for a balanced analysis of risks
  - California occurred because of infrastructure planning not climate
  - Wind damage is an existing issue, but prediction uncertain and modest (5% windstorms)
  - Plant/sub-stations not built in flood risk areas (electricity and water are not a good mix)
  - Sea level rise will be modest in lifetime of existing plant
  - Some issues for warmer regions (hydro, water abstraction for cooling)
- The policy response should be considered
  - Cost-effective and proportionate response, useful to consider cost-benefit analysis
  - Potential for mal-adaptation is high (inefficient, ineffective, reducing future options)
  - mainstream and include CC assessment into infrastructure planning

Electricity supply: Networks, energy and power

- Socio-economic scenario will influence vulnerability
  - In Europe, we are shifting to renewables (sustainable)
  - This in itself generates additional issues – e.g. intermittency from renewables
- For cooling, potentially greater supply implications for peak demand (not annual)
  - Differences between energy (kWh) and power (kW) – important because electricity cannot be stored (cheaply) so supply must meet demand
  - Change in the Mediterranean electricity peak to summer due to AC
  - Increasing summer peak, combined with heat extremes, potentially changes plant margins, extra plant on the system to meet peak summer or extremes (higher prices, for marginal at peak)
- Planned adaptation response might be to look at connectivity / storage
  - research, international cooperation

Electricity demand

- Forecasting of cooling demand include bottom-up (technology) and econometric, but our knowledge remains partial, and there is considerable uncertainty
- Driven by socio-economic (population, household density, income) and other factors
  - Behaviour (comfort levels) and information
  - Technology and efficiency
  - Building design and insulation levels
  - Penetration (which can be induced by extremes)
  - Electricity prices and wealth
- Cooling is not the only extra load on the system. Increased use of electricity for water (desalinisation, pumping), likely most important in same regions (e.g. Med) that seeing increased cooling demand
- Entirely new demands might arise, e.g. electrical cars

Electricity demand: adaptation

- Electrically powered cooling (AC) can be considered an impact or an adaptation – autonomous responses / private agents
- Role of agents and ownership. Construction companies might build in air conditioning to buildings as standard (see cars as an example). Subsequent users (individuals or organisations) have the additional costs of operation
- However, there are other adaptation choices
  - Passive or non mechanical ventilation, shading, design, spatial planning, insulation
  - Potential for adaptation could be significant, in US, potentially reducing projected increases in electricity demand by roughly one third for inland cities, and by as much as 95% for cooler coastal cities.
  - Therefore future cooling is only one socio-economic scenario, usually associated with a strong technology fix and largely autonomous response of individual / private agents – with emission consequences - but there are planned adaptation alternatives.

How effective are European climate policies? A meta-analysis of recent policy evaluations

- **High policy making activity: are they good enough?**
- **Lessons should be learnt from past and current climate policies**
- **Meta-analysis of 262 evaluations from the EU and 6 MS (Germany, UK, Finnland, Poland, Italy, Portugal)**

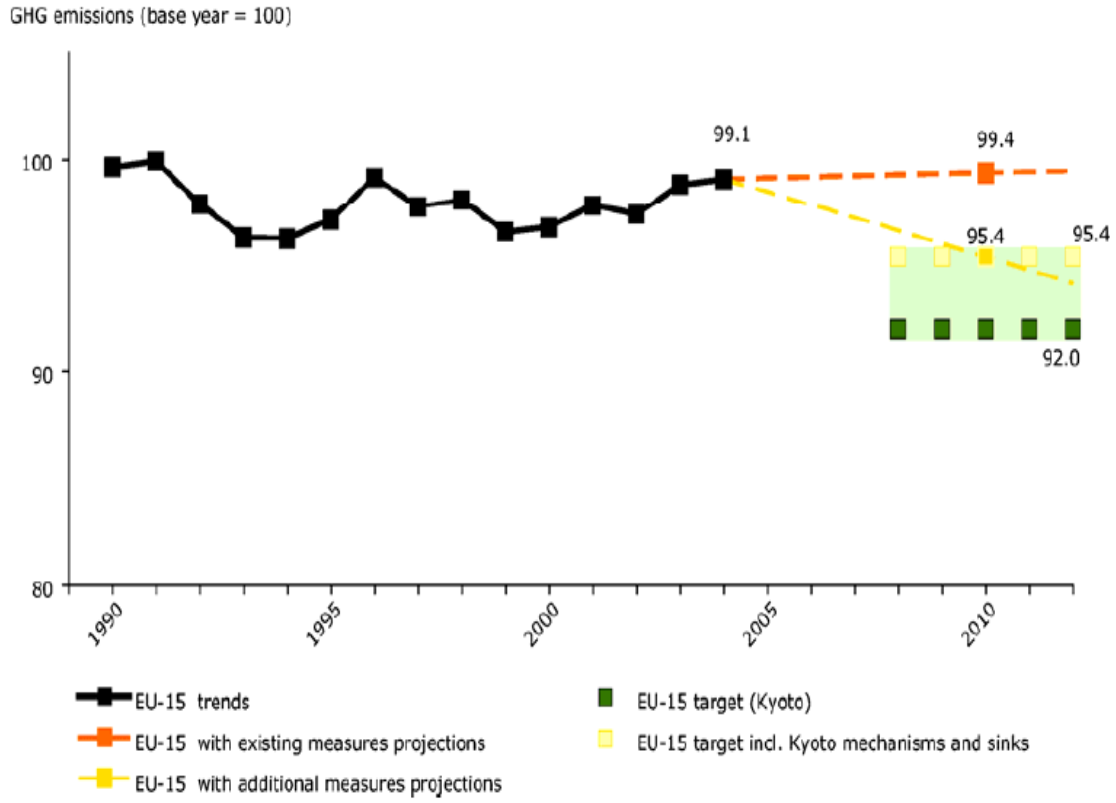


Figure 1. Actual and projected EU-15 greenhouse gas emissions compared with the Kyoto target for 2008-2012, including Kyoto mechanisms and carbon sinks (EEA, 2007).

Governance dilemmas

- **Problem perception and policy objectives**
  - **Which aspects of the policy problem should policy-makers tackle?**
- **Distribution of costs and benefits**
  - **Who should bear the costs?**
- **Level or scale at which to act**
  - **Which level of governance should policy-makers act at?**
- **Mix of governance modes or instruments**
  - **Which instruments should policy-makers adopt?**
- **Timing and temporality**
  - **How should long-term policy frameworks be weighed against changing circumstances?**
- **Implementation and enforcement**
  - **How should policy-makers ensure that the policy goals are achieved?**

Policy landscape

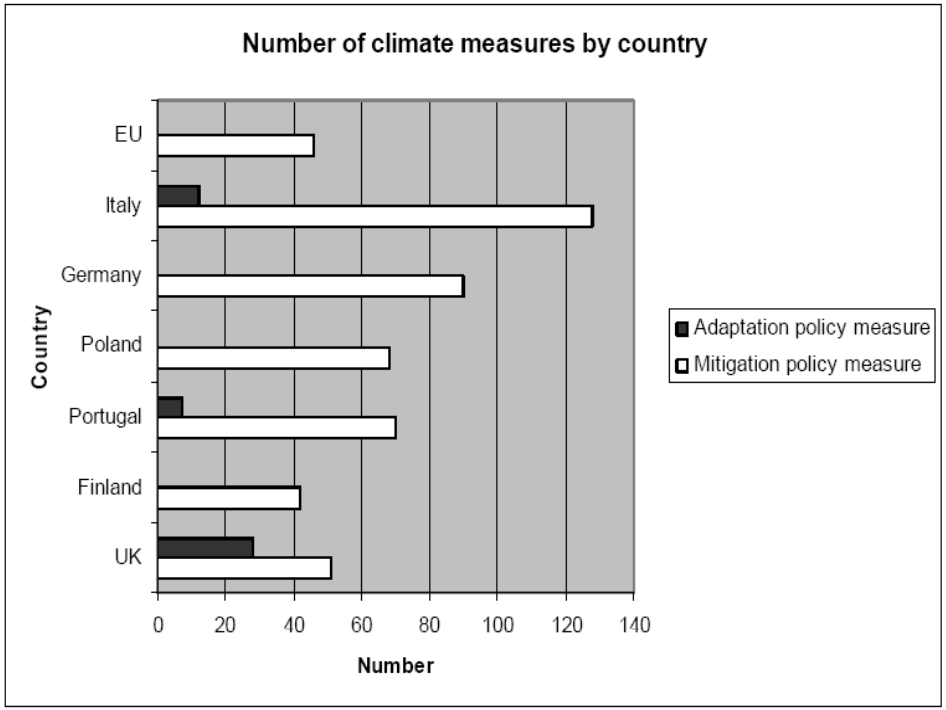
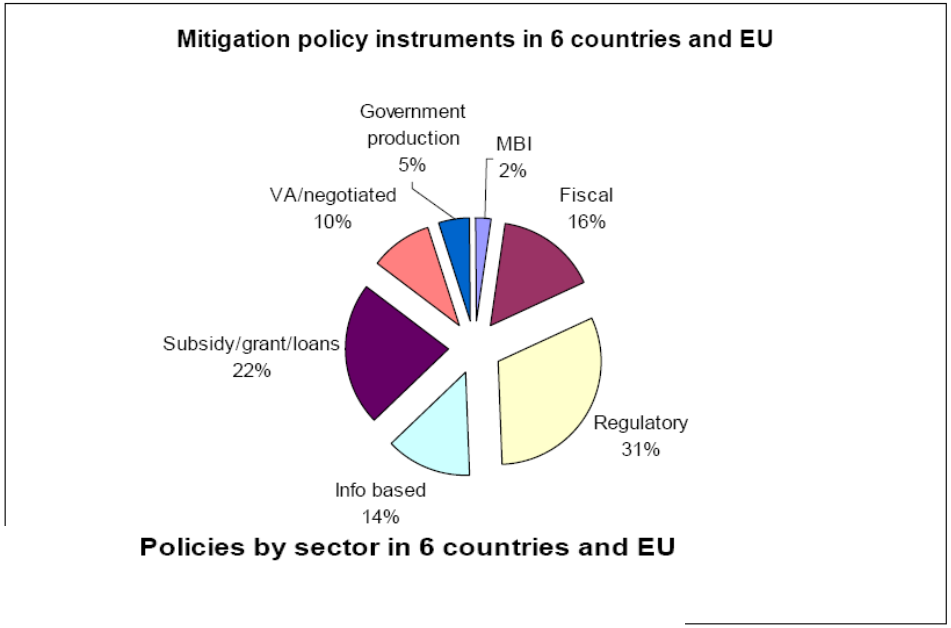
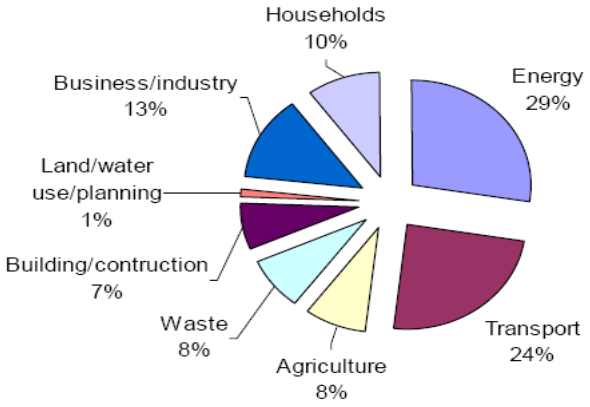


Figure 2. Number of climate measures by country.





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Problem perception and policy objectives

- How a problem is perceived determines the instruments + resources
- Communicate the right objectives
  - Get the price right to accurately reflect the social cost of carbon
  - Identify important co-benefits (e.g. competitiveness; SD)
  - Explain state failure (e.g. necessary economic growth vs. environment)
- Public awareness supports climate policies
  - Not clear if greater public awareness translates into greater effectiveness
  - Generally coincides with proliferating climate policies (new policies boost can be expected)
- Policy efficiency
  - Policies have limited growth of GHGs but more radical approaches are needed
  - Policy-makers will need to seek more distance from powerful lobbies to diminish loopholes

Costs and benefits

- **Distributive equity vs. environmental/economic effectiveness**
  - regulatory policies tend to hide the costs
  - carbon taxes or emission trading expose costs
- **Government policies vs. private sector policies**
  - no clear relationship which policies are more effective (costs could be handed down to consumers)
- **Polluter pays principle**
  - failure to implement ppp compromises effectiveness
  - can win support or enhance feasibility
- **Distributional implications of carbon taxes are a major issue**
  - are found to be mildly regressive but there are exceptions (energy tax in UK)
- **EU ETS**
  - has the potential to minimise marginal abatement costs
  - has been diluted (e.g. grandfathering, restriction to CO_2 and specific sectors)
  - could be addressed by greater harmonisation at EU-level

Levels and scales for policy action

- **Which level should policy-makers act at?**
  - subsidiarity principle
  - MS may not act sufficiently on their own account
  - too much central steering is not politically feasible

- **Common and Coordinated Policies and Measures (CCPMs)**
  - designed to assist MS in reaching targets under EU burden sharing agreement
  - effective drivers for national mitigation action
  - little evidence that CCPMs have compromised national efforts
  - quantitative targets and reporting obligations support effectiveness
  - 25-35% of national climate policies are EU derivatives
  - total RES production grew by 49% between 1990 and 2004

Instruments and modes of governance

- **Hierarchical (e.g. regulations) vs. flexible instruments (self commitment)**

- **Voluntary Agreements (VAs) conceived as efficient alternatives**
  - **but low effectiveness (beyond BAU projections): ca. 5% emission reduction**
  - **lack unambiguous targets**
  - **typically attract 'low hanging fruit'**
  - **produced only gradual improvements rather than innovation**
  - **could be effective if accompanied by proper incentives (Finnish Energy Conservation Agreement)**

- **For VAs to be successful the absence of regulatory pressure must be compensated by strong internal peer or public pressure**

Timing and temporality / predictability of policies

- **Predictability is a core condition to enable successful mitigation schemes**
  - **long time horizons and great uncertainties characteristic of climate change**
  - **the greater the uncertainty the stronger the need to relieve the investor of the risks**
- **Long-term predictable policy frameworks needed to stimulate investment flows for large-scale technological transformation**
  - **need for ambitious long-term emission reduction targets based on sound science**
  - **at sectoral, national, EU and global scales**
- **Dimensions of predictability**
  - **broad-based and continuous political support (due to long planning horizons)**
  - **instrument inherited predictability (e.g. feed-in tariffs or certificate schemes)**
- **Need to adjust instruments regularly**
  - **spot and eliminate inefficiencies or underinvestment**

Implementation and enforcement

- **Implementation gap in EU environmental policies**
  - incomplete adoption, transposition to MS law, and enforcement of policies
  - absence of targets in climate policy related directives
  - sanctions for non-compliance are minor or non-existent (VAs)
- **Monitoring is key precondition**
  - poor provision of effectiveness measures
  - low data quality
  - UK is positive exception
- **Success factors that facilitate implementation**
  - stakeholder participation in design and implementation
  - continuous revision and improvements of instruments
  - flexible, non-bureaucratic implementing agency
  - integration of instruments into effective policy packages
  - political will and commitment to overcome opposition
- **Interpolicy cooperation**
  - coordination across climate related policy domains vs. policy silos (e.g. climate and energy policies → lower prices for consumers vs. env. efficiency)

Avoid the Unmanageable,
Manage the Unavoidable

Thank you for your attention!

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Research needs

- Develop a consistent adaptation framework with adequate timelines for action, responsibilities and instruments
- Mapping of adaptation space
- Mapping of policies in important sectors to identify their degree to deliver consistent adaptation responses
- Focus on urban spaces as centres for mitigation and adaptation
- Develop better damage functions for cost-benefit analysis
- Integrate life-style research