EU-USCA CLIMATE RISK AND RESILIENCE COOPERATION

CLIMATE FINANCE ADVISORS

EUROPEAN UNION

Incorporating Climate Risk in Road Infrastructure Planning

HOW TO USE

This checklist presents three critical steps of climate risk integration into road infrastructure:

1 **Identify and assess climate vulnerabilities and share results with key decisionmakers**

2 **Define priorities and outline and recommend options**

3 **Integrate social equity in prioritization and option evaluation**[8]

This checklist also outlines key aspects of each of the steps that contribute to their successful execution. Real-life examples of how the steps were implemented are presented for each of the steps, with hyperlinks to more detailed public information when available.[1]

PURPOSE

To assist public policymakers, planners, and managers incorporate climate-related physical risks in road infrastructure planning that will help maximize the benefit of public investments in road infrastructure, minimize potential losses and service disruptions, and safeguard life, property, and wellbeing.

Interested in learning more about the EU-USCA Climate Risk and Resilience Cooperation program or Climate Finance Advisors, contact us here: EU-USCA@climate-fa.com

1 Identify and assess climate vulnerabilities and share results with key decisionmakers

☐ Source local data from relevant authorities

EXAMPLE

The National Road Authority of Poland (GDDKiA) and the European Investment Bank (EIB) began a nationwide road vulnerability assessment with a study of past data from 3,300 weather-related damage and disruption events that adversely affected the national road network to identify climate hazards and their impacts.

The joint project between the EIB's Joint Assistance to Support Projects in European Regions (JASPERS) program and GDDKiA sent a **questionnaire** to the 16 regional GDDKiA branches **to gather information on weather events** between 2004 and 2016. Local branches were asked about 12 different weather phenomena including intense rainfall, lightning, strong wind, and flooding.[2] Based on interruption to traffic **data** and reported **damages** to road infrastructure reported, the GDDKiA-JASPERS team identified 3,300 extreme weather events and calculated costs of each event.

☐ Apply risk assessment tools that use global and local data

EXAMPLE

The California State Transportation Authority (CalSTA) and the California Department of Transportation (Caltrans) used district-level vulnerability assessments of the State Highway System (SHS) to identify potential climate hazards.

California produced **downscaled climate models**[3] to translate ten Global Climate Models (GCMs) into concrete hazard assessments at the local level across the state. With the models, Caltrans identified changes in average temperature, precipitation, wildfire, sea-level rise, storm surge, and cliff retreat (including erosion and landslides) as most relevant to the SHS. Caltrans then produced climate hazard maps **with three time horizons** (to 2025, 2055, and 2085) to cover the entire state.

Using Geographic Information System (GIS) and Geospatial data on specific asset sites, CalSTA/Caltrans overlaid SHS assets on these hazard maps to **produce Vulnerability Assessment Maps**, enabling the identification of the most relevant climate stressors for specific SHS assets and the SHS in general.

EXAMPLE

The Minnesota Department of Transportation (MnDOT) studied state-level climate data to identify the most serious climate hazards threatening road infrastructure and is conducting a vulnerability analysis to predict hazard impacts.

MnDOT uses climate data from the Minnesota State Climatology Office of the state's Department of Natural Resources, to identify climate change impacts for the state and gauge the likelihood of these changes. Based on this data, MnDOT has **identified** extreme precipitation and flooding as well as warmer winters as the **primary climate hazards creating financial risk to the state's road infrastructure.** MnDOT is in the process of conducting an Extreme Flood Vulnerability Analysis to study the impacts of predicted extreme flooding on infrastructure assets for the purpose of integrating these impacts in the planning, design, building, and maintenance of road infrastructure to increase the climate resilience of these assets.

EXAMPLE

The National Road Authority of Poland (GDDKiA) and the European Investment Bank (EIB) used historical data and future projections of extreme weather events to create a network-wide vulnerability map.

The GDDKiA-JASPERS team then calculated the exposure (based on observed events and forecasted climate changes) and sensitivity (based on the traffic and/or asset impacts) to **create a vulnerability map of the entire network.**

☐ Consider climate scenarios

EXAMPLE

CalTrans integrated stress testing and scenario analysis into its State Highway Strategic Management Plan (SHSMP).

CalTrans **projected and analyzed different scenarios for greenhouse gas emissions levels and climate impacts** to examine projected costs under different sets of future conditions. Representative Concentration Pathway (RCP) scenarios generated by the Intergovernmental Panel on Climate Change (IPCC) were developed for projected future CO2 levels, ranging from a high estimate (RCP 8.5) consistent with a future in which there are no significant global efforts to limit or reduce emissions, to a low estimate (RCP 2.6), which is a stringent emissions reduction scenario that assumes that global greenhouse gas emissions will be significantly curtailed. **Statewide construction, operation, and maintenance costs were estimated for these scenarios** to examine the cost sensitivity to future emission scenarios. These ranged from an annual $34.7B in a low emission scenario (RCP 2.6) to $45.2B in a high emissions scenario (RCP 8.5).[4] It is expected that the costs and impacts from CalTrans' scenario analysis will be incorporated into its capital investment planning, budgeting, and risk management strategy.

EXAMPLE

The National Road Authority of Poland (GDDKiA) and the European Investment Bank (EIB) JASPERS team used scenario analysis in future projections to augment historical data in conducting a nationwide road vulnerability assessment.

To complement the review of historical data collection, the team **used climate change forecasts and scenarios** from Poland's Institute of Environmental Protection to create a more complete assessment of the vulnerability of Poland's road system to climate change. GDDKiA-JASPERS used costs and impacts observed in the period from 2004 to 2016 to **enhance the assessment and quantification of the financial and operational vulnerability of the road network to forecasted climate impacts** going forward.

☐ Translate and share the results of the risk assessment

EXAMPLE

California translated complex physical climate impact models *into publicly accessible climate hazard maps which are easy to understand for policymakers without climate science training.

California produced its **downscaled climate models** to translate ten Global Climate Models (GCMs) into decision-relevant data and analysis for use at a local level across the state and made these **publicly available on Cal Adapt**, a state-supported web-based resource with actionable climate data and analysis for the general public. Downscaling of global models allows developers and policymakers to better identify hazards deemed most relevant for specific locations in the state.

2 Define priorities and outline and recommend options

☐ Prioritize action against identified risks and vulnerabilities

EXAMPLE

CalSTA and Caltrans developed the State Highway Strategic Management Plan (SHSMP), inclusive of district-level vulnerability assessments, a weighted scoring system to prioritize investment projects, and cost-benefit analysis for identified potential investments.

Caltrans incorporated the climate risks identified in the **district-level vulnerability assessments** into its State Highway System Management Plan (SHSMP). Additionally, Caltrans developed District Climate Adaptation Priority Reports for each district of the state (e.g. District 1 Climate Change Vulnerability Assessment). CalSTA and Caltrans looked at the impacts of a set of climate stressors on many of the SHS assets. The district-level approach allowed the agency to build on "efforts to plan for and adapt to climate change [already] underway in communities across the state"[5] and integrate local knowledge into district technical and adaptation prioritization planning.

Caltrans used a combination of exposure and consequences (impact) metrics to evaluate road infrastructure by asset type and hazards identified. The department integrated these metrics into a single, **weighted scoring system to determine an investment prioritization score.**[6] Each district held workshops to review prioritization based on the in-depth, local-level knowledge of district staff on asset conditions, projects already underway, and past impacts. District Prioritization Reports list the assets by type in each district by these adjusted, cross-hazard prioritization scores to highlight assets most in need of investment for Caltrans's investment planning.

☐ Conduct cost-benefit analysis to assess optimal investment strategies

EXAMPLE

Caltrans used a cost-benefit analysis methodology applied by the state transportation agency assess options and choose optimal resilience investment strategies.

Caltrans conducts **cost-benefit analysis over a 10-year analysis period** using an assumed interest rate based on the escalation rate used in the State Transportation Improvement Plan (STIP) and appropriate costs and benefits specific to the portion of the state highway. Based on these projections, Caltrans decides among four different adaptation options: defend, accommodate, retreat, change policy or practice.[7]

☐ Develop recommendations and action plans for execution

EXAMPLE

GDDKiA/JASPERS developed adaptation action plan recommendations.

The GDDKiA/JASPERS team is in the process of using the results of the climate risk assessment to **develop action plans for the enhanced resilience of the Polish national road network.** These action plans look at the hazards and their effects on the existing road network, new investments, and longer-term strategy and planning for infrastructure. Past data is used to identify different risk levels throughout the system and prioritize general adaptation responses through input from local stakeholders. These analyses will be formalized into adaptation action plans to cover the entire road network.

The GDDKiA/JASPERS project team has developed a methodology for **estimating the overall current and forecasted costs** related to each hazard identified. The cost estimate assumes no adaptation investment is made and uses two variables to calculate total annual costs: **total damage cost** based on number of events, the average unit cost of damage, and the type of road; and **total user cost** based on the average daily traffic, average length of trip, average speed, and a percentage of events leading to blocked traffic.

3 Integrate social equity in prioritization and option evaluation[8]

EXAMPLE

MnDOT incorporated into its resilience strategy and decision-making process resilience actions and investments that address social equity considerations and prioritize the most vulnerable communities.

As part of prioritizing projects and deciding on resilience strategies, MnDOT also **integrates social equity considerations into its assessment** of transportation infrastructure vulnerability to climate change. In its effort to improve the resilience of the state's transportation system, the department recognizes that the "people most vulnerable to climate change are often those already most impacted by environmental and social stressors."[9] During the decision-making process for improving or building transportation infrastructure, MnDOT factors in social vulnerability to "prioritize resilience investments for populations most vulnerable to climate change."[10]

1 Examples in the paper emerged from a webinar held in the context of the EU-USCA program on June 16, 2021, "Resilient Transportation: Adapting Road Networks for Climate Change." A Prezi summary of the webinar can be found on the program website at the following link: Resilient Transportation Webinar Prezi.

2 http://www.jaspersnetwork.org/download/attachments/24150025/1-2-%20Mapping%20vulnerabilities%20on%20existing%20national%20road%20network%20in%20Poland%20-%20G%20Lutczyck.pdf?version=1&modificationDate=1513346216000&api=v2

3 https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf

4 EU-USCA Resilient Transportation Webinar, 6/16/2021, Presentation by CalSTA

5 https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/2019-climate-change-vulnerability-assessments/d1-technical-report-a11y.pdf

6 https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/2020-adaption-priorities-reports/d1-adaptation-priorities-report-2021-a11y.pdf

7 https://dot.ca.gov/-/media/dot-media/programs/asset-management/documents/2021_shsmp_draft_04-27-21.pdf

8 For further guidance on integrating equity considerations into resilience planning and investment, please see the equity section of the EU-USCA 'how-to' guide: "Checklist: Integrating Finance into State Resilience Planning and Implementation". https://climatefinanceadvisors.com/wp-content/uploads/2021/03/EU-USCA-Integrating-Finance-into-State-Resilience-Planning-and-Implementation-Checklist.v1.pdf.

9 http://www.dot.state.mn.us/sustainability/docs/resilience-report-2020.pdf

10 http://www.dot.state.mn.us/sustainability/docs/strategic-plan-2020.pdf

This project has been organized with the financial support of the European Union's Partnership Instrument within the Strategic Partnerships for the Implementation of the Paris Agreement program and the US Climate Alliance. The opinions expressed are the sole responsibility of the authors, and do not necessarily reflect the views of the European Union.