Climate Change Adaptation at European Railway Infrastructure Companies

Results of the UIC ARISCC project

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GHG emissions and railways

Railways as a „GHG efficient“ transport mode

- Status 2007, EU & EFTA, UIC
  - 1.6% CO₂ emissions of all transport
  - 6% of all pass., 10.3% of all freight

- Development 1990-2007
  - -27% in total CO₂ emissions
  - -11% (pass.) and -35% (freight) in specific CO₂ emissions

(UIC 2009, EU Comm. 2007)

- Outlook 2007-2030
  - -50% in specific CO₂ emissions

(UIC/CER Sustainability Strategy 2030)
Impacts of extreme weather events

Railway infrastructure is being affected by natural hazards and extreme weather events today...

.. and manages these events!
Climate change adaptation – Starting point & drivers

• European railway infrastructure companies “feel”
  • that CC consequences are advancing rapidly &
  • the need to develop and implement appropriate strategies for CC adaptation and to exchange knowledge

• Recent legislative/regulative demands (examples)
  • EU: White Paper on adapting to climate change
  • UK: Climate Change Act 2008: governmental power to require ‘bodies with functions of a public nature’ and ‘statutory undertakers’ to perform climate change risk assessment
  • Germany: Federal Railway Authority (EBA) included CC questions into environmental impact assessment (UVP) for new and renewed lines/tracks
Railway infrastructure – Specificities

- Long life time of railway infrastructure and long investment and payback times
- Investment, upgrade and maintenance decisions have consequences for decades on routes and infrastructure subsystems
- Railway infrastructure as a critical infrastructure which has to provide transport services under all conditions
# Expected impacts from climate change

Railways expect impacts of climate change and related weather events on their infrastructure and operation from changing weather patterns, return periods & intensity:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Effect</th>
<th>Impact on Railways/Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
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<tr>
<td>High temperatures and heat waves</td>
<td>overheating</td>
<td>infrastructure &amp; rolling stock equipment</td>
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<tr>
<td>Sudden temperature changes</td>
<td>tension</td>
<td>track buckling</td>
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<tr>
<td>Intense sunlight</td>
<td>overheating</td>
<td>track buckling, slope fires, signaling problems</td>
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<tr>
<td>Precipitation</td>
<td></td>
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<tr>
<td>Intense rainfall</td>
<td>soil erosion, land sides, flooding</td>
<td>damage to embankments, earthwork</td>
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<tr>
<td>Extended rain periods</td>
<td>slower drainage, soil erosion</td>
<td>other infrastructure assets, operation</td>
</tr>
<tr>
<td>Flooding: coastal, surface water, fluvial</td>
<td>landslides</td>
<td>drainage systems, tunnels, bridges</td>
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<tr>
<td>Drought</td>
<td>desiccation</td>
<td>earthworks desiccation</td>
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<tr>
<td>Wind</td>
<td></td>
<td></td>
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<tr>
<td>Storm/gale (inland)</td>
<td>higher wind forces</td>
<td>damage to installations, catenary</td>
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<tr>
<td></td>
<td>uprooting of trees</td>
<td>restrictions/disruption of train operation</td>
</tr>
<tr>
<td>Coastal storms &amp; sea level rise</td>
<td>Coastal flooding</td>
<td>embankments, earthwork, operation</td>
</tr>
<tr>
<td>Lightning strikes &amp; thunderstorms</td>
<td>Overvoltage</td>
<td>catenary and signaling</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Faster plant growth, new plants</td>
<td>vegetation management</td>
</tr>
</tbody>
</table>
UIC ARISCC Project – A Europe-wide Collaboration

ARISCC project – Adaptation of Railway Infrastructure to Climate Change

• Funded by UIC International Union of Railways
• Project manager: DB Environment Centre
• Consultant: IZT Institute for Futures Studies and Technology Assessment, Berlin

Under changing climate conditions, railways have to answer the following questions:

• What are the potential impacts of climate change on your business?
• What and where are your vulnerabilities?
• What are the associated risks for safety & performance?
• What adaptation measures and actions do you implement or have to implement?
Adaptation measures – Approaches & Strategies

• Today’s consequences from extreme weather events and natural hazards as starting point
• Compilation of impacts on infrastructure and operation
• Asset management: knowing your company's infrastructure subsystems and structures (current status and location)
→ Many measures and modules suitable and needed to cope with today’s challenges!
→ Information collection and assessment: patterns, tendencies, weak points and event spots, priorities etc.
→ CC adaptation as a future oriented “brick” of an integrated natural hazards management!
Integrated Natural Hazards Management

Core question: which information are needed to cope with today’s and future’s challenges and impacts?

- **Today's Weather** (Information, monitoring)
  - Weather Warnings
- **Past Weather** (Extreme weather events)
  - Event Database
- **Future Weather** (Regional climate models, weather generators)
  - Modelled Weather Parameters
- **Infrastructure Assets**
  - Asset Database (Locations, maintenance, status, values)
- **Natural Hazards Maps** (flooding, landslides, storms, windthrow, rockfall, avalanches...)
- **Incident/Failure Database** (Delay minutes, line closures, reported damage, incidents)
- **Detailed Data on Infrastructure Assets** (Tracks, earthworks, bridges, tunnels, drainage, signalling, depots)
- **Vulnerability Maps**
- **Risk Management & Risk Maps** (Risks to asset integrity, environment, operation, safety, image)
- **Priority Setting** (Risk classes, cost/benefit assessment, cost scenarios)
- **Adaptation Measures & Strategies**
Insights from European Railway Infrastructure Companies

- Some forerunner companies
- Raising awareness across all companies
- Different systems and tools in use to deal with today’s natural hazards and extreme weather events
  - Please visit the website www.ariscc.org for a full collection of good practise examples
- Climate change seen as additional load to today’s weather patterns
- Adaptation with and within existing tools and approaches
- Going back to „good standards of maintenance“
- Knowing your company’s assets and their conditions
- Adaptation is less research but much more actions
The way ahead..

• ARISCC Final Conference (beginning of 2012)
  • We are happy if you attend..
• ARISCC 2 ?
  • Your collaboration is highly appreciated..
• Spread of knowledge
  • EU new member states ?
• Adaptation of railways in more vulnerable regions
  • South Africa (RSA)
• ...

IZT
Thank you for your attention!

www.ariscc.org

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Commissioned by:

IZT

Mobility Networks Logistics

DB

Infrastruktur Betrieb

Network Rail

OBB

SBB CFF FFS

ProRail, InfraBel, SNCF/RFF,
Trafikverket, Liikennevirast

Commissioned by:
Climate Change Adaptation – An „Easy“ Example

Copenhagen-Ringsted line (DK, 2008)
- Renewal of line for higher capacity
- Assessment of climate change induced additional loads: line robustness in the next 100 years
- Result: 20% more water from heavy rainfalls until 2100
- Solution: Building a drainage system with higher capacity than required by today's standards (+ 30%)
Today’s impacts: systems in use – Weather monitoring

INFRA.wetter, ÖBB Infrastruktur

• Online real-time weather monitoring and weather warning
  • Precipitation/rain, thunderstorms, snow, (high water/floods)
• Overlay with GIS data of railway network/ infrastructure
• Automatic warnings before/ during extreme weather
• Additional, railway-own meteorological stations
• External meteorological service provider

Adaptation: data collection & assessment of past events on changing weather patterns & return periods + future weather from regional climate models → adapt warning levels and thresholds
Today’s impacts: systems in use – Event maps & data

Example of event maps from SBB Infrastruktur

- Compilation and overlay of natural hazard events and resulting impacts on railway operation and infrastructure
- Identification of weak spots and accumulations of events
- Prioritisation and introduction/update of protective measures and processes (e.g. monitoring)

Adaptation: assessment of natural hazards impacts and intensity under changing climate conditions → upgrade of infrastructure/protective measures, intensified monitoring