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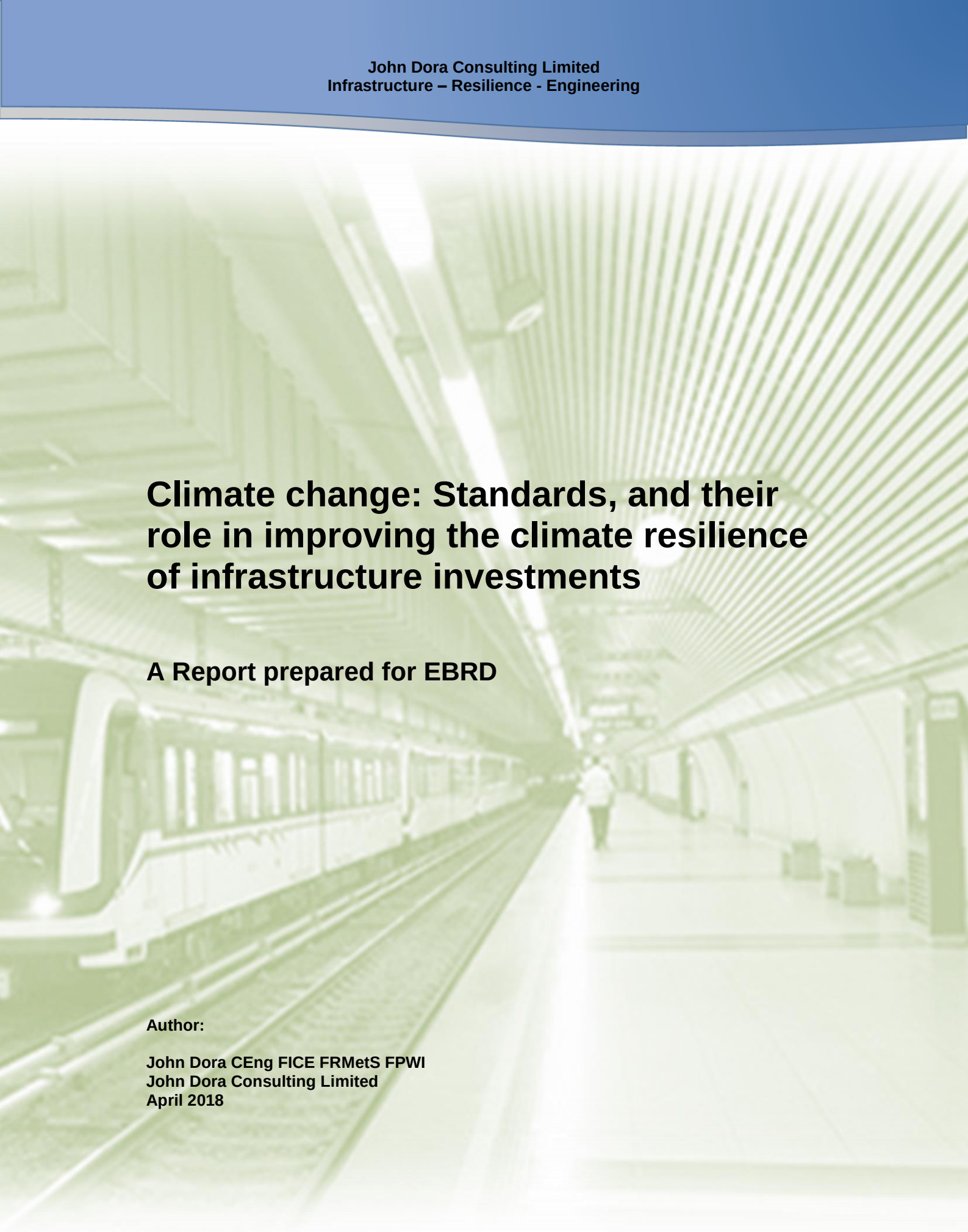

Climate change: Standards, and their role in improving the climate resilience of infrastructure investments

A Report prepared for EBRD

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Executive Summary

This report explores standards related to climate resilience, and how they may be able to contribute towards achieving the 2016 Paris Agreement and its aspirations to upscale financing for climate resilient, long-lived infrastructure. It examines how using standards can assure investors that infrastructure assets are safeguarded against projected impacts of climate change, what 'entry points' are feasible, and how 'front end' transaction costs for integrating climate resilience into investment preparation and execution can be reduced.

The report builds upon information gleaned from the UN COP23 climate change conference in Bonn (November 2017 – Annex A) and from engagement with the EUFIWACC finance and investment community and experts from standards' organisations, via a workshop in Brussels (January 2018).

A chapter on standards sets out how standards are used - to set out test methods; to specify technical aspects of products and services; and to help organisations adopt recognised sound management practice. Standards' development processes are described; those internal to an organisation or sector, and those responding to a market need as drafted by standards bodies, national (e.g. by NEN in the Netherlands or DIN in Germany) or at the international scale by the International Standards Organisation (ISO). Standards can be voluntary (an organisation chooses to adopt it) or mandatory (through legislation, via contract agreements, or internal rules). Many EU member states mandate standards for the structural design of public infrastructure.

Modified and new climate change resilience standards have yet to be introduced. The report describes developments at European and ISO levels. European standards (design and construction standards called 'Eurocodes') specify weather 'loadings' on structures (e.g wind pressures) but these are based on historic weather patterns. A technical report is described which sets out where these standards need to be modified to cater for future weather patterns arising from climate change. ISO is developing new standards on climate change adaptation to help organisations adapt to climate change at policy, strategic and planning levels. The work on the Eurocodes is at an early stage. The first ISO on adaptation ISO 14090 'Adaptation to climate change – Principles, requirements and guidelines' is to be published early in 2019.

Benefits of using standards are many. Specifically, impacts from climate change will affect long life infrastructure (>30 years), its design, operation, maintenance and emergency responses. Standards provide tools for designers, builders, operators and users to ensure infrastructure safety, operability and longevity. Adopted at the early stages of a project lifecycle, standards can help to build in resilience, avoiding costly 'retrofit' solutions. Organisational standards can be covenanted into loan agreements, giving investors assurance that good practice is being followed.

Demonstration of compliance with, for example, ISO 14090, is likely to lead to the market establishing methods of verification and assurance. Where loans are released in tranches, release can be made conditional upon demonstration of compliance.

Recommendations for the investment community include:

- Consider attaining liaison status with the ISO 'parent' committee for adaptation standards, ISO/ SC7, so that EUFIWACC influences the development of relevant standards;

- Engage with the programmes to modify Eurocodes and European Standards;

- Owing to the long development timescales, consider covenanting good practice guidelines from sector bodies e.g. PIARC (roads), PIANC (navigation) and UIC (railways) into infrastructure projects;

- Discuss adaptation and standards at early stages of infrastructure projects with a view to covenanting the adoption of ISO 14090 (when published) into loan agreements;

- Establish mechanisms to ensure the embedding of provisions as set out by ISO 14090 into borrowers' project implementation plans.

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1 Introduction

1.1 Vision

The 2015 Paris Agreement sets a high level of ambition for scaling up financing that supports progress towards climate-resilient development pathways. This implies that financing for infrastructure and other long-lived assets will have to be provided in a way that takes into account projected future climate conditions – and the inherent uncertainties – over their long lifespans, and which ensures that such assets are designed, built and managed in a way that makes them more resilient to the projected impacts of climate change. Financial institutions are therefore interested in scaling up the quantity and quality of their climate resilience investments, in line with the ambitions of the Paris Agreement. They are interested in the potential role of emerging norms and standards related to climate resilience in helping to scale up climate resilience financing, for example by defining and disseminating best practices on climate resilience across the market, and by reducing the transaction costs associated with integrating climate resilience into investment preparation and execution. Financial institutions are keen to understand how the application of such standards may allow investors to commission investments knowing that the climate resilience issues will be adequately addressed.

The purpose of this assignment is to explore how international and European standards related to climate resilience may be able to contribute towards this vision, with investors mandating their use upon borrowers who then will be required to demonstrate compliance.

1.2 Scope

This report is intended as an informative on European and International (ISO) standards that are relevant to climate resilience and climate resilience investments, how they can help achieve the above vision by being applied at different project development stages, and it makes recommendations for further initiatives that could help the market respond to the needs stated above. The report covers new and emerging standards related to climate change adaptation as published, or under revision or development, within the European standards arena managed by the European Committee for Standardization (CEN/CENELEC) which comprise standards such as the Structural Eurocodes and European Standards. The International Standards Organization (ISO) publishes International standards designated 'ISO' and other documents such as Technical Specifications (ISO/ TS).

The report was informed by a workshop held in Brussels on 25th January 2018 and attended by representatives of the European Financing Institutions Working Group on Adaptation to Climate Change (EUFIWACC), national standards bodies BSI (UK), NEN (Netherlands), DIN (Germany) and CEN/ CENELEC (European Union), and Copernicus Climate Change Services.

1.3 Audience

This report is aimed at technical experts working in EUFIWACC and senior members of the investment community with an interest in infrastructure.

2 Standards

2.1 Relevant types of Standards and their use in projects

CEN/ CENELEC describes types of standards and there are three types more relevant to projects as follows[1]:

- **Test methods and analysis standards** - these measure characteristics such as temperature and chemical composition.

Typically these are used by verification and assurance organizations and can be used throughout and infrastructure project's construction phase to assure that the materials used meet the required performance specification – concrete composition and strength is an example;

- **Organization standards** – these describe the functions and relationships of a company, as well as elements such as quality management and assurance, maintenance, value analysis, logistics, project or system management, production management, etc. Typically these are used by larger organizations and corporations, an example being ISO 9001 on quality management.

  In infrastructure project-cycle terms, organizational standards would tend to be applied at or before the early stages of a project to assure project 'sponsors' or organizations that the functions and relationships exist so that e.g. assured quality outputs are achieved. Some organizations might be certified to a standard and the application of such a standard becomes a routine activity regardless of project needs – ISO 9001 would be a typical example, as would ISO 55001 on asset management, which requires processes that link an organization's high-level aims to activities 'on the ground';

- **Specification standards** – these define characteristics of a product (product standards), or a service (service activities standards) and their performance thresholds such as fitness for use, interface and interoperability, health and safety, environmental protection, etc.

  Typically these are used in infrastructure projects at the design stage to perform the structural design calculations (e.g. safety, loadings, resistance to loadings), and to select and specify the desired materials' performance (e.g. concrete strength, paint coatings, fixings).

  During the service life of the infrastructure project, specifications will set maintenance and operational requirements – aspects such as when to inspect, repair and renew components and how to manage train movements, signalling, and despatch in stations. Maintenance standards often are part of the organization's asset management plans, so linking in to ISO 55001 where adopted.

2.2 Harmonized standards

Some European Standards are 'harmonised'. A harmonised standard is a European Standard developed by a recognised European Standards Organisation: CEN, CENELEC, or ETSI. It is created following a request from the European Commission to one of these organisations. Manufacturers, other economic operators, or conformity assessment bodies can use harmonised standards to demonstrate that products, services, or processes comply with relevant EU legislation, such as the Construction Products Directive.

The references to harmonised standards must be published in the Official Journal of the European Union (OJEU). This is to provide access to the latest lists of references of harmonised standards and other European standards. This means that by using these standards, compliance with relevant EU legislation is realised; in formal terms, a 'presumption of conformity with the essential requirements in the law'.

2.3 How standards are developed

There are at least two ways that standards can be developed – those required within a sector, industry or company, and those produced by a standards body such as national (e.g. NEN, DIN), regional (e.g. CEN and CENELEC) or international standard bodies (e.g. ISO, IEC, ITU). The three European Standardization Organizations, CEN, CENELEC and ETSI are officially recognized as competent in the area of voluntary technical standardization by EU Regulation (1025/2012) that settles the legal framework for standardization.

Sectors, industries or companies will have their own development process which might involve internal steering groups, expert advisors, a drafting, vetting and a publication process. Examples of such standards include the UK Energy Networks' Association's ETR 138[2] "Resilience to Flooding of Grid and Primary Substations" and Network Rail's NR/L3/CIV/020 "Design of Bridges".

Standards produced by a standards body respond to a market need. The ISO process[3] is summarised here, other bodies such as CEN/CENELEC use similar processes (see Appendix A.1):

- ISO standards respond to a need in the market, from e.g. a request from industry or other stakeholders. Typically, an interested group communicates the need for a standard to ISO via its national standards body;
- These standards are developed by groups of experts from all over the world, that are part of larger groups called technical committees. These experts negotiate all aspects of the standard, including its scope, key definitions and content;
- Technical committees are made up of experts from the relevant industry, but also from consumer associations, academia, NGOs and government;
- Developing ISO standards is a consensus-based approach and comments from all stakeholders are taken into account.

2.4 Choice v Mandated

Organizations that develop their own standards normally require adherence to them by, for example, internal and external teams, projects or programmes. Standards produced by standards bodies – such as ISOs or European Standards – can be subject to choice. These 'voluntary standards' may become mandatory as a result of its use, reference, or adoption by a regulatory authority, or when invoked in legislation, contracts, purchase orders, or other commercial instruments[4]. *Clients, investors and other organizations can choose to require adherence to standards as part of a contractual agreement.* Technical guides produced by sectors, industries or companies can sometimes be relied upon as examples of good practice in court cases.

Note that while European Standards are 'voluntary', the 'Structural Eurocodes'[5,] used for construction projects, are mandated for public works in the European Union under the Public Procurement Directive[6] (see Box).

STRUCTURAL EUROCODES AND EUROPEAN STANDARDS

Structural Eurocodes specify how structural design should be conducted and were developed to enable the safety of the design of building and civil engineering works and safety in use. They specify 'loadings' and how designers take into account these 'loads' on structures, examples being pressure loads imposed by wind, thermal loads from heat, as well as vehicle, traffic or equipment loads.

Structural Eurocodes include recommended values for all parameters but allow individual countries the possibility to define their own National Determined Parameters, to suit local geographical, geological and climatic conditions.

In most EU Member States, the use of these codes gives a presumption of conformity with their national regulations, but in many cases Structural Eurocodes are called up in national legislation, either by incorporation or by reference. In these cases, the use of Eurocodes is mandatory (see CEN/ CENELEC Guide 28).

Other European Standards can refer to how buildings and civil engineering works are managed and maintained, or can relate to specifications for equipment such as air conditioning, and acceptable temperature ranges for electrical control equipment.

The Structural Eurocodes are currently at a review stage in order to address the variety of new methods, new materials, new regulatory requirements and new societal needs developing and to extend harmonisation[7].

NOTE: Whilst Structural Eurocodes are technically a subset of European Standards, they are referred to in this report as 'Eurocodes'.

2.5 Note on terms in standards

When an organization chooses to adopt, or impose a standard it is agreeing to adhere to the nuances of the language in the standard - any term where, for example, 'shall', 'should' or 'may' appear8:

- 'Shall' clauses are requirements – these must be followed;
- 'Should' clauses are recommendation' – those activities that ought to be followed; and,
- 'May' clauses are 'guidelines' – those activities that are permitted.

2.6 EU requirements of CEN/CENELEC on climate change

(see Appendix A.1)

2.6.1 Eurocodes

Reporting on Eurocodes in relation to climate change was required under an EC Mandate M/515 of 2012 (Appendix A.2). This work is being led by the standards committees responsible for the Eurocodes. The scope of work covers: *"Developing a technical report analysing and providing guidance for potential amendments for Eurocodes with regard to structural design addressing relevant impacts of future climate change (general and material specific)".*

This mandate resulted in a review of Eurocodes and weather parameters (which had been based upon past weather events), relating to common types of structures which are particularly sensible to variations in those parameters, as much as the scientific knowledge allows for at this stage. A specific recommendation that *inspections and maintenance schemes should be emphasized and adjusted for structures approaching their expected life time* is particularly relevant for work associated with and adjoining long-life infrastructure.

Note that the Eurocodes do not address all resilience issues such as flooding from intense and prolonged rainfall, and drainage matters; new guidance was recommended for environmental impacts, including water action and flooding. Flooding is known to be a significant risk to infrastructure.

Work is proposed to provide specific weather data for the Eurocodes via the EU-funded Copernicus Climate Change Services (C3S) programme (see Appendix A.3).

2.6.2 European Standards and sectoral needs

In 2014 the EC, responding to the EU Strategy on adaptation to climate change (see Appendix A.1), requested CEN/CENELEC to contribute to building and maintaining a more climate resilient infrastructure throughout the EU by examining standards in priority sectors:

- Transport infrastructure;
- Energy infrastructure;
- Buildings/ construction.

Additionally Information Communication Technology (ICT) infrastructure has been included.

In response, CEN/CENELEC set up a group on adaptation to climate change to co-ordinate this adaptation-related work, the CEN-CENELEC-ETSI Adaptation to Climate Change Coordination group (ACCCG) . NEN, the Netherlands' standards body, was contracted to carry out the secretarial support of the ACCCG. The group aims at identifying priority standards in each 'sector' for modification to promote adaptation; the current position – on completion of Phase 1 of this work - is that 12 have been noted as requiring modification to make them contribute to more resilient infrastructure systems. One new standard is proposed on 'climate resiliency of construction works'. Phase 2 intends to revise the priority standards to represent best practice in adaptation and resilience building, and further work is anticipated to review and modify all other relevant European Standards to address climate change in time.

Note: Phase 2 work will encompass the sectoral European Standards, all in liaison with the C3S programme (see Appendices A.3, A.4 and A.5).

2.7 Specific Standards

Listed here are relevant ISO and European standards and their status, as referred in the source material (see Appendix A) and in Appendix B. Their use and benefits are discussed in Section 3.

2.7.1 International Standards

ISOs fall into the *Organization Standards* category and those relevant to climate change are:

- ISO 14030 Green Bonds - Environmental performance of nominated projects and assets. This is in draft, work was initiated in 2017, with publication set for 2020;
- ISO 14080 Greenhouse gas management and related activities - Framework and principles for methodologies on climate actions. This is in draft, with publication set for early 2018;
- ISO 14090 Adaptation to climate change – principles requirements and guidelines. This is in draft, with publication set for early 2019;
- ISO 14091 Adaptation to Climate Change – Vulnerability, impacts and risk assessment. This is in draft, work was initiated in 2017, with publication set for 2020;
- ISO/ TS 14092 Greenhouse gas management and related activities: Requirement and guidance for adaptation planning for organizations including local governments and communities. This is in draft, work was initiated in 2017, with publication set for 2018. (Note – a Technical Specification not an International Standard);
- ISO 14097 Investments, financing and climate change. This is in draft, work was initiated in 2017, with publication set for 2020.

2.7.2 Eurocodes

(see Appendix A.2)

The Eurocodes fall into the *Specification Standard* category and include 10 sets of standards (EN 1990 - 1999) covering subjects related to construction. *These codes have yet to be modified to account for future climate changes* although work has been recommended by the owning Standards Committee. The relevant standards for this report are:

- EN 1990: *Eurocode: Basis of structural design* which sets out how subsequent Eurocodes (EN 1991 – EN 1999) are used; and
- EN 1991: *Eurocode 1: Actions on structures.* EN 1991 covers 'mechanical actions' including climate-relevant Snow Loads Part 1-3), Wind actions (part 1-4), and Thermal actions (Part 1-5).

2.7.3 European Standards

Listed below are those in the EC/ CEN/ CENELEC priority sectors. These are *Specification Standards* or *Test/ Analysis Standards* and *have yet to be modified to account for future climate changes:*

2.7.3.1 Building Sector

- EN ISO 15927-4 Hygrothermal performance of buildings – Calculation and presentation of climatic data. Part 4: hourly data for assessing the annual energy use for heating and cooling;
- FprEN 16798-1 and -3; -2 and -4 Energy performance of buildings Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6; and Part 3: Ventilation for non-residential buildings - Performance requirements for ventilation and room-conditioning;
- EN 16309 Sustainability of construction works. Assessment of social performance of buildings - calculation methodology;
- EN ISO 52000-1 Energy performance of buildings - Overall energy use and definition of energy ratings;
- *Proposed Standard* Climate resiliency of construction works.

2.7.3.2 Energy Sector

- EN 16348 Gas infrastructure. Safety Management System for gas transmission infrastructure and Pipeline Integrity Management System for gas transmission pipelines. Functional requirements;
- EN 15399 Gas infrastructure. Safety Management Systems for gas networks with maximum operating pressure up to and including 16 bar;
- EN 1473 Installation and Equipment for LNG – Design of Onshore Installations.

2.7.3.3 Transport Sector

- EN 206 Concrete Specification, performance, production and conformity;
- EN 15723 Closing and locking devices for payload protecting devices against environmental influences - Requirements for durability, operation, indication, maintenance, recycling;
- EN 50125-1, -2 and -3 Railway applications - Environmental conditions for equipment, Part 1: Equipment on board rolling stock, Part 2: Fixed electrical installations, Part 3: Equipment for signalling and telecommunications;
- EN 1915-1 and -2 Aircraft ground support equipment - General requirements, Part 1: Basic safety requirements, and Part 2: Stability and strength requirements, calculations and test methods.

2.7.3.4 Associated ICT Infrastructure

- EN 50600-2-1 and 50600-2-3 Information technology. Data centre facilities and infrastructures, Part 2-1: Building constructions, and Part 2-3: Environmental control.

2.7.4 CEN Guide 32: Guide for addressing climate change adaptation in standards

Special mention must be made of CEN Guide 32 (see Appendix A.6). This guide is intended for standards' writers and reviewers, and provides guidance on addressing aspects of climate change adaptation in European standardization documents.

Whenever a new European standard is drafted or an existing standard is revised or intended to be revised, those involved are encouraged to apply this Guide.

3 Relevance of standards to investors

Whilst it is recognised that the standards covered in the scope of this report are either not yet published, or have not been modified for the purpose of encouraging adaptation, this section describes how they can, in time, mainstream adaptation and provide investors with assurance that adaptation is being addressed in infrastructure projects.

3.1 Benefits of using Standards – how they can make a difference

Standards can have significant impact on climate change adaptation depending on how they are used and by whom they are mandated.

General benefits from using standards include how they (see Appendix A.1):

- are produced by experts and practitioners through a transparent, open and consensus based process;
- embody accepted good practice and can be used to demonstrate adoption of good practice;
- promote technical connectivity, interoperability and sustainability of activities, products and services;
- help with consistent terminology e.g. for climate resilience*;
- are used by many organizations, including governments, regulators and influential clients;
- can be a tool to support legislation;
- form documents for common and repeated use;
- can reflect market needs and opportunities;
- can remove trade barriers and facilitate access to markets;
- can be said to 'have teeth' and influence on infrastructure climate resilience (see Appendix A.7).

Specifically, impacts from climate change will affect infrastructure design, operation, maintenance and emergency responses, and standards provide tools for designers, builders, operators and users to ensure infrastructure safety, operability and longevity. Whilst large infrastructure systems (energy, transport etc) operate over several decades, design, operation and maintenance practices are commonly geared to the climate and its hazards remaining static. Established standards need to be revised urgently to help designers, operators, maintainers and users adapt infrastructure to the changes in climate over time, some impacts being are already evident.

* Note that ISO has established a "Terminology Task Group" that is coordinating and promoting consistency in terminology across all ISO 14xxx series Standards.

3.1.1 ISO Standards

Appendix B lists relevant ISOs, describing them and commenting on their utility for adaptation and resilience-building to investors. In summary:

- ISO 14030 relates to Green Bonds and Projects' environmental performance and will define requirements for green bonds monitoring and disclosure and provides guidance on assurance methods. Adaptation is not in its scope, but its terminology should align with other 'ISO 14xxx'-series standards. **Little impact on adaptation investments**;
- ISO 14080 relates to greenhouse gas-related methodologies for climate actions rather than adaptation. **Little impact on adaptation investments**;
- ISOs 14090 and 14091 relate directly to adaptation and cover processes for adaptation planning and climate change impact assessments – see box. **High impact on adaptation investments**;
- ISO/TS 14092 is a sector-specific Technical Standard intended for local governments and communities. It is not an 'ISO' and could have some impact on infrastructure investments, but it is less likely to be adopted than ISO 14090. **Little impact on adaptation investments**;
- ISO 14097 covers investments, financing and climate change. Its scope is under development and it is mostly related to greenhouse gas reduction, however it is possible

that any metrics proposed by this standard could be of interest to investors. At the Brussels January 2018 workshop it was felt that adaptation is inadequately represented. EBRD is engaged in the working group responsible for its development. **Medium impact on adaptation investments**.

EXAMPLE: ISO 14090, ISO 14091

ISO 14090 'Climate change adaptation, principles, requirements and guidelines' is to be published in 2019. An 'organizational' standard it is intended to guide those preparing adaptation plans, based on international best practice. The standard sets out a structured approach using impact assessments (for which ISO 14091 will give detail) to define organizational risks/ vulnerabilities and opportunities, and to implement plans to address these. Fundamentals include monitoring and evaluating the implementation of the plan, embedding learning, assessing organizational capacity to deliver the plan over time, involving stakeholders, and factoring adaptation into existing polices, strategies and plans. Adopting ISO 14090 will help to assure investors that robust, long-term adaptation plans will be set in place.

ISO 14090 can best be covenanted at an early stage of the investment process (as will other ISOs).

3.1.2 Eurocodes

in many cases Eurocodes are called up in national legislation, either by incorporation or by reference. In these cases, the use of Eurocodes is mandatory. They are therefore powerful tools that ensure the structural safety of infrastructure works and are widely used as requirements in contracts for design and engineering of public works; investors in Europe should not need to mandate their use as they are already required. The Eurocodes are under review for ease of use and new thinking, and this includes for modification to account for future climate change. Eurocodes do not presently account for all weather and climate impacts including flooding and drainage. **High impact on adaptation investments when modified**.

3.1.3 European Standards

The set of European Standards that define the design and operation of infrastructure are also commonly used in contracts, and twelve standards are under review by CEN/CENELEC for modification to account for future climate change.

These 12 sector-specific standards would ordinarily be adopted as 'good practice' by those working in the infrastructure sector.

The European Standards would be applied at the design, construction and operational phases of the relevant infrastructure but the 12 represent a small set of the totality of guidelines available across sectors. **Medium impact on adaptation investments when modified**.

Note: It is intended that C3S future weather data will become intrinsic to the updating of these European Standards with C3S providing the necessary, relevant weather parameters to aid climate-resilient design (see Appendices A.3, A.5).

4 Options for when to use Standards

This section discusses when standards can be introduced and at what stage during the infrastructure project lifecycle, along with discourse on benefits, concerns, non-EU countries and possible initiatives.

4.1 Early stages of an infrastructure project

To improve overall long-term climate resilience of infrastructure projects, investors can include organizational standards ISO 14090 (climate change adaptation) (and possibly ISO 14091 on vulnerability, impacts and risk assessment) as covenants to loan agreements. Discussion of ISO 14090 at pre-agreement stage in the early project development phase will bring transparency and put the investor on a robust footing. Requiring the borrower to adopt ISO 14090 will put them in a good position to anticipate and respond to climate change risks throughout the delivery of the infrastructure project. Investors can then require borrowers to seek some form of evidence to demonstrate compliance with the provisions of the standard, so assuring investors of the delivery of climate resilient infrastructure. Where loans are released in tranches, release can be made conditional upon demonstration of compliance.

Mechanisms can be drafted to ensure the embedding of provisions as set out by ISO 14090 in the borrower's project implementation plan. This could be by cross-referring to Eurocodes and European Standards such that there is a clear 'line of sight' from the adaptation provisions agreed at the outset through to delivery and operation of the infrastructure project.

Note that currently no certification or conformity assessment process for ISO 14090 exists, nor is planned by standards bodies such as ISO, however the act of investors requiring borrowers to demonstrate compliance would likely result in existing certification and conformity assessment bodies offering such services.

4.2 Infrastructure projects' structural design stage

Eurocodes are used at the structural design stage of infrastructure projects and many are mandated by EU member states for public infrastructure projects. Investors therefore will have limited scope to further enhance climate resilience of a specific infrastructure.

The technical report required by EC mandate M/515 sets out actions to incorporate climate change adaptation into Eurocodes. Climate resilience, once mainstreamed into Eurocodes, will thus be systematically incorporated into infrastructure as a result, with or without investor action.

Note that some recommendations from the committee responsible for the Eurocodes relate to important climate resilience areas that are not yet standardised – e.g. they do not presently account for all weather and climate impacts including flooding and drainage. This is a significant gap in the important area of design standards for safety and resilience.

4.3 Infrastructure projects' construction, maintenance and operational stages

European Standards are relevant to stages mainly after the structural design has been completed, for more detailed aspects of infrastructure design, construction maintenance and operation. They tend to be adopted as good practice in contracts and investors should be able to encourage their use if not mandate them.

CEN/ CENELEC have been required by the EC to integrate climate change adaptation into sectoral European Standards. Presently 12 standards related to transport, energy and building/ construction are planned for climate change adaptation modifications, along with one new standard. Climate resilience, once mainstreamed into these standards, will thus be systematically incorporated into infrastructure as a result. This is anticipated to take effect from 2022.

However, it is of note that these 13 standards represent a very small sample of the thousands of European Standards and likely do not cover as wide a range of climate resilience issues as might be possible. The Brussels January 2018 workshop confirmed that the CEN/CENELEC Phase 1 work relied upon the goodwill, capacity and understanding of standards committees in order to produce a list of priority standards. This has resulted in a potentially significant gap in standards requiring modification.

4.4 Non-EU Countries

For non-EU countries, once Eurocodes and European Standards have been modified, investors will be able to enhance climate resilience of infrastructure assets by including adoption of these as a covenant to loan agreements.

This may be challenging where other existing national standards (that have not integrated adaptation) are mandatory. There could be a role for investors to engage with national standards bodies to adjust national design standards in the same way that has been undertaken by CEN/CENELEC for the EU to achieve a similar outcome, however this is a lengthy process (>2 years).

4.5 Possible initiatives

It will take until 2022 for the Phase 2 CEN/CENELEC work on European Standards to complete. ISO14090 will be published early in 2019. In the meantime investors could consider covenanting the adoption of industry-led best-practice guidelines for climate change adaptation into loan agreements, and/ or undertake ad-hoc adaptation assessments and integration of climate resilience measures based upon these guidelines. Sector examples include, "International climate change adaptation framework for road infrastructure[9]" by the World Road Association (PIARC), "Navigating a changing climate[10]" by the International Navigation Association (PIANC), and "Rail Adapt: Adapting the railway for the future[11]" by the International Union of Railways (UIC).

These guidelines are a mix of organizational and design standards. There is a challenge in that there is little track record of implementing these, and impact on specific investments is unknown.

Application of these guidelines and project-by-project adaptation measures will enhance the climate resilience of infrastructure projects.

USE OF STANDARDS - EXAMPLE OF ROADS' INVESTMENT

- Finance: €60M
- Counterparty: Publicly owned roads company in EU accession country
- Use of proceeds: Upgrade and rehabilitation of 100km of road network
- Potential Standards' entry points:
  - Organizational plan for introduction of ISO 14090 and support for roll-out **will assure long-term viability**
  - Requirement for concrete used in construction to meet revised EN 206 *Concrete Specification, performance, production and conformity* **will assure durable materials**
  - Requirement to use revised Eurocodes for structures – bridges, culverts, etc. **will result in robust designs**
  - Ad-hoc project-level climate change adaptation assessment in-line with PIARC guidance, and capacity building, to introduce best-practice approaches, feeding into Policy dialogue to support adjust national design standards **will allow lessons learned to influence Policy and the development of new measures**

5 Conclusions

International standards relating to climate change are still in the development stage. ISO is drafting a series of linked, adaptation-related organizational-level standards for introduction from 2019. These are, as at February 2018, ISOs 14090, 14091 and ISO/TS14092.

ISO 14030 (Green bonds), ISO 14080 (Methodologies on climate actions), ISO/TS 14092 (Local government planning), and ISO 14097 (Climate finance) *are of lesser importance* to investors in relation to climate resilience than are ISO 14090 and ISO 14091. ISO 14097 could benefit with more emphasis on adaptation. Whilst these standards are of lesser importance to investors than are ISO 14090 and ISO 14091, they are all in the development stage and there are risks that scope changes might impact adaptation beneficially or detrimentally.

Eurocodes cover the safe design of infrastructure. Many countries mandate Eurocodes for public works.

European Standards cover detailed design, maintenance and operation of infrastructure and are mainly used in contracts.

Investors can choose to covenant the use of any standards in projects they sponsor.

The Eurocodes have been reviewed and recommendations for modifying these, and introducing new guidelines related to weather and climate change impacts have been made. Assistance from the C3S programme on weather and climate parameters is planned.

13 prioritised European Standards will be modified or introduced, by 2022, to cover future climate changes and associated weather impact with assistance from the C3S programme.

Proposals for modifying Eurocodes and the prioritised European Standards do not cover the whole range of weather/ climate impacts such as floods, and impacts on drainage assets. There are therefore potentially significant gaps in both the Eurocodes and European Standards related to climate resilience.

Until the modified standards are available, investors could choose to covenant good practice guidelines from sector bodies e.g. PIARC, PIANC and UIC into projects.

A specific standards committee recommendation that *inspections and maintenance schemes should be emphasized and adjusted for structures approaching their expected life time* is particularly relevant for work associated with and adjoining long-life infrastructure.

For specific infrastructure investments in the EU, beyond identifying and requiring adherence to legal requirements and standard industry practices, investors have limited scope to further enhance climate resilience of a specific infrastructure asset through specification standards.

By discussing the use of adaptation-related organizational (ISO) and specification (Eurocodes and European Standards) at pre-agreement stages early in the project development phase, and by linking the release of loan monies to borrowers when they demonstrate ‘compliance’ with e.g. ISO 14090, investors will be assured that the issues of resilience and adaptation to climate change will be adequately addressed. Embedding the provisions of ISO 14090 into borrowers’ implementation plans will ensure continuity of the initial adaptation strategy. The approach described in this paragraph will accomplish the vision; the onus shifting to borrowers to provide investors with assurance on making infrastructure climate resilient.

6 Recommendations

Investors should adopt a ‘watching brief’ regarding the evolution of the ‘less influential’ ISO 14030 (Green bonds), ISO 14080 (Methodologies on climate actions) and ISO/TS 14092 (Local government planning).

EBRD (who are represented on the working group for ISO 14097 Climate finance etc.) should ensure that adaptation is featured adequately more prominently in this ISO.

EUFIWACC members should consider the possibility of ISO/SC7 liaison status.

Investors should engage with and support the CEN/ CENELEC 'Phase 2' programme to modify the prioritised European Standards.

Investors should encourage coverage of the whole range of weather/ climate impacts on infrastructure in the Eurocodes and in European Standards.

In view of the timeline for modifying Eurocodes and European Standards, investors should consider covenanting good practice guidelines from sector organizations (e.g. PIARC, PIANC and UIC) into infrastructure projects.

Investors should encourage the use of CEN/ CENELEC Guide 32 in organizations that are developing guidelines for climate change adaptation.

Investors should discuss adaptation and standards at early stages of infrastructure projects with a view to covenanting the adoption of ISO 14090 (when published) into loan agreements, and should link the release of loan monies to borrowers on evidence of 'compliance' with ISO 14090. Mechanisms should be found to ensure the embedding of provisions as set out by ISO 14090 in the borrower's project implementation plan.

7 Key References

[1] Adapted from CEN/ CENELEC: https://www.cencenelec.eu/research/innovation/standardstypes/Pages/default.aspx
[2] http://www.ena-eng.org/ENA-Docs/EADocs.asp?WCI=DocumentDetail&DocumentID=8021
[3] Adapted from ISO: https://www.iso.org/developing-standards.html
[4] ANSI's "Standards Management: A Handbook for Profit"
[5] https://www.cen.eu/work/areas/construction/eurocodes/Pages/default.aspx
[6] http://eurocodes.jrc.ec.europa.eu/doc/publicprocurementdirective.pdf
[7] http://eurocodes.jrc.ec.europa.eu/showpage.php?id=1
[8] https://www.iso.org/foreword-supplementary-information.html
[9] https://www.piarc.org/en/order-library/23517-en-International%20climate%20change%20adaptation%20framework%20for%20road%20infrastructure.htm
[10] http://navclimate.pianc.org/events/navclimate/navigating-a-changing-climate-moving-towards-low-carbon-and-resilient-waterborne-transport-infrastructure
[11] https://uic.org/IMG/pdf/railadapt_final_report.pdf

Appendix A: Syntheses of documents submitted by EBRD to JDCL

A.1 Presentation: Role of European Standards in support of the global effort for tackling climate change and its impacts. Andrea Nam, CEN/ CENELEC, Bonn, November 2017.

This presentation first described CEN, the European Committee for Standardization; CENELEC, the European Committee for Electrotechnical Standardization; and ETSI, the European Telecommunications Standards Institute. Between them more than 200,000 experts are connected with 34 national members across Europe. Affiliates include the national standards bodies in countries that are cooperating with the European Union and internationally with ISO and regions and countries outside the European Union and EFTA. European standards have a potential market of 600 million consumers.

Introductory slides covered, among others:

- The 'harmonization effect'; where the provisions in many countries' standards have been consolidated into one European Standard with conflicting standards removed;
- Why European Standards are unique; being documents for common and repeated use, produced by interested parties through a transparent, open and consensus based process, voluntary in use, reflecting market needs, supporting legislation and aligned with ISO/ IEC standards;
- The added value of standards; reducing transaction costs, increasing safety, promoting technical connectivity, interoperability and sustainability of products and services, aiding compliance with legislation;
- International agreements with strong international influence resulting in agreed primacy of international standards, avoiding duplication at international and European levels and identical worldwide and European Standards.

On climate change adaptation, A Nam related how since 2014 standards work on adaptation has been coordinated as a result of EU Policy and the EC request to CEN/ CENELEC to coordinate and lead this work. The key driver was the EU Strategy on adaptation to climate change – 'COM(2013) 216 final' and its 'Action 7: Ensuring more resilient infrastructure'.

Tasks undertaken by CEN/ CENELEC include supporting the implementation of the EU Strategy to contribute to building and maintaining a more climate resilient infrastructure throughout the EU in three key sectors - transport infrastructure, energy infrastructure and buildings/ construction (and including ICT (Information Communication Technology) infrastructure that are closely interconnected).

Phase 1 of the work is complete – the programming phase – with relevant standards being identified and prioritized with a list of the list of standards (up 20 per sector were originally envisaged) - to be revised and/or adopted first. 13 standards have been identified – 12 existing and one new standard is proposed.

A subsequent phase - Phase 2 - will revise these priority standards to represent best practice [in adaptation and resilience building].

The presentation then described CEN/ CENELEC Guide 32 - Guide for addressing climate change adaptation in standards. This was published in 2016 and is for standard writers, to enable them to identify relevant climate impacts and include climate change adaptation considerations in new or revised standards. It adopts a four-stage 'why – what – how – outcome' process.

Six themes and challenges were listed:

- Importance of awareness raising;
- Understanding climate change and adaptation;
- Guidance and training for standard developers;

- Climate data/projections availability for use;
- Cooperation with policy makers;
- Cooperation with standards development organizations at international level (CEN/ CENELEC sector specific work v. ISO horizontal work).

A.2 Report: Climate Change. CEN Project Team SC1.T5, April 2017.

This report is the final draft of the Technical Report from the Project Team SC1.T5 (PT5) as required by CEN under its Mandate M/515 for the development of the 2nd generation of EN Eurocodes [these are used as the basis for structural design in construction projects – the Eurocodes covered here relate to loadings imposed by weather effects e.g. wind on tall structures]. The intention of the report, among others, was to identify possibilities to advise Eurocode writers on how to refer to and implement possible effects from the known future changes in the climate of extremes in Europe.

Hence, the Report refers to reports and findings especially from the most recent scientific literature available, as well as various socio-economic and other summary reports. The report is set out in 11 sections, including:

- Scope of work;
- Main conclusions of the report;
- General overview on current knowledge concerning climate change;
- Climate parameters in Eurocodes;
- Information relevant for a tentative updating of modelling climatic actions;
- Recommendations for Eurocodes;
- Additional sources of information;
- A recommendation for a European follow-up project on climate maps;
- Conclusions and recommendations.

The report itself covers much technical detail; its conclusions and recommendations are reproduced here in full:

It became very clear from this literature survey that the science of global climate changes is still not sufficiently developed to identify any substantial methods for quantification of extreme values (with given return periods) for neither temperature, wind, rain, snow nor any combination of these, to be valid for the forecast of developing climate in Europe.

The Project Team could not identify in the available literature any new method to assess extreme values of weather parameters for Actions on Structures, based on climatic models for extremes, which are better scientifically justified than those obtained by conventional methods. Today's models give wide dispersions concerning quantitative changes of the weather parameters studied, depending on the parameter and the selected climate scenario. Consequently, quantifications of extremes with given probability levels are not yet feasible enough for design parameters of actions with an adequate level of confidence.

Credible predictions of quantifiable trends were not identified for basic wind velocity, snow load on ground, shade air temperature, ice/glaze accretion on the reference collector, rain intensity, etc., in the available literature.

The following conclusions are therefore recommended until new analytical methods are developed:

Weather parameters significant for specification of characteristics and design loads should be re-examined at regular intervals (recommended maximum 10–15 years) according to conventional methods (extreme value analyses), despite expected deviations from stationary conditions in parent distributions in longer time series.

Verification of partial factors with respect to uncertainties in the extremes of climate actions in connection with regular re-examination of weather parameters.

Inspections and maintenance schemes should be emphasized and adjusted for structures approaching their expected life time.

Models for extreme value calculations of basic variables will need to be updated on the basis of new knowledge on variation of weather parameters, both with respect to traditional input data as well as model data and analysing tools. Should be reviewed at regular intervals (it is assumed 10 - 15 years).

Safety factors should be reconsidered with respect to the above mentioned uncertainties in the extremes of loadings.

About temperature: The trends show increasing, although still not quantifiable, values over all Europe. It should be noted that existing climate change models estimate scenarios of average surface warming from 1,5°C up to 5°C.

About precipitation: Lack of a robust pattern over Europe, although a trend toward more heavy precipitation.

About snow loads: Forms a complex combination of temperature, precipitations and wind which will vary significantly over Europe, even within individual countries.

Extreme winds: Controversy remains regarding long term changes since the middle of the 19th century. Indications of increase in damage in Northern and Central Europe, while Southern Europe may expect fewer extreme wind storms.

Evolution in weather parameters: A procedure to "take snapshots" out of models of the climate at some specified years is not recommended, due to lack of linearity. A full statistical survey is required to get realistic time perspectives for any selected emission scenario.

Also of note was that new guidance was recommended for environmental impacts as these are not adequately addressed in current Eurocodes, including water action and flooding.

A.3 Project: Climate forecast data to be included in standards for infrastructures. Copernicus Climate Change Services, September 2017.

Key points

This document is a proposal from NEN, the Netherlands' standards organization, for providing Copernicus Climate Change Services (C3S) with information regarding weather and climate data needs for infrastructure standards, as determined by standards' users. It is the basis of the contract being undertaken by NEN and consultant BGMI for C3S.

The proposal explains how data needs from the standardization community can influence the outputs of C3S, and how NEN will seek advice using a network of those involved in infrastructure standards in Europe. NEN has now reviewed European Standards for relevance to resilience and adaptation to climate change for CEN/ CENELEC. From this work a selection of pilot standards will be revised, and tools for standards writers will be developed.

NEN's approach was to identify relevant standards' Technical Committees, experts and other stakeholders such as investors and insurance companies and to survey these and other experts, using a questionnaire, telephone interviews and interviews. The results of this exercise were to be discussed in a workshop [November 2017] towards an invitation to tender for further, detailed work on modifying the Eurocodes and European Standards to make them clearer and more suitable to address climate change adaptation. This is 'Phase 2'. This work will drive the production of a weather forecast database that will support infrastructure standards and so allow users to identify weather impacts for future infrastructure.

Other information from the proposal

C3S

The remit of C3S was described – to derive authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide. It will provide key indicators on future climate as well as impacts. The aim of these indicators will be to support European adaptation and mitigation policies in a number of sectors. The service will provide comprehensive climate information and timescales spanning decades to centuries, using earth observations and modelling, supercomputing capabilities. The portfolio of service products will include multi-model seasonal forecasts and climate projections at global and regional scales.

Standards: Improving resilience to climate change

Impacts from climate change will affect infrastructure design, operation, maintenance and emergency responses, and standards provide tools for designers, builders, operators and users to ensure infrastructure safety, operability and longevity. Whilst large infrastructure systems (energy, transport etc) operate over several decades, design, operation and maintenance practices are commonly geared to the climate and its hazards remaining static. Established standards need to be revised urgently to help designers, operators, maintainers and users adapt infrastructure to the changes in climate over time, some impacts being already evident.

Infrastructure standards – Eurocodes and European Standards

The Eurocodes specify how structural design should be conducted within the European Union.

The Eurocodes enable the design of structural - building and civil engineering - works in order to comply with requirements for 'mechanical resistance and stability', and 'safety in case of fire' and 'safety in use'. The Eurocodes are being amended for climate change considerations in an on-going European project, led by NEN and BSI.

'European Standards' comprise many infrastructure types that are not covered by the Eurocodes. These standards are subject to the EC mandate on adaptation to climate change and Phase 1 of this work is complete. Phase 1 identified 13 standards relevant for climate change in three EC priority sectors; transport infrastructure, energy infrastructure and buildings/construction. Phase 2 of the project will revise these standards to include adaptation to climate change. NEN leads this work with with GDV (the German Insurance Association) as chair of the Coordination Group, and BMGI.

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For infrastructure, designers, operators and maintainers need reliable and relevant data about climate change to allow safe and performing services over decadal timescales. These data are not currently available so the proposal identifies a need to fill this gap and engage standards writers and C3S in systematically considering climate change data in standards.

Stakeholders

Standards Technical Committees and Working Groups – those responsible for drafting and updating standards – are to be engaged in the ongoing work to modify Eurocodes and European Standards, and the project liaises with international standards groups such as ISO/TC 207/SC 7 Greenhouse gas management and related activities.

Other stakeholders with interest in adapting infrastructure include the insurance sector, investors in infrastructure - the EBRD (European Bank for Reconstruction and Development) and the ECB/ Jaspers are interested in this work. Liaisons are in place or proposed with the EC, the European Environment Agency; the Covenant of Mayors initiative (1500 cities and communities engaged in energy saving and climate change mitigation and adaptation); the

International Energy Agency and the European Environmental Citizen Organization for Standardization.

A.4 Report: 'Analysis of answers given to questionnaire'. Copernicus Climate Change Services/ BMGI Consulting/ NEN, 17th November 2017.

Note: This document was presented to JDCL as a draft document and was intended as an input to a workshop on standards held by CEN/ CENELEC and Copernicus Climate Change Services (C3S) in Brussels on 22nd November 2017. Its findings relate to an online questionnaire on climate change adaptation in relation to standards for infrastructure, conducted by NEN on behalf of C3S in cooperation with consultant BMGI and KNMI, the Royal Dutch Meteorological Institute.

The key findings noted were that most who replied follow existing standards based upon historical weather patterns rather than use future climate scenarios, that data are scarce, and that is difficult to interpret information. Where future information is used, it is based on national or global databases. Recent past information about extremes is used on occasion, not routinely.

Respondents indicate a clear need for reliable climate data, both recent past and the future in particular for extreme events, in terms of frequency. There is a preference for data for temperatures (high/low), rain, snow, flood and sea level and also for hail, lightning, solar radiation, and air pollution.

Data that can be used easily by non-weather specialists is desired and should be aligned with standards, especially the Eurocodes. Users will need training for interpretation of climate data in standards, for instance regarding questions about the types of data to be used, and how to deal with uncertainties. These data are needed for all types of weather and should cover means and extremes, at hourly and daily resolutions and down to 10 minutes and 3 seconds for wind. Comments were made on spatial resolutions for different weather type e.g. 1-10 Km2 for hail, rainfall, heat islands; how event duration is important for extremes of temperature, solar radiation and drought; how accumulation is relevant for rainfall and snow; and that atmospheric icing should be added.

Information on coincidence of climate events was felt to be vital – e.g. snow followed by rain.

The document then set out questions for the November workshop, such as:

- Whether the interpretation of data needs was correct?
- Projections: should climate projections show impacts for different scenarios, or should this be integrated in a more simple presentation?
- Probabilities: What is the best way to express the probability of events - return periods, percentiles and the number of days that a certain level will be exceeded?
- Uncertainties: Future climate data have uncertainties (due to scenarios and models). How should these be expressed? Would it suit to give a most probable value and a range?
- Training: Respondents indicate that training is needed. What should training be focused at?
- Standards: how to align climate data with specifications in standards?

A.5 Presentation: Future climate data in standards for infrastructures. Ab de Buck, NEN, Bonn, November 2017.

This presentation covered the role of European Standards in support of the global effort for tackling climate change and its impacts, and described how NEN, the Netherlands' Standards body, is working with CEN/ CENELEC to identify pilot standards (13 in number) as part of the EC mandate for inclusion of climate change adaptation in standards for infrastructure.

Infrastructure was shown to be key to the functioning of society, with infrastructure lifetimes up to 100 years. Standards are key to specifying infrastructure design, safety, and operation. Structural Eurocodes define the safety of construction works. All standards help with resilience to extreme weather impacts but weather parameters are based on historic data.

The project 'Future climate data for infrastructures' on behalf of Copernicus Climate Change Services (C3S) was covered; C3S is the EU organization that develops authoritative, quality-assured information about past, current and future states of the climate in Europe. C3S will provide information on all major weather effects, such as: rain, wind, drought, sea level rise and at detailed spatial resolutions. C3S can therefore inform standards and the presentation outlined how NEN and C3S had arranged a questionnaire and workshop in November 2017 to define and take this work further.

The questionnaire's initial results were summarised from the large response of 76 out of 125 polled:

- Most infrastructure types appear vulnerable;
- Climate information is needed for design and operational phase;
- Most respondents need data for extreme temperatures, rain, snow, wind, flood, drought, hail, lightning, solar radiation with information on return periods of extremes up to over 1000 year return periods.

A.6 Presentation: CEN-CENELEC Guide 32 for addressing climate change adaptation in standards – adaptation and transport. Kay Johnstone for BSI, Madrid, 18th January 2016.

This presentation is about the CEN/CENELEC 'Guide 32 for standards writers and looks specifically at the guide in relation to the transport sector. The guide is to aid writers when drafting or modifying standards relating to 'products' [defined as a 'good, service, infrastructure or test'] which might be influenced by the future climate. Key messages are:

- Climate change will affect the fitness for purpose of some products;
- These products interface with many others as part of a 'system';
- In addition, some products have a specific resilience function;
- Product standards have the potential to either constrain or support adaptation;
- Using information about the future presents standard writers with new challenges.

The presentation summarises the guide viz: outlining its step-by-step approach and stating how 'the climate is changing and will continue to change' over future decades despite mitigation efforts. It then outlines why products need to change – to become climate resilient; those that are not fit for the future climate can increase the vulnerability of transport. Basing designs on past climate/ weather could lead to products that are not fit for purpose, and the presentation emphasised that products with long lifetimes are more vulnerable but acknowledged that current risks may be underestimated.

What standards writers ought to consider is described e.g. relevant climate impacts across all life-cycle stages, climate and weather, current and future and impacts across the whole system, as is what data, information should be included in any new and revised standards. The guide's approach involves a checklist and a decision tree which is used to tailor the checklist covering new/ existing standards, short term or long term, climate adaptation product or climate influenced product, what climate information is needed/ available.

A rail example from the UK is given showing how Network Rail used weather data and infrastructure fault data to develop standards covering operational "weather thresholds" for 'normal', 'adverse' and 'extreme' weather conditions.

A.7 Email: 'Do standards have teeth'. Ab de Buck of NEN to Craig Davies of EBRD, 15th November 2017.

Standards are voluntary agreements, but can be influential depending upon how the standard sets requirements – does it have firm requirements, or is it more illustrative? Does it have ways to assess conformity with its provisions?

Furthermore the standard could be specified in contracts for e.g. construction – as accepted good practice – or mandated by law as are the 'Eurocodes' which state requirements for safety for all construction works specifying loadings for weather phenomena such as wind, snow and rain. The Eurocodes are required for public works by European law.

Other European Standards define the design and operation of infrastructure and are commonly specified in contracts. In addition a range of standards is referred to in legislation (the so-called harmonized standards, or h-EN standards).

The above can be said to have 'teeth' by virtue of how they are used.

Global standards for quality management (ISO 9001), environmental management (ISO 14001), asset-management (ISO 55000) have a strong position, as documents that provide clear guidance and are used by a broad range of users.

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Appendix B: Table of proposed ISO Documents with an outline of their utility for long-term adaptation and resilience investments

Reference	Title	Description	Utility to investors in respect of adaptation
ISO 14030	Green Bonds - Environmental performance of nominated projects and assets	Standalone project-related standard to specify eligibility requirements and define procedures for evaluating the environmental performance of green bonds. It defines requirements for green bonds monitoring and disclosure and provides guidance on assurance methods.	Investors will benefit from standardized approaches to defining the eligibility of nominated projects and assets and will be able to make investment decisions based on standardized environmental criteria. Little impact on adaptation/ resilience building for investors.
ISO 14080	Greenhouse gas management and related activities - Framework and principles for methodologies on climate actions	Provides a framework to establish approaches and processes to identify, assess, revise, develop and manage methodologies that reduce current and/or future climate change risk, with a focus on GHG- related methodologies.	Focussed on GHG-related issues. Little impact on adaptation/ resilience building for investors.

ISO 14090	Adaptation to climate change – principles requirements and guidelines	Intended as a 'top-level' framework allowing follow-on standards to follow its terminology and concepts e.g. ISO 14091, ISO TS 14092.	• Covers ANY Organization • Applicable at ANY stage of adaptation; early involvement with interested parties is recommended • Permits CHOICE of e.g. assessments methods for climate change impacts • Flexible – approach is standardized BUT… • Enables tailored solutions, not 'one size fits all' • Strong on Capacity • Strong on Leadership and Commitment High impact on adaptation/ resilience building for investors.
ISO 14091	Adaptation to Climate Change – vulnerability, impacts and risk assessment	A detailed guide on carrying out vulnerability assessments. Fits under ISO 14090 'umbrella'.	Useful adjunct to ISO 14090. High impact on adaptation/ resilience building for investors.
ISO/ TS 14092	Greenhouse gas management and related activities: Requirement and guidance for adaptation planning for organizations including local governments and communities.	Sector-specific document on adaptation planning intended for local governments and communities.	A Technical Standard hence less robust that a full ISO. It is not an 'ISO' .a Could have some impact on infrastructure investments, but it is less likely to be adopted than ISO 14090. Potential for little impact on adaptation/ resilience building for investors.

ISO 14097	Investments, financing and climate change	Scope still under development as at November 2017. The standard will focus on developing a framework to assess the contribution of investments to the Paris Agreement, this will include the process to set targets, climate actions and the metrics to measure progress of the targets and the impact of actions. Standardization avenues around scenarios will also be considered.	Mostly related to GHG reduction but some useful concepts such as the development of metrics could be helpful to investors. Needs to adequately represent adaptation. Potential for medium impact on adaptation/ resilience building for investors.