Framework for Climate Adaptive Buildings

Assessing physical climate risk at the building level

Dutch Green Building Council

Summary for policy makers and real estate professionals

The Framework for Climate Adaptive Buildings (FCAB) offers a practical standard methodology for assessing physical climate risk for existing buildings in the Netherlands. The Framework was developed by Dutch Green Building Council (DGBC) together with a broad alliance of over 40 organisations, among them real estate investors, consulting firms, financial institutions and (semi-)governmental organisations.

The initiative started in response to black box climate risk methodologies that produced risk scores that were difficult to understand. The FCAB methodology is fully transparent, open source and based on freely available geographical information system (GIS) data with national coverage for the Netherlands. The initiative aims to establish a level playing field in climate vulnerability and risk assessments (CVRA) methodologies. The open access character of the methodology is an important driver for a swift uptake in the market.

For calculating the climate risk score at the building level, we take the general formula of risk, combining probability and impact. In our approach we take hazard and exposure as the probability-side, an take the vulnerability of a building (by assessing building characteristics) to estimate the effect of this exposure. See the formula below.

The Framework distinguishes between four main climate themes: heat, drought, heavy precipitation and flooding, which matches the Dutch national approach for climate adaptation.

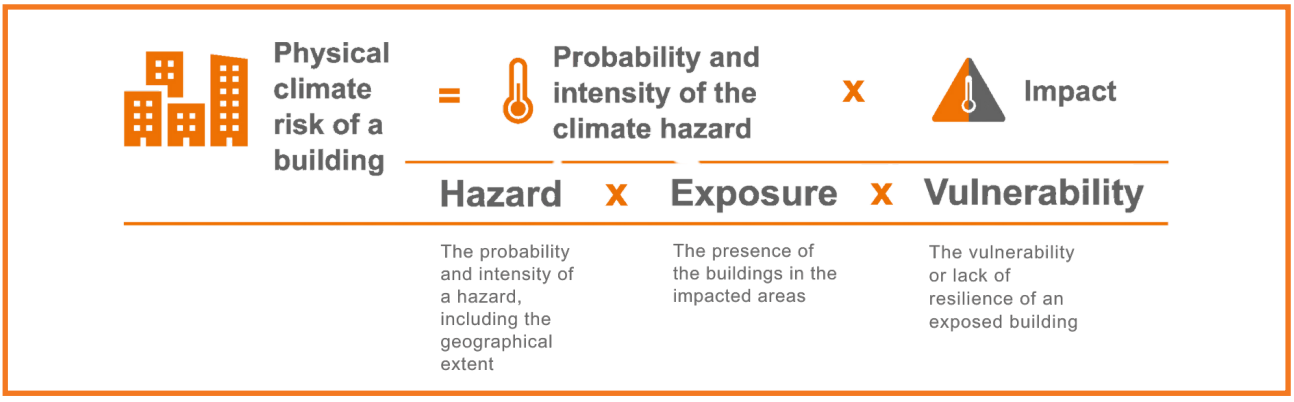
The FCAB methodology consists of three separate publications:

1. A methodology for determining the Building Environment Score
2. A methodology for determining the Building Vulnerability Score and the Building Climate Risk Score
3. A guide for evaluating the risks and taking climate adaptation measures (adaptation plan).

All parts are published in Dutch and freely available. The overall Framework aligns with the EU Taxonomy guidelines, which makes it a valuable instrument for the real estate market. The Framework is a living document and will be revised in the future, when for example new data, new knowledge or new climate scenarios come into play.

Building Environment Score

The first step in the methodology is determining the Building Environment Score. This step corresponds with general risk assessment methodologies by assessing the hazard and exposure for a specific location, regardless of the building type (risk = exposure x vulnerability) .



Framework for climate adaptive buildings

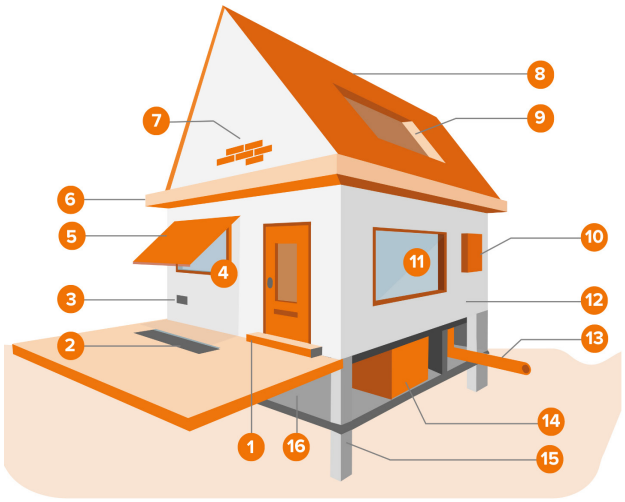
This assessment is completely based on national, freely available open data from the government-funded Dutch Climate Impact Atlas. We selected (in an expert consultation process) seven datasets from this Climate Impact Atlas that are relevant to the effects on buildings. Current and future hazards are assessed. They are categorised by the four themes mentioned above. The seven hazards are: heat stress, wildfires, soil subsidence (causing foundation damage), heavy precipitation, groundwater flooding, flooding from rivers or the sea (more precise: flood depth future research agenda.

Building Vulnerability Score

The second step of the methodology is determining the vulnerability of the building which corresponds with general risk assessment methodologies by assessing the impact on a specific building. Not all buildings are susceptible to a hazard in the same manner. So to determine the Building Vulnerability Score, a list of relevant building characteristics has to be taken into account. Both the selection of the most relevant building characteristics and their relative weight in the methodology were determined in expert opinion sessions. Examples of building characteristics are: construction year (related to foundation pole rot), window surface in relation to the total facade surface, roof type and colour, isolation material (heat stress), height of the doorstep and presence of a basement (risk of flooding from heavy precipitation) and more. For each climate theme, there is a table with all relevant building characteristics and the corresponding scores and weights. The total score per climate theme is the building vulnerability score (0-100), with high scores meaning high vulnerability.

Building Climate Risk Score

After the Building Vulnerability Score is determined, it can be combined with the Building Environment Score to determine the Building Climate Risk Score. For each climate theme, there is a risk matrix with the obtainable Building Environment Scores and Building Vulnerability Scores on the axes. This matrix defines five risk classes: very low, low, medium, high and very high. The Framework suggests that buildings with a Building Climate Risk Score of ‘high’ or ‘very high’ should be considered a ‘material risk’ that (under the EU Taxonomy) should be significantly reduced by taking climate adaptation measures. The Building Climate Risk Score identifies 'red flags' within a building portfolio. It indicates the level of risk, not the actual risk in terms of damage or costs. For the ‘red flags’ a further deep dive on impacts at the building level is advised.



1. Building entrance elevation
2. Drainage channel
3. Inflow sources
4. Glazing ratio
5. Solar shading
6. Overhang
7. Thermal mass
8. Wall and roof colour
9. Insulation
10. Active cooling and ventilation
11. Solar heat gain coefficient
12. Night purge ventilation
13. Anti-return valve
14. Underground systems and utilities (fixed)
15. Foundation type
16. Basement

Relevant building characteristics to the climate hazards in The Netherlands

Adaptation Action

The third publication provides a perspective to building owners on how to set climate adaptation strategy and how to select and plan adaptation measures. The publication puts the risk assessment within the broader scope of a risk management cycle. Before jumping to conclusions (measures) you may need to take a second look at the

red-flagged buildings in terms of a technical deep dive. It is also useful to consider the sensitivity of the building user (e.g. elderly people), or the alignment of measures with the organisation strategy (e.g. mission or risk appetite policies). When it comes to taking measures to significantly reduce the climate risk, the Framework suggests three different kinds of approaches:
1) non-physical measures such as evacuation plans or the education of building users, 2) measures in the surroundings of the building that decrease the exposure and 3) measures at the building level that decrease the building vulnerability. A mix of these measures is suggested to support the resilience of a building and its environment. As an inspiration, the third publication includes a long list of more than 100 climate adaptation measures that are specifically relevant for existing real estate in the Netherlands. The measures are categorised by climate theme, implementation effort and costs.

What's next?

The Framework for Climate Adaptive Buildings is a living document that will be revised in the future when there are new scientific insights, for example regarding IPCC scenarios or building vulnerabilities. Currently, DGBC is exploring the opportunities for collaborative development of improved hazard maps for different climate themes such as water nuisance and heat stress. The project has delivered a research agenda that (with help from academia) can be put into new research programmes.

Lessons learned

During the development period, four notable lessons learned were found:

- There is a need in the market to move awayfrom 'black box' climate risk assessments that deliver outcomes that cannot be understood or benchmarked. Transparency and open access are key elements for success and uptake in the market .
- **A close collaboration between various stakeholders is required.**
  For example, the demand for risk assessments comes from commercial real estate owners, while the data and knowhow come from knowledge institutes. Evaluate the willingness

to pay with commercial real estate companies for the development of a standard framework to assess climate risk in their portfolio. Also (local) governmental organisations might be interested in playing a part. Screening portfolios on climate risk may raise the willingness of private investors to support public or collective climate adaptation measures.

- **Perfect is the enemy of good.**
  The perfect methodology to assess something in the future simply doesn't exist. Developing a standard framework requires constant revision from experts, several iterations and most of all, time. Be pragmatic, put your challenges on a research agenda and move forward.

- **If possible, build on existing frameworks.**
  For example, the Dutch government already had a national stress test approach for climate risk analysis for municipalities. The FCAB Building Environment Score is partially based on this approach which makes the results of the analysis recognisable for municipalities and therefore supports the dialogue between municipality and real estate owners.

International perspective

Organizations often struggle with climate change expertise, prompting the rise of commercial services that evaluate physical climate risks in real estate. This has accelerated with the necessity to report on physical climate risks as part of the EU Taxonomy. As financial actors increasingly depend on these commercial services, the market for climate-risk startups has grown, despite many using 'black-box' methods that lack transparency.

Studies carried out by members of the alliance on various data vendors showed inconsistent risk metrics for real estate assets, highlighting the difficulty investors face due to methodological differences, data source variability, and non-standardized scoring criteria. These disparities hinder accurate risk evaluation, complicate comparisons and obstruct knowledge exchange. To overcome these issues, enhancing transparency and standardizing climate risk assessments are essential for improved cooperation and risk management. To achieve this, we should aim for a common language, moving away from relying on 'black- box' models.
We noted that the FCAB approach is one of the first methodologies that is specific to existing buildings, in the sense that it includes building characteristics in the risk assessment. DGBC has initiated a Special Interest Group within the European Regional Network of the World Green Building Council to further investigate international cooperation on an international standard for physical climate risk assessments for existing buildings.

Contact for more information
Jan Kadijk
Dutch Green Building Council
j.kadijk@dgbc.nl, +31 (0)88 - 55 80 100

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