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CLIMATE-RELATED PHYSICAL RISK ASSESSMENT IN 2023

Népliget Center

1097 Budapest, Könyves Kálmán krt. 11.

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TABLE OF CONTENTS

1. Introduction

Climate-related physical risks:

„Physical risks, such as instances when storms or floods damage homes and roads, or destroy crops, are a direct result of climate change. The frequency and severity of such events have increased in recent decades and they are affecting more and more parts of the economy.

Longer-term changes such as altered precipitation patterns and rising temperatures are also causing disruption to some industries and agriculture. If we do not take steps to slow down these changes, the negative impacts will only worsen."

For the BREEAM certification of the Népliget Center Office Building, the above climate-related physical risks also need to be considered.

2. Basic data

The present study has been prepared for the Népliget Center Office Building (1097 Budapest, Könyves Kálmán krt. 11.) in 2023.

Main data of the Népliget Center Office Building:

Owner: Népliget Béta Ingatlan Kft.

Headquarters: 1097 Budapest, Könyves Kálmán krt.11.

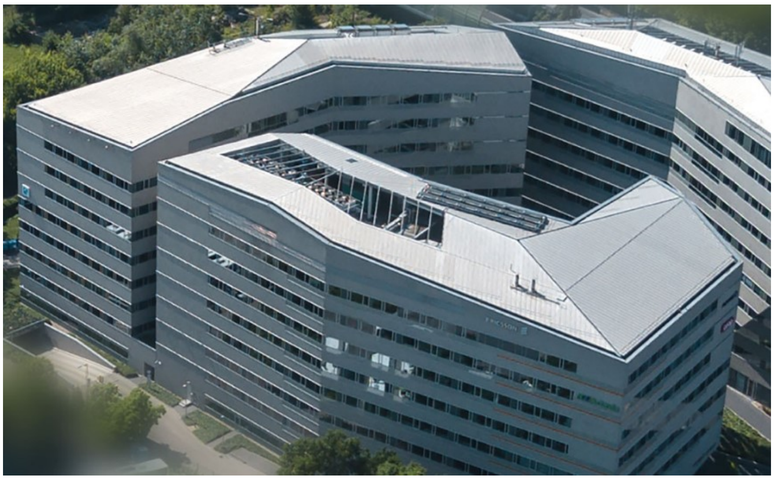
Business premises: 1097 Budapest, Könyves Kálmán krt. 11. Népliget Center

KÜJ (Environmental Customer Code): 102908446

KTJ (Environmental Area Code) Népliget Center Building A: 101652709

KTJ (Environmental Area Code) Népliget Center Buildings B + C: 102107394

Operator: White Star Real Estate Kft. (1124 Budapest, Csörsz utca 49-51.)



Bird's-eye view of the Népliget Center Office Building

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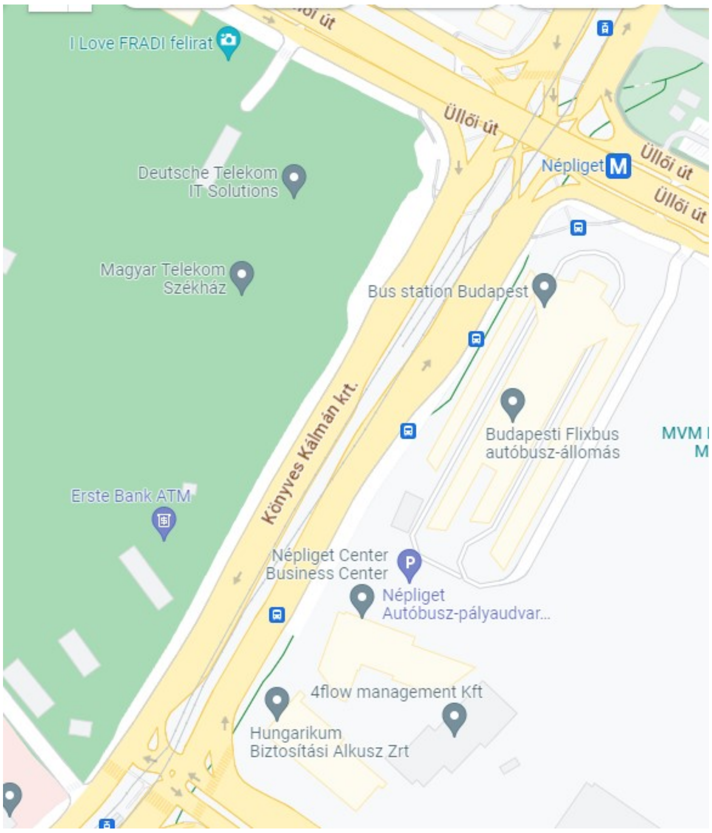
The Népliget Center office building is located in a prominent area of Budapest, at the intersection of Könyves Kálmán krt. and Üllői út (Gyáli út overpass, M5 highway access), next to the Népliget bus station and the MVM Dome (sports hall).



Accessibility of the Népliget Center Office Building

The Népliget Center Office Building can be reached by public transport via the following means: tram line 1, subway M3, bus 901 and bus 918 (night service).

Approach by car is possible from the direction of Könyves Kálmán krt. Népliget Center has a three-level parking lot with 451 parking spaces. The car park is subject to rules of the road.

3. Brief description of the office building and the activity

The Népliget Center Office Building was completed in 2009. It has 26,000 m2 of prime office space, 1900 m2 of inner garden area, 3000 m2 of underground storage and a 451-space parking garage. The Népliget Center Office Building is used primarily for office activities, but the office building also houses a restaurant, a cafe and a car wash. The Népliget Center Office Building is supplied with water, gas and electricity from the municipal network, and the sewerage system is also connected to the municipal network.

4. Assessment of the climate-related physical risks of the company and the building in 2023

For the BREEAM certification of the Népliget Center Office Building, the following aspects need to be assessed according to the BREEAM protocol:

Have the climate-related physical risks of the building been assessed?	0	E	No answer
	0	F	No
	2	G	Yes
	Exemplary	H	Yes, and risks to the value of the building and the community have been identified

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5. Assessment of climate-related physical risks for the Népliget Center Office Building in 2023

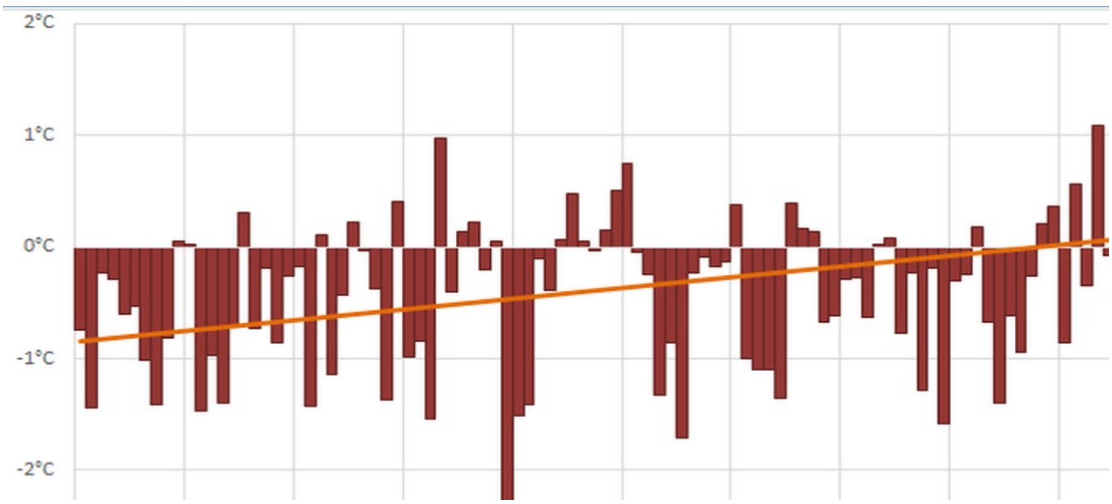
5.1. Climate change susceptibility study

5.1.1. Baseline presentation

Climate change in Hungary is mainly investigated and monitored by the Hungarian Meteorological Service (hereinafter: OMSZ)[1]:

Temperature trends

According to OMSZ data, the time series of annual mean temperatures in Hungary is in line with global trends but shows greater variability due to the smaller area. To illustrate the changes, the anomalies of annual and seasonal values, i.e., the deviations from the 1981-2010 average, which describes the present climate state, are shown in the figure below from the beginning of the 20th century to 2016:



Annual mean temperature anomalies (°C) in Hungary between 1901 and 2016. The values are presented relative to the averages of the 1981 to 2010 period.

The annual mean temperature results show that intensive warming started in Hungary from the early 1980s. The cooler and warmer periods are also reflected in the index values, but from the 1980s on, the increase in the frequency of extreme warm weather situations is unmistakable. The trend values for changes in extreme temperatures suggest that climate change is associated with a clear increase in warm extremes and a decrease in cold extremes over the entire period of the last century.

[1] http://www.met.hu/eghajlat/eghajlatvaltozas/megfigyelt_valtozasok/Magyarorszag/

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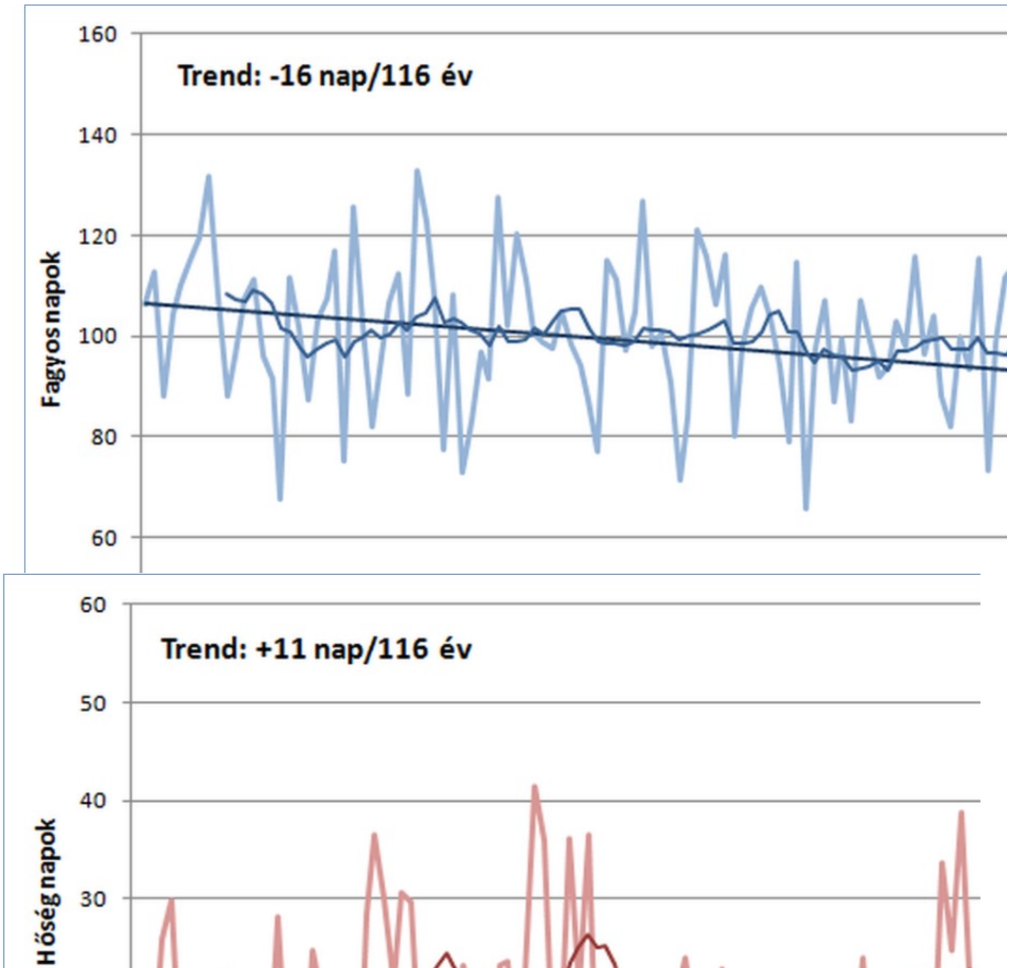
The OMSZ has studied the seasonal mean temperature changes. Based on the measured results, the following conclusions were made:

- the mean spring temperature between 1981 and 2010 was 10.84°C. Spring temperatures have risen by 1.28 degrees Celsius over the entire time series analyzed since 1901. Over the period between 1981 and 2016, the mean spring temperature increased significantly, by 1.5 degrees with 90% confidence.
- the warming trend is mainly reflected in summer temperatures, with an increase of 1.2 degrees Celsius from the beginning of the last century to the present. The mean summer temperature between 1981 and 2010 was 20.26 °C. There have been some cooler summers in the last decade, but lower temperatures were more common in the first half of the century. In the last 36 years, the mean summer temperature has risen by almost two degrees.
- the national mean autumn temperature is 10.33°C. Due to the warm autumns in the middle of the last century, the trend is lower here than in other seasons. The warming is 0.83°C, the change over the last 36 autumns is 1.26°C.
- the mean winter temperature for the 1981-2010 period is -0.08 degrees Celsius. The temperature of winters has increased by 0.97 degrees since 1901, but this change is not statistically significant, and the mean temperature has increased by 1.9 degrees over the last 36 winters.

The trends are shown in the following graphs:



Time series of the annual number of frosty and hot days (based on homogenized, interpolated national averages) with 10-year moving averages and estimated linear trends from 1901-2016. The estimated change over 116 years is illustrated by the trend value shown in the figures.

<u>Examining the trend results, it can be seen that the number of frosty days has been decreasing, while the number of hot days has been steadily increasing over the 116 years studied.</u>

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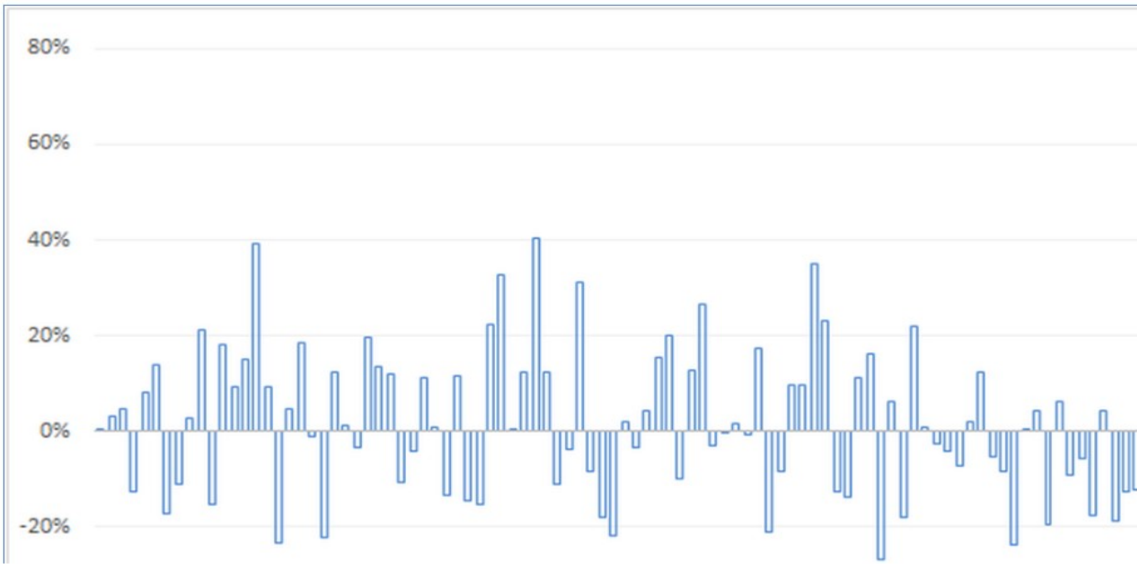
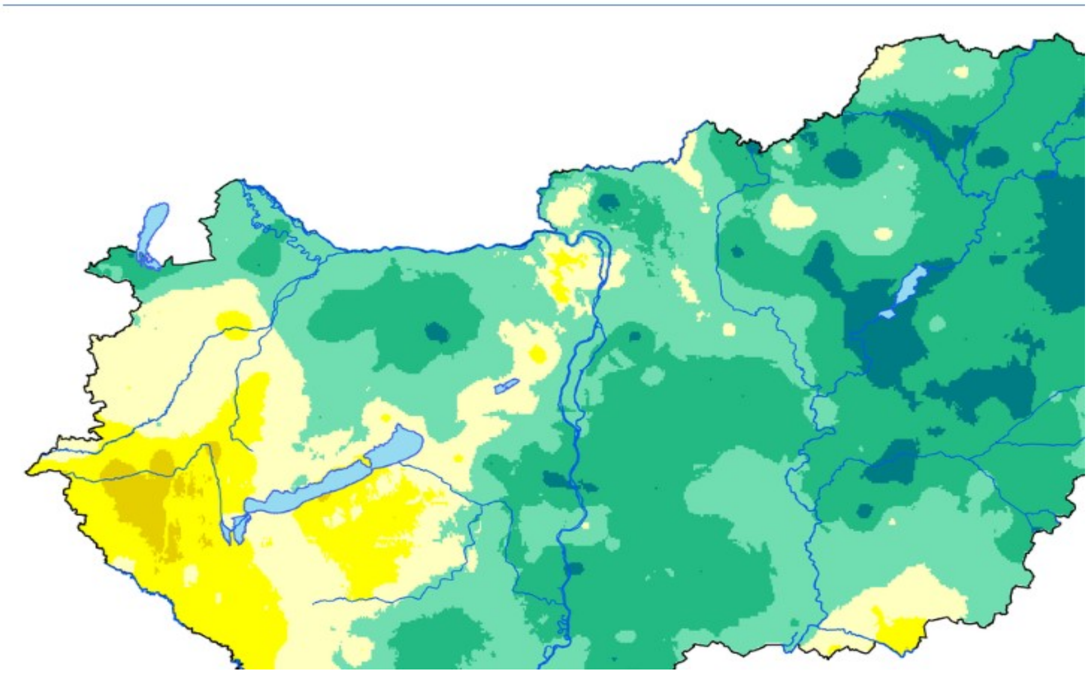
Rainfall trends



Anomalies of the national average annual precipitation totals (1901-2016) (percentage deviations are compared to the average for the years 1981-2010):



Percentage changes in annual precipitation totals between 1961 and 2016

The above figures show that seasonal precipitation variations show much greater temporal variability than the time series of annual anomalies. The average spring precipitation for 1981-2010 is 141 mm. Comparing the four seasons, the largest precipitation decrease occurred in spring, with a value of about 17% based on a time series spanning more than a century.

The multi-year national average of summer precipitation over the period 1981-2010 was 198 mm. The occurrence of dry summers has been relatively consistent since the beginning of the last century. This suggests that drought has been a recurrent feature of our country's climate in the past. The variation in summer precipitation shows an increasing trend, but the change is not significant.

The average precipitation for autumn between 1981 and 2010 is 145.5 mm. The variation is significant and shows a downward trend, but the trend is not clear for this season either.

Winter is our driest season, with an average of 112 mm of precipitation over the winters between 1981 and 2010. Since the beginning of the last century, winter precipitation has been on an increasing trend, but not to a significant extent.

Based on the above graphs it can be stated that there has been a significant decrease in precipitation over most of the country over the last half century.

5.1.2. Description of changes expected in the future

The overwhelming majority of publications in Hungary so far characterize global warming in the region of Hungary as an expected increase in average temperatures and decreasing and territorially variable precipitation. Opinions on the specific values are mixed.

Based on trend analyses for the Carpathian Basin, there is a clear warming trend in temperatures in the second half of the 20th century, and a clear upward trend in the frequency and magnitude of precipitation extremes, while total precipitation is expected to decrease.

The publication Climate Policy, which came out in 2006, presents the projections of the PRUDENCE international project for Hungary from two different aspects. In one case, the researchers examined how Hungary's temperature conditions would evolve with a global average temperature increase of 1°C. The results show that:

Hungary is expected to experience a warming that is more than the global average. The degree of warming is highly variable but is strongest in the summer and weakest in the spring. The annual temperature increase of 1.4 °C is expected to be exceeded in the summer and in the autumn (1.7 and 1.5 °C respectively), while smaller increases are expected in the winter and in the spring (1.3 and 1.1°C). The variation in temperature values is relatively small, although some models simulate values that are smaller than the average global increase (1 degree)[2].

The Intergovernmental Panel on Climate Change (IPCC) is the global climate change organization. It does not carry out its own research, but processes peer-reviewed scientific publications and summarizes their content in reports.

[2] Anda Angéla, Burucs Zoltán, Kocsis Tímea: Globális környezeti problémák és néhány társadalmi hatásuk, TÁMOP-4.1.2-08/1/A-2009-0032 tanulmánya

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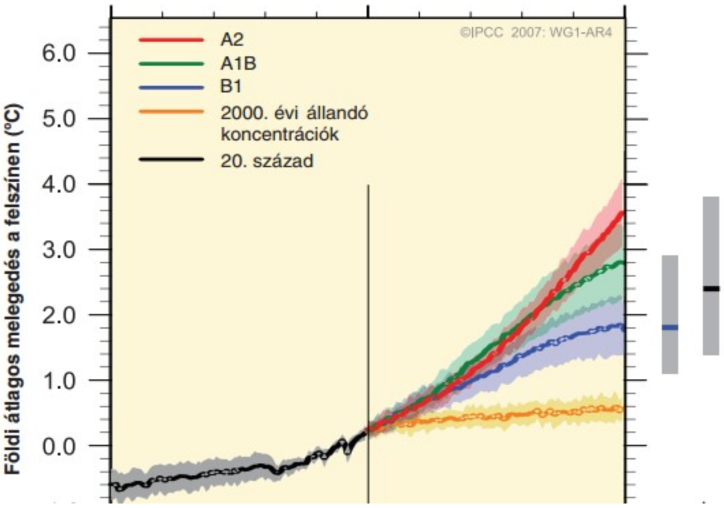
The Panel's Fourth Assessment Report3 (2007) estimates the mean and the range of surface warming using several scenarios/models.

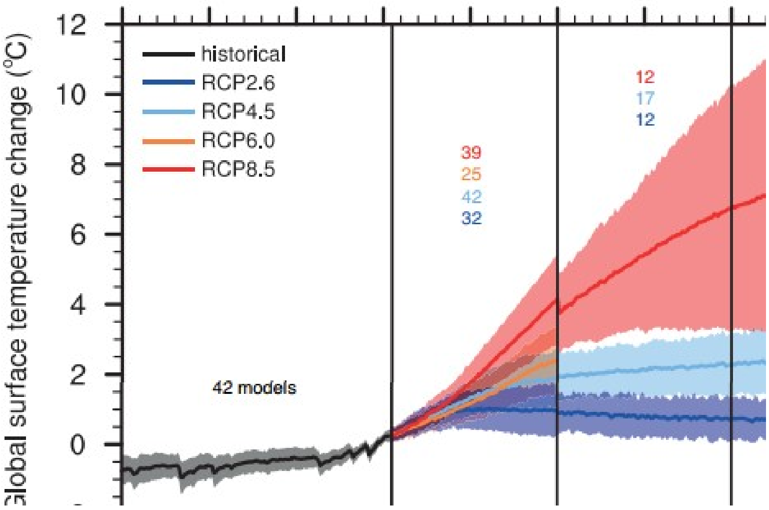
Study results are shown in the following figure:



Mean and estimated range of surface warming based on all models
IPCC Fourth Assessment Report (2007)

The results in the figure show that the most optimistic scenario B1 of the summary assessment also projects a temperature change/increase of 1.8 °C by the end of the century.

In the Panel's latest English-language Fifth Assessment Report (2013)[4], the average surface warming trend over a longer time horizon was also produced, using and further developing the results of the modeling carried out previously:



Mean and estimated range of surface warming based on all models
IPCC Fifth Assessment Report (2013)

3 http://klima.kvvm.hu/documents/92/_ghajlatv_ltoz_s_2007_.pdf
4 https://www.ipcc.ch/report/ar5/wg1/

The Panel's report shows that a gradual increase in average surface temperatures is confirmed for the long term. The most recent 5th Assessment of Climate Change concluded that "the warming of the climate system is clear" and that "human influence is most likely the most significant cause of the warming observed since the mid-20th century".

5.1.3. Activity susceptibility testing[5]

Susceptibility analysis is the exploration of the primary and secondary impacts of climate change on the investment and the service it provides, as well as on the input and output of the service.

The susceptibility of the activity to potential climate hazards can be classified according to 6 factors:

1) on-site assets and processes,
2) production factors (water, energy, etc.),
3) products (including internally produced or purchased intermediate goods),
4) transport links,
5) products or services produced by the activity, and
6) existing assets and infrastructure in the vicinity of the proposed site that may be affected by the proposed activity.

According to the above criteria, the susceptibility of the activity to each of the climate changes that may occur is assessed in a matrix table. In the course of the assessment, different climate parameters are rated 'high', 'medium' or 'low', with respect to the susceptibility to each issue:

[5] Miniszterelnökség: Részletes klímakockázati útmutató 2017. január

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Change in climate parameter	**Are the assets and processes at the investment site affected by climate change?**	**Is the quantity, quality and/or price of production affected by climate change?**	**Are the quantity, quality and/or price of products affected by climate change?**	**Are transport links and the reliability of transport of labor, inputs and products affected by climate change?**	**Is the demand for the goods or services produced affected by climate change?**	**Are the vulnerability and adaptive capacity of existing assets and infrastructure in the vicinity of the proposed site affected by the proposed activity?**
Slow increase in average surface air temperature	Low	Low	Low	Low	Low	Low
Increasing number of summer days (daily max. > 25 °C)	Low	Low	Low	Low	Low	Low
Decreasing number of frosty days (daily min. < 0 °C)	Low	Low	Low	Low	Low	Low
Increase in the number of hot days (daily maximum ≥ 30 °C)	Low	Low	Low	Low	Low	Low
Increase in the number of tropical nights (daily minimum ≥ 20 °C)	Low	Low	Low	Low	Low	Low
Increase in the number of heatwave days (daily mean temperature > 25 °C)	Low	Low	Low	Low	Low	Low
Increase in average daily temperature variation (difference between daily maximum and minimum, °C)	Low	Low	Low	Low	Low	Low
Decrease in annual precipitation	Low	Low	Low	Low	Low	Low
Reduction in the number of days with precipitation (daily precipitation ≥ 1 mm, %)	Low	Low	Low	Low	Low	Low
Increase in average daily precipitation (average precipitation of days with precipitation, mm/day)	Low	Low	Low	Low	Low	Low
Increase in the length of the max. dry period (longest period when the daily precipitation amount < 1 mm, day)	Low	Low	Low	Low	Low	Low
Change in the length of the max. wet period (longest period when the daily precipitation amount ≥ 1 mm, days)	Low	Low	Low	Low	Low	Low
Increase in the number of days with precipitation reaching 20 mm (number of days when the daily precipitation amount ≥	Low	Low	Low	Low	Low	Low

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Change in climate parameter	Are the assets and processes at the investment site affected by climate change?	Is the quantity, quality and/or price of production affected by climate change?	Are the quantity, quality and/or price of products affected by climate change?	Are transport links and the reliability of transport of labor, inputs and products affected by climate change?	Is the demand for the goods or services produced affected by climate change?	Are the vulnerability and adaptive capacity of existing assets and infrastructure in the vicinity of the proposed site affected by the proposed activity?
20 mm, day)						
Slow increase in the average temperature of surface waters	Low	Low	Low	Low	Low	Low
Changes in the seasonal distribution of precipitation	Low	Low	Low	Low	Low	Medium
Increased UV radiation, decreased cloud formation	Medium	Low	Low	Low	Low	Medium
Increase in the number and intensity of cloudburst (stormy weather) events	Medium	Low	Low	Medium	Low	Medium
Increase in the frequency and intensity of flash floods	Low	Low	Low	Low	Low	Low
Increase in the frequency and intensity of flood waves	Low	Low	Low	Low	Low	Low
An increase in the frequency of waterlogging	Low	Low	Low	Low	Low	Low
Decrease in water resources (decrease in summer low water resources in watercourses, more frequent periods of low water levels in lakes, decrease in underground water resources)	Low	Low	Low	Low	Low	Low
Increased incidence of drought	Low	Low	Low	Low	Low	Low
More frequent occurrence of mass movement	No	No	No	No	No	No
Increase in the frequency of forest fires	No	No	No	No	No	No
Wind erosion	No	No	No	No	No	No

Based on the results of the susceptibility test, it can be seen that **"Change in the seasonal distribution of precipitation", "Increase in the number and intensity of cloudburst (stormy weather) events", as well as possible "Increased UV radiation, reduced cloud formation" as a climate parameter changes and their effects may affect the project more seriously.** Considering the long-term processes, we did not consider the magnitude of the individual climate change effects to be high in any of the cases.

5.2. Exposure assessment[6]

After the susceptibility of the planned activity has been determined as described in the previous chapter, the next step is to decide whether and to what extent the location of the activity is exposed to climate change. The exposure assessment was carried out primarily for those effects where a medium or high value was given in the susceptibility test.

Based on the results of the susceptibility test and the previously stated test criteria, the susceptibility of the planning area is evaluated as follows:

Change in climate parameter	Exposed areas	Source of relevant data for Budapest and its region	Extent of exposure
Decrease in annual precipitation	**The entire territory of Hungary, especially the Great Plain.**	https://map.mbfsz.gov.hu/nater	Medium
Slow increase in average surface air temperature	**The entire territory of Hungary, especially the Great Plain and the Transdanubian Hills, as well as the big cities.**	https://map.mbfsz.gov.hu/nater	Medium
Increase in the frequency and intensity of heatwaves	**The entire territory of Hungary, especially the Great Plain and the big cities, to a lesser extent, but especially the Little Hungarian Plain.**	https://map.mbfsz.gov.hu/nater	Medium
Increase in precipitation intensity	**The entire territory of Hungary, especially the areas of the Northern Hungarian Uplands, the Transdanubian Mountains and the Transdanubian Hills.**	https://map.mbfsz.gov.hu/nater	Medium
Changes in the seasonal distribution of precipitation	**The entire territory of Hungary.**	https://map.mbfsz.gov.hu/nater	Medium
Increase in the length of drought periods	**The entire territory of Hungary, especially the Great Plains, as well as areas where water resources are polluted and their use is currently increased.**	https://map.mbfsz.gov.hu/nater	Medium
Decrease in cold extremes/decrease in the number of frosty days	**The entire territory of Hungary.**	https://map.mbfsz.gov.hu/nater	Medium
Increased UV radiation, reduced cloud	**The entire territory of Hungary.**	https://map.mbfsz.gov.hu/nater	Medium

[6] Miniszterelnökség: Részletes klímakockázati útmutató 2017. január

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Change in climate parameter	Exposed areas	Source of relevant data for Budapest and its region	Extent of exposure
formation			
Increase in the number and intensity of stormy weather events	**The entire territory of Hungary, especially the Bakony and Vértes Mountains.**	-	Medium
Increase in the frequency and intensity of unseasonal weather	**The entire territory of Hungary.**	-	Low
Increase in occurrence, frequency and intensity of flash floods	**The entire territory of Hungary, with the exception of the Great Plains and the Little Hungarian Plain, especially in the areas of the Northern Hungarian Uplands, the Transdanubian Mountains, the Transdanubian Hills and the Pre-Alps, as well as in urban areas.**	https://map.mbfsz.gov.hu/nater	Low
Increase in the frequency of waterlogging	**The entire territory of Hungary, depending on topography and soil conditions, land use, especially in the Great Plains.**	www.ovf.hu	Medium
Increase in frequency and intensity of flood waves	**Along rivers (especially the entire length of the Tisza, the Great Plain section of the Danube, the Kőrös and its tributaries, the Rába, some sections of the Dráva)**	www.hydroinfo.hu, www.vizugy.hu	Low
Increase in the frequency of mass movement	**In mountainous and hilly areas.**	https://map.mbfsz.gov.hu/nater	Low
Increase in the frequency of forest fires	**The entire territory of Hungary, especially the Mátra and the Zemplén; the Great Plain and the Little Hungarian Plain are less affected**	https://erdoterkep.nebih.gov.hu/erdokar/index.htm	Low
Decrease in water resources (decrease in summer low water resources in watercourses, more frequent periods of low water levels in lakes, decrease in underground water resources)	**The entire territory of Hungary.**	www.hydroinfo.hu, www.vizugy.hu	Medium

Regarding the operation of the office building, the exposure ot the parameters **"Weather events not characteristic of the season"**, **"Occurrence of flash floods"**, **"The frequency of flood waves"**, **"Increase in the frequency of forest fires"** and the possible **"Increased occurrence of mass movement"** have been evaluated as **low**, while the others were evaluated as **mediu**m.

5.3. Analysis of possible effects[7]

Potential physical impacts on the activity may occur if the project is susceptible to a particular climate parameter and, at the same time, the project site is exposed to that particular climate parameter. Both conditions must be met simultaneously.

If both conditions exist, the degree of potential impact can be determined from the magnitude of the susceptibility and the degree of exposure with the help of the following matrix:

		Exposure		
		Low	Medium	High
Susceptibility	Low	Low	Low	Medium
	Medium	Low	Medium	High
	High	Medium	High	High

The possible effects of climate changes, which meet both the susceptibility and exposure conditions with a medium rating, can be evaluated in relation to the planned activity - using the markings of the above matrix - as follows:

Change in climate parameter	Susceptibility	Exposure	Degree of effect
Changes in the seasonal distribution of precipitation	Medium	Medium	Medium
Increase in the number and intensity of stormy weather events	Medium	Medium	Medium
Increased UV radiation, decreased cloud formation	Medium	Medium	Medium

5.4. Risk assessment[8]

As described in the previous chapter, the results of the detailed analysis show that the expected impacts were rated medium in 3 cases, and high ratings were not justified in any of the cases. For the low potential impacts, risk assessment is not carried out, given the low classification of the expected impacts and therefore the expected low risk.

Negative changes in the performance of injury, damage and loss functions and the possibility of negative environmental impacts are considered as risk. Risk is the product of the magnitude of the potential damage and the probability of the damage occurring.

[7] Miniszterelnökség: Részletes klímakockázati útmutató 2017. január
[8] Miniszterelnökség: Részletes klímakockázati útmutató 2017. január

The following values are used to assess the potential damage/consequence:

1 Insignificant	**2 Small**	**3 Moderate**	**4 Significant**	**5 Catastrophic**

The following values are used to assess probabilities:

1 Rare	**2 Unlikely**	**3 Possible**	**4 Likely**	**5 Almost certain**
Annual chance of 5%	Annual chance of 20%	Annual chance of 50%	Annual chance of 80%	Annual chance of 95%

The following matrix is used to assess the risks:

Probability	**Damage/Consequence**				
	Catastrophic	**Significant**	**Moderate**	**Small**	**Insignificant**
Almost certain	Extreme	Extreme	Extreme	High	Medium
Likely	Extreme	Extreme	High	High	Medium
Possible	Extreme	Extreme	High	Medium	Low
Unlikely	Extreme	High	Medium	Low	Low
Rare	High	High	Medium	Low	No risk

For a minimum duration of 30 years and for impacts that were considered to be of medium value, risk assessment was carried out as follows:

Change in climate parameter	Damage/Consequence		Probability	Risk
	Place	Extent		
Changes in the seasonal distribution of precipitation	In assets	Moderate	Possible	High
	In safety	Small		Medium
	In the environment	Small		Medium
	In society	Insignificant		Low
	In economy	Moderate		High
Increase in the number and intensity of stormy weather events	In assets	Moderate	Possible	High
	In safety	Small		Medium
	In the environment	Small		Medium
	In society	Insignificant		Low
	In economy	Moderate		High
Increased UV radiation, decreased cloud formation	In assets	Small	Unlikely	Low
	In safety	Small		Low
	In the environment	Small		Low
	In society	Insignificant		Low
	In economy	Moderate		Medium

The results of the risk assessment show that **the greatest risk is/may be caused by storm events (e.g. heavy rain, lightning, strong winds), which are difficult to predict but likely to occur on an annual basis, and by changes in the seasonal distribution of precipitation.**

5.5. Demonstrating adaptation to climate change[9]

In this chapter, the results of the identification of adaptation measures to the main climate risks described above and also to address and mitigate climate vulnerability and climate risks are summarized.

[9] Miniszterelnökség: Részletes klímakockázati útmutató 2017. január

5.5.1. Identifying adaptation options

The possible ways of adaptation have been identified based on the technical characteristics of the technology, the expected environmental impacts identified and the risks identified. They are presented here.

As a first step, the main direct consequences that could be caused by the climate change element identified as risky are identified, and then possible risk management activities/adaptation options and their responsible parties are proposed as follows:

Climate change element	Risk	Adaptation options
• Changes in the seasonal distribution of precipitation • Increase in the number and intensity of stormy weather events • Increased UV radiation	• Damage to the premises of the Office Building and transport facilities during storms, to trees and green vegetation. • Power outages during stormy weather. • Damage to the plastic elements of the building due to high heat and high UV radiation.	• Annual maintenance and repairs, • More frequent inspections and reviews, • Allocation of resources to ensure even more frequent maintenance, repairs, • Regular review of the functioning of technical components, • Regular monitoring of weather forecasts and, on the basis of these forecasts, organization and implementation of rapid, preliminary precautionary measures and protective actions. • Use of weather-resistant materials outdoors.

5.5.2. Evaluation of adaptation options

The adaptation options described above are all aimed at reducing the vulnerability of the Office Building and its activities and related assets and equipment, as well as at regularly reviewing capacities and options, and indirectly at preventing potential damage to the environment.

The difficulty of adapting to potential damage caused by stormy weather is due to the difficulty of predicting and forecasting its course and development. In practice, adaptation to such conditions can be managed effectively by applying technical solutions that have been proven useful in many cases already.

The Népliget Center Office Building has been assessed as described above, and the Office Building meets the above criteria, objectives and requirements.

Budapest, November 11, 2023

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