



## INTEGRATED SOLUTIONS TO ADDRESS HIGH LEVELS OF CLIMATE CHANGE

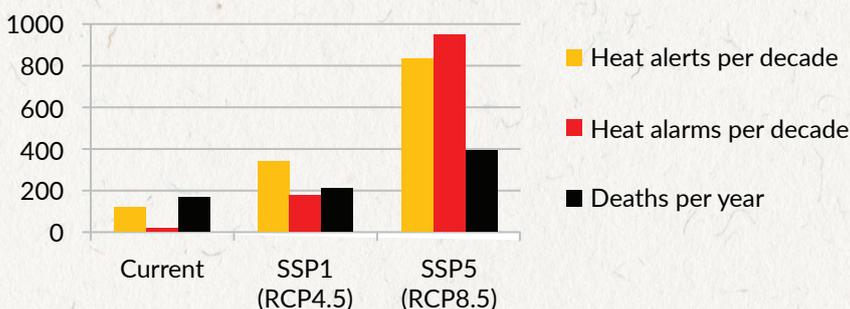
We are not yet on track to meet the Paris agreement goal to keep global mean temperatures well below 2°C (and ideally 1.5°C) above pre-industrial levels. IMPRESSIONS modelled the risks and opportunities of high levels of climate change (above 2°C) in two municipalities in Hungary (Szekszárd and Veszprém) under different socio-economic scenarios, taking into account the interactions between agriculture, water, health and urbanisation.

### Key Findings

- **Hungary is highly vulnerable to climate change impacts** including droughts, floods, heavy rainfall and heat waves. Deaths due to heat stress could double or triple; exposure to Lyme disease will increase; water levels in Lake Balaton could oscillate between low and high extremes and there could be significant impacts on crop yields. Current institutions would not be able to handle such extreme challenges.
- **Societal and institutional transformation is needed**, to strengthen human, social and natural capital and build resilience to change. Local stakeholders must be involved, to take account of the local socio-economic context and increase ownership of the process and the results. Integrated modelling of different sectors (land-use, urbanisation, water and health) combined with participatory research has been successful in developing targeted adaptation responses at the local scale.

### What are the impacts and risks in a future above 2°C?

- **Heat stress:** Heat stress will become a major public health problem due to more frequent and intense heatwaves, leading to almost continuous heatwave alerts during summer. Across eastern Europe as a whole, heat-related mortality is expected to double for a 2°C warming and triple for a 5°C warming.



*Number of days per decade with heat alerts and heat alarms, and heat-related deaths per year in Szekszárd, Hungary in 2071-2100 for moderately (RCP4.5) and extremely (RCP8.5) high climate change vs the baseline in 1981-2010.*

- **Water management:** More intense rainfall events and greater oscillation between extreme dry and extreme wet periods are projected to affect water availability and runoff. The water level of Lake Balaton, a key national and international asset, may oscillate between extreme low and extreme high levels more frequently, with major implications for the ecological functioning and socio-economic uses of the lake.
- **Lyme disease:** Lyme disease risks are projected to increase nationwide in all scenarios due to higher temperatures, which increase tick activity, and an increase in the area of forest, which is a major tick habitat. The impacts are worse under the higher climate change scenario (RCP8.5).
- **Land use and crop production:** Projections of the yields of key crops under different scenarios vary greatly but heat stress and water stress will certainly have a major impact on crop production and ultimately will hinder agricultural productivity and food security. Urbanization is expected to reverse, and out-migration from the capital and major towns is projected to occur under all scenarios.

## What are the transformative solutions?

Stakeholders developed a set of pathways for transforming society to address the causes of climate change while also adapting to the impacts. Three of these pathways play an essential role under all scenarios.

Inclusive and multi-level governance for sustainability	This includes strict and enforced environmental standards; zero tolerance of corruption; independent communication channels; devolution of power to local organizations; and incentives for voting. This supports the implementation of all other pathways by setting up the framework conditions for actors to move towards sustainability and resilience. It enables strong governmental regulations and incentives to support efficient resource management; it enables collaboration across scales and sectors; and it underpins local and rural development by strengthening local democracies and local investments in infrastructure and technologies
Healthy lifestyles and new education systems	This includes awareness raising activities to promote traditional, low-consumption lifestyles; education for individual responsibility and sustainability; society-wide nutrition and fitness programs; heat stress management; and value systems based on well-being. It underpins demand for sustainable products by educating people about lifestyle choices. It also supports local democracies by building the capacities of people to participate in decision-making.
Sustainable and resilient water management	This combines incentives for water saving; grey water recycling; distributed micro-reservoir systems for extreme dry and extreme wet conditions; measures to increase the water retention capacity of the soil; and revitalization of locally embedded water management institutions. It can improve water storage capacity significantly in all scenarios, and also develops an integrated resource management framework that can promote synergies between water, agriculture and energy.

Transformative solutions will also need to manage trade-offs between climate adaptation and climate mitigation. For example, in some scenarios public cooling centres and air conditioned resting places are set up to reduce heat stress, which could increase emissions unless renewable energy is used. Similarly, there could be a trade-off between the need to set a strong regulatory framework at the national level and the goals of community governance.

### Policy Recommendations

- Take a longer term view in municipal adaptation and development strategies, to address the high levels of climate change projected further into the future (not just immediate needs).
- Engage local stakeholders in identifying vulnerability issues and risks, developing future visions and constructing transition pathways. This helps to identify place-specific issues, and people involved in developing adaptation solutions are more likely to have ownership and actually implement them.
- Implement practical solutions at the local level, to raise awareness and build capacity for further action, e.g. expanding green space, implementing water storage and water re-use technologies and encouraging urban agriculture.
- Diversify crop production to build resilience in the face of uncertain climate impacts.
- Move towards governance for a climate-resilient and sustainable society, with strong regulations, standards and incentives (e.g. for zero-energy housing, renewable energy and organic agriculture).
- Invest in research to i) reduce uncertainty over local impacts (e.g. on crop yields), and ii) translate scientific models into information that can be used by non-scientists the municipal level.
- To encourage lifestyle and behaviour change, make maximum use of the media, the education system and the art community to engage a wide range of audiences.

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