Slovak Hydrometeorological Institute, Jeséniova 17

26-28 May, 2010 - Bratislava, Slovakia

Mid-term Workshop - Bratislava

Experience of vertical handling of topics Sea level rise, Navigation and Energy

by Jean-Luc RAHUEL

SOGREAH Consultants – Research Partner n°10

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Experience with « vertical handling » of topics

Application to Sea level rise, Navigation & Energy

- ✓ Analytical grid
- ✓ Optimisation of the research effort
- ✓ Anticipation – proactive attitude
- ✓ Early results available
- ✓ Iterations are easier
- ✓ Consistency in the reporting
- ✓ Reporting can always be further enriched

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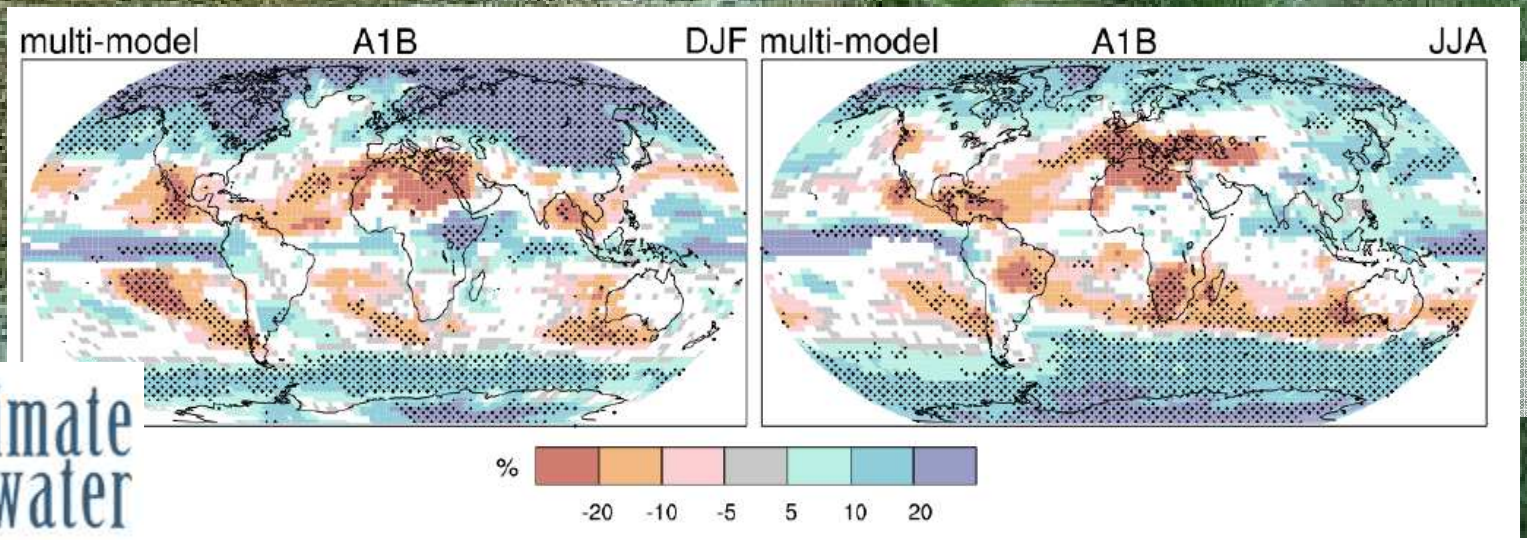
WATER INDUSTRIES, NAVIGATION, ENERGY

Major climate change impacts

- **Modifications of water regime expected : increase of annual precipitations in the North, decrease in the South**
- **Decrease in water availability during summer season**
- **Sea level rise**
- **Many industries can and should save water in their processes**
- **Navigation will face difficulties, adaptation is needed**
- **Hydropower and thermal plants will face difficulties, adaptation is also needed**



Predicted evolution of precipitations in 2090-2099 v/s situation in 1980-1999

IPCC 2007

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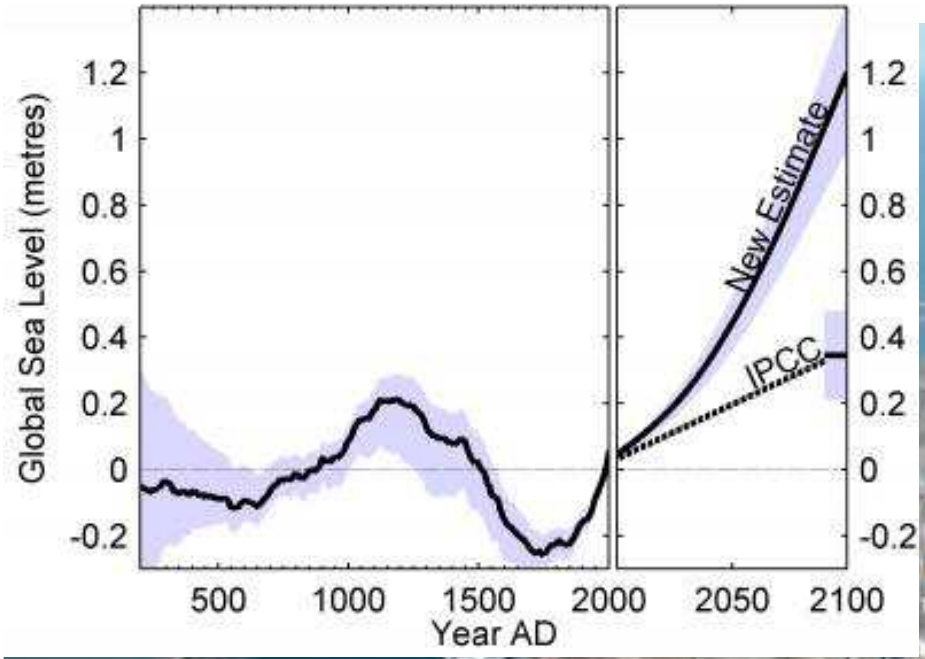
NAVIGATION

Major climate change impacts on marine navigation



Sea level rise impact

Caption: The curve shows the sea level from the year 2000 to the year 2100. The future rise in sea level of 1 m is calculated from global warming of 3 degrees in this century. The dotted line indicates the UN Intergovernmental Panel on Climate Change's prediction. The blue shade indicates the calculations' degree of uncertainty.
Credit: Aslak Grinsted, Niels Bohr Institutet

•**Positive impacts :** it allows greater underkeel clearance for vessels.

•**Negative impacts :** coastal erosion ; degradation of port structures ; incidents of overtopping and lowlands flooding ; increased corrosion of decks, wharfs and jetties ; increased salinity of estuaries ; reduction of top clearance between ships and bridges.

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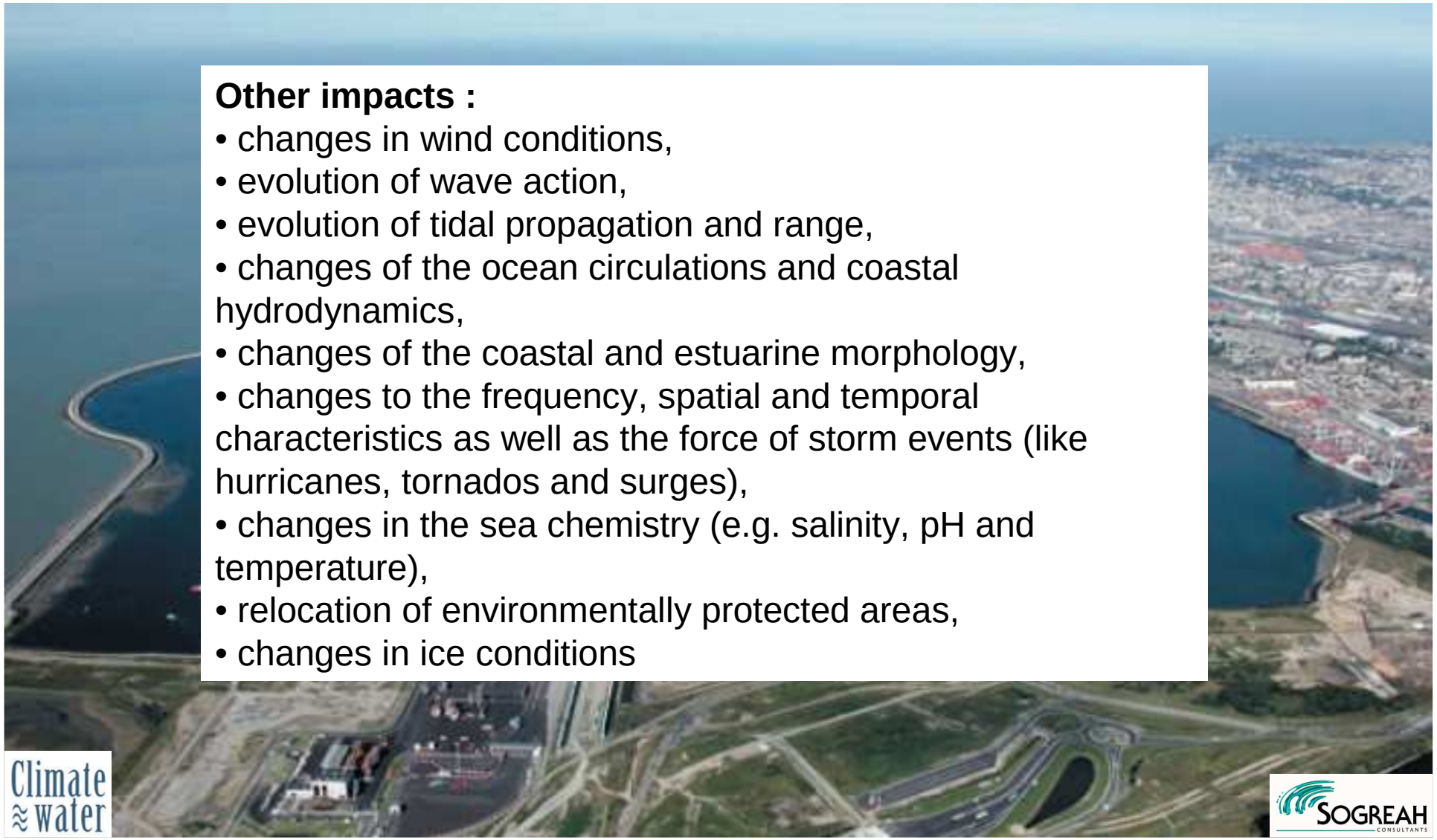
NAVIGATION

Major climate change impacts on marine navigation (Cont'd)



Other impacts :

- changes in wind conditions,
- evolution of wave action,
- evolution of tidal propagation and range,
- changes of the ocean circulations and coastal hydrodynamics,
- changes of the coastal and estuarine morphology,
- changes to the frequency, spatial and temporal characteristics as well as the force of storm events (like hurricanes, tornados and surges),
- changes in the sea chemistry (e.g. salinity, pH and temperature),
- relocation of environmentally protected areas,
- changes in ice conditions

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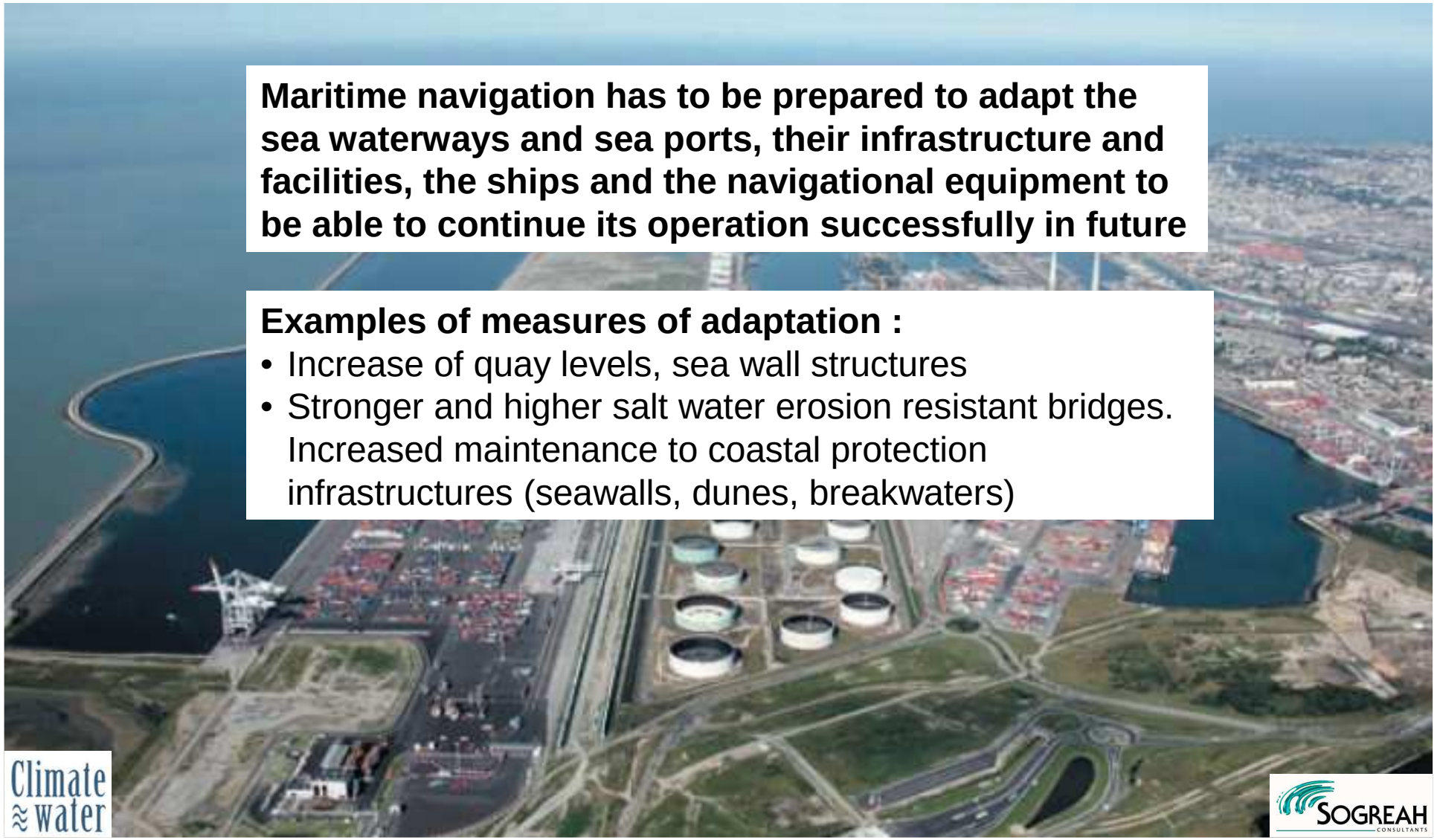
Adaptation measures needed for marine navigation



Maritime navigation has to be prepared to adapt the sea waterways and sea ports, their infrastructure and facilities, the ships and the navigational equipment to be able to continue its operation successfully in future

Examples of measures of adaptation :

- Increase of quay levels, sea wall structures
- Stronger and higher salt water erosion resistant bridges. Increased maintenance to coastal protection infrastructures (seawalls, dunes, breakwaters)

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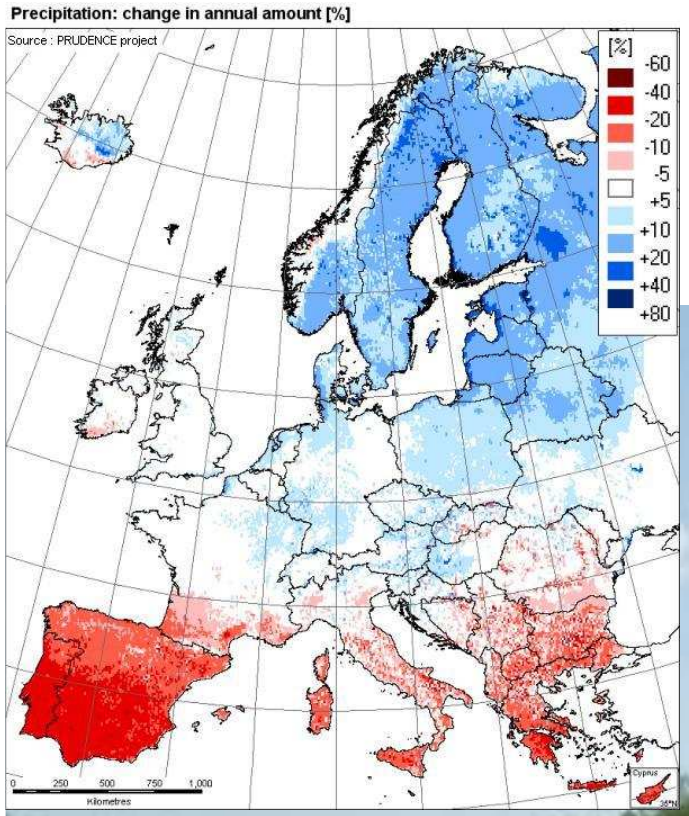

NAVIGATION

Major climate change impacts on inland navigation

Inland navigation is primarily influenced by the specific changes of the hydrological characteristics in each river basin like:

- decrease or increase of the water supply in the navigable river sections/waterways (e.g. effects of the changes to snowmelt dominated basins, as well as precipitation),
- increase of more extreme hydrological conditions with more intense and long lasting high waters (floods) and low waters (droughts),
- changes of river morphology,
- changes in the efficiency of existing waterway infrastructure,
- increase of water temperature.

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NAVIGATION

Adaptation measures needed for inland navigation

Measures : Creation of water storage, adaptation of sediment management (dredging or artificial sediment supply), reduction of vessels weight, deepening of channels.

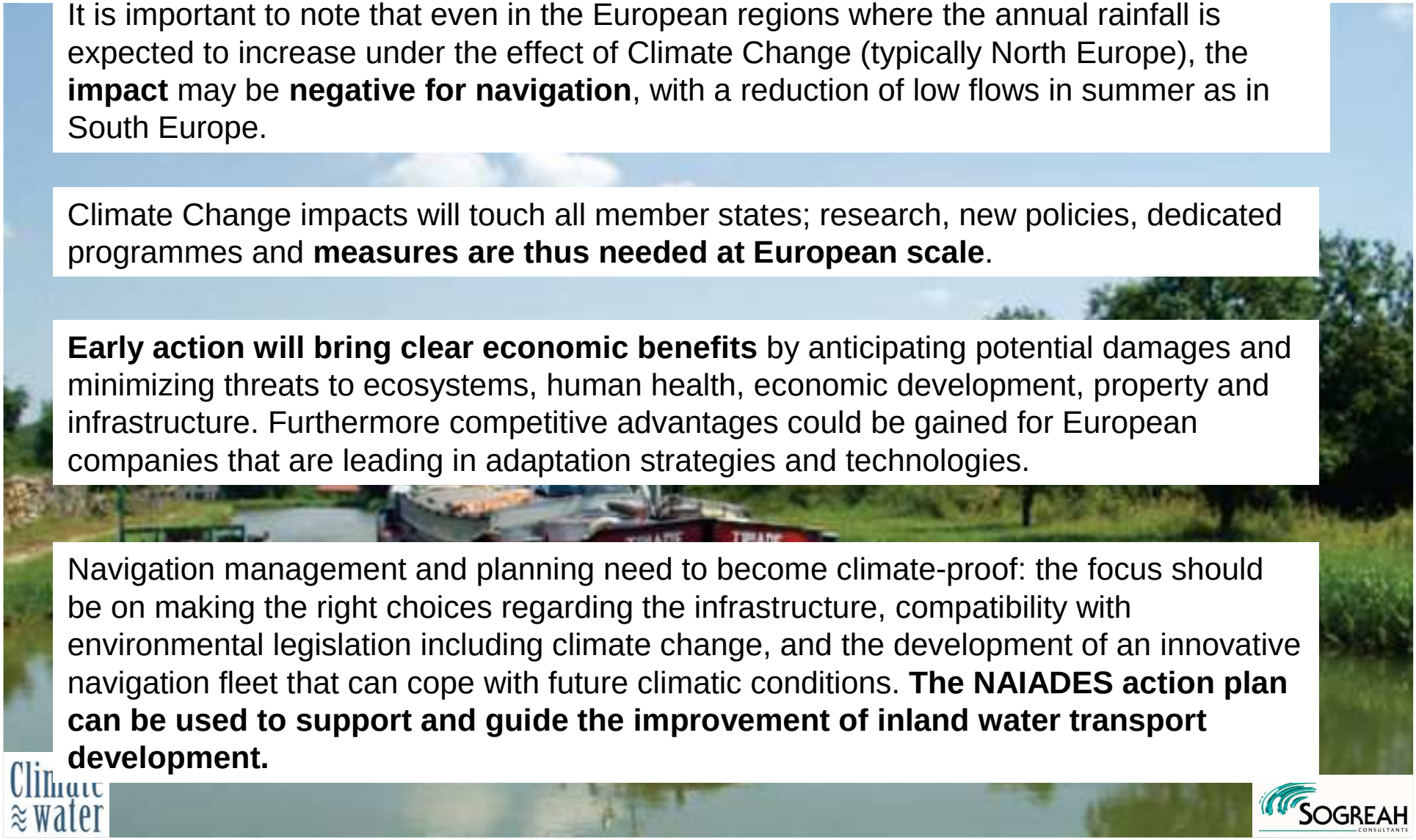
Successful adaptation strategies have to follow a common and integrated approach that covers measures in all water-related sectors. Navigation management and planning need to become climate-proof: the focus should be on making the right choices regarding the infrastructure, compatibility with environmental legislation including climate change, and the development of an innovative navigation fleet that can cope with future climatic conditions.

In democratic countries it is nowadays impossible to progress in a project without launching **constructive discussions** with all involved parties, including political leaders, environment associations, general public, etc. Experience shows that 30 years are needed to lead a major structural project from its early concept, through the various levels and types of studies, until its complete achievement

These constructive discussions should begin as soon as possible and should be supported by high quality, **independent, research work and consulting studies** that everybody can trust. The driving forces behind the project must be clearly explained. All constructive remarks arising in the constructive discussions shall be considered, and if relevant, taken into account.

NAVIGATION

Policy implications of adaptation needs



It is important to note that even in the European regions where the annual rainfall is expected to increase under the effect of Climate Change (typically North Europe), the **impact** may be **negative for navigation**, with a reduction of low flows in summer as in South Europe.

Climate Change impacts will touch all member states; research, new policies, dedicated programmes and **measures are thus needed at European scale**.

Early action will bring clear economic benefits by anticipating potential damages and minimizing threats to ecosystems, human health, economic development, property and infrastructure. Furthermore competitive advantages could be gained for European companies that are leading in adaptation strategies and technologies.

Navigation management and planning need to become climate-proof: the focus should be on making the right choices regarding the infrastructure, compatibility with environmental legislation including climate change, and the development of an innovative navigation fleet that can cope with future climatic conditions. **The NAIADES action plan can be used to support and guide the improvement of inland water transport development.**

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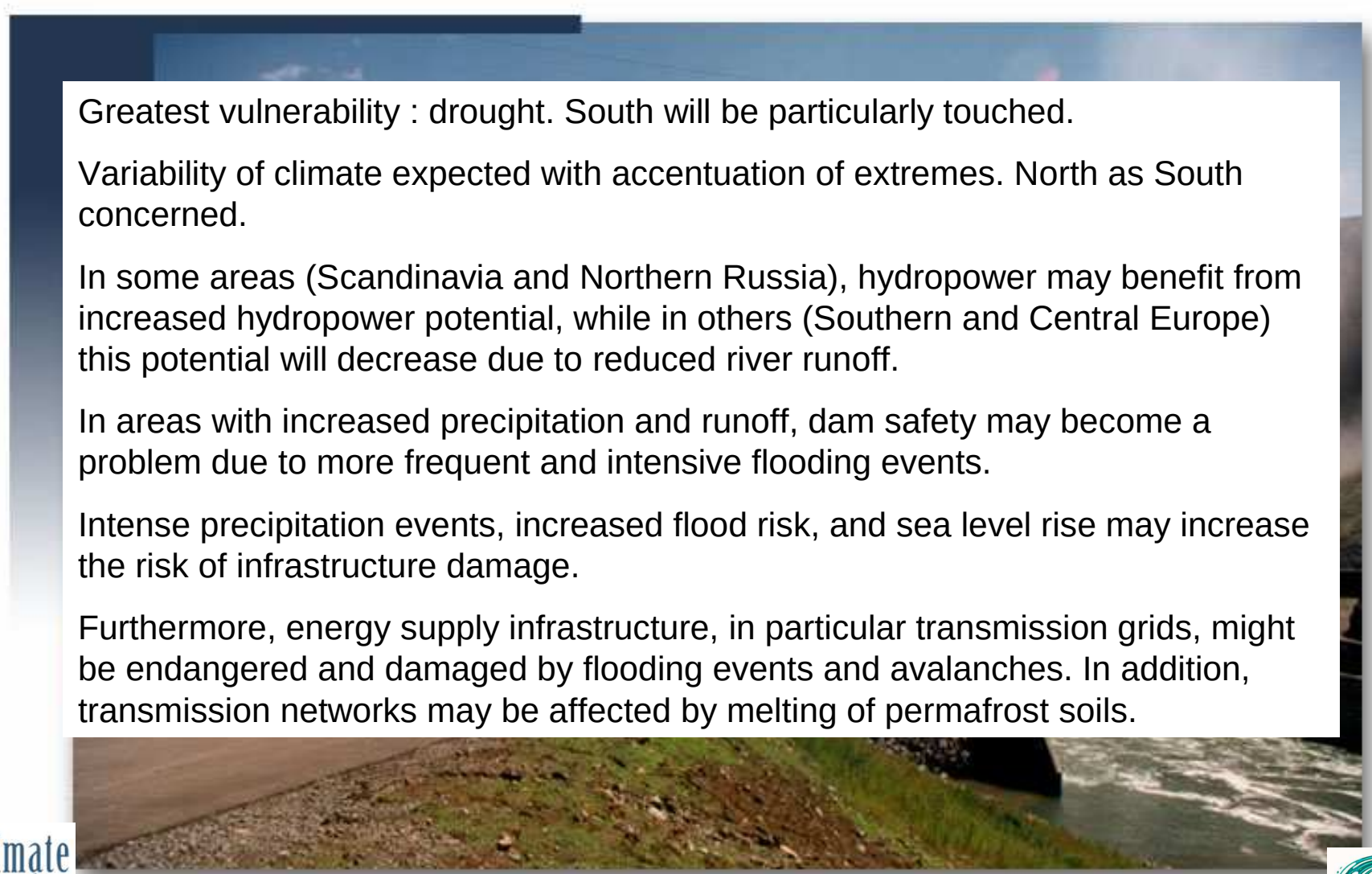
HYDROPOWER

Major climate change impacts on hydropower



Greatest vulnerability : drought. South will be particularly touched.

Variability of climate expected with accentuation of extremes. North as South concerned.

In some areas (Scandinavia and Northern Russia), hydropower may benefit from increased hydropower potential, while in others (Southern and Central Europe) this potential will decrease due to reduced river runoff.

In areas with increased precipitation and runoff, dam safety may become a problem due to more frequent and intensive flooding events.

Intense precipitation events, increased flood risk, and sea level rise may increase the risk of infrastructure damage.

Furthermore, energy supply infrastructure, in particular transmission grids, might be endangered and damaged by flooding events and avalanches. In addition, transmission networks may be affected by melting of permafrost soils.

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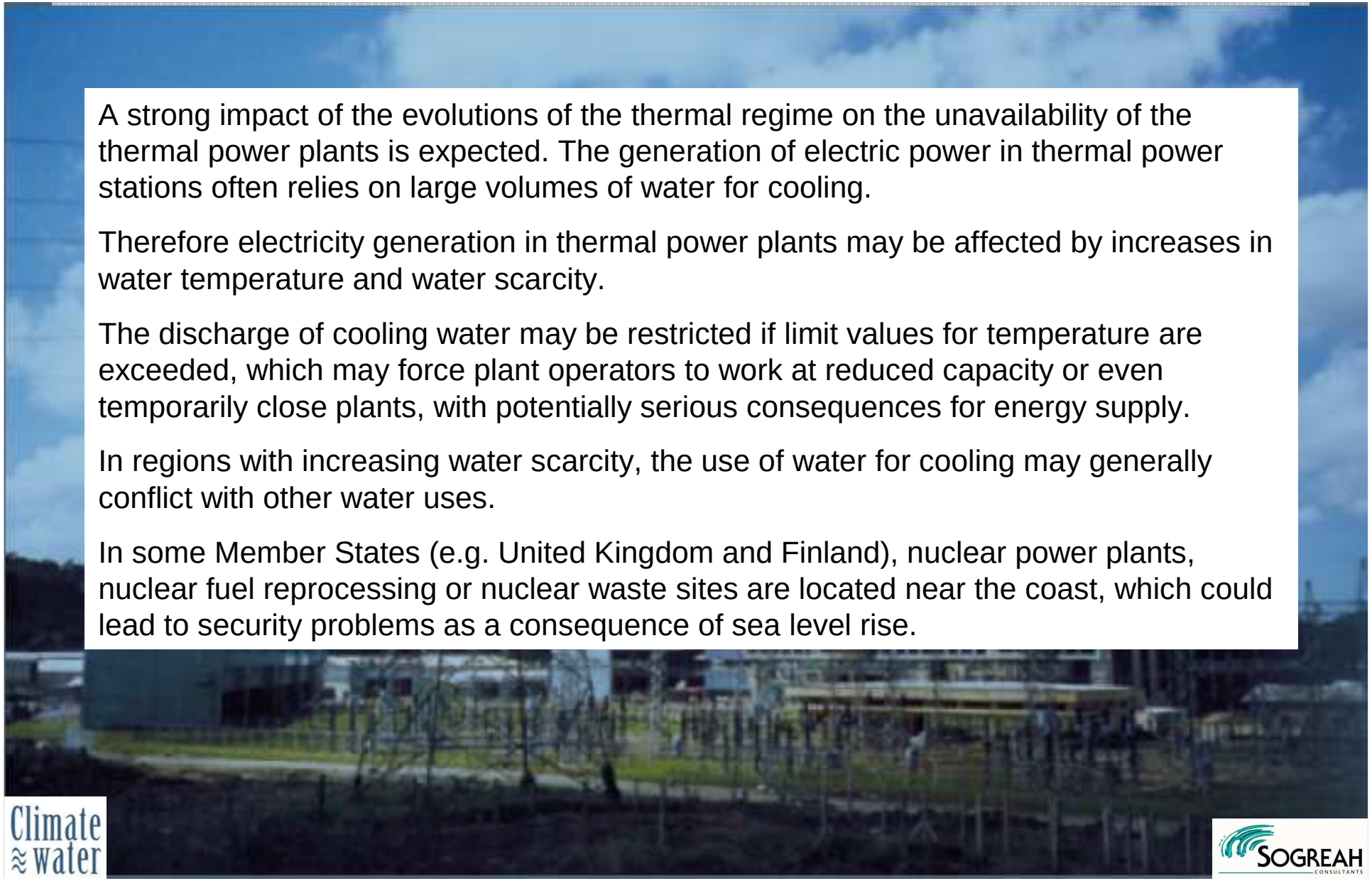
Thermal power plants

Major climate change impacts on thermal power plants



A strong impact of the evolutions of the thermal regime on the unavailability of the thermal power plants is expected. The generation of electric power in thermal power stations often relies on large volumes of water for cooling.

Therefore electricity generation in thermal power plants may be affected by increases in water temperature and water scarcity.

The discharge of cooling water may be restricted if limit values for temperature are exceeded, which may force plant operators to work at reduced capacity or even temporarily close plants, with potentially serious consequences for energy supply.

In regions with increasing water scarcity, the use of water for cooling may generally conflict with other water uses.

In some Member States (e.g. United Kingdom and Finland), nuclear power plants, nuclear fuel reprocessing or nuclear waste sites are located near the coast, which could lead to security problems as a consequence of sea level rise.

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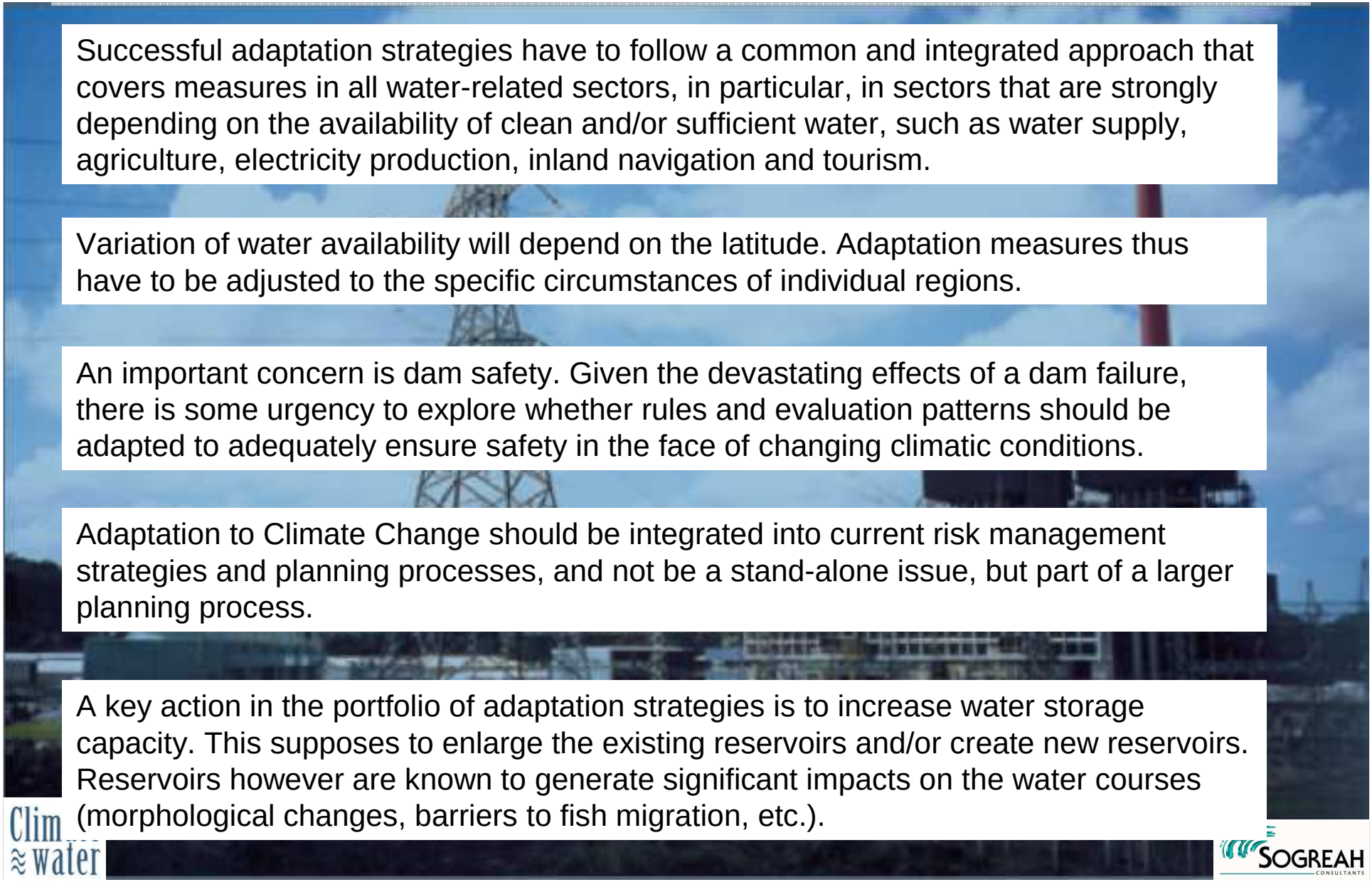
Hydropower and thermal power plants

Adaptation measures needed



Successful adaptation strategies have to follow a common and integrated approach that covers measures in all water-related sectors, in particular, in sectors that are strongly depending on the availability of clean and/or sufficient water, such as water supply, agriculture, electricity production, inland navigation and tourism.

Variation of water availability will depend on the latitude. Adaptation measures thus have to be adjusted to the specific circumstances of individual regions.

An important concern is dam safety. Given the devastating effects of a dam failure, there is some urgency to explore whether rules and evaluation patterns should be adapted to adequately ensure safety in the face of changing climatic conditions.

Adaptation to Climate Change should be integrated into current risk management strategies and planning processes, and not be a stand-alone issue, but part of a larger planning process.

A key action in the portfolio of adaptation strategies is to increase water storage capacity. This supposes to enlarge the existing reservoirs and/or create new reservoirs. Reservoirs however are known to generate significant impacts on the water courses (morphological changes, barriers to fish migration, etc.).

Hydropower and thermal power plants

Adaptation measures needed (Cont'd)

New reservoir construction is being increasingly constrained, particularly in Europe, by environmental regulations and high investment costs. Are reservoirs acceptable in application of the WFD? What are the criteria to consider to declare that a water body is in a good environmental status?

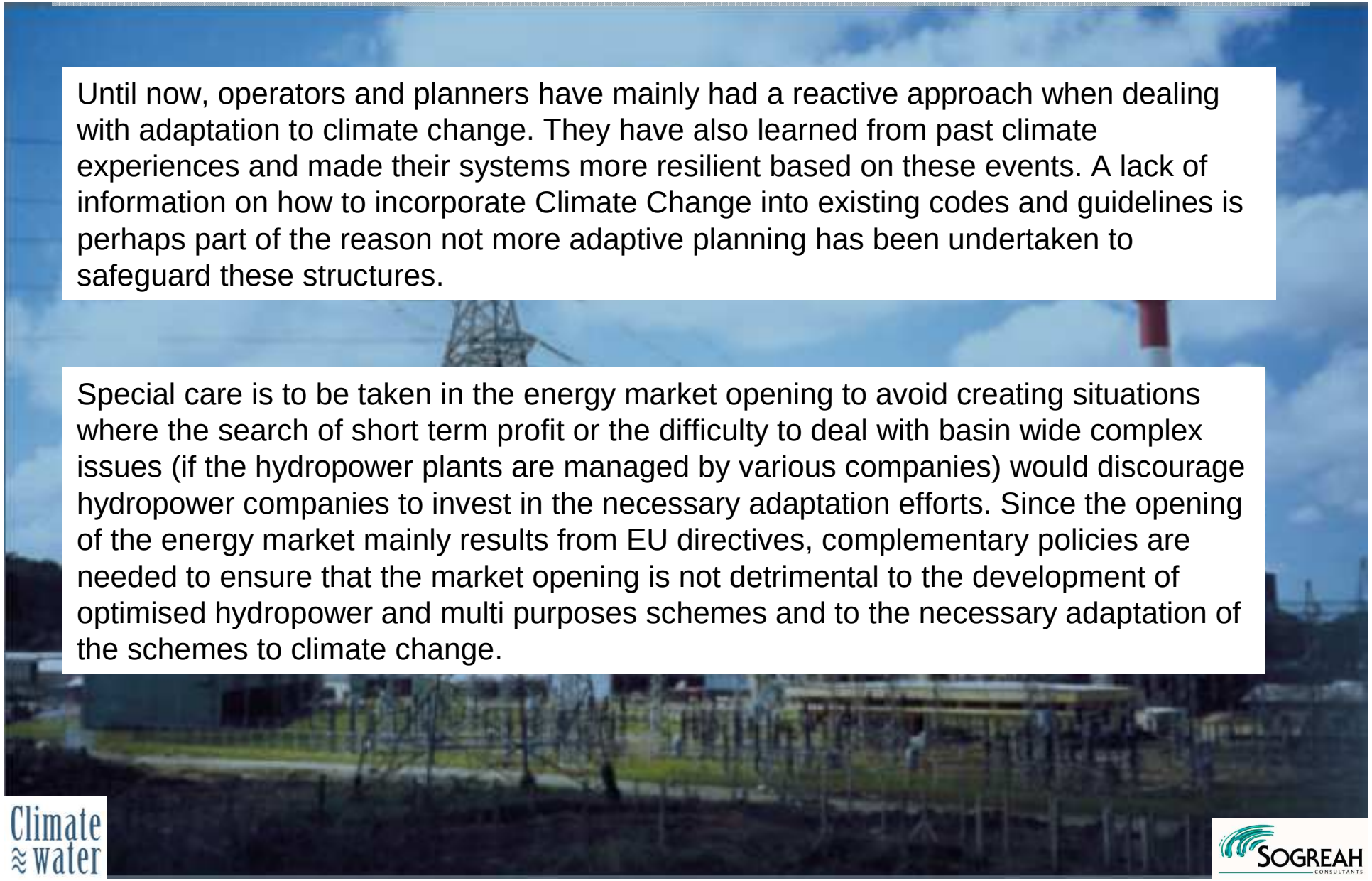
Among existing or planned reservoirs several have (or will have) multi-purpose objectives. In these cases the impact of climate change on hydropower is even more difficult to assess due to the many interactions and the associated constraints of the water multi-use. Managing a multi-purpose hydraulic scheme is indeed extremely complex. A reduction of inflows would have general negative impacts on all uses: hydroelectricity, thermal plants cooling, irrigation, drinkable water supply, tourism, fire fight.

The obligation of competition in the renewal of hydroelectric concession is a head-ache for very complex multi-purpose hydraulic systems, in particular when the dates of the renewing are not the same for each hydropower plant of the same system (this is generally the case). Indeed all the components of the system are linked, aimed at optimizing hydropower and other services.

Decentralised approaches and changes in the whole electricity supply systems, including the energy mix and transmission and distribution grids, as well as its organisation (including market opening) will have to support adaptation.

Hydropower and thermal power plants

Policy implications of adaptation needs



Until now, operators and planners have mainly had a reactive approach when dealing with adaptation to climate change. They have also learned from past climate experiences and made their systems more resilient based on these events. A lack of information on how to incorporate Climate Change into existing codes and guidelines is perhaps part of the reason not more adaptive planning has been undertaken to safeguard these structures.

Special care is to be taken in the energy market opening to avoid creating situations where the search of short term profit or the difficulty to deal with basin wide complex issues (if the hydropower plants are managed by various companies) would discourage hydropower companies to invest in the necessary adaptation efforts. Since the opening of the energy market mainly results from EU directives, complementary policies are needed to ensure that the market opening is not detrimental to the development of optimised hydropower and multi purposes schemes and to the necessary adaptation of the schemes to climate change.

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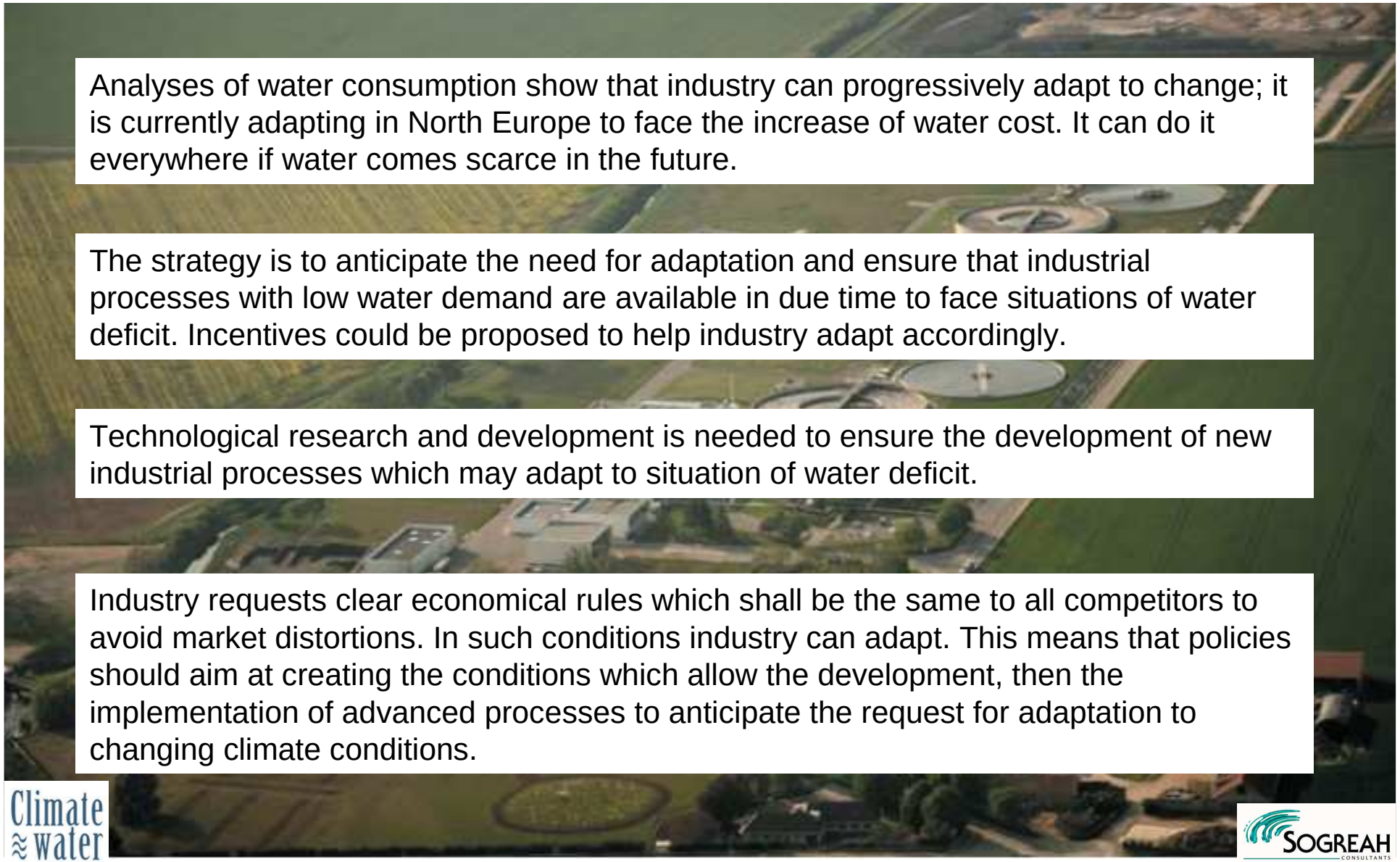
Other water industries

Climate change impacts and adaptation strategy



Analyses of water consumption show that industry can progressively adapt to change; it is currently adapting in North Europe to face the increase of water cost. It can do it everywhere if water comes scarce in the future.

The strategy is to anticipate the need for adaptation and ensure that industrial processes with low water demand are available in due time to face situations of water deficit. Incentives could be proposed to help industry adapt accordingly.

Technological research and development is needed to ensure the development of new industrial processes which may adapt to situation of water deficit.

Industry requests clear economical rules which shall be the same to all competitors to avoid market distortions. In such conditions industry can adapt. This means that policies should aim at creating the conditions which allow the development, then the implementation of advanced processes to anticipate the request for adaptation to changing climate conditions.

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