17 Sector Interactions, Multiple Stressors, and Complex Systems

Landslide blocking a road in California

Key Message 1

Interactions Among Sectors

The sectors and systems exposed to climate (for example, energy, water, and agriculture) interact with and depend on one another and other systems less directly exposed to climate (such as the financial sector). In addition, these interacting systems are not only exposed to climate-related stressors such as floods, droughts, and heat waves, they are also subject to a range of non-climate factors, from population movements to economic fluctuations to urban expansion. These interactions can lead to complex behaviors and outcomes that are difficult to predict. It is not possible to fully understand the implications of climate change on the United States without considering the interactions among sectors and their consequences.

Key Message 2

Multisector Risk Assessment

Climate change risk assessment benefits from a multisector perspective, encompassing interactions among sectors and both climate and non-climate stressors. Because such interactions and their consequences can be challenging to identify in advance, effectively assessing multisector risks requires tools and approaches that integrate diverse evidence and that consider a wide range of possible outcomes.

Key Message 3

Management of Interacting Systems

The joint management of interacting systems can enhance the resilience of communities, industries, and ecosystems to climate-related stressors. For example, during drought events, river operations can be managed to balance water demand for drinking water, navigation, and electricity production. Such integrated approaches can help avoid missed opportunities or unanticipated tradeoffs associated with the implementation of management responses to climate-related stressors.

Key Message 4

Advancing Knowledge

Predicting the responses of complex, interdependent systems will depend on developing meaningful models of multiple, diverse systems, including human systems, and methods for characterizing uncertainty.

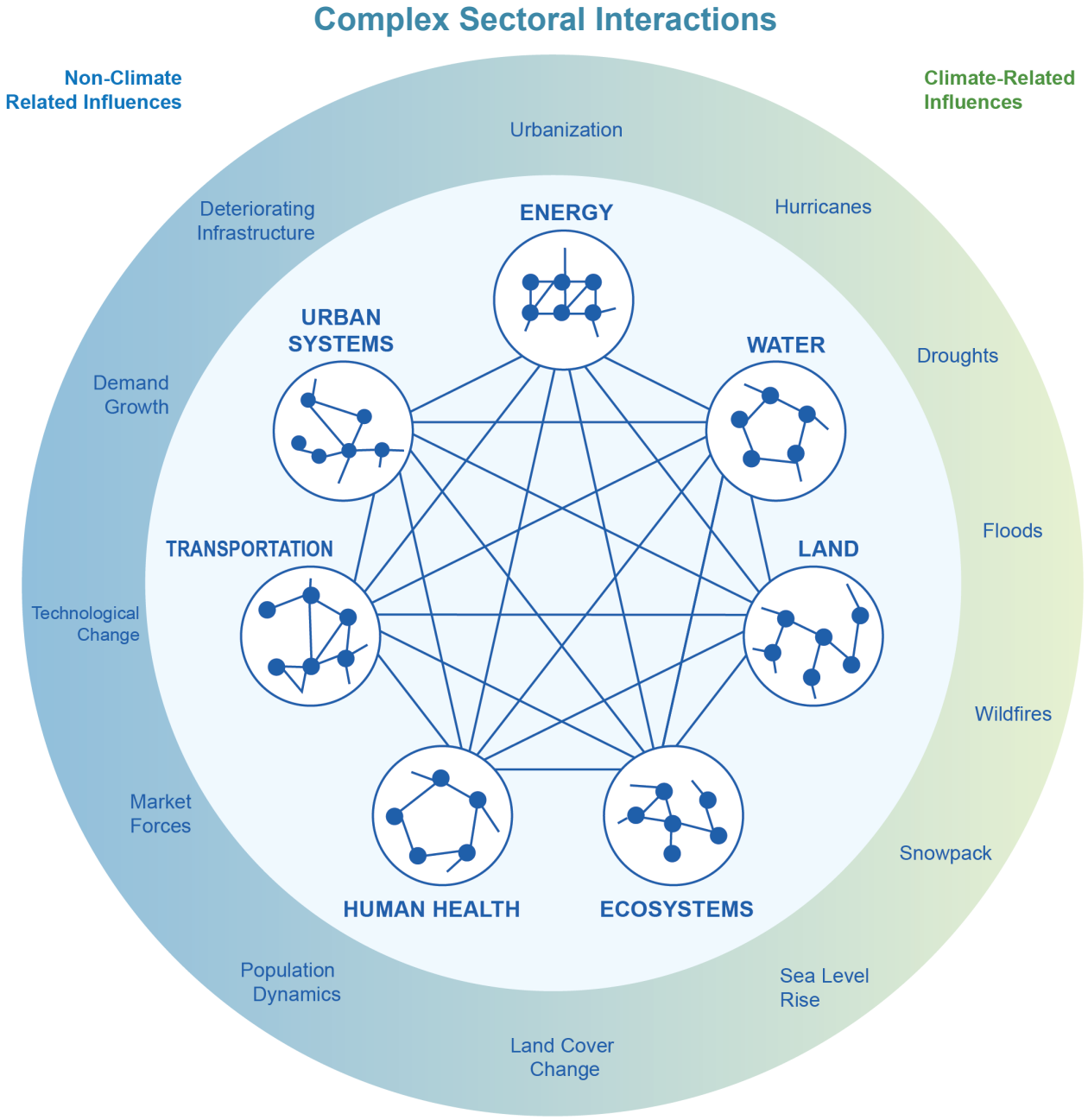
Executive Summary

The world we live in is a web of natural, built, and social systems—from global and regional climate; to the electric grid; to water management systems such as dams, rivers, and canals; to managed and unmanaged forests; and to financial and economic systems. Climate affects many of these systems individually, but they also affect one another, and often in ways that are hard to predict. In addition, while climate-related risks such as heat waves, floods, and droughts have an important influence on these interconnected systems, these systems are also subject to a range of other factors, such as population growth, economic forces, technological change, and deteriorating infrastructure.

A key factor in assessing risk in this context is that it is hard to quantify and predict all the ways in which climate-related stressors might lead to severe or widespread consequences for natural, built, and social systems. A multisector perspective can help identify such critical risks ahead of time, but uncertainties will always remain regarding exactly how consequences will materialize in the future. Therefore, effectively assessing multisector risks requires different tools and approaches than would be applied to understand a single sector by itself.

In interacting systems, management responses within one system influence how other systems respond. Failure to anticipate interdependencies can lead to missed opportunities for managing the risks of climate change; it can also lead to management responses that increase risks to other parts of the system. Despite the challenge of managing system interactions, there are opportunities to learn from experience to guide future risk management decisions.

There is a large gap in the multisector and multiscale tools and frameworks that are available to describe how different human systems interact with one another and with the earth system, and how those interactions affect the total system response to the many stressors they are subject to, including climate-related stressors. Characterizing the nature of such interactions and building the capacity to model them are important research challenges.



Sectors are interacting and interdependent through physical, social, institutional, environmental, and economic linkages. These sectors and the interactions among them are affected by a range of climate-related and non-climate influences. *From Figure 17.1 (Sources: Pacific Northwest National Laboratory, Arizona State University, and Cornell University).*

Introduction

The world we live in is a web of natural, built, and social systems—from global and regional climate; to the electric grid; to water management systems such as dams, rivers, and canals; to managed and unmanaged forests; and to financial and economic systems. Climate affects many of these systems individually, but they also affect one another, and often in ways that are hard to predict. In addition, while climate-related risks such as heat waves, floods, and droughts have an important influence on these interdependent systems, these systems are also subject to a range of other factors, such as population growth, economic forces, technological change, and deteriorating infrastructure (Figure 17.1).

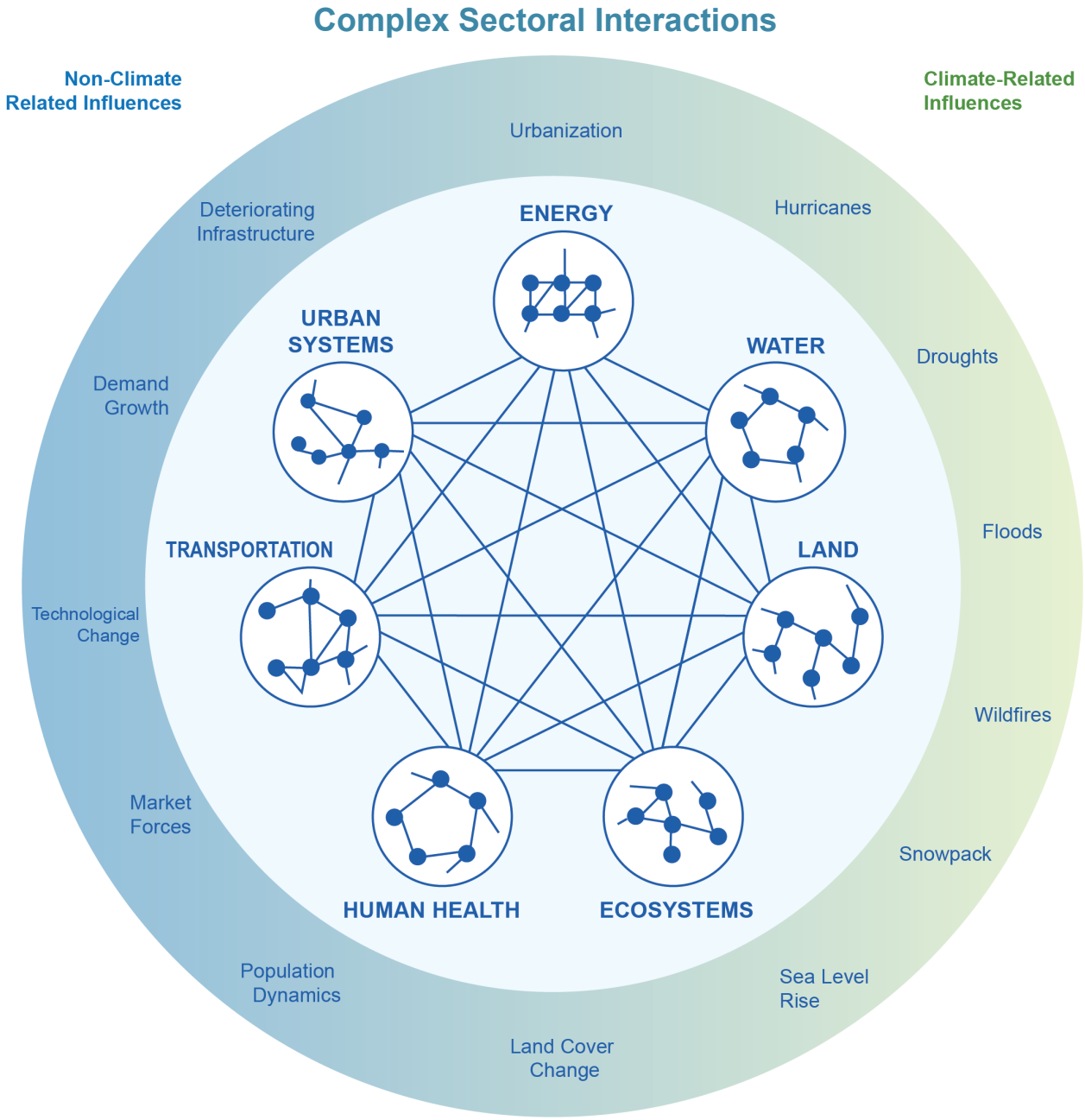


Figure 17.1: Sectors are interacting and interdependent through physical, social, institutional, environmental, and economic linkages. These sectors and the interactions among them are affected by a range of climate-related and non-climate influences. Sources: Pacific Northwest National Laboratory, Arizona State University, and Cornell University.