



INTRODUCING *BREAKTHROUGHS*

This is the story of nuclear innovation as an enabler of global clean energy systems.

Nuclear energy is an important part of global energy supply. It is an emissions-free source of reliable, baseload electricity that currently produces one-third of the world's non-emitting electricity. More than 440 nuclear reactors are currently operating in 30 countries, with about 60 more reactors presently under construction.

To meet global clean energy objectives, modelling by the International Energy Agency estimates that global nuclear energy generation will need to nearly double by 2040.

This will require refurbishment of existing reactors around the world, some of which are already completed or underway. In the next two decades, the global market for new nuclear power is estimated at \$2.6 trillion.

CLEAN ENERGY CROSSROADS

At the same time, the world is in the midst of a fundamental change in the way we power our societies.

The need for clean, reliable energy is growing globally. Alongside other renewable sources, society is increasingly powered by larger shares of variable renewable energy from wind and solar. The electrification of end-uses such as transportation that have traditionally relied on fossil fuels is bringing new sources of demand to increasingly decentralized and dynamic electricity grids. The very nature of the electricity grid is evolving too, as technologies become available that allow traditional consumers to produce or store electricity, and sell it back to the grid.

Beyond electricity, meeting global clean energy goals will require radical changes in other industrial sectors, including transportation, manufacturing, and agriculture. Many of these changes require new solutions—such as carbon capture, utilization, and storage—that go beyond options available today.

Energy systems of the future must also retain the confidence of the people and communities they serve. Energy systems need to remain affordable, safe, secure, sustainable, and reliable, and be implemented on a foundation of certainty and trust that protects the public and the environment.

NUCLEAR AS AN ENABLER OF CLEAN ENERGY

Countries will need multiple energy options to meet these challenges; nuclear energy systems can be part of the solution.

The model of nuclear energy as a large, central source of baseload electricity is changing. In some areas, markets are signalling for smaller, simpler, lower-cost nuclear energy systems. And in many countries, there is a greater emphasis on private sector development of technologies and projects.

There is an important story that has not been told in the broader clean energy dialogue: the story of nuclear innovation and the opportunities it can seize to complement and enhance tomorrow's clean energy systems.

This book tells that story.

ABOUT THIS BOOK

This isn't a typical policy report. *Breakthroughs* is a collection of stories of nuclear innovations and how they enable clean energy systems.

Each story is a short introduction to a new and exciting innovation that is here already, or is expected to be available in the near term.

The goal of *Breakthroughs* is to spark imagination and challenge ideas on what nuclear energy's role could be in energy systems of the future.

Three important points about this book

- 1 First, this is not just a technology story. In many cases, the key innovations lie in economic and social innovation—from disruptive business models to new models for engagement and gaining public confidence.
- 2 Second, the focus of this book is near-term innovation. The stories are not science fiction. The examples in this book intentionally focus on realistic, near-term applications of innovative technologies and systems. Many of these innovations already exist and are being implemented.
- 3 Third, *Breakthroughs* is a starting point for an examination of how nuclear energy can complement the broader clean energy sector. It is meant to capture your interest, spark your imagination, and challenge your conceptions of what nuclear energy can be.

Breakthroughs brings the story of nuclear energy as an enabler of clean energy systems to the broader discussion underway at the Clean Energy Ministerial. It highlights opportunities to build stronger, cross-sectoral partnerships through the “Nuclear Innovation: Clean Energy Future” (NICE Future) initiative. And it reveals the important role that nuclear energy can play in bringing about reliable, affordable, and clean energy systems of the future.