Preface

Ferenc L. Toth

International Atomic Energy Agency (IAEA),
Wagramer Str. 5, P.O. Box 100,
1400 Vienna, Austria
Email: F.L.Toth@iaea.org

Biographical notes: Ferenc L. Toth is senior energy economist in the Planning and Economic Section, IAEA. Over the past 30 years, he worked as senior scientist and project leader on development, energy, and environment issues at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria, and at the Potsdam Institute for Climate Impact Research (PIK) in Potsdam, Germany. His current projects include energy economics and policy analysis; climate change mitigation, impacts, and adaptation; energy security; sustainable energy development strategies. He was coordinating lead author and lead author of several chapters of reports by the Intergovernmental Panel on Climate Change (IPCC).

Energy is generally recognised as a central issue in sustainable development. The provision of adequate energy services at affordable costs, in a secure and environmentally benign manner and in conformity with social and economic developmental needs is an essential element of sustainable development. Reliable energy services are an important precondition for investments that bring about economic development. Among other things, they facilitate the learning and study and improved health care that are crucial for developing human capital. They also promote social equity by giving the less well-off the chance to study, thus providing a possible escape from poverty. Energy is therefore vital for alleviating poverty, improving human welfare and raising living standards.

Fossil fuels are projected to remain the main sources in the global energy economy for the next few decades. The contribution of nuclear energy to the global energy supply is also expected to increase. The increasing concern over anthropogenic climate change and the need to reduce greenhouse gas emissions poses a major challenge to the fossil fuel industry. If large-scale reductions of greenhouse gas emissions are necessary over the next few decades, the viability of fossil fuels will depend on the possibility and prospects of preventing the release of carbon dioxide (CO_2) into the atmosphere by capturing and disposing of it in geological formations. CO_2 capture and disposal has emerged as one of the principal fields of scientific research and technological R&D.

Over the past 50 years, nuclear energy has been pursued by an increasing number of countries for a variety of reasons, ranging from fast growing energy demand to energy supply security and, more recently, as part of climate change mitigation strategies. The safe disposal of the resulting radioactive waste (RW) has been one of the main predicaments from the beginning, and it remains an issue that the nuclear industry needs to resolve in order to improve the prospects for nuclear energy to contribute to resolving the enormous energy challenges the world faces in this century. Geological disposal has been studied for decades by the nuclear industry to ensure the safe and reliable separation of radioactive waste from the environment. Over the past two decades, major scientific and technological advances have been made towards the safe temporary storage and final disposal of RW. The disposal of RW in geological media is considered by most scientists and engineers engaged in the issue to be a safe and viable method for isolating it from the hydrosphere, the atmosphere and the biosphere.

Geological disposal of carbon dioxide and that of radioactive waste gives rise to many common concerns in domains ranging from geology to public acceptance. In this respect, comparative assessments reveal many similarities, ranging from the transformation of the geological environment and safety and monitoring concerns to regulatory, liability and public acceptance issues. However, there are profound differences on a broad range of issues as well, such as the quantities and hazardous features of the materials to be disposed of, the characteristics of the targeted geological media, the site engineering technologies involved and the timescales required for safe containment at the disposal location. There are ample opportunities to learn from comparisons and to derive insights that will assist policymakers responsible for national energy strategies and international climate policies.

Recognising these opportunities, the International Atomic Energy Agency (IAEA) initiated a Cooperative Research Project in which research teams from nine Member States contributed to comparative assessments in selected thematic areas pertinent to the geological disposal of CO_2 and RW. This special issue presents the main results of the project. Its objective is to summarise the lessons from the project in the fields of CO_2 and RW disposal by providing an in-depth comparative assessment of their similarities and differences, of related issues that have already been resolved and of the key challenges that remain; it also evaluates the policy implications for moving the process further. Contributors to this special issue come from a broad range of scientific disciplines, including geology, geography, environmental sciences, engineering, economics, sociology, and political science.

I believe the comparative assessment presented here will be of interest to a wide audience. The greatest effort was made by the authors and the editor to ensure the neutrality and objectivity of the comparative technology analyses. Considering the ample opportunities for knowledge transfer and learning between the CO_2 and RW management research communities, this special issue can be expected to trigger more collaborative projects to explore the open issues still further. On the policy side, the insights presented by the authors are likely to provide useable knowledge to assist policymakers in resolving major challenges encountered during the formulation of national energy and climate strategies.

It is important to clarify the terminology used in this special issue right at the outset. The emplacement of CO_2 in geological formations is widely called storage, sequestration or disposal and these terms are used interchangeably throughout the special issue. The terminology is well-defined for radioactive waste: storage means the keeping of spent fuel and other RW in temporary storage facilities, while the term disposal is used for the permanent emplacement in geological formations.

Finally, I would like to thank Janet Marr, Manager of *IJGEI*, for her support throughout the publication process. I am indebted to the referees who devoted their time to provide valuable comments and suggestions for improving the papers. I also thank Elizabeth Camfield, Milenko Matosic, Giuseppe de Simone and Eric Williams for their help in producing this special issue.