Acknowledgements

This study was prepared by the World Energy Outlook (WEO) team in the Directorate of Sustainability, Technology and Outlooks (STO) in co-operation with other directorates and offices of the International Energy Agency. The study was designed and directed by Laura Cozzi, Chief Energy Modeller and Head of Division for Energy Demand Outlook, and Tim Gould, Head of Division for Energy Supply and Investment Outlooks. Stéphanie Bouckaert led on end-use modelling and analysis. Daniel Crow co-led the climate and environment analysis and led the behaviour analysis. Tae-Yoon Kim co-led the fuel supply analysis. Christophe McGlade co-led the climate and environment analysis, and the analysis of fuel supply. Pawel Olejarnik co-ordinated the oil, natural gas and coal supply modelling. Brent Wanner led the power sector modelling and analysis. Daniel Wetzel co-led the energy demand analysis.

Key contributions from across the WEO team were from: Zakia Adam (lead on data management, contributed to fossil fuel subsidies), Lucila Arboleya Sarazola (investment and finance), Yasmine Arsalane (lead economic outlook, power), Simon Bennett (energy technology), Arthur Contejean (lead on energy access and developing countries), Davide D’Ambrosio (lead on data science, power), Amrita Dasgupta (energy access, climate and environment), Thibault Deletombe (industry), John Connor Donovan (power and data management), Musa Erdogan (industry and data management), Eric Fabozzi (power and electricity networks), Pablo Gonzalez (investment and finance), Timothy Goodson (lead on buildings and demand-side response), Paul Hugues (industry and transport), Vanessa Koh (power and energy storage), Lilly Yejin Lee (transport and aviation), Kieran McNamara (electricity networks and nuclear), Laura Maiolo (oil and gas supply), Ariane Millot (buildings, climate and environment), Toru Muta (fuel supply), Yoko Nobuoka (investment, coal), Sebastian Papapanagiotou (electricity networks and power), Claudia Pavarini (lead on energy storage, power), Daniele Perugia (financing of solar PV and electricity networks), Apostolos Petropoulos (lead on transport, climate and environment), Ryszard Pospiech (supplier modelling and data management), Arnaud Rouget (energy access and Africa), Jasmine Samantar (energy access and Africa), Andreas Schroeder (lead on industry), Rebecca Schulz (oil and gas supply), Leonie Staas (climate and environment), Michael Waldron (lead on investment), Molly A. Walton (fuel supply), Peter Zeniewski (lead on natural gas). Teresa Coon, Marina Dos Santos and Eleni Tsoukala provided essential support.

Edmund Hosker carried editorial responsibility.

Debra Justus was the copy-editor.

Colleagues from the Energy Technology Policy (ETP) Division led by Timur Gül provided valuable help on demand modelling and analysis, with overall guidance from Araceli Fernandez Pales. Peter Levi, Hana Mandova and Tiffany Vass contributed to the analysis on industry; Leonardo Paoli, Jacopo Tattini and Jacob Teter contributed to the analysis on transport; Thibaut Abergel and Chiara Delmastro contributed to the analysis on buildings; Jose Bermudez Menendez and Uwe Remme contributed to the analysis on power and...
hydrogen. Other key contributors from across the agency were: Laszlo Varro, Carlos Fernández Alvarez, Heymi Bahar, Tomas De Oliveira Bredariol and Inchan Hwang.

Mechthild Wörsdörfer, Director of STO, provided encouragement and support throughout the project. Valuable comments and feedback were provided by other senior management and numerous other colleagues within the IEA. In particular, David Turk, Keisuke Sadamori, Amos Bromhead, Alessandro Blasi, Nick Johnstone, Neil Atkinson, Joel Couse, Peter Fraser, Paolo Frankl, Tom Howes, Brian Motherway, Aad van Bohemen, Rebecca Gaghen, Masatoshi Sugiura, Christophe Barret, Toril Bosoni and Jean-Baptiste Dubreuil.

Thanks go to the IEA’s Communication and Digitalisation Office for their help in producing the report and website materials, particularly to Jad Mouawad, Jethro Mullen, Astrid Dumond, Jon Custer, Christopher Gully, Katie Lazaro, Julie Puech, Magdalena Sanocka, Rob Stone and Therese Walsh. Diana Browne, Ivo Letra and Ben McCulloch provided essential support to the production process. IEA’s Office of the Legal Counsel, Office of Management and Administration and Energy Data Centre provided assistance throughout the preparation of the report.

The IEA is grateful for the guidance and valuable advice of Peter Betts on climate issues.

Valuable input to the analysis was provided by: David Wilkinson (independent consultant); Markus Amann, Peter Rafaj, Gregor Kiesewetter, Wolfgang Schöpp, Chris Heyes, Zbigniew Klimont, Jens Borken-Kleefeld and Pallav Purohit (International Institute for Applied Systems Analysis); Elisa Puzzolo, Daniel Pope and Matthew Shupler (University of Liverpool).

The work could not have been achieved without the support and co-operation provided by many government bodies, organisations and companies worldwide, notably: Enel; Energy Market Authority, Singapore; Eni; European Commission; Ministry of the Environment, Land and Sea, Italy; Ministry of Economy, Trade and Industry, Japan; The Research Institute of Innovative Technology for the Earth, Japan; and Toshiba.

Activities within the IEA Clean Energy Technologies Programme provided valuable support to this report. Thanks also go to the IEA Energy Business Council, IEA Coal Industry Advisory Board, IEA Energy Efficiency Industry Advisory Board and the IEA Renewable Industry Advisory Board.

Peer reviewers

Many senior government officials and international experts provided input and reviewed preliminary drafts of the report. Their comments and suggestions were of great value. They include:

Emmanuel Ackom UN Environment Programme (UNEP), Technical University of Denmark Partnership (DTU)
Keigo Akimoto The Research Institute of Innovative Technology for the Earth, Japan
Acknowledgements

Venkatachalam Anbumozhi  Economic Research Institute for ASEAN and East Asia (ERIA)
Peter Bach  Danish Energy Agency
Marco Baroni  Independent consultant
Paul Baruya  Clean Coal Centre
Tom Bastin  UK Department for Business, Energy and Industrial Strategy
Harmee Bawa  Hitachi ABB Power Grids
Christian Besson  Independent consultant
Rina Bohle Zeller  Vestas, Denmark
Serge Braz  EDF
William Brent  Power for All
Mick Buffier  Glencore
Nick Butler  Kings College London
Guy Caruso  Center for Strategic and International Studies (CSIS), United States
Kimball Chen  Global LPG Partnership
Xavier Chen  Statoil China
Drew Clarke  Australian Energy Market Operator
Russel Conklin  US Department of Energy
Ian Cronshaw  Independent consultant
François Dassa  EDF
Ralf Dickel  Oxford Institute for Energy Studies, United Kingdom
Giles Dickson  WindEurope
Loic Douillet  GE Power
David Elzinga  Asian Development Bank
Simon Evans  Carbon Brief
Fridtjof Fossum Unander  Research Council of Norway
Jean-François Gagné  Department of Natural Resources Canada
Faith Gan  Energy Market Authority, Singapore
Karthik Ganesan  Council on Energy, Environment and Water (CEEW)
Dolf Gielen  International Renewable Energy Agency (IRENA)
Craig Glazer  PJM Interconnection
Andrii Gritsevskyi  International Atomic Energy Agency (IAEA)
Andrea Guerrero  United Nations
Michael Hackethal  Federal Ministry for Economic Affairs and Energy, Germany
James Henderson  Oxford Institute for Energy Studies, United Kingdom
Cameron Hepburn  Oxford University, United Kingdom
Masazumi Hirono  Tokyo Gas
Takashi Hongo  Mitsui Global Strategic Studies Institute, Japan
Jan-Hein Jesse  JOSCO Energy Finance and Strategy Consultancy
Noah Kaufman  Columbia University, United States
The individuals and organisations that contributed to this study are not responsible for any opinions or judgments it contains. All errors and omissions are solely the responsibility of the IEA.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.