This has been an extraordinarily turbulent year for the global energy system. Covid-19 unleashed a crisis of exceptional ferocity on countries around the world, with severe impacts on lives and livelihoods. The crisis is still unfolding today – and its consequences for the world's energy future remain highly uncertain.

The International Energy Agency (IEA) responded quickly and assertively to the pandemic, refocusing our work to assess the impacts of the crisis across all the key fuels and technologies. We enabled governments, companies and citizens to better understand the emerging trends, such as the unparalleled plunge in global energy investment and its consequences. We offered practical policy advice, most notably in the *WEO Special Report on Sustainable Recovery*, which shows how governments – by implementing targeted energy policies – can boost economic growth, create jobs and put global emissions into decline over the next three years. Following that, we drew on the IEA's ever-growing convening power to bring together 40 Ministers from countries representing over 80% of the global economy at the IEA Clean Energy Transitions Summit on 9 July 2020, where they discussed the importance of a clean and resilient recovery.

The work of the IEA remains centred on the range of energy challenges the world faces today – and on how the pandemic is affecting them. We are contending with old and new threats, both to the energy supplies that economies and societies rely on today – and to the all-important clean energy transitions that will shape their future. Our flagship publication, the *World Energy Outlook (WEO)*, is no exception. This year's *WEO* has adapted to the pandemic's disruption in three key ways.

First, Covid-19 has introduced huge near-term uncertainty about the future of energy, so *WEO-2020* focuses much more than its predecessors on the next 10 years. We are entering a critical decade for accelerating clean energy transitions and putting emissions into structural decline.

Second, a key question is the future severity of the pandemic and its economic implications. In response, we have introduced a new scenario, the Delayed Recovery Scenario, to explore this and consider the different outcomes, depending on whether the world gets the pandemic under control in 2021 or it turns into a more prolonged crisis and a deeper economic slump. This has huge implications for the energy sector, especially in the developing world. A delayed economic recovery results in slower emissions growth, but it is not an answer to climate change. Our analysis makes it clear that the somewhat lower emissions come for all the wrong reasons and at huge economic and social costs.

Third, the rising number of countries and companies committing to net-zero emissions is a profoundly important development. All the pledges announced so far are in line with the vision mapped out in our Sustainable Development Scenario, in which countries achieving net-zero emissions by 2050 spur the world as a whole to reach it by 2070. But when I sat down at the beginning of this year with the lead authors of the *WEO*, Laura Cozzi and Tim Gould, we agreed it was time to deepen and extend our analysis of net-zero emissions.

That is why we have a new case in this *WEO*: the Net Zero Emissions by 2050 case, which examines what it would take to get the entire world to net zero by mid-century.

How the world rises to these challenges will define our energy future and determine the success or failure of efforts to tackle climate change. The IEA has made its own position clear. Since the scale of the Covid-19 crisis began to emerge, we have been leading the calls to put clean energy at the heart of the economic response to ensure a secure and sustainable recovery.

Today, we are seeing optimistic signs that clean energy transitions are gaining momentum. In this *WEO*, we highlight the enormously consequential nature of the choices and responsibilities facing decision makers. The massive sums of money they are committing to spur economic recovery are a historic opportunity to significantly accelerate transitions towards a cleaner and more resilient energy future. This is the moment for ambitious action. As this *WEO* makes clear, decisions taken now will echo down through generations to come.

I would like to conclude by noting that the essential insights contained in this publication are the result of a tremendous amount of painstaking number crunching, shrewd analysis and commendable hard work from the entire *WEO* team. I would like to thank all of those colleagues, under the exemplary leadership of Laura and Tim, for their dedicated efforts.

Dr. Fatih Birol
Executive Director
International Energy Agency

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. **Paweł 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** (supply 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

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
Harmeet 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

Yoichi Kaya	The Research Institute of Innovative Technology for the Earth, Japan
Michael Kelly	World LPG Association
Robert Kleinberg	Columbia University, United States
Hidechika Koizumi	Ministry of Economy, Trade and Industry, Japan
Phoebe Koundouri	Athens University of Economics and Business
Ken Koyama	Institute of Energy Economics, Japan
Atsuhito Kurozumi	Kyoto University of Foreign Studies
Sarah Ladislaw	Center for Strategic and International Studies (CSIS), United States
Francisco Laveron	Iberdrola
Lee Levkowitz	BHP
Li Jiangtao	State Grid Energy Research Institute, China
Felix Chr. Matthes	Öko-Institut – Institute for Applied Ecology, Germany
Antonio Merino Garcia	Repsol
Cristobal Miller	Department of Natural Resources, Canada
Simone Mori	Enel.
Peter Morris	Minerals Council of Australia
Isabel Murray	Department of Natural Resources, Canada
Steve Nadel	American Council for an Energy-Efficient Economy, United States
Henri Paillere	International Atomic Energy Agency (IAEA)
Pak Yongduk	Korea Energy Economics Institute (KEEI)
Ignacio Perez Arriaga	Comillas Pontifical University's Institute for Research in Technology, Spain
Glen Peters	CICERO
Koen Peters	GOGLA (Global association for the off-grid solar energy industry)
Stephanie Pfeifer	The Institutional Investors Group on Climate Change (IIGCC)
Cedric Philibert	French Institute of International Relations, Centre for Energy & Climate
Dmitry Popov	CRU
Andreas Regnell	Vattenfall
Rasmus Nicolas Ringgaard	Permanent Delegation of Denmark to the OECD
Seth Roberts	Saudi Aramco
Vera Rodenhoff	Federal Ministry of Environment, Nature Conservation and Nuclear Safety, Germany
Hans-Wilhelm Schiffer	World Energy Council
Filip Schittecatte	ExxonMobil
Adnan Shihab Eldin	Foundation for the Advancement of Sciences, Kuwait
Adam Sieminski	Kapsarc
Paul Simons	Yale University
Stephan Singer	Climate Action Network International

Jim Skea	Imperial College London
John Staub	US Energy Information Administration
Ottavia Stella	Eni
Jonathan Stern	Oxford Institute for Energy Studies, United Kingdom
Wim Thomas	Royal Dutch Shell
Johannes Trüby	Deloitte
Nikos Tsafos	Center for Strategic and International Studies (CSIS), United States
Frank van der Vleuten	Ministry of Foreign Affairs, The Netherlands
Noé Van Hulst	Ministry of Economic Affairs & Climate Policy, The Netherlands
Tom Van Ierland	DG Climate Action, European Commission
Frank Verrastro	Center for Strategic and International Studies (CSIS), United States
David Victor	UC San Diego School of Global Policy and Strategy, United States
Akira Yabumoto	J-Power
William Zimmern	BP
Christian Zinglersen	European Union Agency for the Cooperation of Energy Regulators (ACER)

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.