

# World Energy Outlook 2021

International  
Energy Agency

iea

# World Energy Outlook 2021

[www.iea.org/weo](http://www.iea.org/weo)

# INTERNATIONAL ENERGY AGENCY

---

The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.

Please note that this publication is subject to specific restrictions that limit its use and distribution. The terms and conditions are available online at [www.iea.org/t&c/](http://www.iea.org/t&c/)  
This publication 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.

Source: IEA. All rights reserved.  
International Energy Agency  
Website: [www.iea.org](http://www.iea.org)

## IEA member countries:

Australia  
Austria  
Belgium  
Canada  
Czech Republic  
Denmark  
Estonia  
Finland  
France  
Germany  
Greece  
Hungary  
Ireland  
Italy  
Japan  
Korea  
Luxembourg  
Mexico  
Netherlands  
New Zealand  
Norway  
Poland  
Portugal  
Slovak Republic  
Spain  
Sweden  
Switzerland  
Turkey  
United Kingdom  
United States

The European Commission also participates in the work of the IEA

## IEA association countries:

Brazil  
China  
India  
Indonesia  
Morocco  
Singapore  
South Africa  
Thailand

The *World Energy Outlook (WEO)* is usually published in November. However, for the second year in a row, the International Energy Agency (IEA) is releasing our flagship report a month early, in October. We did this last year because it was an exceptional year defined by the Covid-19 crisis. This year is another exceptional year because of the COP26 Climate Change Conference meeting in Glasgow.

This COP – short for the Conference of the Parties, the main decision-making body of the United Nations Framework Convention on Climate Change – is particularly significant. It is the first test of the readiness of countries to submit new and more ambitious commitments under the 2015 Paris Agreement. It is also an opportunity – as the *WEO-2021* states – to provide an “unmistakeable signal” that accelerates the transition to clean energy worldwide.

This year’s edition of the *WEO* has been designed, exceptionally, as a guidebook to COP26. It spells out clearly what is at stake – what the pledges to reduce emissions made by governments so far mean for the energy sector and the climate. And it makes clear what more needs to be done to move beyond these announced pledges towards a pathway that would have a good chance of limiting global warming to 1.5 °C and avoiding the worst effects of climate change.

For this, the analysis in *WEO-2021* relies on our landmark report published earlier this year – *Net Zero by 2050: A Roadmap for the Global Energy Sector* – which is now an integral part of the pioneering energy modelling work that goes into producing the *WEO* each year.

The IEA’s work this year has demonstrated our commitment to leading clean energy transitions globally by enabling governments to understand what they need to do to put emissions into rapid and sustained decline. But we have also made very clear that countries’ transitions have to be secure, affordable and fair for all citizens. If governments do not ensure that these key elements are at the core of their policy making for the transformation of their energy sectors, then they risk failure.

At the time of publication of this year’s *WEO*, governments are getting an advanced warning of this risk, with the prices of natural gas, coal and electricity rising to all-time highs in many regions. The key reasons for these sharp increases in energy prices are not related to efforts to transition to clean energy. They include a rapid economic rebound from last year’s pandemic-induced recession, weather-related factors, and some planned and unplanned outages on the supply side.

However, that does not mean clean energy transitions in the years ahead will be free from volatility. The current context underscores the value of the special analysis that we carried out for *WEO-2021* on energy security risks in transitions. This analysis highlights the potential vulnerabilities that need to be on the radar screens of politicians and other decision makers as the world navigates this essential but deeply challenging era of change for our energy systems.

Successful transitions must be secure, or they will not happen fast enough to ward off catastrophic climate change. And they must have people at their centre, as the IEA has emphasised through the work of the Global Commission on People-Centred Clean Energy Transitions, which I convened in early 2021. Headed by Danish Prime Minister Mette Frederiksen, the Global Commission brings together national leaders, government ministers, civil society representatives and other prominent figures to identify how to ensure that the transition to clean energy is fair and inclusive for everyone. It will publish its recommendations ahead of the start of COP26 at the end of October 2021.

As always with the energy sector, investment is critical. The IEA has been warning for years that current investment levels in the global energy sector are inadequate – both to meet near-term energy needs and long-term transition goals. It is hard to understate the dangers inherent in today's shortfall in spending on clean energy transitions, compared with the levels required. If we do not correct it soon, the risks of destabilising volatility will only grow as we move forward.

Reaching the critical but formidable goal of net zero emissions by 2050 will require major efforts from across society – but it also offers major advantages in terms of human health and economic development. What comes through very clearly in this new *WEO* are the huge opportunities that come with clean energy transitions – for manufacturers of wind turbines, batteries, electrolysers and a host of other technologies. A new global energy economy is emerging, with the potential to create millions of decent jobs across a host of new supply chains. To make this a reality, government leaders in Glasgow must play their part by making the 2020s a decade of massive clean energy deployment.

Finally, I would like to thank the truly exceptional work – in extremely challenging times – by the team of IEA colleagues who worked so hard and so effectively on this *WEO* under the outstanding leadership of my colleagues Laura Cozzi and Tim Gould.

**Dr Fatih Birol**  
**Executive Director**  
**International Energy Agency**

Foreword.....	3
Acknowledgements.....	5
Executive summary .....	15
Introduction .....	23

## 1 Overview 25

Introduction .....	27
1.1 A new energy economy is emerging.....	29
1.2 Scenario trajectories and temperature outcomes .....	32
1.3 Keeping the door to 1.5 °C open .....	36
1.4 Energy consumers of tomorrow.....	43
1.5 Mobilising investment and finance .....	47
1.6 People-centred transitions.....	53
1.7 Phasing out coal .....	57
1.8 Prices and affordability.....	63
1.9 Energy security and the risk of disorderly change.....	68
1.10 Fuels: old and new.....	73

## 2 State of play 79

2.1 Introduction.....	81
2.2 Energy and the Covid-19 pandemic.....	82
2.2.1 Economy and public health .....	82
2.2.2 Recovery spending and energy investment.....	85
2.2.3 Energy demand and supply .....	88
2.2.4 Emissions .....	91
2.3 Where do we go from here? .....	92
2.3.1 Climate pledges .....	92
2.3.2 WEO-2021 scenarios.....	94
2.4 Inputs to the scenarios .....	96
2.4.1 Economic and population assumptions.....	96
2.4.2 Energy prices .....	98
2.4.3 Carbon prices.....	103
2.4.4 Technology innovation, deployment and costs .....	103

3.1	Introduction.....	109
3.2	Achieving net zero emissions by 2050.....	110
3.3	Moving from announced pledges to achieve net zero emissions by 2050..	115
3.4	Electricity sector .....	124
3.5	End-use sectors .....	132
3.5.1	Industry.....	132
3.5.2	Transport .....	140
3.5.3	Buildings .....	146
3.6	Methane emissions from fossil fuel operations .....	154
3.7	Behavioural change .....	158
3.7.1	Role of behavioural change and materials efficiency.....	158
3.7.2	Behavioural changes in advanced economies and emerging market and developing economies .....	161
3.8	Announced pledges and air pollution.....	163

4.1	Introduction.....	167
4.2	Implementation gap .....	167
4.2.1	CO <sub>2</sub> emissions .....	168
4.2.2	Energy access.....	175
4.3	Energy demand.....	180
4.3.1	Energy demand trends to 2030 .....	180
4.3.2	Energy demand trends after 2030.....	184
4.4	Transitions in final energy consumption .....	186
4.4.1	Energy efficiency improvements .....	187
4.4.2	Electrification.....	191
4.5	Electricity .....	194
4.5.1	Electricity demand.....	195
4.5.2	Electricity supply.....	198
4.5.3	Electricity system flexibility .....	203
4.5.4	Networks .....	207

5.1	Introduction.....	213
5.2	Liquid fuels .....	214
5.2.1	Oil trends to 2030 .....	215
5.2.2	Oil trends after 2030.....	219
5.2.3	Biofuels and hydrogen-based fuels .....	223
5.3	Gaseous fuels .....	226
5.3.1	Natural gas trends to 2030 .....	227
5.3.2	Natural gas trends after 2030.....	231
5.3.3	Low-carbon hydrogen and biogas .....	233
5.4	Solid fuels .....	240
5.4.1	Coal trends to 2030 .....	241
5.4.2	Coal trends after 2030 .....	244
5.4.3	Solid bioenergy .....	245

6.1	Introduction.....	249
6.2	Energy security in increasingly integrated systems.....	250
6.2.1	Electricity security.....	252
6.2.2	New demands on fuel infrastructure.....	258
6.2.3	Additional energy conversions .....	263
6.2.4	Building climate resilient infrastructure .....	266
6.3	International aspects of energy security .....	269
6.3.1	Critical minerals .....	271
6.3.2	Oil and gas investment .....	277
6.3.3	New patterns of energy trade .....	282

**Annexes**

<b>Annex A. Tables for scenario projections.....</b>	<b>291</b>
<b>Annex B. Design of the scenarios.....</b>	<b>327</b>
<b>Annex C. Definitions .....</b>	<b>351</b>
<b>Annex D. References .....</b>	<b>369</b>
<b>Annex E. Inputs to the World Energy Model.....</b>	<b>379</b>



该文档为预览版，仅保留部分内容，  
下载完整版报告请关注公众号或添加研究员微信



### 亚洲油气决策者俱乐部

聚焦国内外行业信息的领先海洋油气媒体  
公众号定期分享优质报告  
在推送发布一个月内可免费下载



### 扫码添加研究员微信

添加好友后发送名片并备注想要获取具体某  
一份报告的名称，即可领取完整版报告