

# Table of contents

<b>Introduction</b>		<b>6</b>
	<b>Foreword</b>	<b>6</b>
	<b>Executive summary</b>	<b>7</b>
	<b>Acknowledgements</b>	<b>12</b>
<b>Part 1</b>	<b>Setting the scene</b>	<b>16</b>
<b>Chapter 1</b>	<b>The global outlook</b>	<b>19</b>
	Introduction	21
	Global modelling results	27
	Technologies for energy transformations	34
	Achieving climate ambitions: The gap to 2°C and beyond	39
<b>Chapter 2</b>	<b>Tracking clean energy progress</b>	<b>49</b>
	Tracking progress: How and against what?	51
	Tracking clean energy progress and the Paris goals	52
	Summary of progress	55
	Renewable power	64
	Nuclear power	68
	Natural gas-fired power	70
	Coal-fired power	72
	Carbon capture and storage	74
	Industry	76
	Chemicals and petrochemicals	80
	Pulp and paper	82
	Transport	84
	Electric vehicles	86
	International shipping	88
	Fuel economy of LDVs	90
	Transport biofuels	92
	Buildings	94
	Building envelopes	96
	Lighting, appliances and equipment	98
	Renewable heat	100
	Energy storage	102
	Technology overview notes	104

## Part 2

## Catalysing energy technology transformations

116

<b>Chapter 3</b>	<b>Accelerating the transition to sustainable buildings</b>	<b>119</b>
	Overview	121
	Forging a pathway to sustainable buildings	125
	Energy technology strategies for sustainable buildings	132
	Building energy communities and low-carbon synergies	149
	Buildings sector investment needs	152
	Policy actions to support buildings sector decarbonisation	154
<b>Chapter 4</b>	<b>Advancing the low-carbon transition in industry</b>	<b>161</b>
	Overview	163
	The decarbonisation challenge in industry	163
	Strategies to support climate ambition	166
	Optimising industry for system-level efficiency	172
	Decoupling production and CO <sub>2</sub> emissions in energy-intensive industry	175
	Investment needs for deep CO <sub>2</sub> emissions reductions in energy-intensive industry	205
	Policy actions to support industry sector decarbonisation	206
<b>Chapter 5</b>	<b>Steering transport towards sustainability</b>	<b>215</b>
	Overview	218
	The decarbonisation challenge for transport	218
	Low-carbon opportunities for each transport mode	221
	Investment requirements	263
	Policy actions to realize comprehensive cuts in transport emissions	264
<b>Chapter 6</b>	<b>Transforming electricity systems</b>	<b>273</b>
	Overview	276
	Decarbonisation pathways for the power sector	278
	Investment needs	288
	Key technologies for the transition	289
	Electricity system infrastructure in the B2DS: Supporting the transformation to a low-carbon power sector	296
	Early retirements	304
	Impacts of delayed action	306
	Policy actions for fast-tracking integrated electricity systems towards zero emissions	309
<b>Chapter 7</b>	<b>Delivering sustainable bioenergy</b>	<b>315</b>
	Overview	317
	Bioenergy in decarbonisation scenarios	322
	Technologies and strategies for decarbonisation	326
	Bioenergy technology priorities for deep decarbonisation	340
	Delivering sustainable feedstock for bioenergy	344
	RD&D priorities	351
	International collaboration and initiatives	352
	Policy requirements for increased bioenergy	354

<b>Chapter 8</b>	<b>Unlocking the potential of carbon capture and storage</b>	<b>361</b>
	Overview	363
	The role of CCS in decarbonising the energy sector	364
	Building a CCS system	375
	CO <sub>2</sub> storage	380
	CO <sub>2</sub> -EOR	386
	CO <sub>2</sub> utilisation	388
	Storage availability allows government to regulate and support CO <sub>2</sub> capture	389
	Policy actions to support CCS deployment	389

## Annexes

394

<b>Annex A</b>	<b>Analytical approach</b>	<b>395</b>
<b>Annex B</b>	<b>Abbreviations and acronyms</b>	<b>412</b>
<b>Annex C</b>	<b>Definitions, regional and country groupings and units</b>	<b>418</b>
<b>Annex D</b>	<b>List of figures, tables and boxes</b>	<b>431</b>