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Reaching zero with renewables in transport & industry

Presenter:

- Dr Paul Durrant, Head of End-use Sectors & Bioenergy, IRENA

TUESDAY, 18 AUGUST 2020 • 15:00-15:30 CEST

SPEAKER

Dr Paul Durrant
Head of End-use Sectors & Bioenergy
IRENA

The **slides** and a **recording** at https://irena.org/events/2020/Jun/IRENA-Insights & in the handouts section

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Reaching Zero with Renewables

Eliminating emissions in Industry & Transport

Dr. Paul Durrant
Head of End-use Sectors & Bioenergy

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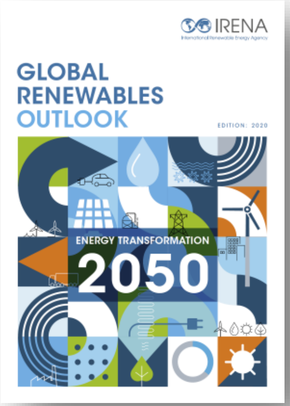
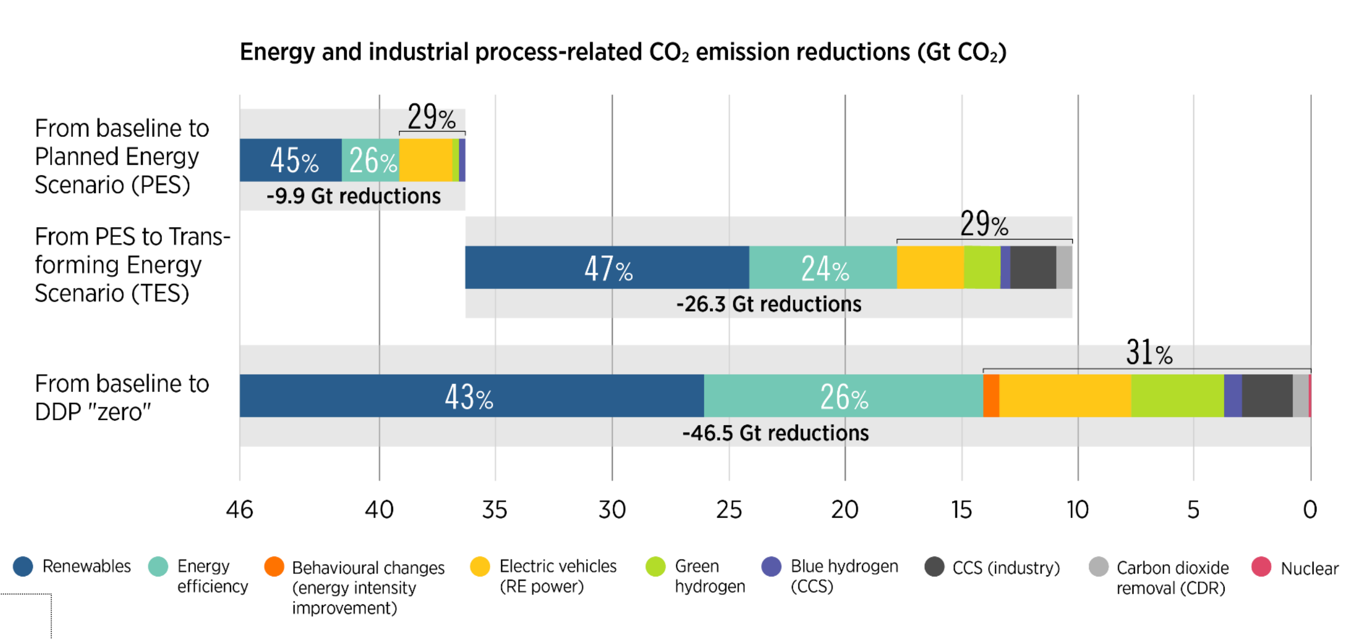
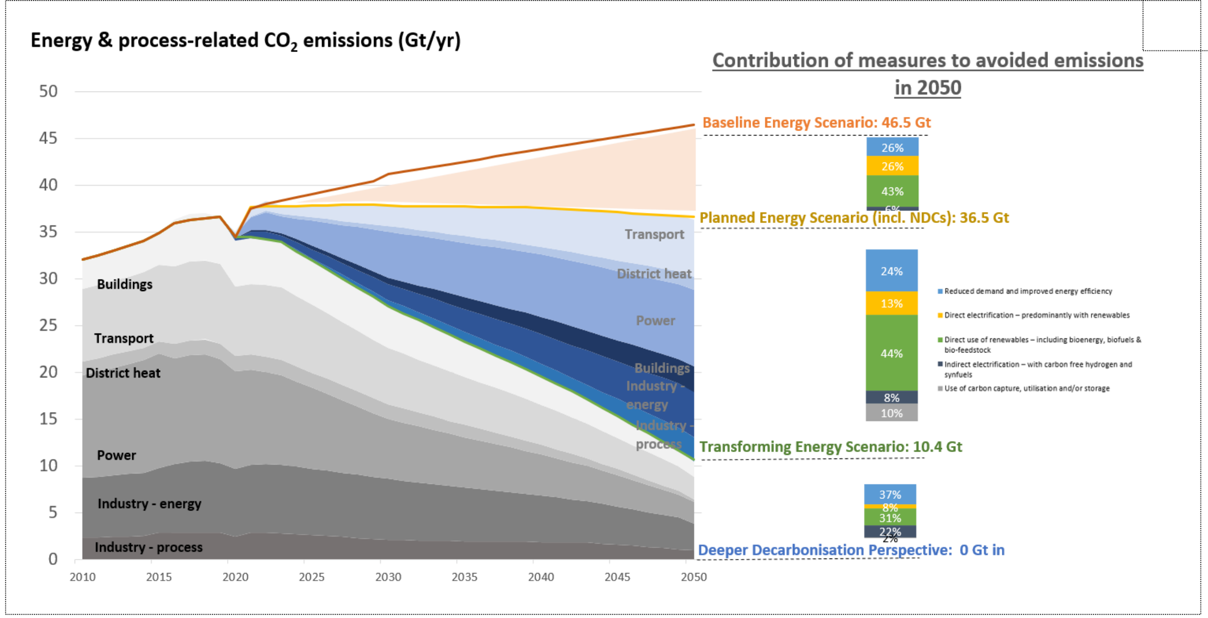
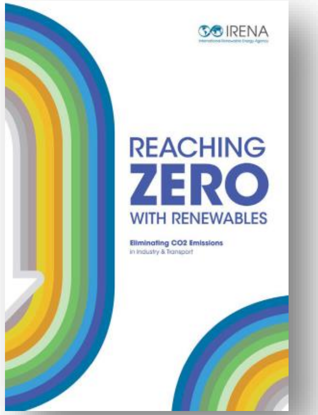
Exploring pathways to zero emissions



Energy-related CO_2 annual emissions trajectories from 2010 till 2050 and IRENA's scenarios – from IRENA's [Global Renewables Outlook, April 2020]







IRENA's Reaching Zero with Renewables report explores some options in more depth. It will be published in late-September 2020.

Note – all figures presented in this slide-deck are provisional and may be updated in final Reaching Zero with Renewables report.

Measures for zero emissions

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A goal of reaching zero in each sector requires a very different mindset compared to an objective of merely reducing emissions… there are only a very small number of currently conceived options in each sector that are consistent with a zero CO2 emissions objective.

1. Reduced demand and improved energy efficiency	▪ Reduce energy and material demand and intensity of use through a range of actions including: energy efficiency, behavioural and process changes, relocation and the application of circular economy principles.
2. Direct electrification – predominantly with renewables	▪ Directly use clean electricity, sourced predominantly from renewables, to provide energy requirements.
3. Direct use of renewables – including bioenergy, biofuels & bio-feedstock	▪ Directly utilise renewables for energy and feedstocks, particularly the use of sustainable biomass including through the direct use of bioenergy for heat and the production and use of biofuels and bio-feedstocks. Utilise solar and geothermal for some heat requirements.
4. Indirect electrification – with green hydrogen and synfuels	▪ Source energy and feedstocks from hydrogen or fuels produced from hydrogen (synthetic-fuels) using CO2 captured from non-fossil-fuel sources. The hydrogen should be 'clean' and preferably 'green' i.e. sourced from renewables.
5. Use of carbon capture, utilisation and/or storage	▪ Capture most or all CO2 emissions from energy production or other processes and either store the captured CO2 permanently or utilise the CO2 in ways in which it won't be later released. This may also include the capture of CO2 from processes or the atmosphere specifically for use in creating chemical feedstocks or fuels.

Note: In some specific sectors other strategies will contribute too – for example replacements for clinker, the use of alternative building materials or the relocation of plants to better utilise renewables resources.

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Energy Demand and Emission Reduction Scenarios for Industry

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Sectors	Metric	2017	2050 (Planned Energy Scenario)	2050 (Transforming Energy Scenario)	Progress made in CO_2 reduction from 2017to TES	Additional progress needed in CO_2 reduction from TES to zero
Industry total (energy, process, NEU, waste)	Energy (EJ/year)	157	246	190	2.9 GT/yr reduction (32% of 2017 total)	6.3 GT/yr reduction (68% of 2017 total)
	CO_2 emissions (Gt/year)	9.2	11.9	6.3		
	Renewable energy share** (%)	11%	20%	52%		
Iron and Steel (energy and process)	Energy (EJ/year)	32	27	36***	1.1 GT/yr reduction (44% of 2017 total)	1.4 GT/yr reduction (56% of 2017 total)
	CO_2 emissions (Gt/year)	2.5	2.9	1.4		
	Renewable energy share** (%)	4%	12%	55%		
Chemicals and Petrochemicals (energy, process, NEU non-stored, and waste)	Energy (EJ/year)	46.8	79.8	53.4	0.6 Gt/yr reduction (30% of 2017 total)	1.4 GT/yr (70% of 2017 total)
	CO_2 emissions (Gt/year)	2	3.3	1.4		
	Renewable energy share** (%)	3%	2%	29%		
Aluminium (energy, process, electricity-related)	Energy (EJ/year)	4.5	5.8	4.0	0.1 GT/yr reduction (13% of 2017 total)	0.7 GT/yr (88% of 2017 total)
	CO_2 emissions (Gt/year)	0.8	1.4	0.7		
	Renewable energy share** (%)	16%	38%	60%		
Cement and Lime (energy and process)	Energy (EJ/year)	15.6	13.3	10.3	1.1 GT/yr reduction (39% of 2017 total)	1.7 GT/yr (61% of 2017 total)
	CO_2 emissions (Gt/year)	2.8	2.7	1.7		
	Renewable energy share** (%)	6%	20%	56%		

**Emissions include those from energy and process; **Including electricity and District Heating; ***Energy demand for iron and steel includes blast furnaces and coke ovens. Demand increases under TES due to 500 Mt of DRI-based steel being added. This leads to increased steel production overall as it is now green steel.; Source: (IRENA, 2020a) and (IEA, 2017); NEU = non-energy use*

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Options for Reaching Zero – in key Industry Sectors

Sector	Options	Indicative additional inputs needed to reach zero emissions by 2060
Iron & Steel	**Hydrogen-DRI-EAF:** • Produce iron via the Direct Reduction process using green hydrogen; • Produce steel using Electric Arc Furnaces; • All heat and electricity inputs sourced from renewables. **CCUS:** • Apply CCUS to existing iron & steel production processes. • All heat and electricity inputs sourced from renewables.	▪ Circa 8EJ/yr of hydrogen needed for DRI. ▪ Circa 3EJ/yr of biomass or needed for energy. ▪ Circa 1Gt of CO_2 captured per year
Chemicals & Petrochemicals	**Bio-based hydrocarbons:** • All heat & electricity inputs sourced from renewables; • Biomass used for chemical feedstocks **Synthetic-hydrocarbons:** • All heat & electricity inputs sourced from renewables; • Synthetic hydrocarbons – produced from green hydrogen and clean CO_2 sources – used for chemical feedstocks. **CCUS** • Apply CCUS to existing production processes. • All heat and electricity inputs sourced from renewables.	▪ Circa 7EJ/yr of hydrogen or synfuels needed for energy & feedstocks. ▪ Circa 8EJ/yr of biomass needed for feedstocks. ▪ Circa 1.4EJ/yr of biofuels/RE needed for energy. ▪ Circa 0.5Gt of CO2 captured per year.
Aluminium	**Renewable power & inert anodes:** • All heat & electricity inputs sourced from renewables • Switch to the use of inert anodes	▪ Circa 550 TWh of renewable electricity needed to power all aluminium plants
Cement & Lime	**Clinker substitutes:** • Reduce clinker production by partially substituting alternative binders. **Cement substitutes:** • Avoid clinker emissions by using alternative cement formulations. **CCUS & Renewable energy:** • Use renewable sources for energy needs • Apply CCUS to process emissions **Alternative building materials:** • Use renewable building materials instead of cement.	▪ Circa 11EJ/yr of biofuels & waste-equivalent needed for energy input to kilns. ▪ Circa 0.5Gt of CO2 captured per year via CCS and 0.5Gt per year through BECCS

Energy Demand and Emission Reduction Scenarios for Transport

Sectors	Metric	2017	2050 (Planned Energy Scenario)	2050 (Transforming Energy Scenario)	Progress made in CO2 reduction from 2017to TES	Additional progress needed in CO2 reduction from TES to zero
Transport Total	Energy (EJ/year)	117	135	86	5.6 GT reduction (70% of 2017 total)	2.4 GT/yr reduction (30% of 2017 total)
	Energy-related CO_2 emissions (Gt/year)	8	8.6	2.4		
	Renewable energy share (%)	3	10	56		
Shipping	Energy (EJ/year)	11.3	13.7	7.4	0.4 GT reduction (44% reduction of 2017 total)	0.5 GT reduction (56% of 2017 total)
	Energy-related CO_2 emissions (Gt/year)	0.9	1	0.5		
	Renewable energy share (%)	-	3	12		
Road Freight	Energy (EJ/year)	32.3	35.1	21.1	1.7 GT reduction (74% of 2017 total)	0.6 GT reduction (26% of 2017 total)
	Energy-related CO_2 emissions (Gt/year)	2.3	2.3	0.6		
	Renewable energy share (%)	1.5	9	62		
Aviation	Energy (EJ/year)	13.5	30.8	15.1	0.2 GT reduction (22% of 2017 total)	0.7 GT reduction (78% of 2017 total)
	Energy-related CO_2 emissions (Gt/year)	0.9	2.1	0.7		
	Renewable energy share (%)	-	10	40		

*Source: (IRENA, 2020a) and (IEA, 2017); *Under IRENA's Deep Decarbonisation Pathway*

Options for Reaching Zero – in key Transport Sectors

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Sector	Options	Indicative additional inputs needed to reach zero emissions by 2060
Road Freight	**Battery Electric Vehicles (BEVs):** • Use electric motors powered by a battery pack, charged with renewable electricity **Fuel Cell electric Vehicles (FCEVs):** • Use electricity produced by a fuel cell powered by compressed (green) hydrogen **Advanced Biofuels:** • Use biomass-based diesel substitutes, such as biodiesels and renewable diesels	▪ Circa 7EJ/yr of hydrogen and synfuels. ▪ Circa 2EJ/yr of biofuels/RE needed. ▪ Circa 10EJ/yr of electricity needed.
Aviation	**Biojet:** • Use fuels produced from biomass **E-fuels:** • Use synthetic fuels produced from CO_2 & green hydrogen **Electric-powered:** • Use propulsion systems powered by a battery pack, charged with renewable electricity	▪ Circa 6EJ/yr of hydrogen needed for synfuels. ▪ Circa 10EJ/yr of biofuels/RE needed.
Shipping	**Advanced Biofuels:** • Use of biomass-based fuels such as biodiesel, renewable diesel, bio-fuel oil and liquefied biogas. **E-fuels:** • Use green hydrogen or synthetic fuels such as green methanol, ammonia and methane.	▪ Circa 12EJ/yr of hydrogen needed for ammonia and synfuels. ▪ Circa 1.5EJ/yr of biofuels/RE needed.

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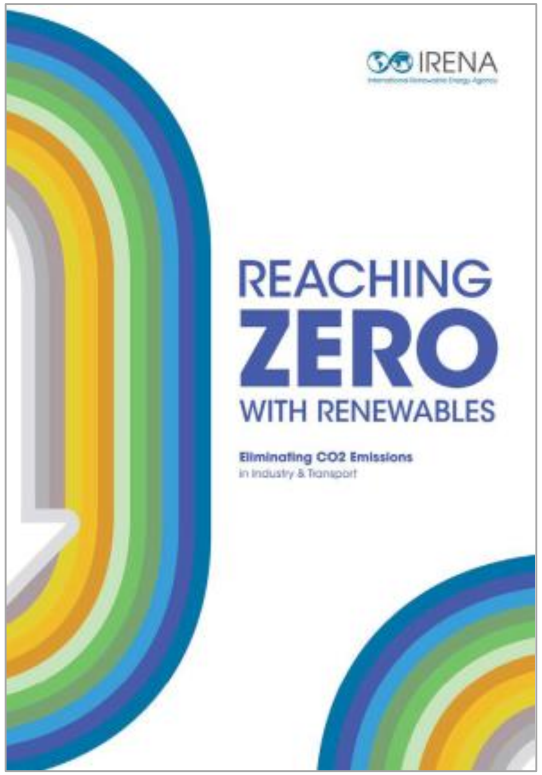
Challenges & Actions

Challenges
High costs of new technologies and processes.
Gaps in knowledge & confidence.
Need for new enabling infrastructure or upgrades to existing infrastructure
Highly-integrated operations and long established practices
Uneven, large and long-term investments needs
Dependency on progress in the energy sector
Gaps in carbon accounting
Competitiveness & carbon leakage risks for first-movers
Legacy policy & regulatory frameworks
Insufficient Research, Development & Demonstration (RD&D)

Actions needed
Pursue a renewables-based strategy for end-use sectors with an end-goal of zero emissions.
Develop a shared vision and strategy & co-develop practical roadmaps involving all major players
Build confidence & knowledge amongst decision makers
Plan and deploy enabling infrastructure early on.
Foster early demand for green products and services
Develop tailored approaches to ensure access to finance
Collaborate across borders
Think globally, utilise national strengths
Establish pathways for evolving regulation & international standards
Support RD&D and systemic innovation



Thanks for your attention.

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Q & A
10 min

IRENA VIRTUAL EDITION INNOVATION WEEK 2020

5th – 8th October 2020

- Innovation Week 2020 builds on IRENA Innovation Weeks in 2016 & 2018 and regional Innovation Days in 2019. Key insights are available online at www.irena.org/innovation
- Focus: **the use of renewables in the energy-end-use sectors of transport & industry**
- Aims to:
  - **Connect** experts and policy makers from IRENA's 161 member countries,
  - **Showcase** emerging innovative solutions from around the world,
  - **Inspire and inform** the transition to a renewable future.
- Programme and speakers soon at innovationweek.irena.org
- Any questions: innovationweek@irena.org

INNOVATION WEEK 2018
solutions for a renewable-powered future

2018 event included over 80 expert speakers & 350 participants from over 70 countries.

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NEXT WEBINARS

- ❑ **TUESDAY, 25 August 2020 • 10:00 – 11:00 AM CEST**
  “Innovations for a decentralised, renewable-powered system: Peer-to-peer electricity trading”
  For more information and to register: https://irena.org/events/2020/Aug/IRENA-SEDA-Joint-Webinar

- ❑ **WEDNESDAY, 2 September 2020 • 15:00 – 15:30 CEST**
  “Energy Sector Subsidies - A look at the first estimate of their total value?”
  For more information and to register: https://irena.org/events/2020/Jun/IRENA-Insights

- ❑ **TUESDAY, 20 October 2020 • 16:00 – 17:00 CEST**
  “Innovations in electricity market design for solar and wind integration – Lessons learned from Europe”
  To register: https://irena.org/events/2020/Oct/Innovations-in-electricity-market-design-for-solar-and-wind-integration

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