Renewable Energy Trends and Prospects
Solar & Wind: LCOE/auction price evolution overview - Continued rapid cost reduction in the coming years

IRENA costing database of 15,000 large scale RE power projects and 1.5 million rooftop PV systems

Covering half of all existing and planned RE capacity

Source: IRENA
Renewables & electrification can deliver 75% of energy-related CO₂ emission reductions needed.

Source: IRENA
The share of renewables in total final energy consumption (TFEC) needs to ramp up six-fold – from a historical average of 0.25 percentage points per year to almost 1.5 percentage points per year.
Electrification paired with renewables is a major solution for decarbonisation.

By 2050,
- Electricity becomes the central energy carrier
- 86% of electricity generation will come from renewables

A transformed energy system: Scaling up renewables not just for power, but also for heat and transport.
Innovation landscape for power sector transformation

- EVs and smart charging
- Storage
- Artificial Intelligence
- Digitalisation - IoT
- Blockchain
- Hydrogen, PtX

- Platform business model
- Aggregators- VPP

- Massive expansion of interconnections and supergrids
- Electrification of end use sectors
- Value complementarities in VRE
- Encourage Flexibility, pricing that supports DSM/DSR
- Decentralised system and Distributed generation
“The other half” – hard-to-decarbonise sectors

• Zero carbon 2050 means also a climate neutral industry sector
• The power sector is making progress
• Electromobility is emerging as a solution for light-duty vehicles
• This leaves “the other half”
  ➢ Energy-intensive industry
  ➢ Other transportation modes
• Solutions need to be tailored to sectoral needs
• Requirements:
  ➢ Affordable technology
  ➢ An enabling framework for sectors that are operating in an international and very competitive market (carbon leakage)
  ➢ Fear of carbon leakage and loss of competitiveness has resulted in a lack of policy action to date
Source of hydrogen – today and 2050
A shift to clean hydrogen with a key role for green hydrogen

Today:
About 14 EJ hydrogen produced mainly from fossil source - green and blue hydrogen production is negligible

2050:
Two-thirds of hydrogen produced could come from green hydrogen

Demonstration projects with electrolysis – with increasingly bigger sizes (> 50 MW)

Source: IRENA (2019)
Hard-to-decarbonise sectors

- Road freight transport
- Aviation
- Shipping
- Iron and steel making
- Aluminium making
- Chemicals and petrochemicals production
- Cement making
- Greening the gas system
- Desalination
## Global energy and climate relevance of hard-to-decarbonise sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>2017 Final energy use [EJ/yr]</th>
<th>2017 CO₂ emissions [Gt/yr] (Direct and indirect energy &amp; process)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road freight</td>
<td>24.0</td>
<td>1.75</td>
</tr>
<tr>
<td>Aviation</td>
<td>13.5</td>
<td>0.85</td>
</tr>
<tr>
<td>Shipping</td>
<td>9.1</td>
<td>0.68</td>
</tr>
<tr>
<td>Iron and steel</td>
<td>34</td>
<td>3.63</td>
</tr>
<tr>
<td>Aluminium</td>
<td>6.0</td>
<td>0.85</td>
</tr>
<tr>
<td>Chemical and petrochemical</td>
<td>46.8</td>
<td>2.72</td>
</tr>
<tr>
<td>Cement</td>
<td>10.7</td>
<td>2.48</td>
</tr>
<tr>
<td>Gas sector</td>
<td>130.0</td>
<td>7.28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>274.1</strong></td>
<td><strong>20.24</strong></td>
</tr>
</tbody>
</table>
Solutions

- Electrification
- Hydrogen
- E-fuels: Synfuels and synthetic feedstocks
- Circular economy
- CCUS
- BECCS
Thank you!

Select 2019 publications

www.irena.org/publications