How to Make IEEE More Relevant to the Working Engineer: Sustainable Developments in the Global Electric Power Sector

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TECHNICAL SOLUTIONS
Global Electricity Generation Mix 1985-2019

Source: https://ourworldindata.org/electricity-mix
Global Energy Use in 2019

Source: https://ourworldindata.org/electricity-mix
Six Greenhouse Gases

Carbon dioxide (CO₂)
Methane (CH₄)
Nitrous oxide (N₂O)
Hydro fluorocarbons (HFCs)
Per fluorocarbons (PFCs)
Sulphur hexafluoride (SF₆)

1997 CO₂ emissions from fossil fuels and cement production: 30.4 billion tons
2018 CO₂ emissions from fossil fuels and cement production: 41.1 billion tons

- Carbon Dioxide: 76%
- Methane: 16%
- Nitrous Oxide: 6%
- HFC, PFC, SF6: 2%

Concentrations factored in
Where the gas comes from

**CO₂ emissions**, tonnes, bn

- China
- United States
- EU27

**United States, greenhouse-gas emissions**
By sector, 2018, % of total

- Transport: Light vehicles, Heavy vehicles
- Electricity
- Industry
- Commercial & residential
- Agriculture

Sources: EPA; Global Carbon Project

*Excluding land use change

The Economist
CO₂ Emissions

Source: The Economist 20 Feb 2021
A great leap forward
United States, installed electricity capacity
By power source, gigawatts

Sources: BloombergNEF; Princeton University
*Under a scenario of high electrification
Source: The Economist 20 Feb 2021
Over 75% of Global Demand for Coal Comes from Asia
## Emission Characteristics of Power Plants in the US (gm/kWh)

<table>
<thead>
<tr>
<th>Plant Type</th>
<th>NOx</th>
<th>SO₂</th>
<th>CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>2.32</td>
<td>0.004</td>
<td>490</td>
</tr>
<tr>
<td>Oil</td>
<td>2.02</td>
<td>5.08</td>
<td>781</td>
</tr>
<tr>
<td>Coal</td>
<td>3.54</td>
<td>9.26</td>
<td>1090</td>
</tr>
</tbody>
</table>
Top Ten Countries Total Installed Renewable Energy Capacity in 2018

Source: International Renewable Energy Agency IRENA [https://www.irena.org/Statistics/]
Sun down
Energy costs, $ per MWh

Solar

Wind

Coal

Source: Lazard

High and dry
China, cost of electricity, new renewable facilities* compared with existing coal and gas providers†
Forecast, $ per megawatt-hour, 2019 $

Source: BloombergNEF

*Levelised †Marginal

Offshore wind
Gas
Coal
Onshore wind
Solar (utility-scale PV)

Source: The Economist 4-10 July 2020

Source: The Economist 5-11 December 2020
So, What is the bottom line?

- Efforts in the electric power sector by replacing fossil fuel with renewables and nuclear will help.
- But if emission from the transportation sector continues to rise, the power sector contributions will not be enough.
- Large scale Electric Vehicle deployment will help, but question remains – how will the EV be powered.
Message to the Young Generation

Focus on what you can do to reduce the Carbon Footprint

Don’t ask why others are not doing their part

Show them what can be done
Thank You

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