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Net Zero by 2050 – The Need for Baseload Power

University of Dundee
Centre for Energy, Petroleum & Mineral Law and Policy
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Mark M. Moseley
Principal, MMM Infra
Mark.Moseley@MMMInfra.com
www.mmminfra.com

Outline of the Presentation

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Five main topics

I. The Imperative of Reaching Net Zero by 2050

II. The Need to Decarbonise Power Generation

III. The Increasing Size of the Challenge

IV. The Real Cost of Electricity

V. The Need for Baseload Power

I. The Imperative of Reaching Net Zero by 2050

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Key Aspects of the Glasgow Climate Pact, signed at COP26

- **the Glasgow Climate Pact*, agreed upon by 197 nations at COP26, calls upon countries to limit the temperature increase to 1.5°C above pre-industrial levels, by reducing CO_2 emission to 'net zero' by 2050:**

limiting global warming to 1.5 °C requires rapid, deep and sustained reductions in global greenhouse gas emissions, including reducing global carbon dioxide emissions by 45 per cent by 2030 relative to the 2010 level and to net zero around midcentury, as well as deep reductions in other greenhouse gases

*available at https://unfccc.int/sites/default/files/resource/cma2021_L16_adv.pdf

I. The Imperative of Reaching Net Zero by 2050 (cont.)

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The IPCC *Special Report on the impacts of global warming of 1.5°C*

- **the agreement at COP26 was driven by the findings in the 2018 United Nations Intergovernmental Panel on Climate Change (IPCC) *Special Report on the impacts of global warming of 1.5°C*, which examined the 'pathways' necessary to achieve 1.5°C above pre-industrial levels, and the consequences of failing to follow those pathways:**

In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO_2 emissions decline by about 45% from 2010 levels by 2030 … reaching net zero around 2050 … .

*available at https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_HR.pdf (see Section C: Summary for Policymakers)

I. The Imperative of Reaching Net Zero by 2050 (cont.)

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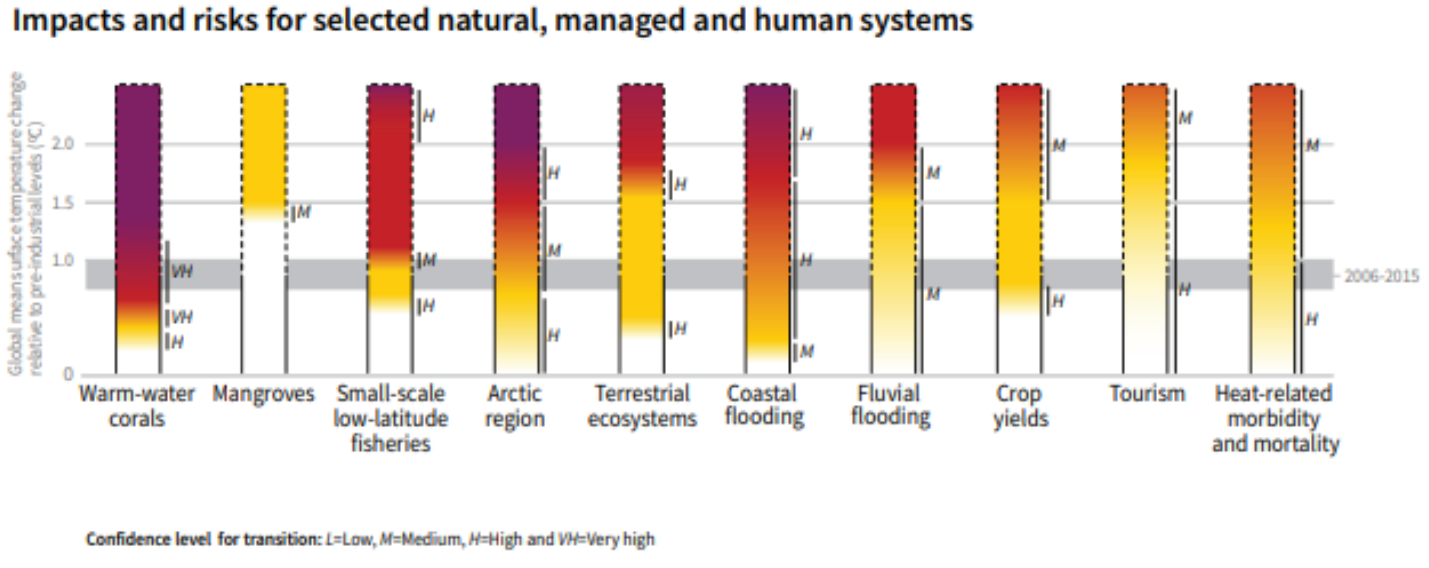
Failure to reach the 1.5°C target will be severe – and, in some cases, irreversible

- **the IPCC *Special Report* examined the impact of exceeding the 1.5°C target on selected systems:**



Key:
Purple – very high risk of severe impacts, with significant irreversibility
Red – severe and widespread impacts
Yellow – detectable impacts attributable to climate change
White – no detectable impacts

II. The Need to Decarbonise Power Generation

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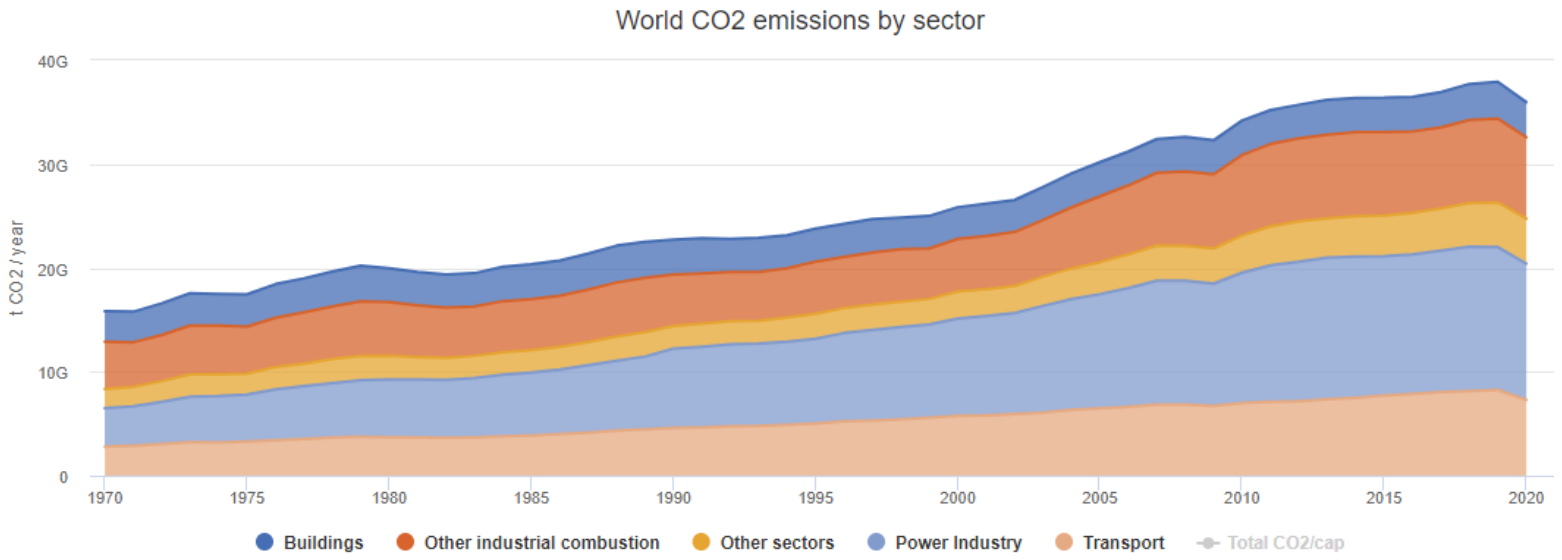
More than a third of global CO_2 emissions come directly from the power sector



Source: The EC Emissions Database for Global Atmospheric Research, available at: https://edgar.jrc.ec.europa.eu/climate_change

II. The Need to Decarbonise Power Generation (cont.)

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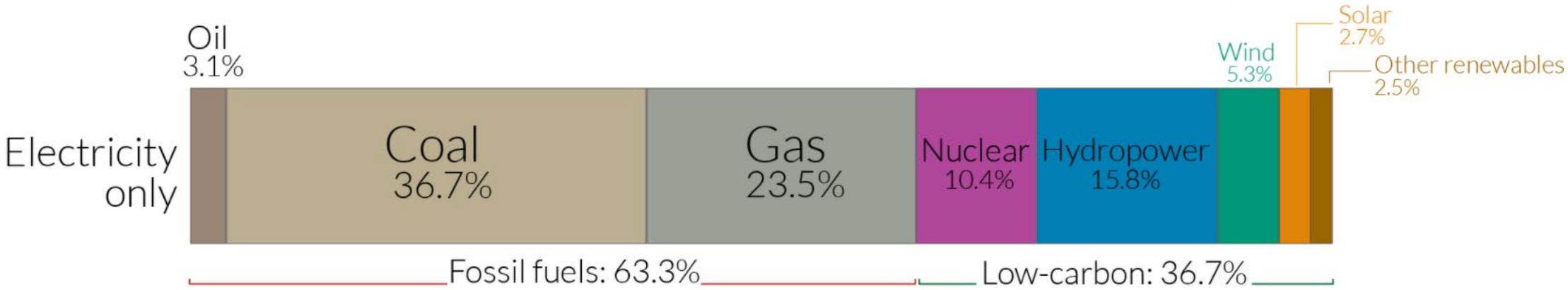
- **almost two-thirds of global power generation continues to be based on fossil fuels:**



- **the global ratio of fossil fuel generation to low-carbon generation is about the same as it was in 2000**

Source: Our World in Data, as prepared by Hannah Ritchie, using the 2019 data presented in the *BP Statistical Review of World Energy 2021* report, see: https://ourworldindata.org/electricity-mix

III. The Increasing Size of the Challenge

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Demand for electricity will surge

- **almost all forecasters predict a significant increase in electricity demand between now and 2050, due to sustained population and economic growth, intensive electrification and the build-up of hydrogen and electrofuel infrastructure:**
  - **the IPCC *Special Report on the impacts of global warming of 1.5°C** states that *From 2020 to 2050, the quantity of electricity supplied in most 1.5°C pathways with no or limited overshoot more than doubles***
  - **the Enerdata *Global Energy & Climate Change Outlook 2050*** forecasts that: *Global electricity generation will surge by 83% over 2020-2050, with non-OECD accounting for the vast majority of this increase***

* available at https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter2_High_Res.pdf. See Chapter 2, Pages 134
**available at https://eneroutlook.enerdata.net/total-electricity-generation-projections.html

III. The Increasing Size of the Challenge (cont.)

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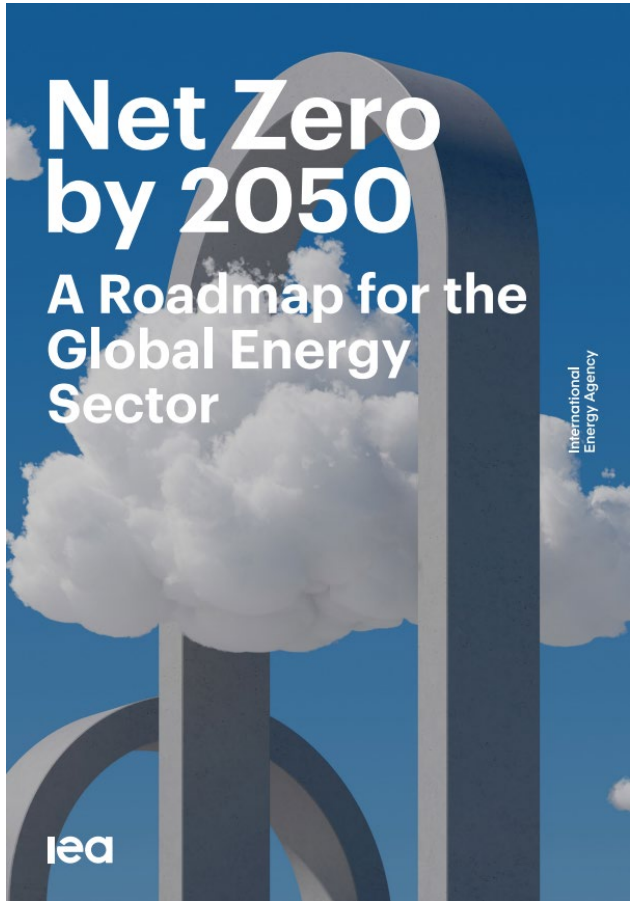

- **the May 2021 International Energy Agency (IEA) Special Report on *Net Zero by 2050 – A Roadmap for the Global Energy Sector** presents the IEA's Net-Zero Emissions Scenario, under which the growth in global electricity demand is described as follows:**

Final consumption of electricity increases by 25% from 2020 to 2030, and by 2050 it is more than double the level in 2020. The increase in electricity consumption from end-uses sectors and from hydrogen production means that overall annual electricity demand growth is equivalent to adding an electricity market the size of India every year…

*available at https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf . See Page 60.

IV. The Real Cost of Electricity

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Plant-Level costs of renewable energy are going down – but there is a problem

- **Plant-Level costs were traditionally measured by the metric of Levelised Unit Cost of Electricity (LCOE), which allows for a comparison of the discounted lifetime costs (in $/MWh) of different generation technologies**
- **the LCOE numbers for some of the key Variable Renewable Energy (VRE) technologies have been dramatically declining – notably Solar PV generation**
- **LCOE numbers do not, however, show the full picture**

IV. The Real Cost of Electricity (cont.)

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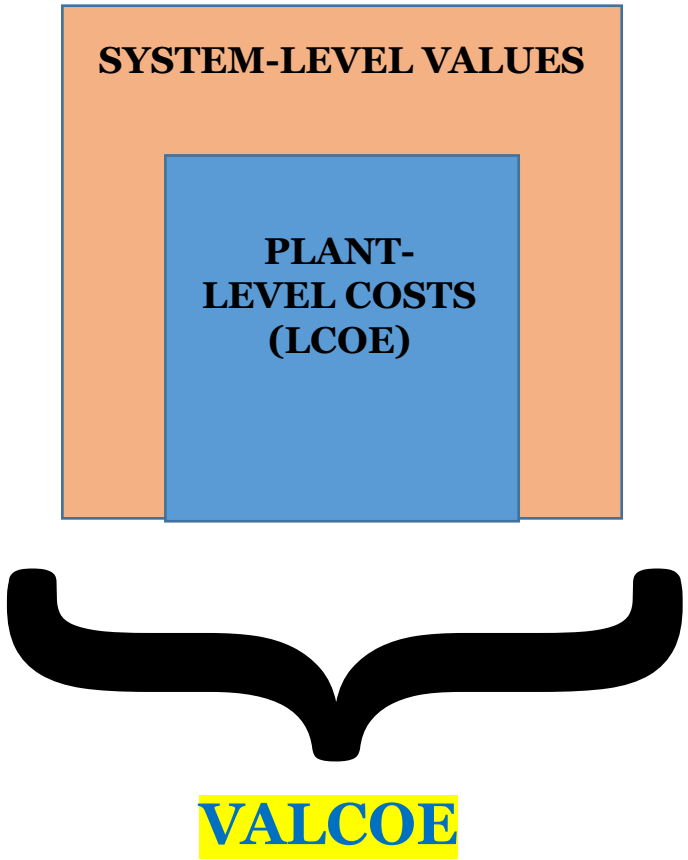
The IEA's new metric for comparing generation technologies: Value-Adjusted Levelised Unit Cost of Electricity (VALCOE)



IV. The Real Cost of Electricity (cont).

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VALCOE provides a better metric for comparing different generation technologies

- **the IEA has described VALCOE as follows*:**

VALCOE builds on the foundation of LCOE** that incorporates all cost elements, **but also adds three categories of value in power systems**: energy, flexibility and capacity. Combining these elements provides **a stronger basis for comparisons between variable renewables like solar PV and dispatchable

*see the IEA February 2019 commentary *Is exponential growth of solar PV the obvious conclusion?,* available at https://www.iea.org/commentaries/is-exponential-growth-of-solar-pv-the-obvious-conclusion.

IV. The Real Cost of Electricity (cont).

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System-Level issues are real – and significant

- **the three components of VALCOE are:**
  - **energy value: i.e., the average price received per unit of generation over the course of a year, based on least-cost merit order dispatch and simulated wholesale electricity prices**
  - **capacity value: i.e., the ability of a technology to reliably meet demand, contributing to the adequacy of the system**
  - **flexibility value: i.e., non-energy ancillary services required in power systems, such as primary and secondary reserves, frequency regulation and synchronous inertia**

IV. The Real Cost of Electricity (cont).

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The value of variable renewable generation decreases as more of that type of power is added

- **Energy Value**: ***The simulated energy values also capture the extent of cannibalisation effects as the share of variable renewables increase, whereby the expansion of variable renewables reduces their own market value***

- **Capacity Value**: ***…offshore wind power*** **[has]** ***a much higher capacity credit than solar PV in key markets (though still less than dispatchable power plants due its variability)***

- **Flexibility Value: …flexibility value is set to become more important as the share of variable renewables rises in regions around the world**

*quotations taken from the IEA's *Projected Costs of Generating Electricity 2020 Edition* available at https://iea.blob.core.windows.net/assets/ae17da3d-e8a5-4163-a3ec-2e6fb0b5677d/Projected-Costs-of-Generating-Electricity-2020.pdf. See Page 77 and 78.

IV. The Real Cost of Electricity (cont).

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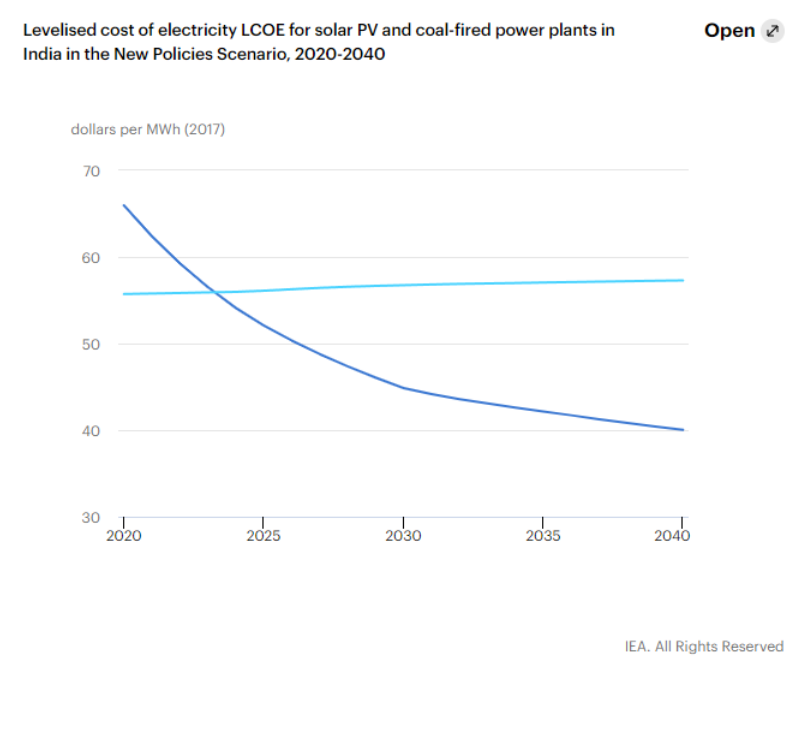
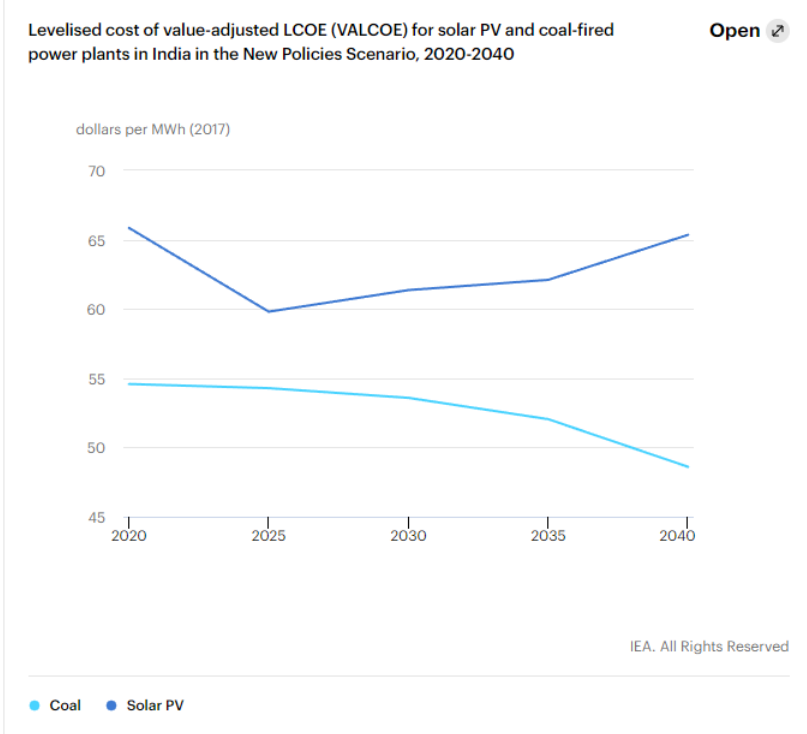
- **the IEA dramatically illustrated the impact of VALCOE, by forecasting solar PV and coal prices in India*:**





*taken from the IEA February 2019 commentary *Is exponential growth of solar PV the obvious conclusion?,* available at https://www.iea.org/commentaries/is-exponential-growth-of-solar-pv-the-obvious-conclusion.

V. The Need for Baseload Power

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To be economically sustainable, electricity markets will require dispatchable baseload power as part of the mix of generation technologies

- **as VRE generation shares (dominated by wind and solar) reach significantly higher percentages of the overall generation mix in a market, total system level costs will escalate significantly**
- **accordingly, in developing a strategy for decarbonising the electricity sector in an affordable manner, policymakers must balance VRE with available dispatchable low-carbon generation technologies, and other solutions**

V. The Need for Baseload Power (cont.)

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A wide range of technologies will need to be used in electricity markets to reach Net Zero by 2050

- **low-carbon, dispatchable baseload, options include:**
  - **hydropower**
  - **geothermal**
  - **nuclear**
- **in addition, electricity markets should incorporate technologies for storing/transferring VRE generation, such as:**
  - **battery storage**
  - **pumped-storage hydroelectricity**
  - **hydrogen energy storge**
  - **regional interconnectors**
- **we also need to continue to develop technologies for mitigating carbon emissions and achieving greater energy efficiency:**
  - **carbon capture utilisation and storage**
  - **demand side management**

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