Power: investment need to 2050

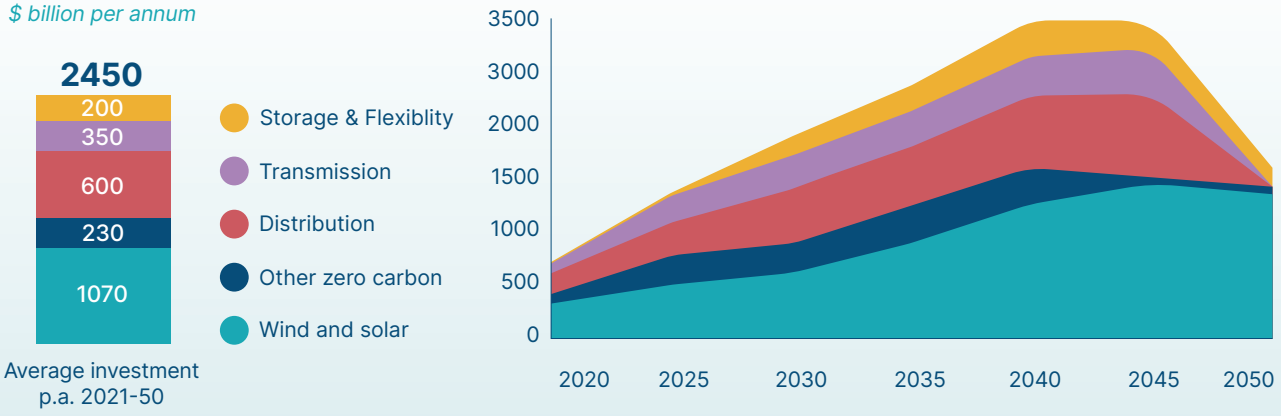
2021-2050 annual average investment	Share of total low-carbon investments
$2.45 tr	70%

Investment needs

2050 targets	Increase annual electricity production 4x to 90-130,000 TWh.
Investment needs	**Zero-carbon generation:** increase installed wind capacity from 850 GW to 13,000-15,000 GW and solar capacity from 970 GW to ~30,000 GW by 2050. **Transmission and distribution network:** investments to expand and upgrade network needed ~5 years ahead of electricity demand. **Storage and flexibility:** battery storage to increase from <1 TWh today to 11 TWh by 2050; seasonal variation requires 1,000 GW of hydrogen turbine capacity and limited role for natural gas turbines with carbon capture and storage (CCS).
Investment milestones	$750bn today → $2 trillion by 2030 → $3 trillion by 2040
Where?	Investments this decade will be dominated by high-income countries and China (~$1.3bn per year). Middle and low income countries need to invest ~$700bn a year by 2030 and this requirement will increase over time.
Gross or net?[1]	Estimates are presented as gross investment, though in reality this would be partially offset by declining investments in fossil fuel production and power plants. In middle- and low-income countries, the majority of investment would be required anyway to grow their electricity systems.

Global annual investment

$ billion per annum



Outlook to 2030

- Wind and solar electricity production are now cost-competitive against new and existing fossil for bulk electricity provision in countries representing 90% and 66% respectively, of global electricity generation
- Higher fossil fuel prices have created incentives to accelerate renewables build out to create energy security and reduce future consumer costs
- However, a temporary increase in the cost of some inputs and high interest rates have increased the nominal cost of capital – a critical determinant of the relative cost of renewable versus fossil fuel investments. This has particular implications for the significant scale up in low-carbon power required in middle and low income countries, where the cost of capital is typically higher.

2030 target

5-7x increase in annual wind and solar installations

$2 trillion investment

x3 scale up

Sources: SYSTEMIQ analysis for the ETC (2022); BNEF (2022), *Energy Investment Trends*; IEA (2022), *World Energy Investment 2022*.

[1] The ETC's investment estimates differ in approach by sector. Gross investment refers to the total investment required under a 1.5 degree net zero pathway, regardless of how much investment would have occurred anyway. Net investment is the incremental investment required compared to a BAU scenario.

Note: All figures are in US dollars. Other zero carbon includes hydropower, nuclear and bioenergy.

Power: how to mobilise finance

Required real economy policies

	Challenges	Real economy policies needed — Priority policy
Create a clear strategic vision	• National power system decarbonisation strategies lacking in ambition or clarity. • Continued investment in new fossil fuels sends mixed signals to investors.	• National **quantitative targets** for zero-carbon electricity capacity in 2030. + • Plans to phase out coal power generation (e.g., by 2030 and 2035) and unabated natural gas. • Integrated vision for power generation buildout and network design.
Address the "green premium" challenge	• Subsidies and Power Purchase Agreement (PPA)s for fossil fuels reduces relative competitiveness of renewables. • Uncertain pace of electrification across sectors.	• **Carbon pricing** + • Contracts-for-difference with additional green premiums where low-carbon technologies (e.g., floating wind) are still not competitive and in certain countries. • Electrification incentives and subsidies (e.g., for heat pumps, electric vehicles (EVs)). • Remove remaining fossil fuel subsidies.
Reduce downside risks	• Uncertain and volatile future prices which increase the cost of capital. • Influence of cost of capital on levilised costs.	• Appropriate power market design, including **long-term contracts** (e.g., 15 years) which guarantee offtake prices. + • Annual auctions to competitively procure new renewable capacity.
Remove supply bottlenecks	• Lengthy and complicated planning and permitting processes. • "Not in my backyard" (NIMBY) and local opposition. • Insufficient / slow grid expansion due to uncertainty of demand and short-term regulatory approaches. • Potential supply chain bottlenecks for key materials.	• **Streamlined planning, permitting** and acquisition processes (e.g., digitalisation, "one-stop shops"). + • Regulatory frameworks to enable anticipatory investment in power networks. • Sufficient investments in transmission and distribution (T&D) • networks ahead of demand. • Clear plans for supply chain expansion and workforce. • Wider reforms to planning and permitting, including zoning.

What obstacles cannot be fully addressed by real economy policies?

Minimal additional action required	In high-income countries and China	• With the policies described above, the vast majority of investment needed in higher income countries and China can be mobilised by the private sector.
Significant additional action required	In middle- and low-income countries	• Higher cost of capital is a significant barrier to investment, given the high upfront capital requirements of low-carbon power investments.

see next page

Additional actions required

Financial institutions

- Development of managed phase out plans for fossil fuel assets to ensure an orderly and just transition:
  - › Set out clear "red lines" defining what fossil fuel investments will not be supported.
  - › Develop consensus on credible financing mechanisms for the early phase out of coal plants.
- Develop strategies for significantly scaling up finance for low-carbon power generation.

Power: additional actions to mobilise finance in middle- and low-income countries

Additional real economy policies required

Challenges	Real economy policies needed
• Many countries do not yet have a fully liberalised electricity market and have less advanced system operator capabilities. • Off-taker risk due a lack of creditworthiness of the utilities. • Lack of grid and network capacity. • Lack of economic dispatch in wholesale power markets.	• Massive scale up in T&D investments and grid access. • Progressive evolution towards liberalised markets, combined with long-term contracts. • While politically sensitive, reforms to improve creditworthiness of utilities (e.g., improve cost-recovery of end-user tariffs, transparency in flow of funds to electricity generators). • Harmonising frameworks between regions to ensure larger balancing area and power dispatch across countries and regions.

Additional financing challenges

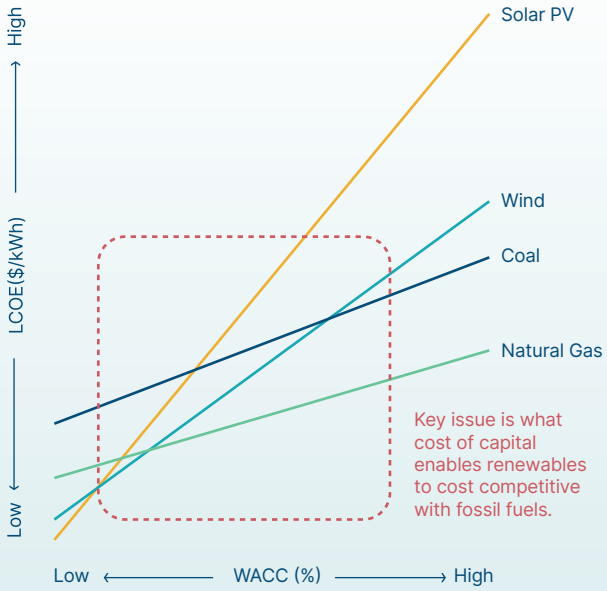
High cost of capital has significant implications given the capital-intensive nature of the investments required. It reflects:

- Project-specific risks, due to weaker policy or regulatory environment for renewables in some countries.
- Sector-specific risks, including off-taker risk.
- Geography-specific risks - actual or perceived – for example, due to macroeconomic risks, the small size of some economies, underdeveloped financial systems.

Implications:

- IEA estimates that nominal financing costs are up to 7 times higher than in the US and Europe.
- At higher levels of cost of capital, financing costs account for an increasingly high share of the levilised costs of renewable energy investments compared to fossil fuel investments.
- Middle- and low-income countries do not have access to the low cost capital needed to finance a rapid scale up in clean power.

Weighted average cost of capital (WACC), $/kWh



Additional actions required

Mobilising domestic savings and private finance

- Improved tax collection and reduced fossil fuel subsidies to increase fiscal resources
- Growth of local currency capital markets.

Multilateral development banks

- Expand financial capacity, for example, through treatment of "callable capital" in capital adequacy assessments or new capital subscriptions.
- Create the conditions for profitable investments and private finance through:
  - › Policies: Help countries develop energy transition strategies and policies.
  - › Pipeline: Proactively develop bankable projects.
  - › Private sector: Work with the private sector to catalyse private finance, including in the form of blended finance (e.g., via guarantees).

Financial institutions

- Understand the scale and nature of the energy transition opportunity in different groups of lower income economies, for example, through teams on the ground in key markets.
- Actively develop project pipelines in specific areas of technology or sector focus.
- Identify where financial institutions should build relationships with multilateral development banks (MDBs) to help design and implement blended finance approaches.

Note: Middle and low income countries are not homogenous, but to different degrees, tend to face additional challenges and require additional actions.