Session 2-Turning grid planning to bankable grid pipelines: risk allocation and policy signals from scenarios

Delivering large-scale grid infrastructure projects

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IRENA

- Intergovernmental Organization (IGO)
- Established in 2011
- Headquarters in Masdar City, Abu Dhabi, UAE
- IRENA Innovation and Technology Centre – Germany
- Permanent Observer to the United Nations – New York

Mandate

To promote the widespread adoption and sustainable use of **all forms of renewable energy** worldwide

Bioenergy | Geothermal Energy | Hydropower | Ocean Energy | Solar Energy | Wind Energy

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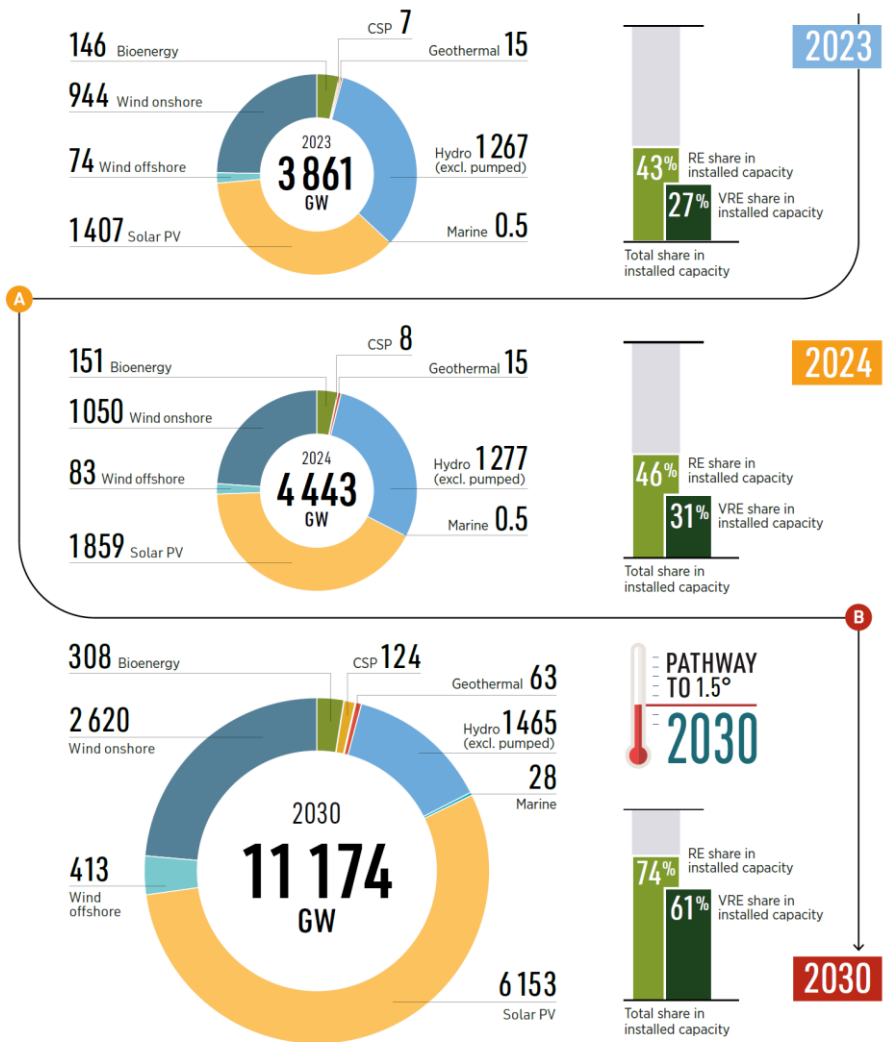
Tripling of renewable power

Declining costs of solar and wind

Challenges to large scale grid infrastructure projects

Effective grid planning and financing as signals to reducing risks.

Annual renewable power capacity additions set a new record in 2024.



Global installed renewable power capacity in the 1.5°C Scenario, 2023, 2024 and 2030

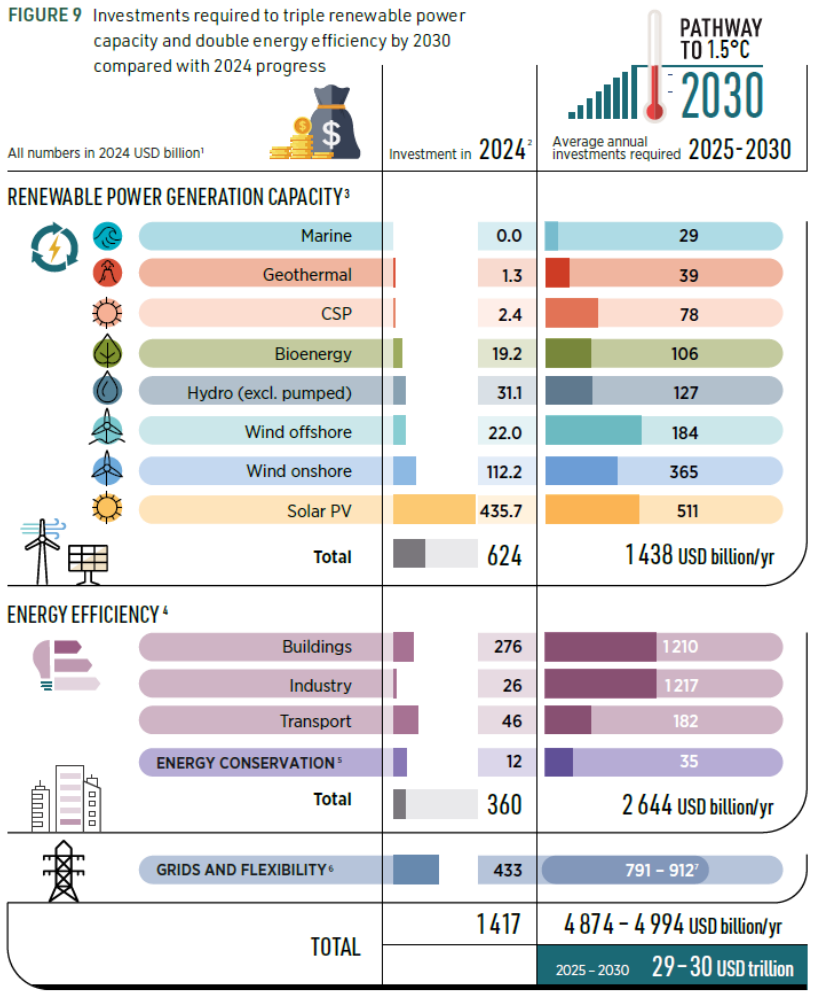
Renewables and enabling technologies additions grew.

- Renewable capacity additions reached 582 gigawatts (GW) in 2024.
  - Solar energy accounted for most of the new capacity additions in 2024.
  - Global wind power capacity additions in 2024 were 114.3 GW.
- In 2024, 8.3 GW of pumped hydro storage capacity and 74 GW (around 180 GWh) of battery storage was added.
- Grid length has almost doubled over the past 30 years, driven by expansion of distribution networks.

- But reaching national goals also means adding or refurbishing a total of over 80 million kilometers of grids by 2040 (as of 2022).

Source: IRENA, COP30 and GRA (2025), Delivering on the UAE Consensus: Tracking progress toward tripling renewable energy capacity and doubling energy efficiency by 2030; IEA(2023) Electricity Grids and Secure Energy Transitions.;

Substantial investment and financing gap exists in grid infrastructure.



Investments required to triple renewable power capacity and double energy efficiency by 2030 compared with 2024 progress.

Investment in renewable capacities grew.

- Total global investment in renewable power generation capacity reached USD 624 billion in 2024,10 up by 7% from the previous year.
- Investment in battery storage grew by 33% year-on-year in 2024, reaching USD 54 billion and marking a new record high
- The tripling of renewable power capacity by 2030 will require an additional USD 8.6 trillion in investment in the period 2025–2030.

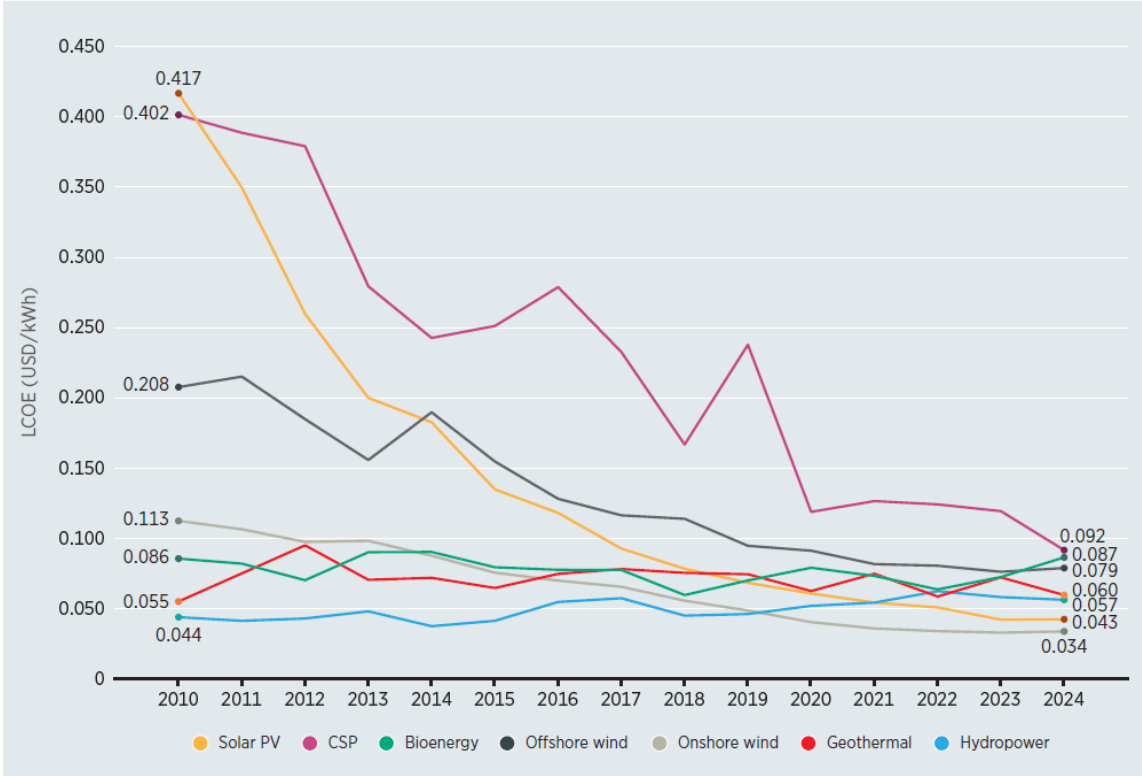
- Average investment of USD 791–912 billion is required in grids and flexibility yearly between 2025 and 2030, inclusive, up from a current investment of USD 433 billion - **almost double**.

Renewables remained the most cost-competitive option for new electricity generation in 2024.

Total installed costs of renewables declined.

- TIC fell to
  - USD 691/kW for solar PV,
  - USD 1 041/kW for onshore wind, and
  - USD 2 852/kW for offshore wind
- Battery storage costs declined by 93% from 2010 to 2024, falling from USD 2 571/kWh to USD 192/kWh.

- Curtailment is on the rise - Germany nearly doubled the volume of curtailed solar photovoltaic (PV) electricity in 2024.
- Grid connection queues persist - More than 1,700 GW of renewable energy blocked in Europe by grid bottlenecks and by mid-2024, over 1,650 GW of solar, wind, and hydropower capacity was in advanced development stages and still waiting for grid connection.



Notes: CSP = concentrating solar power; kWh = kilowatt hour; LCOE = levelised cost of electricity; PV = photovoltaic; USD = United States dollar.

Global weighted-average LCOE from newly commissioned utility-scale renewable power technologies, 2010-2024

Source: IRENA (2025), Renewable power generation costs in 2024; https://strategicenergy.eu/solar-curtailment-germany; IEA (2025) Renewable-electricity ; https://www.iea.org/reports/renewables-2024/executive-summary;

Large-scale grid infrastructure projects are complex undertakings.

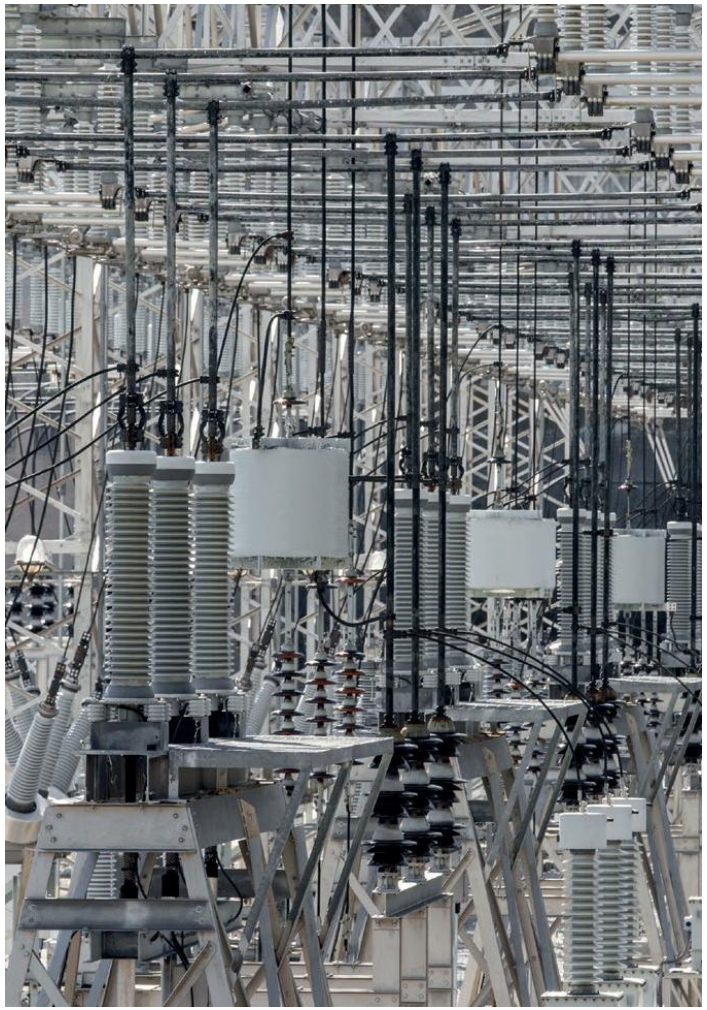
Delivering large scale grid projects is challenging.

- Complexity
  - **Planning**
- Permitting
- Cost and time overruns
- Supply chains
- Skills
  - **Finance**

- Almost 80% of projects encounter budget overruns and over 50% experience delays.
- Prices and waiting times for new transformers and cables have almost doubled.

Source: UNEZA (2025), Delivering large-scale grid infrastructure projects, https://www.mckinsey.com/capabilities/operations/our-insights/reimagining-engineering-to-deliver-more-projects-more-efficiently ; https://www.iea.org/reports/building-the-future-transmission-grid/executive-summary;

Effective grid infrastructure planning enables the timely and cost-efficient delivery of projects.

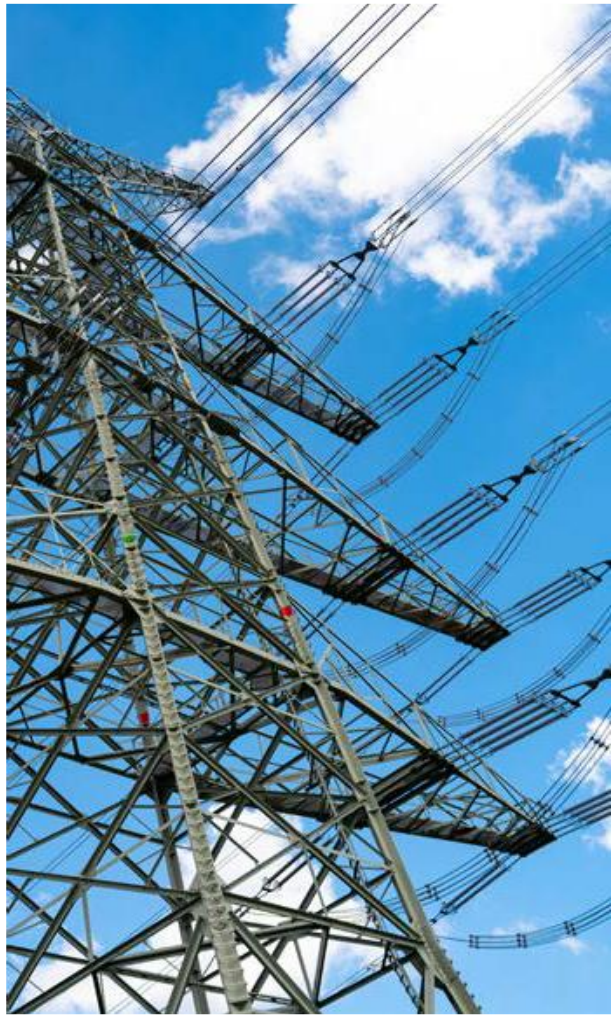


Long-term planning enables anticipatory investments.

- **Ensure long-term, holistic, coordinated planning:** shift from a project-by-project approach towards a programmatic approach.
- **Undertake continuous stakeholder** engagement-communicate transparently on all viable options for the location of grid infrastructure.
- **Ensure the planning and permitting approach is appropriate for delivery of large-scale infrastructure:** Identify and address permitting or approval challenges.
- **Supportive policy-making and incentive mechanisms**

Source: UNEZA (2025), Delivering large-scale grid infrastructure projects, https://www.mckinsey.com/capabilities/operations/our-insights/reimagining-engineering-to-deliver-more-projects-more-efficiently ; IDB and WEF (2025) Advancing Latin America's Power System Transformation;

Stakeholder engagement ensures a coordinated and resilient transition by aligning their grdi operator scenarios with national energy plans.



Estimating grid needs through stakeholder engagement and scenario building is key.

- **Engaging early with grid operators** to incorporate existing plans and limitations into the planning process.
- **Engaging with distribution-level operators** to ensure compatibility with local conditions and identify any vital issues that might affect planning.
- **Including regulators responsible for issuing permits** to grid operators ensures that the energy system's legal and regulatory framework aligns with national scenarios and transition goals.
- **Involving grid operators** to ensure that the most cost-efficient solutions will be prioritised.

Source: IRENA (2025), Participatory processes for strategic energy planning: A toolkit for national energy planners;

There is a need for long-term, stable, consistent and reliable governance, from policies to regulatory frameworks

A long-term, stable, consistent and reliable governance approach is more attractive than investment incentives.

- **Ensure business case proposals are based on a clear and unique market need** - based on feasibility studies
- **Ensure proposals are linked to long-term plans for the region, and offer adequate returns -** ensure there is an adequate return on capital to incentivise continued investment in regulated projects-
- **Foster greater predictability and cost recovery**
- **Reduce the cost of capital** - explore PPAs, green bonds and innovative project finance structures.

Source: IRENA (2025), Participatory processes for strategic energy planning: A toolkit for national energy planners;
IDB and WEF (2025) Advancing Latin America's Power System Transformation;

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