Concentrating Solar Power

INSIGHTS FOR POLICY MAKERS

Concentrating solar power (CSP) plants use mirrors to concentrate sunlight onto a heat receiver, which collects and transfers the solar energy to a heat transfer fluid. The fluid can be used to supply heat for end-use applications or to generate electricity through conventional steam turbines. Large CSP plants can be equipped with a heat storage system to allow for heat supply or electricity generation at night or when the sky is cloudy. This may increase significantly the capacity factor (i.e. the annual operation time) in comparison with other variable renewable energy sources (i.e. solar photo-voltaics, wind). There are four CSP plant variants, namely ***Parabolic Trough***, ***Fresnel Reflector***, ***Solar Tower*** and ***Solar Dish,*** with different design, mirrors and receivers, heat transfer fluids and heat storage. The first three variants are basically power plants for centralised electricity generation, with parabolic trough being the most mature and commercial technology. *Solar Dishes* are more suitable for distributed generation.

CSP plants require high direct solar irradiance to work and are therefore a technology option for installation in the *Sun Belt* region (between 40 degrees north and south of the equator). This region includes the Middle East, North Africa, South Africa, India, the South-West United States, Mexico, Peru, Chile, Western China, Australia, South Europe and Turkey. The technical potential of CSP-based electricity generation in most of these countries may be many times higher than the electricity demand, resulting in opportunities for electricity export through high-voltage lines.

However, the development of CSP is at an early stage, with about 2 GW of installed capacity worldwide (2012), though an additional 12 GW capacity is planned for installation by 2015. For comparison, the solar photovoltaic (PV) capacity in operation amounts to about 90 GW, with some 20 GW of new installations in 2012. The investment and generation costs of CSP plants are currently higher than PV costs. They are expected to fall by 10-15% by 2015 owing to technology learning, economies of scale, improvements in manufacturing and performance. This will also reduce the CSP electricity generation cost to around USD 0.15-0.24/kWh (levelised cost). By 2020, expectations are that CSP capital costs will decline further by 30% and 40%.

Similar to PV, an advantage of CSP plants is that the energy production virtually corresponds with peak electricity and cooling demand period in sunbelt countries. If combined with a heat storage system, CSP plants can also provide intermediate- and base-load electricity. This increases significantly the dispatchability of CSP electricity as well as its economic competitiveness and the integration in the electric grids. However, there is a trade-off between the heat storage capacity and the CSP capital cost. Another advantage of the CSP technology is the ease of integration into existing fossil fuel-based power plants that use conventional steam turbines to produce electricity, whereby some of the steam produced by the combustion of fossil fuels is substituted by solar heat from the CSP plant. Similar to conventional power plants, large CSP installations need water to cool and condense the steam cycle. Since water is often scarce in the Sun Belt regions, wet or air-based dry cooling towers are needed, which may add up to 10% to the CSP investment cost.

Compared with PV, CSP is still a relatively capital-intensive technology with a small market. However, it could become economically competitive as a result of increased deployment and significant capital cost reductions. In addition to electricity generation, CSP plants with heat storage may have other sustainable applications, such as heat and power co-generation for residential and industrial use, water desalination, and enhanced oil recovery. CSP deployment also has the potential for local value addition through localisation of components production, operation and maintenance, thus creating local development and job opportunities.

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