Photovoltaic Solar Power

INSIGHTS FOR POLICY MAKERS

Solar photovoltaic (PV) cells convert sunlight directly into electricity. Currently, crystalline silicon (c-Si) and the so-called thin-fi lm (TF) technologies dominate the global PV market. In a c-Si PV system slices (wafers) of solar-grade (high purity) silicon are made into cells that are assembled into modules and electrically connected. TF PV technology consists of thin layers of semiconducting material deposited onto inexpensive, large-size substrates such as glass, polymer or metal. Crystalline silicon PV is the oldest and currently dominant PV technology with approximately 85-90% of the PV market share.

The manufacture of solar PV systems basically comprises of four phases: production of the semiconducting material (90% of poly-silicon is supplied by a handful of companies in the United States, Japan, Europe, and China); production of the PV cells, which often requires sophisticated manufacturing (most solar cells are produced in China, Germany, the US and Japan); production of PV modules, a labor-intensive process whereby the cells are encapsulated with protective materials and frames to increase module strength (around 1,200 companies worldwide currently produce solar PV cells and modules); and installation of PV modules, including the inverter to connect the PV system to the grid, the power control systems, energy storage devices (where appropriate) and the final installation in residential or commercial buildings or in utility-scale plants. The cost of a PV module typically ranges between 30-50% of the total cost of the system. The remaining costs include the balance of system and the installation - which can be as low as 20% for utility-scale PV plants, 50-60% for residential applications, and as a high as 70% for off -grid systems, including energy storage (usually batteries) and back-up power.

PV power has an enormous energy potential and is usually seen as an environmentally benign technology. Over the years a good number of countries have implemented specific policies and incentives to support PV deployment. This has led to a rapid increase in the total installed capacity of PV from 1.4 GW in 2000 to around 100 GW at the end of 2012, with about 30 GW of capacity installed per year in 2011 and 2012. The associated industrial learning and market competition have resulted in very significant and rapid cost reductions for PV systems. Continued cost reductions for PV systems are an essential requirement for accelerating the attainment of grid-parity of electricity generated using on-grid solar PV systems. In countries with good solar resources and high electricity tariff s, residential solar PV systems have already reached parity with electricity retail prices, whilst in general PV is now fully competitive with power generated from diesel-based on- and off -grid systems.

The choice of solar PV technology for installation is often based on a trade-off between investment cost, module efficiency and electricity tariff s. Compared with c-Si-based PV systems, the production of TF PV system is less energy-intensive and requires significantly less active (semiconducting) material. TF solar PV is therefore generally cheaper, though less efficient and requires substantially more surface area for the same power output, than c-Si-based systems. The module cost of c-Si PV systems have fallen by more than 60% over the last two years; in September 2012, Chinese-made modules averaged USD 0.75/watt, while TF PV modules. Consequently, even though TF PV has experienced tremendous growth a few years ago, more recently its market share is decreasing and the current outlook for further growth in the deployment of this technology is uncertain and will depend heavily on technology innovation.

Solar PV, as a variable renewable electricity source, can be readily integrated into existing grids up to a penetration level of about 20% depending on the configuration of the existing electricity generation mix and demand profiles. Increasing the integration of a high level of variable renewable power from PV systems into electricity grids requires, in general, re-thinking of grid readiness with regards to connectivity, demand-side response and/or energy storage solutions. However, the on-going reduction of financial incentives in many leading markets, together with the overcapacity of the PV manufacturing industry, suggest that module prices will continue to decline, leading to parity in off - and on-grid PV. It is noteworthy that, since 2001, the global PV market has grown faster than even the most optimistic projections. However, it is not clear whether the deployment of PV will slow down or continue to grow same as in the recent past years.

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