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Silicon wafers being unloaded from the PECVD (plasma-enhanced chemical vapor deposition) furnace, after deposition of the antireflection coating, in the Restaure photovoltaic silicon cell fabrication platform set up at CEA/Grenoble, with support from Ademe.

II. THE PHOTOVOLTAIC PATHWAY

Photovoltaics, the direct transformation of light into electricity, is, of the three pathways for solar energy, the one experiencing most rapid growth, and for which scientific and technological advances are most promising, as regards significant improvements in its economic balance. While the long-term trend, in Europe, is favorable, with annual growth set at 30%, the cost per photovoltaic kilowatt-hour remains some ten times higher than that achieved with natural gas or nuclear energy (after connection to the grid), this being a handicap, at first blush, for high power ratings. For remote locations, where its advantage is unquestionable, in spite of the added cost of storage between insolation periods (this more than compensating for savings in terms of connection costs), this pathway sets its future prospects on marked module cost reductions. Such reduction may only be achieved by way of technological breakthroughs, to which CEA, active as it has been, in this area, for some thirty years, intends making a contribution, as lynchpin of French research and technology, and a key protagonist on the European scene.

One of the avenues being pursued concerns fabrication of high-efficiency cells from mineral or organic thin films, with particularly strong expectations with respect to the "all-polymer" path, complementary of the silicon pathway. Concurrently, device reliability needs must be improved, this being another factor making for an improved overall balance.

To achieve easier transfer to industry of laboratory outcomes, CEA is relying, in particular, on the new cell fabrication platform set up in Grenoble, this complementing its other R&D resources, including those installed at Cadarache, allowing testing of cells and entire photovoltaic systems in actual operating conditions. Another path for cost reductions being explored by CEA research workers consists in construction of systems integrated into the built environment: this affords new prospects, aside from the sole generation of electricity.

Finally, a major research and development effort is making it possible to look to considerable advances, regarding energy storage. This, usually a weak point in energy systems, is crucial for photovoltaics, as indeed for all renewable energies, the more so when what is at stake is integration, in one form or another, into the distribution grid. Work in this area is concerned equally with improving conventional lead-acid battery performance, and with new pathways.