Energy research at a glance

The Weizmann Institute is a powerhouse of basic research in alternative and sustainable energy. The Weizmann Institute focuses on the basic scientific challenges of energy research in much the same way as the 64 mirrors that were placed strategically at the Canadian Institute, concentrate sunlight at a single target on its solar tower. The synergy of its interdisciplinary approach rallies the strengths of physics, chemistry, biology, biochemistry, mathematics and computer sciences, molecular genetics, plant sciences, materials sciences, chemical physics, and other perspectives to the challenge of producing clean, dependable, and affordable energy for the future.

In a field that is often distracted by short-term solutions and quick fixes, the Weizmann Institute's focus is on long-term solutions, which requires the patience of basic research. Weizmann scientists begin with analyzing how photons transfer their energy to atoms and molecules; how electrons, ions, and electrical charges move within and between materials; how to increase the usable spectrum of sunlight captured by tuning photovoltaic cells to operate on different wavelengths; how biochemical pathways can be analyzed to assess their potential for new ways to biofuels, i.e., how understanding the biology, biochemistry and biophysics of natural energy conversion, can guide us towards more efficient conversion paths. Major milestones include:

SOLAR RESEARCH

- The solar tower and laboratories of the Canadian Institute for the Energies and Applied Research (CIEAR) were completed in 1987, one of the most advanced facilities for research in concentrated solar energy ever built on an academic campus.
- Concentrated solar power designs proven at the Weizmann Solar Tower are in use or in progress from China to the Negev, Spain to California.
- Weizmann scientists have contributed basic science underlying three generations of solar cells, from the first silicon cells to new generations of nano solar cells.
- They created the first solar "batteries" that can both create and store solar energy,
- Weizmann scientists demonstrated solar-pumped lasers that can be tuned to drive specific chemical reactions.
- They identified and adapted a key concept from nature to create new combinations of materials that "self-assemble" in solution, towards self-assembling solar cells.
- Weizmann scientists helped develop extremely thin absorber (ETA) cells, which save on material costs and are nowadays at the forefront of novel photovoltaics.
- Solar cell researchers now include also specialists in optical physics to find new ways to manipulate sunlight for more efficient solar to electrical energy conversion.

BIOFUELS RESEARCH

- Weizmann scientists are searching plant genomes for species and traits with potential for biofuels—fuels whose source is derived from plants and algae. They are examining the metabolism of plants to find ways to increase the production plants' building blocks for use as energy sources.
- Our scientists are also investigating new ways to break down common crop wastes, such as cellulose, into basic sugars that are useable for fuel. One approach has been to combine the cellulose-degrading elements from bacteria, fungi, and algae into bioengineered "artificial cellulosomes."
- Systems biologists are working with plant scientists to possibly "re-wire" and genetically engineer photosynthetic bacteria, algae, and other types of cells to efficiently convert sunlight and carbon dioxide into simple sugars and lipids that can be converted into biofuels.

SYNTHETIC FUELS

- Scientists have demonstrated how to use solar energy to convert a wide variety of chemical feedstocks into the components necessary for storable clean fuels.
- Weizmann scientists pioneered solar-driven chemistry to refine zinc from zinc oxide, which is usable for fuel cells, an approach that serves as example for various energy storage options.
- They have demonstrated solar thermal splitting of methane and solar reforming of hydrocarbons for synthetic fuels.
- One promising approach has been to use a solar-heated "melt" of salts to convert carbon dioxide into carbon monoxide (easily turned into fuel) and oxygen.
- Another group has developed a novel clean catalyst that uses sunlight to speed the hydrolysis of water into hydrogen and oxygen.