DuPont Photovoltaic Solutions

INCREASING THE EFFICIENCY AND LIFETIME OF SOLAR MODULES
The need to reduce our dependence on fossil fuels is becoming increasingly evident – it's a global challenge that is driving demand for more sustainable energy solutions.

Delivering on the promise of a low-carbon economy means finding renewable alternatives. Whether the motivation is increased demand on oil reserves, energy security, or climate change, the world needs to use energy smarter and to generate more of it from renewable sources.

At DuPont, our belief in the power of science to dramatically improve people’s lives and protect the planet we all share – our science is helping transform the sun’s potential into clean, efficient, sustainable energy the world needs to thrive.

Delivering on the promise of a low-carbon economy means finding renewable alternatives. Whether the motivation is increased demand on oil reserves, energy security, or climate change, the world needs to use energy smarter and to generate more of it from renewable sources.

We understand the science of cost-effective solar energy. And we offer some of the world’s most innovative materials solutions available today for photovoltaic (PV) cells and modules. With more than 25 years experience in PV materials development, applications know-how, manufacturing expertise and global market access, we can help you lower the cost per installed watt of PV energy, increase the efficiency and longevity of solar modules, and meet green manufacturing guidelines – all while increasing your productivity and bottom-line.

Our broad and growing portfolio of solutions is key to both crystalline silicon and thin film solar cell and module manufacturing. Our products are designed to work together to help increase the number of watts per manufacturing dollar, increase the efficiency and lifetime of solar modules, and to help meet green manufacturing guidelines.

Harnessing today’s innovative solutions

Our broad and growing portfolio of solutions is key to both crystalline silicon and thin film solar cell and module manufacturing. Our products are designed to work together to help increase the number of watts per manufacturing dollar, increase the efficiency and lifetime of solar modules, and to help meet green manufacturing guidelines.

The need to reduce our dependence on fossil fuels is becoming increasingly evident – it’s a global challenge that is driving demand for more sustainable energy solutions.

Delivering on the promise of a low-carbon economy means finding renewable alternatives. Whether the motivation is increased demand on oil reserves, energy security, or climate change, the world needs to use energy smarter and to generate more of it from renewable sources.

At DuPont, our belief in the power of science to dramatically improve people’s lives and protect the planet we all share – our science is helping transform the sun’s potential into clean, efficient, sustainable energy the world needs to thrive.

Delivering on the promise of a low-carbon economy means finding renewable alternatives. Whether the motivation is increased demand on oil reserves, energy security, or climate change, the world needs to use energy smarter and to generate more of it from renewable sources.

We understand the science of cost-effective solar energy. And we offer some of the world’s most innovative materials solutions available today for photovoltaic (PV) cells and modules. With more than 25 years experience in PV materials development, applications know-how, manufacturing expertise and global market access, we can help you lower the cost per installed watt of PV energy, increase the efficiency and longevity of solar modules, and meet green manufacturing guidelines – all while increasing your productivity and bottom-line.

Our broad and growing portfolio of solutions is key to both crystalline silicon and thin film solar cell and module manufacturing. Our products are designed to work together to help increase the number of watts per manufacturing dollar, increase the efficiency and lifetime of solar modules, and to help meet green manufacturing guidelines.
PV modules that last 25 years and more.

Quality and durability

DuPont materials have been successfully in use for more than twenty five years, ensuring durability for module makers who can guarantee reliable production of electricity for system owners.

Weather-resistant backsheet materials

DuPont™ Tedlar® PVF film is the industry standard for UV- and weather-resistant backsheets. Used for more than twenty five years in the majority of backsheets for photovoltaic modules with crystalline silicon, Tedlar® film provides the basis for the most popular backsheet construction (TPT™ Laminate, where T stands for Tedlar®).

Long-term protection
- UV resistant
- Resistance to weathering
- Mechanical barrier
- Electrical insulation
- Strength & durability

Increased power
- Improved efficiency through higher reflectivity

Encapsulation materials

DuPont™ Elvax® EVA resins are UL-recognised, crosslinkable resins used for adhering individual cells from impact. They enable sunlight transmission, helping to improve productivity.

- High clarity and most widely used for encapsulation Roberts
- Softened shock absorbing
- Proven durability over decades of use

DuPont™ PV5300 ionomer encapsulant sheets are designed for PV modules which are more sensitive to moisture and for architectural applications that require exceptional strength.

- High clarity
- High strength and stiffness
- Low moisture absorption
- Proven durability over decades of use

Thermoplastic polyester resins

DuPont™ Rynite® polyester resins are specifically designed for production and assembly of rigid framing, fixtures, junction boxes and connectors.

- Simplify module handling and transport through function integration
- Enable simpler field installation
- Ease of use on flat and curved roofs

DuPont™ SunX® EVA resins are an UL-recognised, crosslinkable resin used for adhering individual cells from impact. They enable sunlight transmission, helping to improve productivity.

- High clarity and most widely used for encapsulation Roberts
- Softened shock absorbing
- Proven durability over decades of use

Increased power
- Improved efficiency through higher reflectivity

Durability
DuPont photovoltaic materials allow for higher cell and module efficiency by reducing loss of sunlight and minimizing contact resistivity.

**DuPont™ Kapton® polyimide films**
- **thin film substrates**
  - DuPont™ Kapton® polyimide films are engineered to provide high performance and long-term reliability to a-Si and CIGS photovoltaic substrates.
  - **Roll-to-roll processing**
  - **Low CTE to minimize stress**
  - **Low moisture uptake**
  - **Excellent electrical properties and increased voltage endurance**
  - **Ceramic filled versions to increase corona resistance and thermal conductivity**

**PET/polyester films**
- DuPont™ Teijin Films™ makes value-adding, cost-effective, UV-stabilized polyester films.
  - **Mylar®**, **Melinex®** and **Teijin™ Teoron®** PET films
  - For backsheet laminations
  - **Enhanced hydrolysis performance**
  - **Dielectric properties**
  - **High reflectance**
  - **Enhanced UV protection**
  - **Durability**

**Poly-silicon manufacturing**
- DuPont™ Niapure® and DuPont™ Niapure® Select sodium metal enable low cost manufacturing processes of PV-grade silicon.
  - **Excellent purity that increases yield**
  - **Reliable supply**
  - **Powerful reducing agent critical to alternative Poly-silicon processes, such as Virassa and SRI**
  - **Integrated product safety management**

**Thin film substrates**
- DuPont™ Teijin Films™ make value-adding, cost-effective, UV-stabilized polyester films.
  - **Mylar®**, **Melinex®** and **Teijin™ Teoron®** PET films
  - For backsheet laminations
  - **Enhanced hydrolysis performance**
  - **Dielectric properties**
  - **High reflectance**
  - **Enhanced UV protection**
  - **Durability**

**Materials for the highest module efficiency**

**Performance and efficiency**

**Photovoltaic metallizations**
- DuPont™ Solamet® metallizations pastes lower the bar for PV cell metallizations and improving cell efficiency.
  - **Crystalline silicon**
    - Lead and cadmium-free options for more eco-conscious manufacturing
    - **Greater conversion efficiency and productivity**
  - **Thin films technologies**
    - **Development for low contact/gridline resistance**
    - **Fine line patterning down to 80 microns**
    - **High compatibility and adhesion on transparent conductive oxides**
  - **Gas barrier properties**
  - **Exceptional mechanical stability**
  - **High light transmittance**
  - **Increased power output**
  - **Lightweight and flexible**
  - **Excellent UV resistance**
  - **High temperature dimensional stability**
  - **High reflectance**

**Frontsheet materials**
- Less fragile than glass, DuPont™ Teflon® films deliver increased power output with lightweight, durable materials.
  - **High light transmittance**
  - **Increased power output**
  - **Lightweight and flexible**
  - **Excellent UV resistance**
  - **Exceptional mechanical stability**

Cost Reduction

DuPont encapsulant sheets deliver long-term protection for the most sensitive portions of photovoltaic modules.

DuPont™ PV5200 PVB encapsulant sheets
Based on DuPont™ Butacite®
70 years of glass adhesion history brought to PV
Very familiar to glass laminators
Offers a quick, reliable solution for modules needing to pass safety glass codes
Also available in white, allowing dual function as encapsulant and back reflector

DuPont™ PV5300 ionomer encapsulant sheets
Based on DuPont™ SentryGlas®
Delivers the industry's most advanced clear structural sheet
Proven glass adhesion
Helps meet the world's toughest building codes
Superior lamination performance

Encapsulant sheets

DuPont science is bringing products to both crystalline silicon and thin film solar cell and module manufacturing to help reach better yield, higher throughput and equipment uptime.

DuPont™ Kalrez® perfluoroelastomer parts
Resist harsh chemicals and high temperatures for exceptional equipment sealing performance.

DuPont™ Zalak® high performance seals
A cost-effective alternative to select applications where traditional sealing materials are insufficient

DuPont™ Vespel® parts
The low wear and friction performance of DuPont™ Vespel® parts and shapes makes it a leading choice for reduced scratches in glass and wafers

DuPont™ Vespel® end-effectors
This ultra-high modulus composite product line also offers low deflection with vibration dampening, allowing faster and more precise handling of the glass and wafer substrate.

High performance seals and parts

DuPont™ science provides quality materials, design solutions, manufacturing processes and components to help lower the cost per PV kWh.

DuPont™ Rynite® PET thermoplastic polyester resins
Increase safety, eliminate corrosion and provide long-lasting performance for junction boxes and structural components in harsh environments.

DuPont™ Kalrez® perfluoroelastomer parts
Resist harsh chemicals and high temperatures for exceptional equipment sealing performance.

DuPont™ Zalak® high performance seals
A cost-effective alternative to select applications where traditional sealing materials are insufficient

Structural components

Design flexibility for ease of assembly
Improved installation cost
Eliminates outdoor corrosion issues
Low dimensional change in the environment
Weight reduction

Helping to reduce total system costs.
Enabling new applications

DuPont innovative products and engineering solutions enable development of new PV technologies, offering lightweight, higher efficiency, lower cost and greater design flexibility for ease of assembly.

Ionomer encapsulant sheets

DuPont™ PV5300 ionomer encapsulant sheets are designed for PV modules which are more sensitive to moisture and for architectural applications that require exceptional strength.

- High clarity
- High strength and stiffness
- Low moisture absorption

Nylon resins

DuPont™ Zytel® nylon resin – for robust and aesthetic glass reinforced inverter housing.

- High mechanical strength
- Excellent balance of stiffness/toughness
- Good high temperature performance
- Good electrical and flammability properties
- Good abrasion and chemical resistance

Teﬂon® FEP/ETFE films

DuPont™ Teﬂon® FEP/ETFE Films for lightweight and ﬂexible modules, as well as roll-to-roll manufacturing processes.

- Highest transparency ﬁnished sheet used in PV today
- Effective protection against moisture
- Superior adhesion to EVA
- Selectable thicknesses to choose
- Suitable for ﬂexible modules on ﬂat and curved surfaces
- Unbreakable
- Corners will not chip
- Safer and easier to install than glass

Building-integrated photovoltaics

DuPont™ Gevity® BIPV – new, patented photovoltaic system, specially designed for sloped roof integration. A ready-to-install kit consisting of a photovoltaic laminate attached within a frame of DuPont™ Nylon composite material, moulded in a single piece, galvanised steel bushings and stainless steel attachments, inverter and connection boxes.

- Quick and easy to install
- Optimises water drainage
- High surface efﬁciency
- Stacked module validation
- Reliable, high performance materials
- Resistance to ice, cold, wind and snow loads
- Corrosion resistant
- Innovative fast and integration
- Compatible with almost every type of roof structure

*) Currently available in France

1 Communication inv. Novem.
We collaborate closely with many players in the PV industry to develop technology partnerships for the creation of solar modules that run more efficiently, last longer and make solar energy a more viable alternative for everyone.

**Partnership for today and tomorrow**

DuPont materials have been at the forefront of innovation for more than two decades, setting new PV industry standards around the world. We continue to invest in both capacity expansions to meet the need for new innovative solutions to support the explosive industry growth and the development of technologies to address different applications within the industry.

**ACCELERATING GRID PARITY ACHIEVEMENT**

As a leading supplier of materials for the emerging thin film market, we are also leading the discovery of new solutions for amorphous silicon (a-Si) and CIGS thin film. We are also developing new, innovative materials to enable concentrated photovoltaics (CPV). With significant investments in product development and manufacturing capacity, DuPont is well positioned to help the industry meet grid parity faster with new technologies, hopefully within the end of this decade in the Western hemisphere.

**Modules that last 25 years and more.**

DuPont materials ensure durability for module makers who can guarantee reliable production of electricity for system owners.

**Highest cell and module performance.**

DuPont materials improve cell and module efficiency by maximizing both sunlight and minimizing contact resistivity.

**Lower total system costs.**

DuPont provides quality materials, design solutions, manufacturing processes and components to help reduce the cost per PV kWh.

**Innovations in technology, design and aesthetics.**

DuPont offers innovative solutions in new PV technologies, enabling lightweight, higher efficiency, lower cost and highly aesthetic architectural integration.