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POLICY PAPER

Securing Europe's Solar Sovereignty: A Policy Agenda to Elevate European-Made Solar Production Machinery in European PV

1 Introduction and Objectives

The European PV industry is under increasing pressure in global competition, as non-EU manufacturers (notably China) leverage massive subsidies and local market protection—such as strict “first-serve” rules—to bolster their domestic supply chains. To secure the EU's strategic autonomy in the solar sector and preserve high-tech jobs and production sites in Europe, targeted support for European machine builders is essential.

This policy paper explains why **“European-made machines”** are superior, identifies current market and regulatory challenges, and proposes concrete support measures.

2 “European-made machines”: Quality, Sustainability and Security Advantages in Nine Dimensions

2.1 Technological and economical de-risking

From back in the 1990s, PV production has been industrialized in Europe. From then onwards, European research centres and technology companies have continuously improved on efficiency, industrialisation, durability, sustainability and cost – but also open cooperation with China. This combination resulted in PV being the cheapest technology to produce electricity today and in future.

While Europe has been very generous in teaching China how to produce PV and offering a perfect market for Chinese products, today China is not reacting on equal terms. In fact, China is protecting its dominance in the sector increasingly with export restrictions of equipment, dumping of production equipment, components and products.

Without any changes, China will be able not only to dominate the technology but also the pricing.

Against this backdrop, European equipment producers

- are a warrant that PV production know-how is not being monopolized and could also be used and applied in other regions of the world
- provide a guarantee to ensure Europe's independence in the energy sector.
- ensure that European solar PV research will continue to contribute to the European economy, GDP and the European trade balance
- are an insurance against market failures and political directives in China with respect to the supply of PV production equipment and the research for solar PV in China
- are a warrant that PV production know-how in Europe remains available to assess technical developments, quality and reliability of imported PV products.

2.2 Safety

European machines meet the highest safety standards:

- **Safety PLCs** based on **IEC 61508** and **ISO 13849-1** ensure functional safety across the entire lifecycle.
- Safety-critical components comply with **EN ISO 12100**, **EN 60204-1**, and **EN ISO 13850** (emergency stop)—they're not just "yellow plastic boxes with a red button".
- All embedded software modules undergo rigorous **validation processes** according to IEC standards.
- Robust certification of ATEX 2014/34/EU (Atmosphères Explosibles) compliance when machines are intended for use in potentially explosive atmospheres.
- Materials and non-consumable components are selected or designed for **10+ years** of safe operation.

2.3 Reliability & Availability

- Components engineered for **10+ years** of service life deliver a high **MTBF** (Mean Time Between Failures), reducing downtime and total cost of ownership.
- **Line-level testing** (instead of tool-by-tool only) enhances overall system robustness.
- High uptimes, minimized maintenance requirements, and a "**Designed to maintenance**" philosophy enable quick repairs and predictable schedules.

2.4 After-Sales Service & Expertise

- **On-site service** extends beyond installation and ramp-up phases.
- 10 years' availability of spare parts and right-to-repair
- Tiered **Service Level Agreements** with guaranteed spare-parts availability.

Highly trained, factory-certified service engineers vs. on-the-job training models seen elsewhere

2.5 Sustainability

European producers allow for manufacturing under the strictest environmental standards. This comes to **Life Cycle Assessments (LCA)** show that optimized supply chains significantly cut CO₂ emissions in material sourcing and production.

- Energy efficiency of equipment according to label equals energy efficiency in operation (up to **40% less energy consumption** compared to Chinese equipment with equivalent energy label). This enables wafer/cell/module producers using European equipment to succeed better in future EcoDesign rankings.
- Contractual agreements guarantee on power consumption to proof energy labelling.
- EU manufacturers need to comply with the **EU Industrial Emissions Directive (2010/75/EU)**, which requires the use of the best available technology to reduce the environmental impact of the production. That means the equipment itself is made with a much smaller environmental impact than what you'd typically find from Chinese factories.
- EU's EcoDesign rules (ESPR) can become a differentiator if tools *must* meet tough standards for using way less water, chemicals, and electricity. European companies have been designing for this for years because of strict thinking and laws. Chinese tools usually don't have these built-in efficiencies, meaning higher running costs and bigger environmental headaches down the line.
- European equipment developers and producers have been **committed to efficiency and waste-reduction for decades** and developed a respective attitude in their engineering. With millions of solar modules produced in a gigawatt-factory per year, every percent point of higher production yield results in a decrease of hundreds of tons in waste production.

2.6 Innovation & IP

- European machine builders lead in R&D ("best in class"), whereas others often follow or copy.
- **Close cooperation with leading European research** institutes and university is fundamental for next generation PV and continuous improvements.
- A clear legal framework – **Unitary Patent** (Reg. 1257/2012) and forthcoming **Unified Patent Court** – strengthens IP protection and legal certainty across Europe.

2.7 Regulatory Independence

- European machine builders are **able and willing to deliver in Europe**
- **Chinese vendors are increasingly restricted to export equipment,** components, materials, and consumables as the recent example for export bans on battery equipment and materials, as well on rare-earths proof shows. Also wafering equipment is subject of export restrictions. Even standard parts not affected by export bans are frequently not being delivered to outside China, according to reports; this hinders solar production companies to start-up production

2.8 CE Conformity & Regulatory Assurance

European machines are fully designed and built to meet the EU's rigorous CE conformity framework. CE marking is not just a label—it is a legally binding declaration that the equipment complies with all relevant EU safety, health, and environmental protection requirements. This provides operators and policymakers with legal certainty, smooth market access, and confidence in long-term operational reliability.

- **Structured conformity assessment:** Depending on machine category and risk, European manufacturers use the appropriate conformity modules (e.g. internal production control, EU type-examination, or full quality assurance), including Notified Bodies where required.
- **Complete technical documentation:** Risk assessments, drawings, control system descriptions, safety calculations, and test reports are compiled into a full technical file, archived for at least 10 years and available to authorities upon request.
- **Accurate and transparent Declaration of Conformity:** Every machine is accompanied by an EU Declaration of Conformity listing all applicable directives, regulations, and standards, providing legal traceability.
- **Mechanical design and safety requirements** follow the **Machinery Directive 2006/42/EC**, ensuring harmonized risk assessment and CE conformity with the capability to provide a testified construction file to proof CE compliance
- **Harmonized safety standards:** Designs are based on harmonized EN and ISO standards such as EN ISO 12100 (risk assessment), EN 60204-1 (electrical equipment of machines), EN ISO 13849-1 (functional safety), and IEC standards for software validation — ensuring compliance through recognized technical pathways.
- **Future-proof compliance:** European manufacturers are already aligning with the new Machinery Regulation (applicable from 2027), which introduces updated requirements on digital documentation, cybersecurity, and high-risk systems.

Through strict adherence to EU CE rules and harmonized standards, European machine builders deliver equipment that is legally sound, operationally safe, and future-ready—significantly reducing regulatory risk for operators and policymakers alike

2.9 Cybersecurity

European toolmakers treat cybersecurity not as an afterthought, but as a core design and operational principle. This is essential in a world where industrial espionage, ransomware, and state-level cyber operations increasingly target critical clean-tech infrastructure. Secure machines are strategic assets for Europe’s energy sovereignty.

- Built-in cybersecurity by design: European tools integrate security measures from the earliest design phases in line with **the EU Cybersecurity Act (Reg. (EU) 2019/881)** and **IEC 62443** standards for industrial automation and control systems.
- **Secure embedded software:** Firmware and control software are developed under rigorous lifecycle processes, including code signing, vulnerability testing, and version control. Remote access points are hardened and strictly documented, minimizing attack surfaces.
- Compliance with the upcoming **EU Machinery Regulation (EU) 2023/1230**: This regulation explicitly addresses cybersecurity risks, requiring manufacturers to prevent unsafe behavior caused by intentional third-party manipulation. European manufacturers are ahead of the curve in implementing these provisions.
- Controlled connectivity: All external communication interfaces, from Ethernet ports to remote maintenance VPNs, follow **strict authentication and encryption protocols**. Default passwords and “open ports” practices – common in lower-cost machines – are avoided entirely.
- Alignment with the **NIS2 Directive (EU) 2022/2555**: European vendors enable operators to comply with NIS2 cybersecurity obligations by providing secure network integration, incident logging, and vulnerability disclosure channels.
- **No hidden backdoors or opaque firmware:** European machines come without security-critical dependencies on foreign cloud services or hidden remote-control capabilities, reducing geopolitical risk and ensuring full operational sovereignty.
- **Ongoing security maintenance:** Regular firmware updates, vulnerability management, and transparent patch cycles ensure long-term resilience over the entire equipment lifetime.

By embedding cybersecurity standards into the core of tool design and operation, European machine builders not only protect industrial production against disruptions

but also help operators comply with emerging EU cybersecurity regulations—creating a decisive strategic and operational advantage.

3 Challenges & Market Failures

1. **Subsidy Race:** Third-country subsidies distort competition.
2. **Local Content Requirements:** Local content rules in third countries e.g. in automotive demonstrate how global market share of EU vendors can be lost without EU response.
3. **Access to Capital:** High upfront costs for advanced machinery hinder SMEs and mid-caps.
4. **Loss of industrial innovation capabilities due to weak demand from outside China**
5. **Bundling** of uncompetitive/low-quality equipment with state-of-the-art equipment **to outcompete European suppliers**
6. **Basic IP/Patent portfolio for TopCon/HJT hold by Chinese companies**
7. **Chinese equipment often comes with financing to Europe**
8. Many **Chinese equipment manufacturers** have produced **equipment on stock** which now is being offered on the European market – with the risk to contributing to “Chinese solar modules made in Europe”

4 Recommended Support Measures

Measure	Description
1. “Made in Europe” Bonus (Local Content Premium) and Vouchers	X % bonus (e.g. 50 %) on purchase price for European machines to be granted to manufacturing companies. SME could be benefit in the form of vouchers to simplify bureaucracy. Bonus to be included in the Industrial Decarbonisation Accelerator Actand
2. Inclusion in “Made in Europe” Certificates of Origin Scheme	Downstream products produced with or incorporating Made in Europe equipment would qualify for additional Made in Europe certificates of Origin (% MiE per € value addition)
3. Low- or Zero-Interest Loans	Provided via InvestEU/EIB at 0–0.5 % p.a. for European machine purchases; conditional on ≥ 50 % spend with European manufacturers.
4. Invest-backed Loans with European-Spend Requirement	Loans to end users if ≥ 50 % of funds are demonstrably spent on European

	machinery (akin to IPCEI models in R&D consortia).
5. European-Backed Leasing Programs	Leasing companies backed by EIB guarantees for machines/lines, optionally with buy-back clauses.
6. Anti-Dumping & Import Duties	Use EU standard anti-dumping instruments to counter unfair subsidies (e.g. by bundeling un-competitive equipment to monopoly eq) from third countries.
7. Exclusive EU Use of Subsidized R&D	Publicly funded R&D outputs licensed exclusively to European firms for X years (e.g. 5 years), followed by open-access licensing.
8. Demonstration & Pilot Lines	Co-fund “demo” factories for solar machinery to achieve scale, share best practices, and establish training centers.
9. Compliance enforcement of CE and other standards	When used in (partly) public-funded production plants the production equipment from outside Europe shall be inspected with regards to CE compliance and compliance with other mandatory standards by certified independent European auditors

5 Best Practices from Other Sectors

- **Automotive Scrappage Schemes (2008/09):** Temporary purchase incentives drove rapid sales growth; a time-limited machine subsidy could yield similar results.
- **EV-Premium:** Italy is granting EV incentives only for cars whose components are at least 40% sourced from within the the EU. France is granting EV incentives only to cars whose overall production carbon footprint is below a strict threshold, effectively excluding Chinese cars.
- **IPCEI Model** (microelectronics, batteries): Coordinated state aid with knowledge spillovers achieved private R&D leverage up to 1:1.5.

6 Conclusion

The proposed measures create a **level playing field** for European machine builders, secure strategic autonomy, and strengthen the Single Market. A mix of **direct and**

indirect incentives, preferential financing, trade measures, compliance enforcement, cybersecurity measurements, and IP safeguards will swiftly restore competitiveness and innovation leadership in Europe.

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