Technical Sheet for Solution Implementation

On-Farm Solar Business Models

Thematic Area: Environmental Sustainability.

Priority: Management of resources and adaptation of practices to climate changes.

Need: Energy Management; Photovoltaic energy: How to obtain information and advice on photovoltaic energy; Renewable energies: Solutions for the use and production of non-fossil energies in equine farms (for example biogas, solar energy, etc.); Improving the energy efficiency of farms, how to reduce waste?; Information on financing and/or investments for renewable energies;Renewable energies: what use and production systems are possible on equine farms?

Solution EU Number: CC-9.

Content of the Solution: Using solar energy for electricity production on farms – either for self-consumption, selling surplus energy to the grid, or leasing land for solar installations (including agrivoltaics).

Reasons for Implementing this Solution

Implementing solar energy solutions enables farms to reduce energy costs, strengthen self-sufficiency, and diversify income streams. At the same time, it contributes to environmental sustainability by lowering dependence on fossil energy sources.

Description of Solution Strategies

Solar photovoltaic (PV) systems offer farms a reliable and increasingly affordable way to produce clean electricity. Depending on the business model, panels can be installed on existing farm buildings, on unused land parcels, or integrated into farming activities through agrivoltaics. The choice of model depends on farm-specific needs, available land, and financial considerations.

System types: Roof-mounted, ground-mounted, or agrivoltaics.

Power range: 10–100 kWp for farm-scale systems; >1 MWp for leased land projects.

Performance: 800–1,000 kWh/kWp/(depends on country); 1 kWp requires 6–10 m².

Lifetime: Modules 25–30 years, inverters 10–15 years.

Business models:

- Own farm installations:
  - Saving electricity costs through self-consumption.
  - Possibility to sell surplus electricity if connected to the public grid Increasing farm self-sufficiency.
  - Reduced dependence on non-renewable energy sources.
- Land leasing:
  - Possibility to gain significant financial benefits from long-term contracts (15–30 years).
  - Use of parcels not suitable for agriculture.
  - Diversification of farm activities through agrivoltaics (dual land use).

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Funding & Subsidies: Depending on country, support may be available through EU programs (e.g., CAP, Rural Development Funds) or national energy schemes. Subsidies often cover part of investment costs or provide low-interest loans.

Limitations:

- Seasonal production (most yield April–September; very low production in winter months).
- Large systems require permits and a reliable grid connection.
- Feed-in tariffs can be relatively low, limiting income from surplus sales.
- Long-term land leasing contracts may reduce flexibility in future land use.

Environmental impact: Avoided emissions of 0.5–0.7 t CO_2 per kWp per year.

Implementation Steps

1. Planning & Assessment
- Careful evaluation of energy needs, available land/roof area, and potential benefits.
- Compare pros and cons of self-use vs. leasing models.

2. Panels for Own Farm
- Request quotes from several contractors and compare offers.
- Select a reliable installer and electricity company for grid connection.
- Apply for permits and check subsidy/financing opportunities.
- Install system, connect to grid, and put panels into operation.
- Monitor production and impacts on farm energy costs.

3. Leasing Land for Solar Projects
- Identify suitable land parcels.
- Consult legal and financial advisors before signing contracts.
- Negotiate lease terms (duration, payment, responsibilities).
- Finalize contract and oversee site preparation if required.

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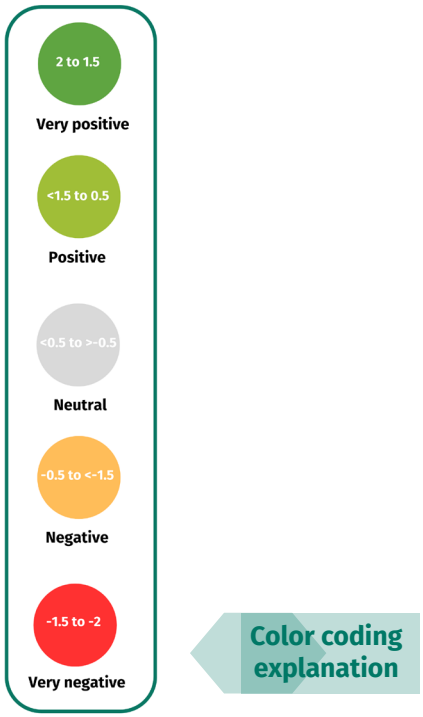
How Will this Solution Impact the Performance of your Farm ?

TOPIC	SCORE
Social	1.50
Economics	0.50
Welfare	0
Health	0
Environmental	1.00
Pasture access and management	0
Global	0.58



Socioeconomics: This solution will support the social performance of the farm because it aligns with the strong social license and public support for renewable energy. By adopting solar power, the farm demonstrates environmental responsibility, which strengthens its reputation and community trust. If the system functions well, it can also ease the burden of daily work, showing attention to both sustainability and quality of life.

This solution will support the economic performance of the farm because it can lower long-term energy costs and improve overall efficiency. However, profitability depends on farm size and energy needs, as sun energy is less available in winter. The system requires a high initial investment that takes several years to compensate, and durability over time is a key factor for financial viability. Overall, it offers long-term savings potential but poses significant short-term financial challenges.

Health & Welfare: This solution has a neutral impact on the farm's everyday health performance as it does not help to maintain low levels of pain and drug use. It also has a neutral effect on the welfare performance of the farm as it is not related to a positive emotional state or provision of welfare-friendly housing conditions for the animals.

Environmental Sustainability: This solution supports the environmental performance of the farm because it helps with the adoption and mitigation of climate change, halting biodiversity loss via reduced CO2 emissions and reduces use of fossil energy. It is also possibility for better water management by giving energy to water pumps and other equipment.

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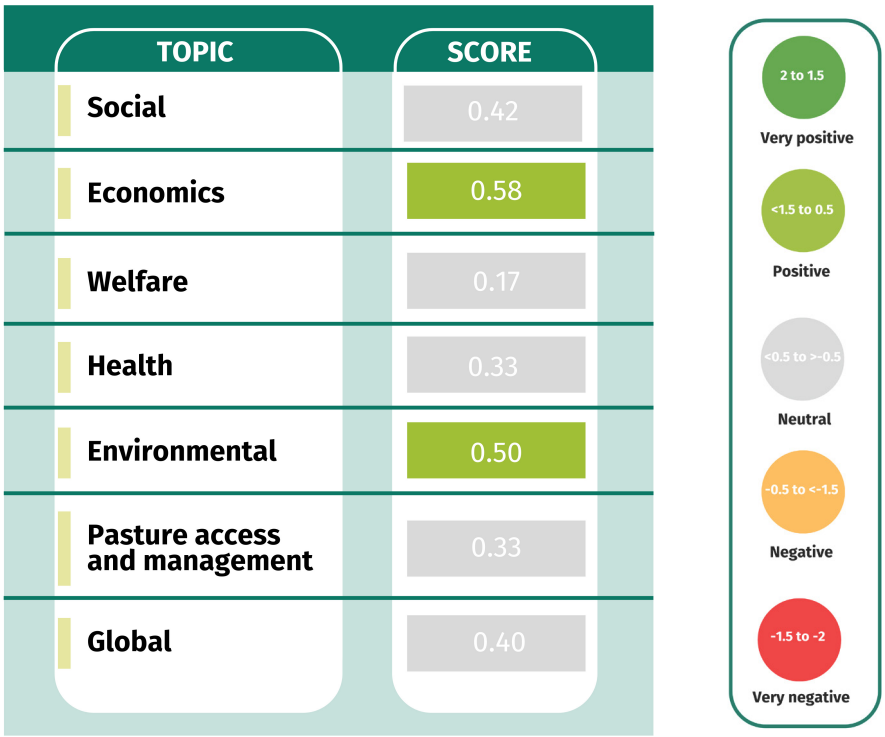
How Will this Solution Impact the Resilience of your Farm?



Socioeconomics: This solution will not impact the social performance of the farm facing external challenges assessed because its main effects are technical and financial rather than social. Although renewable energy is generally well accepted, the influence on community relations, trust, or cohesion remains limited and indirect.

This solution will support economic performance of the farm facing external challenges assessed because it reduces energy costs, increases self-sufficiency, and improves resilience during crises. It offers long-term financial benefits, especially in times of rising energy prices, even if the high initial investment requires years to be compensated.

Health & Welfare: This solution does not directly enhance the farm's health performance under external challenges as it has no potential to reduce pain or medication use. Similarly, this solution does not directly improve the welfare performance of the farm in the face of external challenges. It does not necessarily lead to a better emotional state for the horses or improved living conditions.

Environmental Sustainability: This solution will support environmental performance of the farm facing external challenges assessed because use of it is more profitable during inflation extreme weather event, because it reduces the CO2 emissions and makes water management easier during the draughts. This solution will not impact land access or management performance of the farm facing external challenges assessed because it will not prevent the loss of agricultural land.

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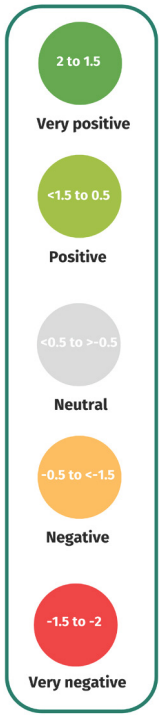
How Can this Solution Help your Farm Cope with Specific External Challenges to Become More Resilient?

CHALLENGES	SCORE
Inflation	0.92
Pandemic	0
High welfare standard	0.42
High infectious diseases	0
Extreme weather event	0.75
Loss/limited access to grassland	0.42



Inflation & Social Crises: This solution will support the global performance of the farm facing inflation because energy self-sufficiency reduces dependence on external markets and cost pressures. It also enhances environmental durability through lower emissions, while stable energy supply indirectly supports animal welfare and working conditions.

This solution will not impact the global performance of the farm facing pandemics because its effects are limited to technical energy savings. It does not significantly influence social resilience, health, or welfare under such circumstances.

Welfare & Diseases: This solution will not support the farm's overall performance when facing infectious disease challenges. In such cases, it cannot prevent mortality, disease-related pain, or the need for curative medication. Likewise, this solution has little potential to strengthen the farm's overall performance when adapting to compulsory high welfare standards, as its impact is not related to these challenges.

Climate Change & Access to Land: Environmental challenge: this solution will support the global performance of the farm facing abnormally high temperatures and draughts because it reduces CO2 emissions and makes water management easier during the draughts. In addition, it increases self-sufficiency and reduces energy costs, which has positive effect on profitability and increases farm capital

Land access/management challenge: this solution will not impact the global performance of the farm facing loss or limited access to agricultural land. It does, however, increase flexibility of the resources.

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Cost-Benefit Analysis

Costs

Socioeconomics:

- Investment costs: equipment, installation, and grid connection (approx. 800–1,200 €/kWp).
- Maintenance & operation costs: 1–2% of investment/year.
- End-of-life/destruction costs: decommissioning, disposal, recycling of PV panels.
- Land use costs: panels take up field area (esp. for ground-mounted or leased systems).
- Financial & safety risks: fire risks, liability issues, legal/contractual uncertainties.
- Production variability: mismatch between demand (winter) and supply (summer).
- Low/volatile income from surplus electricity sales (oversupply in summer).
- Dependency on foreign production (most panels imported from China, linked to environmental and geopolitical concerns).
- Socio-economic insurance costs.
- The system of energy production is connected with the public energy system in all EU countries. There are possible institutional risks for quine farms.

Health & Welfare:

- No direct costs identified for equine welfare, but risks may arise if panel placement interferes with stables, paddocks, or grazing areas.
- The placement of the panels on animal farms should be studied more.

Benefits

- A Energy self-sufficiency: reduced dependency on external energy providers.
- Cost savings: lower electricity bills over system lifetime.
- Diversified income: leasing land for PV projects provides long-term stable returns.
- Positive image: sustainability and alignment with EU climate & energy policy goals.
- Contribution to rural development: new business opportunities, potential community benefits.
- Employment effects: local jobs in installation, operation, and maintenance.
- It is expected that solar panels will be cheaper in the near future.

- Farms that adopt profitable and sustainable solutions can reinvest in better animal care and facilities.
- Agrivoltaics may provide shaded areas on pastures, potentially beneficial for animal comfort (if designed appropriately).
- Strengthened farm economy indirectly supports long-term welfare of equines.

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Costs

Environmental Sustainability :

- Negative visual impact: changes in rural scenery, potential conflicts with landscape values.
- Biodiversity risks: soil and vegetation changes beneath panels, limited movement for large mammals.
- Panel production impacts: resource use (rare metals, water, toxins), environmental burden mainly outside EU.
- End-of-life challenges: recycling and safe disposal of panels (toxic materials risk).
- Loss of agricultural land.

Cooperation between Farms:

- Joint use of solar systems may be technically and legally complex.
- Uncertainty if direct electricity sales to neighbors are permitted or practical under current grid and market rules.
- Shared investments require agreements on ownership, operation, and responsibilities, which may increase risks of conflict.

Benefits

- Climate protection: reduction of CO_2 emissions (0.5–0.7 t CO_2 avoided per kWp per year).
- Improved air quality (indirectly): less fossil fuel usage.
- Sustainable farm business models: additional income can support better long-term land management and environmentally friendly farming.
- Potential biodiversity gains: pollinator habitats and mixed land use in agrivoltaics.

- Potential for cooperative solutions if legal frameworks allow (shared infrastructure, lower unit costs).
- Strengthened local cooperation between farms could create synergies in energy management and long-term resilience.
- Even if direct electricity sales are not feasible, cooperation may be possible in planning, contracting, or joint leasing schemes.

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Websites

- English
  - European Union – Enhancing production and use of renewable energy on the farm https://ec.europa.eu/eip/agriculture/en/focus-groups/enhancing-production-and-use-renewable-energy-farm.html
  - European Comission - Agrivoltaics alone could surpass EU photovoltaic 2030 goals https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/agrivoltaics-alone-could-surpass-eu-photovoltaic-2030-goals-2023-10-12_en
  - NC State University – Considerations for Transferring Agricultural Land to Solar Panel Energy Production https://craven.ces.ncsu.edu/considerations-for-transferring-agricultural-land-to-solar-panel-energy-production/
- French
  - Commisison eurepéenne - L'agrovoltaïque à lui seul pourrait dépasser les objectifs photovoltaïques de l'UE à l'horizon 2030 https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/agrivoltaics-alone-could-surpass-eu-photovoltaic-2030-goals-2023-10-12_en?etransnolive=1&prefLang=fr&etrans=fr
- German
  - Europäische Komission - Agrivoltaik allein könnte die Photovoltaik-Ziele der EU für 2030 übertreffen https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/agrivoltaics-alone-could-surpass-eu-photovoltaic-2030-goals-2023-10-12_en?prefLang=de&etrans=de
- Suomi
  - Motiva - Ylijäämäsähkön myynti https://www.motiva.fi/ratkaisut/uusiutuva_energia/aurinkosahko/aurinkosahkojarjestelman_kaytto/ylijaamasahkon_myynti
  - Salo Solar - AURINKOSÄHKÖJÄRJESTELMÄ Aurinkopaneelit maatilalle https://salosolar.fi/jarjestelma-maatila/
  - Pro Agria - Aurinkosähkö maatilalla - suunnittelua ja turvallisuutta https://www.proagria.fi/blogit/ilmasto-muutoksessa/aurinkosahko-maatilalla-suunnittelua-ja-turvallisuutta

Publications

- Soto-Gómez, D. (2024). Integration of Crops, Livestock, and Solar Panels: A Review of Agrivoltaic Systems. Agronomy, 14(8), 1824. https://doi.org/10.3390/agronomy14081824

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Annex

Ideas to Animate a Workshop About the Solution

- Ask solar technology providers, renewable energy advisors, or agricultural cooperatives to sponsor the workshop.
- Find a model farm with solar installations (roof-mounted, ground-mounted, or agrivoltaics) where the workshop can take place.
- Complete the required tasks and let the participants take part in demonstration activities (e.g., monitoring production, evaluating shading on pastures, simulating energy use).

Proposed Structure for the Workshop on Business Models for On-Farm Solar Energy Production

1. IIntroduction to Solar Energy Solutions
- What is solar photovoltaic (PV) energy?
- Key features and components (modules, inverters, grid connection).
- Types of solutions available: roof-mounted, ground-mounted, agrivoltaics, land leasing.

2. Benefits of Solar Energy in Equine Farms
- Cost savings through reduced electricity bills.
- Energy self-sufficiency and reduced dependency on fossil fuels.
- Diversified farm income via leasing or agrivoltaics.
- Contribution to farm's sustainable image and compliance with policy goals.

3. Practical Applications on Equine Farms
- Installing panels on stables, barns, or riding arena roofs.
- Agrivoltaics: combining grazing or fodder production with solar panels.
- Using solar to power lighting, ventilation, water pumps, or heating.

4. How to Choose the Most Suitable System
- Evaluation of the farm's energy needs (lighting, heating, machinery).
- Assessment of roof structure, land availability, and shading.
- Criteria for technology choice: panel type, inverter capacity, monitoring systems.
- Price comparisons and consideration of subsidies.

5. Hands-On Demonstration
- Live demo on a farm with solar panels in use.
- Monitoring energy production via digital dashboards.
- Testing shading effects in paddocks or fields.
- Safety measures for installation and operation.

6. Maintenance and Troubleshooting
- Cleaning and taking care of panels (dust, snow, bird droppings).
- Monitoring performance and recognizing underproduction.
- Checking inverters and electrical connections.
- Common troubleshooting steps.

7. Case Studies and Real-World Examples
- Examples of equine farms using solar energy for electricity or leasing land.
- Discussion of experiences with agrivoltaics and lessons learned.
- Farmer/operator testimonials on financial and operational outcomes.

8. Cost Analysis and Return on Investment (ROI)
- Typical investment vs. lifetime energy cost savings.
- Leasing vs. owning models and their financial impact.
- ROI calculation based on farm size, energy demand, and usage profile.
- Long-term financial stability through diversification.

9. Q&A Session
- Open discussion for participants to ask about technical, financial, or practical aspects.
- Addressing concerns about seasonality, animal welfare, or long-term contracts.

10. Wrap-Up and Resources
- Summary of key points covered in the workshop.
- Distribution of resource list: suppliers, advisors, online platforms.
- Guidance on subsidies, certifications, and regulatory requirements.
- Information on potential discounts or partnerships with solar providers.