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Effective raspberry processing technologies that incorporate best environmental practices

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The State of the Industry, Challenges, and Prospects

Almost 100% of raspberry processing in Ukraine is focused on freezing!

names

Outlook: ensuring energy independence, continued focus on organic products (growing by 10–15% annually), certification, transition to green, waste-free technologies

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Raspberries as a raw material for processing

High free water content, high respiration rate, low mechanical strength, porous structure

High enzyme activity: proximity to cooling facilities and processing capacity

Presence of seeds (6–12%): the need for degumming in the production of juices and jams

Biochemical composition: dry matter – 12–16%, soluble solids – 8–12%, pectin – 0.5–1.0%, fiber – 6.0–7.0%, acids – 1.5–2.5%, including salicylic and ellagic acids (anti-inflammatory, antioxidant, and antitumor properties), vitamin C – 26–30 mg%

One of the most profitable crops for processing, thanks to its high added value and stable demand in foreign markets.

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Main areas of processing

Flash freezing – 88–92% of the market. Our main export product! Extra, Grade A – 80–95% whole berries – HoReCa, confectionery industry, decoration; Grade B (50–80% whole berries), Gris/Crambl (less than 50%) – jams, yogurts, smoothies, purees, fillings, etc.

Freeze-drying – 3% of the market for confectionery, granola, muesli, dairy products, teas, fruit compotes, chocolate, and the healthy food market

Purees, jams, preserves – 5–7%

- Can be made using substandard or frozen produce
- Filling for baked goods; an ingredient in desserts, dairy dishes, beverages, etc.

Beverages, fruit compotes, artisanal products:

Artisanal products—fruit leather, jams, preserves, wine, etc.
Juice—fresh, concentrated

*Raspberries are the top choice for cost-effectiveness in freeze-drying. Thanks to their hollow structure, they dry faster than strawberries, saving up to 20% in electricity.

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Quality requirements for fresh berries

Berries of a single pomological variety, of a typical size, whole, fresh, clean, ripe, healthy, free of excess moisture, foreign odors, and off-flavors (DSTU 7176:2010. Fresh Raspberries. Technical Specifications)

Physical and chemical	• Berry integrity (at least 95% for IQF) Mechanical damage – no more than 5–10%; Organic impurities – 0.3–0.5%
Biochemical	• Soluble solids content: 8–10% for frozen products, 10–12% for purees Titratable acidity: 1.2–2.0% (1.3–1.8% for IQF)
Safety indicators	• - Levels of nitrates, heavy metals, and radionuclides do not exceed established limits - Free of pathogens and pesticide residues
Critical defects	Rotten or moldy berries, the presence of pests (larvae), the presence of foreign objects (glass, metal)

Using varieties adapted to climate change will ensure predictable yields and the opportunity to receive a grant to offset the cost of seedlings

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Selection of varieties for processing

Selection criteria

Key requirements: high density, firm berries, uniform, intense color, ability to retain shape after thawing, pronounced aroma

Technical specifications: "dry separation," juice loss after defrosting—no more than 5%, absence of "crumbs"—no more than 5–10%

Size (diameter): extra (95/5) for IQF freezing – 18–22 mm; Ripeness: unripe – no more than 2–5%, overripe – 3% (for jams – 10%)

Adapted varieties

Variety name	Density	Contents of the RDP, %
(Polka)	Very high	10,5-12,0
(Polana)	Average	8,5-10,0
(Sugana)	Maximum	10,0-11,5

The most common standard variety for industrial freezing in Europe and Ukraine is Polka; for freeze-drying, it is Sugana and Joan J (thornless).

When using varieties listed in the Variety Register, you can receive a "Start Your Own Business" grant and have the cost of seedlings reimbursed

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Flash freezing* - the golden key to export opportunities!

Advantages

- Microcrystallization of ice
- Preserving the density, shape, and texture of the berries
- Minimal loss of weight (0.5–1.0%), nutrients, juice, and vitamins
- Rapid suppression of microbial activity

Types

Static Shock Freezing, Chambers (Static Shock)	Small and medium-sized farms
Fluidization - IQF (Individual Quick Freezing), fluidization tunnels	• Medium-sized and large professional export-oriented factories

*a technology in which the process of turning water into ice (from 0°C to -5°C) occurs as quickly as possible (in less than 30 minutes)

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The stages of IQF freezing

Harvesting and Pre-cooling

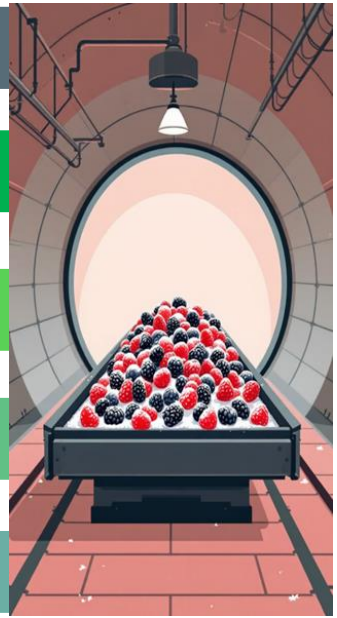
Incoming inspection and checking, either manual or automated

IQF freezing process: temperature -35 to -42 °C, duration 10–15 minutes

Vibration sorting (removal of crumbs and small berries), optical sorting

Weighing, dosing, and packaging (2.5–5.0 kg), metal detection

Warehousing, storage, and logistics at temperatures of -18 to -22 °C*



***Even a brief drop in temperature to -12...-15°C can cause the berries to deform and stick together! Loading and unloading operations must not exceed 30 minutes!**

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Ukrainian producers of frozen raspberries

Ukraine consistently ranks among the top three producers of frozen raspberries. There are currently over 100 companies operating in this market

Large-scale (capacity of 10,000 tons per season or more) – global export leaders (the U.S., Canada, Japan): certified and energy-independent!	**Medium-sized (capacity of 3,000 to 10,000 tons per season)** – direct exports to the EU (grant support, product range expansion)
Tevitta (Cherkasy Oblast) owns over 200 hectares of plantations, uses IQF freezing technology, holds HACCP and BRC certifications, and exports to 20 countries	**Agro Organic (Rivne Oblast**) is a vertically integrated company with storage facilities capable of holding 1,500 tons of produce
Alte Foods (Kyiv Oblast) opened in 2022, featuring innovative equipment (OctoFrost), optical sorters, and HACCP, BRC, and Organic certifications	**Malyn Factory (Zhytomyr Oblast)** processes up to 40 tons per day, provides services to farmers, and holds HACCP and organic certifications
T.B. Fruit (Lviv / Vinnytsia regions) – frozen produce, juices, purees; large export volumes dictate prices in western regions	**HIGHBERRY (Volyn Oblast)** exports to 5 countries, owns 400 hectares of land, and operates Unidex tunnels with a production capacity of up to 60 tons per day
Artberry / Art Prom (Dnipropetrovsk Oblast) They operate a large-scale facility featuring flash-freezing tunnels and warehouse terminals	**Yarofruit LLC (Lviv Oblast)** supplies up to 7,000 tons of products annually to more than 23 countries; certified to HACCP, BRC, and Organic standards

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Techniques for drying raspberries

Technology	Process / Chas	Advantages	Disadvantages
Air-solar	2-3 won	Low costs	Weather dependent, low quality.
Convective (lozenges/powder)	Warm air (45-60°C), 12-14 hours.	Accessibility, simple automation	Risk of burning, loss of nutrients.
Infrared (optical)	IR rays, 4-8 hours.	Speed, sterilization	Risk of uneven drying, high cost of lamps.
Sublimation (lyophilization)	Deep vacuum + frost, 20-34 hours.	Retains 98% of vitamins, shape, color, and crunch effect. Low eco-footprint during logistics.	High cost of equipment. (Premium price: 2.5-4.5 thousand UAH/kg).

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The main stages of the freeze-drying process

Reception and Preparation
Inspection, selection, cleaning of ibru

Shock freezing
Microcrystallization at temperatures
-40°C

Primary drying (Sublimation)
Creating a vacuum, evaporating ice, heating to

Secondary drying (Further drying)
Moisture reduction to 3-5%, temperature threshold not higher than 60°C.

Packaging
Immediately pack in airtight, moisture-proof, light-proof containers.

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The production stages of mashed potatoes

Quality requirements for puree:Moisture content: 8–10%;no seeds, sugar, artificial colors, or preservatives(clean label)

Shelf life at a temperature of +10–15°C, - 6–12 months, minimalcarbon footprint

Raw material preparation: cleaning, washing, inspection, heating to 45–55°C, straining
- **Pit removal (straining machine, 0.4–0.8 mm sieve)**

Deaeration: Removing air from the pureed mixture under vacuum—prevents oxidation (darkening) and separation of the puree, and extends shelf life

Heat treatment: Rapid heating to t +85–105°C for 30–60 s - instant cooling - neutralizes microflora and preserves taste and aroma

Aseptic packaging (maintaining sterility): The puree cooled to t +20-25°C is fed into a sterile chamber, where it is automatically filled into aseptic sterile bags (Bag-in-Box) with a capacity of 20-200 kg.

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Technological stages of jam production

Texture: homogeneous, thick, jelly-like mass that does not spread, CP content 65-68%

*To reduce the price, manufacturers often use a "raspberry blend": 70% seedless raspberries + 30% applesauce

Raw material preparation
- Removal of pits (anti-stone machine, 0.4-0.8 mm sieve)
- About 12% of raw materials are lost! – high cost
- *

Mandatory use of vacuum devices!
Boiling at +60...+65 °C (40-50 min.) - the only and energy-saving way to preserve color! (green practice)

Thickening - adding pectin and acid
- pectin - 12-15 g/kg jam
- for the production of thermostable or dietary jam with a low sugar content (up to 30%) LM-pectins are used

Deaeration (removal of air)
- At the end of cooking in a vacuum chamber, the vacuum is sharply increased for 2–3 minutes
- The jam becomes transparent, does not oxidize

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Advantages of pastila as a processed product

- Pastila is a product that can be made locally and with local ingredients. This provides an opportunity to support local producers and reduce the carbon footprint.
- Pastila is an ideal product for craft production, as it does not require significant initial capital investments and provides the opportunity to create exclusive flavors.

Ринок пастили в Україні на 95 % складається крафтових виробників та сімейних ферм.

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Technological stages of pastille production

***applesauce, pectins, sometimes sweeteners**

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Total ecological footprint of recycled products

Frozen products

Processing time: 15-25 min (shock in the tunnel).

Energy for processing: 80-120 kWh/t.

Energy storage: Very high (1-3 kWh/t/day).

Overall ecological footprint: High.

Sublimated products

Processing time: 20-34 hours (chamber cycle).

Energy for processing: High (180-300 kWh/t).

Energy storage: Zero costs.

Overall ecological footprint: Medium.

Aseptic puree

Processing time: 30-60 s (sterilization).

Energy for processing: Low (30-60 kWh/t).

Energy storage: Zero costs.

Overall ecological footprint: Low.

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Best green practices in raspberry processing technologies

Green technologies in berry processing are designed to promote energy efficiency, reduce greenhouse gas emissions, minimize waste, and eliminate the use of chemical preservatives.

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Autonomous power supply

The use of renewable and alternative energy sources (solar power plants (SPPs), combined systems, cogeneration plants, biofuels) has become a critical survival and development strategy for Ukrainian raspberry freezing plants in 2024–2025..

Technology comparison

	Industrial solar power plants ("green energy") – agrovoltaics (Agro-Frost, Tevitta, Eco Berry)	**Cogeneration plants(biofuel)** (T.B. Fruit, large agricultural holdings)
Main advantages	Free energy during the day, covering up to 40–70% of the plant's electricity needs during peak loads, reducing carbon footprint!	Produce electricity and heat. Weather and grid independent, efficient all year round (ideal for cold storage), heat recovery (efficiency 88-92%)
State support	Preferential loans "5-7-9", preferential import without VAT	Priority connection and grants, preferential import without VAT

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"Green" energy

For exports to the EU, the presence of "green" energy becomes an additional advantage in certification

Competitive advantage	Reporting
Labeling products as “climate neutral” is a big advantage for the European consumer	Businesses that do not have renewable energy sources may find themselves outside the premium contract market.

Cost of solar panels: $500-800/kW - https://dks-solar.com.ua/, turnkey solar power plant (5 kW): from $3,375. Average payback period - 3-4 years.

Rooftop solar power plants are more popular for processing plants, as cold storage and freezing plants have huge roof areas. In addition, the panels protect the roof from overheating in the summer, which further reduces the cost of cooling the building.

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Use of natural refrigerants

Aimed at reducing the use of hydrofluorocarbons (HFCs), which are potent greenhouse gases (freons), to reduce the carbon footprint; adaptation to the requirements of the Kigali Amendment and European norms on the use of HFCs –
https://brgroup.com.ua/ua/a475117-kigalijska-popravka-monrealskogo.html

Technology features

- **Ammonia** is effective for cooling and freezing, the lowest cost per 1 kW of cooling, zero ozone depletion potential
  Carbon dioxide is used in cooling systems in cold rooms, ideal for shock freezing, sublimation, allows you to get hot water. Modern CO2 systems consume less electricity.

Replacing HFCs with natural hydrocarbons will reduce environmental impact and increase production efficiency. Leaking 1 kg of Freon harms the climate as much as emitting 3.9 tons of carbon dioxide

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Reusable packaging

The technology aims to reduce CO_2 emissions by reducing the production of new packaging

Technological cycle

- Container collection
- Cleaning and disinfection
- Inspection, rejection
- Repair or disposal

Advantages	Disadvantages
Reduction of waste by 20-30% compared to disposable packaging;saving resources https://linkpack.com.ua/bagatooborotna-upakovka-scho-ce-i-chogo-stosutsja/	High start-up costs for equipment and logistics. The need to motivate consumers to return packaging

Return on investment for medium-sized enterprises 2–5 years https://zerowasteeurope.eu/press-release/new-study-proves-reusable-packaging-is-economically-viable-at-scale/

Environmentally friendly packaging

Must provide a high barrier against moisture and oxygen, while meeting sustainable development principles such as recycling or composting, reusability, and non-toxicity

Comparison of the most common eco-packaging for different types of products

Parameter	Frozen	Sublimated	Puree
Key requirement	Frost resistance, hydrobarrier	Water-, light-tightness, tightness	Airtightness and protection against oxygen
The best eco-option ismono-materials*	Cardboard packaging with insert bags	Pouches (doypack) made of mono-polyethylene (can be matte, glossy, with a "window")	Aseptic Bag-in-Box packaging (2-1000 l) TECHNOLOGIA (https://technologia.com.ua/)

*Using mono-materials (Mono-PE-monopolyethylene), which are easily 100% recyclable and reduce the amount of plastic per unit of product. Payback period – up to 2 years (https://www.smithers.com/services/market-reports/packaging/future-of-mono-vs-multi-material-packaging-to-2028)

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Cyclical use of water

Cascading water use: water used in one processing stage is reused in another stage where water quality requirements are lower; creation of closed-loop water supply systems

*https://techhorticulture.com/u-prioryteti-ekonomiya-vodnyh-resursiv-i-povtorne-vykorystannya-ochyshhenoyi-vody/

Key Benefits

Adaptive	Для соціально-економічного розвитку
A 50–90%* reduction in the need for fresh water; a decrease in the volume of wastewater requiring treatment; lower costs for heating and cooling water due to temperature stabilization in closed-loop systems	The ability to conduct economic activities in the context of climate change (jobs, wages, taxes).

Implementation: Installation of water collection, filtration, and reverse osmosis systems that enable the purification of water used to wash berries, containers, and production lines, allowing for its reuse;payback period: 2–4 years*

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Use of electric vehicles

It ensures energy efficiency, reduces the carbon footprint, and prevents quality loss in finished products; the transition to electric vehicles is a food safety requirement at processing plants

UNIDEX fluidization tunnels utilize energy-efficient electrical systems—conveyor belts with adjustable speeds (0.1–0.3 m/s) and vibrating pulsators to prevent the berries from sticking together http://www.jagodnik.info/zamorozhuvannya-malyny-u-flyuyidyzatsijnyh-tunelyah-unidex/

Electric pallettrucks – for moving pallets in a vertical plane

Electric pallet trucks – Ideal for moving pallets of raspberries between production areas and maneuvering in narrow aisles

Reach trucks - high-lift stackers designed for use in the narrow aisles of cold storage facilities

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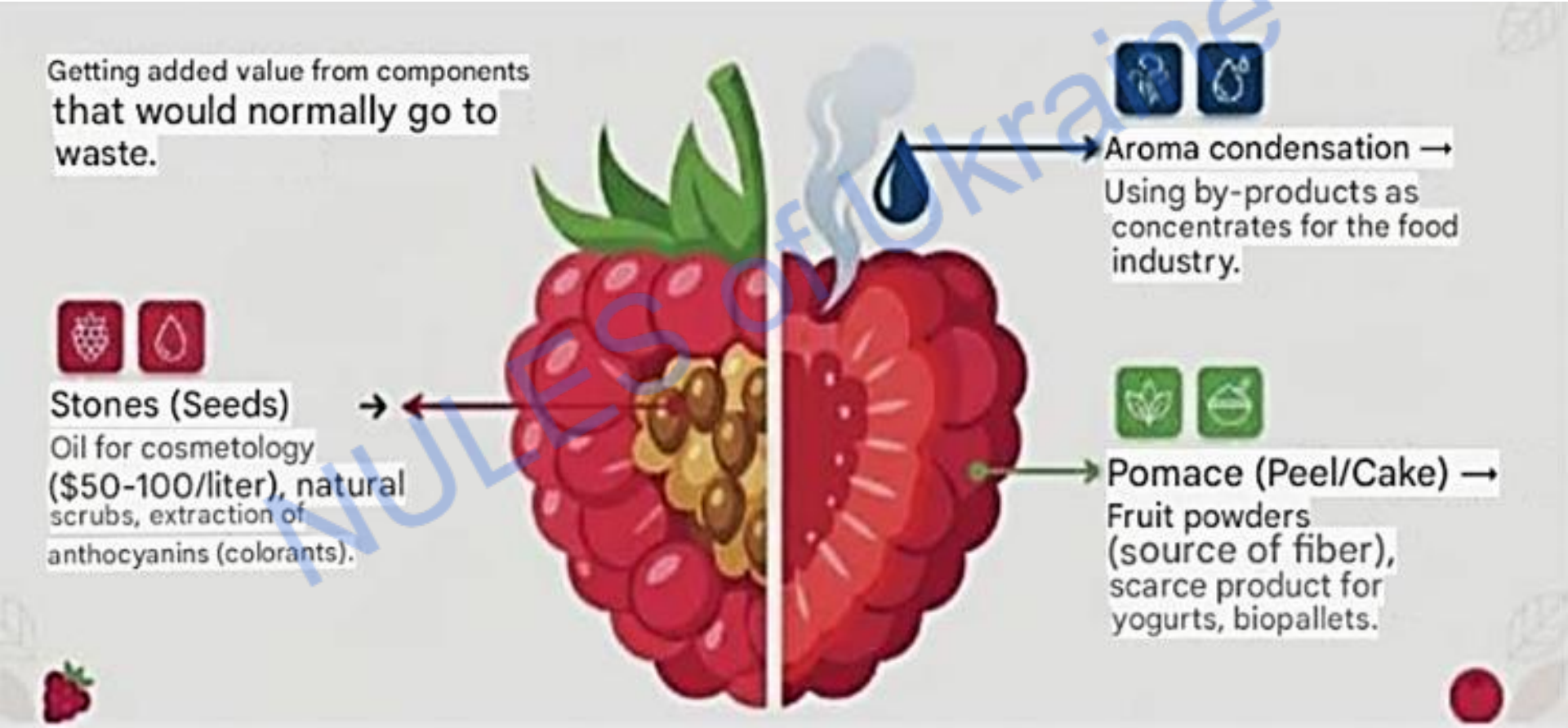
Waste-free raspberry processing technologies (Zero Waste)



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The use of green practices in raspberry processing

Practice	Implementation	Result/benefit
Heat recovery from refrigeration units	Installation of heat exchangers that channel this heat to heat water and facilitate the freeze-drying process of berries	Free hot water for washing production lines, containers, and staff showers; heat for drying berries—energy savings
Rainwater harvesting	Collecting rainwater in tanks and using it for industrial purposes: washing containers, raw materials, processing lines, lids, etc.	A 30–50% reduction in water supply costs compared to using centralized sources
The Use of AI-Based Process Control Systems	Real-time monitoring of product moisture and temperature, automatic shutdown when the desired parameters are reached	Optimizing the duration of freezing and drying using such systems will reduce energy consumption

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The use of green practices in raspberry processing

Freezing “cooling agents” (ice or special gels) overnight can save up to 40% on electricity!

Using sandwich panels with a thickness of 150–200 mm for frozen food storage rooms (-18°C...-25°C) saves energy

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Implementation of green practices at Ukrainian companies

TBF Group (T.B. Fruit) – a group of companies (7 plants) and the largest fruit and berry processor in Ukraine – is actively investing in energy efficiency and implementing green practices. It owns orchards covering more than 3,500 hectares and operates its own transportation company.

https://tbf-grp.com/

Renewable energy: In 2025, the company secured funding to build a 4.3 MW cogeneration plant and a 3.7 MW solar power plant.

Biofuel production
- In-house bioethanol plant, collection and liquefaction of carbon dioxide
  By-products: distiller's grains (animal feed), corn oil

Zero-waste production
- In-house pectin production facility
  Production of pallets and animal feed

Closed-loop water supply system
- four-stage eco-friendly water purification system (sand and carbon filters, UV rays)

The principle of "vertical integration" and traceability has been implemented—tracking the product's journey from farm to fork

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Implementation of green practices at Ukrainian companies

ALTE Group (Alte Foods) is one of the largest exporters and one of the most technologically advanced companies in Ukraine's fruit and vegetable processing sector

https://altefoods.com/

Energy efficiency and product quality: rooftop solar power plant installed, heat recovery, use of natural hydrocarbons, production in compliance with international standards, full traceability

IQF technology	• OctoFrost modern freezing tunnels, optical sorters, metal detectors
Working with local communities	• Short supply chains – reducing the carbon footprint
Zero-waste technologies	• Sorting waste is used to produce concentrates or biofertilizers
Eco-friendly packaging	• use of recyclable packaging

Alte Foods - this is an example of how a company is built in accordance with European environmental standards in order to be competitive in the EU and U.S. markets.

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Strategic Directions for the Development of Berry Processing Enterprises in the Context of Climate Change

In the face of global warming and unpredictable rainfall, Ukraine's raspberry processing strategy is shifting from simple "freezing" to high-tech, resource-efficient production

Energy Efficiency and Renewable Energy	• Using solar power systems to offset peak loads in the summer Heat recovery for water heating
Water Resources Management	• Closed-loop systems (recycling) On-site treatment plants
Waste Reduction and Recycling (Zero Waste)	• Processing crumbs into puree and fillers; using pits and oilcake
Standard packaging	• Eco-friendly packaging Reusable containers
Adapting standards to "organic" and "sustainability"	• Verification of product quality and safety, carbon footprint, and transition to natural refrigerants

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THANK YOU FOR YOUR ATTENTION!