



CEPA

CLEAN ENERGY POWER ALLIANCE

TECHNICAL INTELLIGENCE BRIEF

MEAT, POULTRY & RENDERING EDITION

YIELD • RECOVERY • WATER •
ENERGY • RESOURCE VALUE



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Prepared by



EterSolis

Waste & Carbon Management



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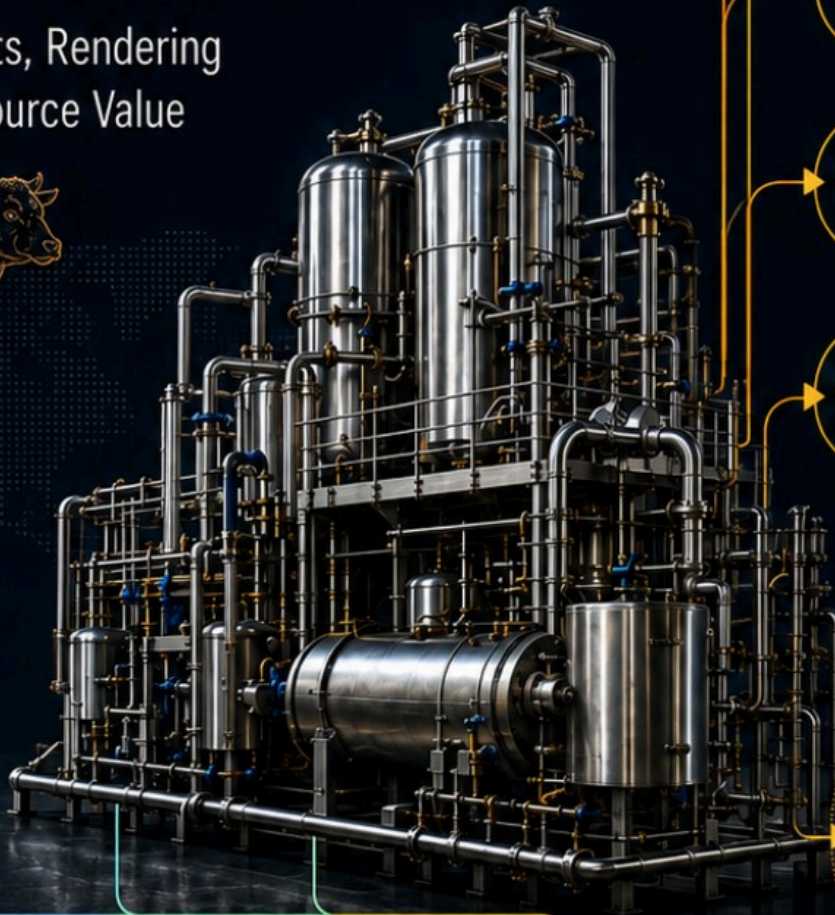
CLEAN ENERGY POWER ALLIANCE

TECHNICAL INTELLIGENCE BRIEF

MEAT, POULTRY & RENDERING EDITION

FROM CARCASS YIELD TO RESOURCE VALUE

Yield, By-Products, Rendering
and Verified Resource Value



EDIBLE
PRODUCTS



BLOOD &
PROTEIN
RECOVERY



FATS & OILS
RECOVERY



RENDERED
PROTEIN & MEAL



RENDERED
FATS & OILS



WATER
RECOVERY



WASTEWATER
TREATMENT



ENERGY
RECOVERY

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CEPA TECHNICAL INTELLIGENCE BRIEF | PUBLICATION CONTROL

From Carcass Yield to Resource Value



CEPA-TIB-MEAT-001-20260906

A decision-grade operating framework for yield, edible and inedible co-products, rendering, water, wastewater, refrigeration and verified resource recovery across meat and poultry processing.



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CONTROLLING EXECUTIVE FINDINGS

- 1 Carcass and material yield must separate saleable product, edible co-product, inedible by-product, process loss, water change and inventory effects.
- 2 Blood, fats, proteins and solids should be captured before dilution whenever sanitary, technical and legal conditions permit.
- 3 A material with potential economic value is not automatically eligible for a higher-value route; sanitary classification and traceability govern destination.
- 4 Rendering should be evaluated as a controlled production process with yield, moisture, energy, quality and receiving specifications.
- 5 Wastewater treatment cannot recover the full value of material that should never have entered the drain.
- 6 Refrigeration, chilling and retained water materially affect both physical yield and energy/water performance.
- 7 A recovery claim requires evidence of accepted mass and final beneficial use, not merely collection or shipment.

DECISION-GRADE PUBLICATION SYSTEM

Evidence boundary

Source-level measurement

Normalized metric

Technical decision

Verified outcome

MPR-001 | Sources: C01, C04, C05, C07

This publication is technical intelligence, not certification or a substitute for jurisdiction-specific legal or regulatory advice.

Scope, sanitary boundary and evidence discipline

KEY

Sanitary classification and lawful destination take precedence over resource-value optimization.

TECHNICAL BASIS

The scope covers live/raw input, slaughter and further processing, edible co-products, animal by-products, blood, fat, organs, bone, feathers, rendering, product quality, floor/drain exclusion, water, retained water, reuse, wastewater, pretreatment, biological/anaerobic treatment, nutrients, refrigeration, odour, air emissions, carbon, KPIs and economics.

DECISION INTERPRETATION

EU Category 1/2/3 terminology is used only as EU law; it is not exported to other jurisdictions. U.S. Part 432 limits are legal only for covered subcategories. EU BAT values are technical performance evidence for covered installations. Industry and legacy guidance are contextual and never override current law.

CONTROL ACTION

Attach jurisdiction, denominator, evidence class and sanitary status to every material claim.

REQUIRED RECORDS

Source; legal/technical status; facility/process boundary; species; denominator; period; route/classification; uncertainty.

AUDIT / ESCALATION TRIGGER

Escalate when a material is called waste, co-product or recoverable without a defined sanitary/legal basis.

MPR-002 | Sources: C01, C02, C04, C05, C06 | Claim: claim_meat001_p02_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Executive material-value operating system

KEY

The value hierarchy is product -> edible co-product -> lawful animal by-product route -> rendered product -> biological/energy recovery -> treatment/disposal, subject at every step to sanitary and legal constraints.

TECHNICAL BASIS

Value is destroyed when biological material is diluted into wastewater, mixed across sanitary categories, overheated, oxidized, contaminated, allowed to spoil or loses traceability. Conversely, not every separated material should be pushed upward in value; classification, pathogen risk, receiving specification and market acceptance determine the lawful route.

DECISION INTERPRETATION

Executives should ask four questions at each stream: What is it? What is its sanitary/legal status? What quality does the next route require? What measured mass actually reaches that route? Only then should economics determine priority.

CONTROL ACTION

Create a stream disposition matrix with lawful and approved destinations.

REQUIRED RECORDS

Stream identity; source; classification; quality; mass; storage condition; permitted route; receiving specification; acceptance evidence.

AUDIT / ESCALATION TRIGGER

Escalate any proposed valorization route that begins with market price before sanitary classification is resolved.

MPR-003 | Sources: C04, C05, C06 | Claim: claim_meat001_p03_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Integrated slaughter, processing and rendering map

KEY

Slaughter, further processing, by-product handling, rendering and wastewater are physically connected and should be mapped as one material system.

TECHNICAL BASIS

The operating chain can include receiving, stunning/slaughter, bleeding, hide/feather removal, evisceration, trimming, washing, chilling, fabrication, further processing, edible co-product segregation, inedible collection, rendering and wastewater treatment. Each transfer point can change quality, water content or legal destination.

DECISION INTERPRETATION

Map equipment-level interfaces where high-value material can enter drains, floor collection, mixed by-product bins or lower-value routes. The map should show both mass and sanitation boundaries because a route may be technically possible but legally prohibited after contamination.

CONTROL ACTION

Create a PFD/Sankey linking product, co-products, by-products, water and residuals.

REQUIRED RECORDS

Flow path; equipment; mass measurement; water addition/removal; classification change; destination; sanitation boundary.

AUDIT / ESCALATION TRIGGER

Escalate any major stream whose mass or route is known only from invoices rather than plant process records.

MPR-004 | Sources: C04, C05, C15 | Claim: claim_meat001_p04_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Whole-facility mass-balance architecture

KEY

A credible facility mass balance must resolve biological material and water separately before unaccounted mass is labeled loss.

TECHNICAL BASIS

Incoming live or raw mass becomes carcass/product, edible co-products, animal by-products, blood, fat, bone, feathers, wastewater solids, evaporated moisture, retained process water, waste, inventory change and unaccounted variance. Chilling and scalding can add or remove water, while rendering removes moisture and separates fat/protein fractions.

DECISION INTERPRETATION

Use total mass plus component balances where needed. Report carcass/product yields on declared live, dressed or raw-material bases and keep retained water visible. Rendering balances should report incoming raw material, moisture basis and saleable outputs without importing a universal sector yield.

CONTROL ACTION

Close daily/weekly mass balances and reconcile scale/meter uncertainty.

REQUIRED RECORDS

Live/raw weights; carcass/product weights; co-product/by-product bins; water addition; rendering feed/output; inventory; waste; uncertainty.

AUDIT / ESCALATION TRIGGER

Escalate persistent unaccounted mass or yield changes that track water addition rather than biological recovery.

MPR-005 | Sources: C04, C07, C11 | Claim: claim_meat001_p05_core
 CEPA does not publish a universal rendering yield from the current public evidence base.

Livestock receiving and live-weight boundary

KEY

Yield analysis begins with a stable incoming-weight definition and a clear treatment of fasting, transport shrink, condemned animals and holding losses.

TECHNICAL BASIS

Live weight can change before slaughter through feed/water status, transport, lairage and animal condition. Purchased head count is not a yield denominator. Plants should define whether live weight is scale weight on arrival, preslaughter weight, hot carcass basis or another controlled denominator.

DECISION INTERPRETATION

Use an independently calibrated scale and document exclusions. Compare yield only when the same denominator and timing are used. Separate biological variation from plant process efficiency.

CONTROL ACTION

Standardize incoming-weight capture and species/lot linkage.

REQUIRED RECORDS

Animal/lot ID; scale weight; time; exclusions/condemnations; species/class; carcass link; calibration.

AUDIT / ESCALATION TRIGGER

Escalate yield comparisons using different live-weight timing or undocumented condemned/excluded animals.

MPR-006 | Sources: C12, C04 | Claim: claim_meat001_p06_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Beef/cattle processing profile

KEY

Cattle processing creates large, distinct material fractions whose value and regulatory route depend on sanitary segregation and quality preservation.

TECHNICAL BASIS

Key stages include hide removal, bleeding, head/feet handling, evisceration, splitting, trimming, washing, chilling and fabrication. Blood, hides, edible organs, fat, bone and inedible material should not be collapsed into one "by-product" number. EU BAT also reports cattle-specific energy and wastewater performance on carcass and per-animal denominators.

DECISION INTERPRETATION

Use a stage balance and species-specific denominator. Water, trim, contamination and condemnation should be recorded separately. Benchmarking to another species or to a plant with different fabrication depth is not valid without boundary adjustment.

CONTROL ACTION

Create cattle stage-yield and material-route dashboards.

REQUIRED RECORDS

Live weight; hot/cold carcass; trim; edible organ mass; hide; blood; fat/bone; condemnations; water; wastewater.

AUDIT / ESCALATION TRIGGER

Escalate cattle yield comparisons that omit fabrication scope or retained water.

MPR-007 | Sources: C04, C05 | Claim: claim_meat001_p07_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Pork processing profile

KEY

Pig processing has different scalding, dehairing, evisceration and chilling interfaces than cattle, so resource metrics require species-specific boundaries.

TECHNICAL BASIS

EU BAT reports pig energy and wastewater ranges separately from cattle and poultry and identifies water-saving techniques such as efficient scalding and dry collection of certain intestinal contents. These differences show why one universal slaughter benchmark is technically weak.

DECISION INTERPRETATION

Map pig-specific water and material interfaces, including scalding systems, hair/bristle handling, blood, stomach/intestine contents, fat, edible offal and carcass wash/chill. Normalize to carcass or animal only when source and facility use the same basis.

CONTROL ACTION

Create pig process KPIs with declared denominator and scalding/chilling scope.

REQUIRED RECORDS

Animal count; carcass tonnes; scalding water; blood; gut contents; fat; offal; wastewater; energy.

AUDIT / ESCALATION TRIGGER

Escalate pig water/energy benchmarking to cattle or poultry data without explicit conversion and boundary note.

MPR-008 | Sources: C04 | Claim: claim_meat001_p08_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Poultry processing profile

KEY

Poultry processing combines very high throughput with scalding, defeathering, evisceration and chilling systems that can materially affect water, energy and retained-water performance.

TECHNICAL BASIS

Key material streams include blood, feathers, viscera, fat, condemned parts and wastewater solids. Chilling approach strongly influences water use and retained-water considerations. EU BAT provides chicken-specific energy and wastewater ranges, while FSIS retained-water rules govern U.S. product requirements.

DECISION INTERPRETATION

Use bird count and carcass-tonne denominators separately. Track feather and viscera mass and avoid treating all poultry residuals as one rendering feed because quality and processing route differ.

CONTROL ACTION

Create poultry line mass/water balances by shift and product family.

REQUIRED RECORDS

Bird count; live/carcass mass; scald/chill water; retained water; feathers; viscera; blood; rejects; energy.

AUDIT / ESCALATION TRIGGER

Escalate yield improvements coincident with higher retained-water levels or changes in chilling method without normalization.

MPR-009 | Sources: C04, C07 | Claim: claim_meat001_p09_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Further-processing operations

KEY

Further processing introduces formulation, cooking, coating, brining, marination, freezing and packaging losses that must be separated from primary slaughter yield.

TECHNICAL BASIS

Grinding, deboning, portioning, injection, tumbling, cooking and freezing can change water, fat and solids balance. Brines and marinades add mass; cooking removes water/fat; breading/coating creates pickup and fines; trimming and changeovers generate recoverable or waste streams.

DECISION INTERPRETATION

Create a separate further-processing balance rather than attributing downstream losses to slaughter yield. Track added water/ingredients and cooking loss so apparent yield is not confused with formulation pickup.

CONTROL ACTION

Balance each major process on product-equivalent and component basis.

REQUIRED RECORDS

Input meat; added water/brine; ingredients; trim; pickup; cooking yield; drip; rejects; packaging giveaway.

AUDIT / ESCALATION TRIGGER

Escalate final yield KPIs that combine slaughter and further-processing stages without stage reconciliation.

MPR-010 | Sources: C01, C04 | Claim: claim_meat001_p10_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Carcass and saleable-yield accounting

KEY

Yield is decision-grade only when the numerator and denominator identify product state, temperature/water condition, species, period and included co-products.

TECHNICAL BASIS

Hot carcass, cold carcass, boneless meat, packaged product and total saleable output are different numerators. Live weight, carcass weight and raw material are different denominators. Water retention, chilling loss, trimming and further processing can materially change the ratio.

DECISION INTERPRETATION

Publish a yield dictionary before benchmarking. Use stage yields and a bridge from live/raw input to saleable product plus co-products/by-products. Avoid one headline yield that hides where material moved.

CONTROL ACTION

Lock yield definitions in the KPI register and prevent ad hoc denominator changes.

REQUIRED RECORDS

Numerator/denominator; state; temperature; water condition; included/excluded co-products; period; species; scale IDs.

AUDIT / ESCALATION TRIGGER

Escalate yield changes that cannot be reproduced from source records or that use a revised denominator without historical restatement.

MPR-011 | Sources: C04, C07 | Claim: claim_meat001_p11_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Edible co-products versus inedible by-products

KEY

Commercial value, edibility and animal-by-product status are separate concepts that require explicit classification.

TECHNICAL BASIS

Edible organs, fats or other co-products may enter food channels when sanitary and regulatory requirements are met. Other material may be excluded from human food but still have lawful feed, pet-food, technical, rendering, fertilizer, energy or disposal routes depending on jurisdiction and status. EU law provides a formal animal-by-product category system; other jurisdictions use different rules.

DECISION INTERPRETATION

Maintain a route matrix for each stream and do not relabel material after the fact to improve a recovery metric. The classification must follow the actual sanitary decision and destination.

CONTROL ACTION

Link each co-product/by-product bin to an approved specification and route.

REQUIRED RECORDS

Stream name; food eligibility; legal classification; temperature/time; contamination status; approved destination; acceptance record.

AUDIT / ESCALATION TRIGGER

Escalate when a stream switches from food/co-product to inedible route without the loss being recorded as a quality/yield event.

MPR-012 | Sources: C05, C06 | Claim: claim_meat001_p12_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Sanitary classification and disposition control

KEY

Potential value never overrides sanitary classification, traceability or legally permitted destination.

TECHNICAL BASIS

EU Regulation 1069/2009 distinguishes Category 1, 2 and 3 animal by-products and assigns different use/disposal possibilities. Category 3 can include certain materials from animals fit for human consumption but not intended for it, while higher-risk categories require stricter routes. Implementing rules add processing conditions.

DECISION INTERPRETATION

Use classification as a hard gate before evaluating price. Store and transport material so that the sanitary category cannot be lost through mixing, contamination or temperature abuse. Non-EU facilities must use their own applicable law rather than importing EU categories.

CONTROL ACTION

Create classification decision trees and controlled bin/transport identification.

REQUIRED RECORDS

Source animal/material; inspection/disposition; category/legal status; reason; segregation; processing route; movement record.

AUDIT / ESCALATION TRIGGER

Escalate mixed-category bins, missing traceability or proposed high-value routes that are not legally permitted.

MPR-013 | Sources: C05, C06 | Claim: claim_meat001_p13_core
 EU Category 1/2/3 terminology is jurisdiction-specific and must not be presented as global law.

Blood capture, quality and destination

KEY

Blood should be managed as a concentrated biological material stream before it becomes a wastewater load, where sanitary and legal conditions permit.

TECHNICAL BASIS

Blood contains high concentrations of organic material and nutrients relative to ordinary wash water, so uncontrolled drain entry can create disproportionate treatment load. The exact COD/BOD/nitrogen concentration varies with dilution, sampling and species; CEPA therefore does not publish one universal concentration as a flagship benchmark. Quality also deteriorates with contamination, time and temperature.

DECISION INTERPRETATION

Measure blood mass or volume at collection, capture losses separately and assign the lawful receiving route. Prevent dilution at source because treatment cannot restore food/feed/technical quality once contaminated.

CONTROL ACTION

Install or validate dedicated collection and overflow/spill accounting.

REQUIRED RECORDS

Blood mass/volume; dilution status; species; time/temperature; contamination; accepted mass at receiver; wastewater loss estimate.

AUDIT / ESCALATION TRIGGER

Escalate significant blood loss to drains or use of legacy concentration figures without source/method qualification.

MPR-014 | Sources: C03, C04, C15 | Claim: claim_meat001_p14_core
Directional source-control evidence is strong; a universal modern blood COD/BOD concentration range remains an evidence gap.

Fat, grease and tallow streams

KEY

Fat should be kept out of wastewater where lawful recovery is technically available because dilution converts a product stream into a treatment problem.

TECHNICAL BASIS

Fat can arise from trimming, separation, cooking, skimming, rendering and wastewater pretreatment. Quality depends on source, contamination, oxidation, moisture, solids and temperature. U.S. wastewater rules regulate oil and grease in certain subcategories, while EU BAT emphasizes source prevention and recovery techniques.

DECISION INTERPRETATION

Measure recovered fat by source and quality rather than counting all interceptor/DAF material as equivalent to clean trim fat. Higher-value recovery normally requires segregation before wastewater contact.

CONTROL ACTION

Create a fat-route hierarchy and weigh clean versus recovered-from-wastewater fractions separately.

REQUIRED RECORDS

Fat mass; source; moisture/solids; FFA/quality where relevant; temperature; contamination; destination; O&G wastewater data.

AUDIT / ESCALATION TRIGGER

Escalate recovery claims that combine clean tallow/feedstock with wastewater skimmings without quality distinction.

MPR-015 | Sources: C02, C04 | Claim: claim_meat001_p15_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Organs, offal and edible co-products

KEY

Edible co-product value depends on rapid identification, hygienic handling, temperature control and destination specification.

TECHNICAL BASIS

Organs and offal can be food products, edible co-products, animal by-products or condemned material depending on inspection, market and jurisdiction. Delay, cross-contamination and poor segregation can convert a higher-value edible stream to a lower-value route even when the material mass is unchanged.

DECISION INTERPRETATION

Track yield loss when edible material is downgraded. The KPI should distinguish mass generated from mass accepted by the edible route. A high collection rate is not success if quality rejection is high.

CONTROL ACTION

Create route-specific quality specifications and rejection coding.

REQUIRED RECORDS

Mass generated; mass accepted; rejection reason; temperature; time; inspection status; receiving specification; price/value.

AUDIT / ESCALATION TRIGGER

Escalate recurring downgrades without root-cause analysis or when rejected edible co-products disappear into generic by-product totals.

MPR-016 | Sources: C05, C04 | Claim: claim_meat001_p16_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Bone, connective tissue and protein fractions

KEY

Protein- and mineral-rich fractions require moisture, contamination and receiving-specification control before their value can be compared.

TECHNICAL BASIS

Bone, connective tissue and other fractions can enter rendering, gelatin/collagen, pet-food, feed or technical routes depending on jurisdiction and specification. Raw composition varies by species and process. USDA ARS data on rendered MBM from 19 North American facilities show substantial composition variability, supporting the need for site-specific quality data.

DECISION INTERPRETATION

Use dry-matter or moisture-normalized composition when comparing outputs. Do not convert MBM composition ranges into universal raw-material-to-product yields.

CONTROL ACTION

Specify target route and measure moisture/composition on the relevant basis.

REQUIRED RECORDS

Raw mass; moisture; protein/mineral/fat where relevant; species mix; contamination; receiving spec; accepted mass.

AUDIT / ESCALATION TRIGGER

Escalate yield claims derived from product composition or from as-received mass without moisture normalization.

MPR-017 | Sources: C11, C05 | Claim: claim_meat001_p17_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Poultry feathers and feather-processing routes

KEY

Feathers are a distinct keratin-rich stream whose route and processing requirements should be evaluated separately from mixed poultry offal.

TECHNICAL BASIS

Feather handling can include collection, dewatering, hydrolysis/processing, meal production or other technical routes depending on sanitary and market requirements. EU BAT includes feather processing within the animal by-product scope and reports resource-performance evidence for relevant operations.

DECISION INTERPRETATION

Measure feather mass, water content and contamination at collection and after dewatering/processing. Avoid mixing feathers with higher-moisture viscera if separate processing improves quality or reduces energy demand.

CONTROL ACTION

Create a feather-specific mass and moisture balance.

REQUIRED RECORDS

Wet feather mass; moisture; dewatering; process energy; product mass/quality; wastewater; destination.

AUDIT / ESCALATION TRIGGER

Escalate feather recovery claims based on wet mass alone or without the final product/destination evidence.

MPR-018 | Sources: C04, C06 | Claim: claim_meat001_p18_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Rendering process architecture

KEY

Rendering is a production process that separates moisture, fat and protein/mineral fractions under controlled time-temperature and handling conditions.

TECHNICAL BASIS

Process configurations vary, but common functions include size reduction, cooking/drying, separation/pressing/centrifugation, fat polishing, meal grinding and air/odour control. EU BAT treats rendering and related animal by-product operations as resource- and emissions-controlled industrial processes. USDA ARS facility data demonstrate process and raw-material variability.

DECISION INTERPRETATION

Evaluate rendering using feed quality, throughput, residence time/temperature, moisture removal, fat separation, energy, wastewater, air emissions and saleable-product quality. Do not manage it as a disposal black box.

CONTROL ACTION

Create a rendering PFD with meters/scales at feed and saleable outputs.

REQUIRED RECORDS

Feed mass/moisture; temperature/time; fat output; meal output/moisture; evaporated water; wastewater; energy; air controls.

AUDIT / ESCALATION TRIGGER

Escalate rendering operations without a reconciled feed-to-products/water/residuals balance.

MPR-019 | Sources: C04, C11 | Claim: claim_meat001_p19_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Rendering material balance without false universal yields

KEY

Facility rendering yield should be measured directly on a declared raw-material and product-moisture basis; CEPA should not publish a universal sector yield from the current public evidence base.

TECHNICAL BASIS

Raw rendering material varies by species, tissue mix, moisture, fat content, contamination and prior processing. USDA ARS data show substantial MBM composition variation across 19 facilities, while current industry LCA work has collected broader primary data but does not provide a public validated universal fat/meal yield factor suitable for this issue.

DECISION INTERPRETATION

Report fat and meal yields separately, define as-sold or dry basis, reconcile water removal and inventory and disclose raw-material mix. Benchmark only among comparable feeds and processes.

CONTROL ACTION

Implement daily rendering feed/product/moisture reconciliation.

REQUIRED RECORDS

Accepted raw mass/moisture; saleable fat; saleable meal and moisture; rejects; inventory; condensate/evaporation; wastewater.

AUDIT / ESCALATION TRIGGER

Escalate any universal rendering yield claim unless a new, comparable primary dataset is obtained and reviewed before publication.

MPR-020 | Sources: C11, C14 | Claim: claim_meat001_p20_core
This is a deliberate evidence constraint, not a missing manuscript section.

Rendering energy and moisture control

KEY

Energy performance in rendering is strongly connected to the mass of water that must be heated and removed.

TECHNICAL BASIS

EU BAT reports a broad annual energy range for rendering, fat melting, blood and feather-related operations of 120-910 kWh per tonne raw material and wastewater discharge of 0.20-1.55 m³ per tonne raw material within the stated BAT scope. The broad range reflects process and feed differences and must not be used as a universal target.

DECISION INTERPRETATION

Reduce unnecessary water entering rendering feed, use heat recovery where practical, control cooking/drying endpoints and compare energy only on aligned raw-material and process boundaries. Overdrying product can waste energy and alter quality.

CONTROL ACTION

Add energy per tonne raw feed plus moisture-in/moisture-out to the rendering dashboard.

REQUIRED RECORDS

Raw feed mass/moisture; steam/fuel/electricity; product moisture; condensate; wastewater; heat-recovery data.

AUDIT / ESCALATION TRIGGER

Escalate energy benchmarking without raw-material moisture or process-scope alignment.

MPR-021 | Sources: C04 | Claim: claim_meat001_p21_core
 EU BAT values are BAT-associated performance levels for covered operations.

Rendered-product quality and receiving specifications

KEY

Recovery is complete only when the rendered output meets a defined specification and is accepted by a lawful receiving market.

TECHNICAL BASIS

Quality variables can include moisture, protein, fat, ash/mineral, free fatty acids, oxidation, contaminants, particle size and microbiological requirements depending on the product and destination. USDA ARS MBM data show significant composition variability across facilities, so one generic specification is inappropriate.

DECISION INTERPRETATION

Separate production yield from saleable yield. Material produced but rejected, downgraded or returned should not count as fully recovered. Receiving specifications should be version-controlled and linked to batch/lot records.

CONTROL ACTION

Create product-specific release and customer-acceptance records.

REQUIRED RECORDS

Batch; mass; moisture/composition; contaminants; release test; customer spec; accepted/rejected mass; downgrade reason.

AUDIT / ESCALATION TRIGGER

Escalate recovery KPIs that count material at the renderer gate without final product acceptance evidence.

MPR-022 | Sources: C11, C05 | Claim: claim_meat001_p22_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Product loss, floor solids and drain exclusion

KEY

Keeping biological solids off the floor and out of drains preserves value and reduces wastewater load simultaneously.

TECHNICAL BASIS

Loss can occur through trimming, dropped product, spills, broken equipment, overflows, line changeovers and washdown. Once material mixes with floor debris or wastewater, sanitary classification and quality can change and higher-value routes may close. EU BAT emphasizes dry collection and source-control techniques.

DECISION INTERPRETATION

Use dry pickup, dedicated containers, equipment capture and housekeeping before hose-down. Measure solids collected by source and distinguish edible, inedible but recoverable, and disposal streams.

CONTROL ACTION

Create floor/drain exclusion standards and measure captured solids.

REQUIRED RECORDS

Dropped/spilled mass; source; sanitary status; dry collection; drain-screen solids; washdown timing; destination.

AUDIT / ESCALATION TRIGGER

Escalate rising drain-screen/DAF solids without source-area root cause.

MPR-023 | Sources: C04, C15 | Claim: claim_meat001_p23_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Water-use architecture

KEY

Water should be mapped by function and species/process area before intensity comparisons or reuse projects are approved.

TECHNICAL BASIS

Major uses include animal/carcass washing, scalding, defeathering, evisceration equipment, chilling, sanitation, product cooling, transport/flumes, rendering, boilers, cooling and employee/sanitary services. EU BAT provides species-specific wastewater ranges, demonstrating how process configuration changes intensity.

DECISION INTERPRETATION

Build a water balance by process area and distinguish product-contact from non-contact utility water. Measure both freshwater and wastewater flow; a reduction in freshwater that increases product loss or sanitation failure is not an improvement.

CONTROL ACTION

Meter major use areas and define normalized intensity denominators.

REQUIRED RECORDS

Flow by area/use; production/carcass tonnes; sanitation cycles; temperature; product-contact class; wastewater flow.

AUDIT / ESCALATION TRIGGER

Escalate site-wide water targets applied uniformly across processes with different hygiene and product requirements.

MPR-024 | Sources: C04, C08 | Claim: claim_meat001_p24_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Carcass washing, chilling and retained water

KEY

Retained water is a product/yield variable that must remain visible rather than being hidden inside carcass or poultry yield.

TECHNICAL BASIS

Under 9 CFR 441.10, U.S. establishments must demonstrate to FSIS, using data collected in accordance with a written protocol, that retained post-evisceration process water is an unavoidable consequence of a process used to meet applicable food-safety requirements. The establishment must maintain the protocol and make new or revised protocols available for FSIS review; applicable retained-water labeling requirements remain in force.

Chilling methods can change uptake/loss, product temperature, microbiological performance and water intensity.

DECISION INTERPRETATION

Keep biological yield and retained-water change separate. When comparing chill systems or yield, report product weight before/after chilling, allowed/protocol basis and any labeling implications. Do not describe added water as improved biological recovery.

CONTROL ACTION

Integrate retained-water measurement into yield and chilling KPI reviews.

REQUIRED RECORDS

Pre/post chill weights; process conditions; protocol; retained-water result; product label basis; temperature; water use.

AUDIT / ESCALATION TRIGGER

Escalate yield improvement not reconciled to retained-water data or process-protocol changes.

MPR-025 | Sources: C07, C10 | Claim: claim_meat001_p25_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Water and solution reuse boundaries

KEY

Meat and poultry reuse decisions must follow the specific sanitary framework for raw, RTE, reconditioned and non-contact uses.

TECHNICAL BASIS

FSIS guidance under 9 CFR 416.2(g) distinguishes water, ice and solution reuse by use and contamination control. Guidance can clarify implementation but does not have the force of law. The required evidence depends on whether reused water contacts raw product, ready-to-eat product, equipment or non-product areas.

DECISION INTERPRETATION

Define the proposed source and exact receiving use, then confirm current FSIS/legal requirements and validate contamination controls. Avoid importing the broader food/beverage reuse model without considering meat/poultry-specific rules.

CONTROL ACTION

Require food-safety and regulatory sign-off for each reuse pathway.

REQUIRED RECORDS

Source; prior contact; receiving use; treatment; microbial/chemical controls; legal/guidance basis; monitoring; diversion.

AUDIT / ESCALATION TRIGGER

Escalate generic "recycled water" permissions that do not identify raw/RTE/contact class.

MPR-026 | Sources: C08, C09, C10 | Claim: claim_meat001_p26_core
FSIS guidance is interpretive and must be distinguished from binding regulatory text.

High-strength wastewater source map

KEY

Wastewater strength is created by specific process losses and cannot be understood from final effluent concentration alone.

TECHNICAL BASIS

High-load sources can include blood, fat, meat particles, manure/gut contents, product residues, brines, rendering waters and concentrated cleaning streams. Large low-load wash flows can dilute concentration while pollutant mass remains high. EPA Part 432 and EU BAT organize controls around sector/process boundaries rather than a single generic meat-wastewater profile.

DECISION INTERPRETATION

Map flow and load at source areas before treatment. Use event-based sampling for high-strength streams and reconcile captured product/solids against wastewater loads.

CONTROL ACTION

Build source flow x concentration load maps for COD/BOD/TSS/O&G/nutrients as applicable.

REQUIRED RECORDS

Flow; COD/TOC; BOD5 where used; TSS; O&G/HEM; nitrogen; phosphorus; pH; source event; sampling method.

AUDIT / ESCALATION TRIGGER

Escalate source-control claims based only on lower final-effluent concentration after added dilution.

MPR-027 | Sources: C01, C02, C03, C04 | Claim: claim_meat001_p27_core
U.S. regulated terminology and EU BAT parameters should retain their source-specific names.

BOD, COD, TSS, oil/grease and nutrient loading

KEY

Wastewater parameters represent different physical/chemical burdens and must not be substituted for one another without a defined relationship.

TECHNICAL BASIS

COD/TOC describe oxidizable organic load by different methods; BOD5 reflects biodegradable oxygen demand; TSS tracks suspended solids; O&G/HEM captures extractable oil/grease under specified methods; nitrogen/phosphorus reflect nutrients. EU slaughter/ABP BAT direct-discharge ranges include COD, TSS, TN and TP, while U.S. Part 432 can impose mass-normalized BOD5, TSS and O&G limits by subcategory.

DECISION INTERPRETATION

Use the parameter specified by the applicable permit/rule and add process indicators where useful. Do not relabel O&G as a generic universal FOG legal limit. Convert mass and concentration only with measured flow and correct time basis.

CONTROL ACTION

Create a wastewater metric dictionary tied to methods and legal basis.

REQUIRED RECORDS

Parameter; method; sampling basis; concentration; flow; mass load; permit/BAT context; process source.

AUDIT / ESCALATION TRIGGER

Escalate comparisons between mg/L and kg/t or between COD and BOD without the required conversion or relationship.

MPR-028 | Sources: C02, C04 | Claim: claim_meat001_p28_core
EU direct-discharge BAT and U.S. Part 432 legal limits are different evidence types and denominators.

Pretreatment and solids/fat recovery

KEY

Pretreatment should capture material before biological treatment when physical separation is feasible and sanitary destination is defined.

TECHNICAL BASIS

Screens, rotary sieves, catch basins, skimming and dissolved-air flotation can remove solids and fat. These steps protect downstream treatment, but material recovered from wastewater is not automatically equivalent to clean source-separated co-product and may have more limited lawful routes.

DECISION INTERPRETATION

Measure captured dry solids/fat, not only wet sludge volume. Compare source-separation opportunities before expanding end-of-pipe capture. Verify classification and destination of screenings/float.

CONTROL ACTION

Track pretreatment capture mass and quality by source.

REQUIRED RECORDS

Influent/effluent TSS/O&G; sludge/float mass and solids; polymer/chemical use; destination; source-area loss data.

AUDIT / ESCALATION TRIGGER

Escalate increasing DAF solids treated as a recovery success when source losses are rising.

MPR-029 | Sources: C04, C02 | Claim: claim_meat001_p29_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Biological wastewater treatment

KEY

Biological treatment is a compliance and load-removal system, not a substitute for preventing edible or renderable material from entering wastewater.

TECHNICAL BASIS

Aerobic and other biological systems remove biodegradable organic load and can support nutrient control, but they require energy, biomass management and stable influent conditions. High fats, solids, disinfectants or shock loads can impair performance. Direct-discharge limits depend on jurisdiction and permit.

DECISION INTERPRETATION

Control influent by source segregation and equalization, then operate biological treatment within a defined loading envelope. Track energy, sludge and nutrient performance alongside effluent compliance so treatment success does not hide upstream losses.

CONTROL ACTION

Set influent loading and process-control limits tied to source events.

REQUIRED RECORDS

Flow/load; DO; biomass/solids; nutrient ratio; energy; sludge; effluent; upset events; source-loss correlation.

AUDIT / ESCALATION TRIGGER

Escalate repeated treatment upsets caused by preventable process dumps or high-strength source releases.

MPR-030 | Sources: C01, C02, C04 | Claim: claim_meat001_p30_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Anaerobic treatment and biogas potential

KEY

Anaerobic treatment can recover energy from suitable high-strength biodegradable streams, but suitability depends on composition, inhibition, solids, temperature and gas use.

TECHNICAL BASIS

Meat/rendering wastewater and residues can be strong anaerobic candidates when load is sufficiently concentrated and stable. Fats can increase methane potential but also create long-chain fatty-acid inhibition; sanitizers, salinity, ammonia and temperature can matter. IPCC provides accounting methods for methane from industrial wastewater but not a facility design guarantee.

DECISION INTERPRETATION

Characterize the feed and intended gas utilization before claiming biogas value. Separate avoided treatment energy, generated methane, flaring and parasitic energy. Source-separated edible/renderable material should not be sent to digestion merely to maximize gas.

CONTROL ACTION

Run biochemical/treatability testing and a gas-use plan before full design.

REQUIRED RECORDS

COD load; biodegradability; FOG; TKN/ammonia; inhibitors; temperature; methane flow/composition; flare/use; digestate/sludge.

AUDIT / ESCALATION TRIGGER

Escalate projects based only on theoretical methane yield without inhibition and gas-use evidence.

MPR-031 | Sources: C04, C16 | Claim: claim_meat001_p31_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Nutrient and residual-resource recovery

KEY

Nutrient recovery is justified by concentration, mass flow, product quality and destination - not simply by detecting nitrogen or phosphorus.

TECHNICAL BASIS

Nitrogen and phosphorus occur in biological materials and wastewater, but most recovery technologies require specific concentration and chemistry. EU food-sector BAT, for example, treats phosphorus recovery such as struvite as applicable to sufficiently high-phosphorus/high-flow streams rather than universally. Meat/ABP systems should apply the same concentration-first logic.

DECISION INTERPRETATION

Quantify kg nutrient per day and chemical form before selecting recovery technology. Compare recovery with upstream source segregation and lawful co-product routes. Verify the recovered product specification and receiving market.

CONTROL ACTION

Create a nutrient mass balance before technology screening.

REQUIRED RECORDS

TN/TKN/ammonia; TP/orthophosphate; flow; pH/alkalinity; solids; recovered product; contaminants; market/destination.

AUDIT / ESCALATION TRIGGER

Escalate nutrient-recovery claims based only on concentration without total mass flow or product quality.

MPR-032 | Sources: C04, C16 | Claim: claim_meat001_p32_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Refrigeration and cold-chain energy

KEY

Refrigeration protects food safety and yield but is also a major energy system whose performance depends on load, temperature lift, heat rejection and operating discipline.

TECHNICAL BASIS

Chilling/freezing loads include product heat, infiltration, fan/pump energy, defrost, lighting and process heat. Overcooling can waste energy, while inadequate cooling can create safety, shelf-life and yield losses. EU BAT slaughter energy ranges include the whole covered installation boundary and therefore should not be attributed solely to refrigeration.

DECISION INTERPRETATION

Use refrigeration KPIs linked to tonnes/product temperature and separate base load from process load. Recover heat where technically useful and verify that energy measures do not compromise required product temperatures or retained-water controls.

CONTROL ACTION

Create refrigeration load and efficiency dashboards by major system.

REQUIRED RECORDS

kWh; tonnes chilled/frozen; suction/condensing conditions; product temperatures; defrost; heat recovery; downtime; losses.

AUDIT / ESCALATION TRIGGER

Escalate energy reduction that increases product temperature excursions or shelf-life loss.

MPR-033 | Sources: C04 | Claim: claim_meat001_p33_core
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Odour, air emissions and nuisance control

KEY

Odour and air-emission control begins with rapid material handling and source containment before end-of-pipe treatment.

TECHNICAL BASIS

Rendering and animal by-product operations can emit odorous compounds, VOCs, ammonia and hydrogen sulfide. EU BAT provides channelled-emission BAT-AEL ranges for certain covered operations, including odour, TVOC, NH₃ and H₂S. These values are process/regulatory context, not ambient community thresholds.

DECISION INTERPRETATION

Control residence time, temperature, enclosure, negative pressure, capture and treatment. Monitor complaints and process events alongside stack/channelled measurements because nuisance can reflect fugitive releases not captured in one outlet sample.

CONTROL ACTION

Create an odour/air source map and preventive maintenance plan.

REQUIRED RECORDS

Source; enclosure; airflow; treatment; odour/TVOC/NH₃/H₂S where applicable; downtime; complaints; material age/temperature.

AUDIT / ESCALATION TRIGGER

Escalate odour events during bypass, maintenance or overloaded material storage.

MPR-034 | Sources: C04 | Claim: claim_meat001_p34_core
 EU BAT channelled ranges include odour 200-1,100 ouE/m³, TVOC 0.5-16 mg C/Nm³, NH₃ 0.1-4 mg/Nm³ and H₂S <0.1-1 mg/Nm³ for relevant covered operations.

Carbon and energy accounting architecture

KEY

Carbon accounting should distinguish purchased energy, onsite fuel, refrigeration losses, wastewater methane, biogas recovery and avoided-product claims rather than collapsing them into one "circular carbon" number.

TECHNICAL BASIS

Facility emissions can arise from electricity, boilers, refrigeration refrigerants, wastewater treatment and transport. Anaerobic systems can generate methane for use or flaring; uncontrolled methane is a liability, not a credit. Resource recovery can affect lifecycle emissions, but avoided-burden claims require a declared method and counterfactual.

DECISION INTERPRETATION

Build the operational inventory first, then model project effects separately. Keep direct measured energy and emissions distinct from lifecycle avoided-emission estimates. Do not subtract speculative credits from compliance inventories.

CONTROL ACTION

Create a carbon ledger linked to meters, fuel records, refrigerant records and wastewater/biogas data.

REQUIRED RECORDS

Energy/fuel; refrigerant type/loss; wastewater methane method; biogas generation/use/flare; transport; product/co-product allocation method.

AUDIT / ESCALATION TRIGGER

Escalate carbon savings claims without a defined baseline, allocation method or methane capture/use evidence.

MPR-035 | Sources: C16, C04 | Claim: claim_meat001_p35_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

KPI and benchmark-normalization system

KEY

Benchmarking is valid only when species, product state, process scope, denominator, period and evidence type are aligned.

TECHNICAL BASIS

EU BAT illustrates the point: cattle, pigs and chickens have separate annual ranges for energy and wastewater on carcass-tonne and sometimes per-animal bases. Rendering uses raw-material tonnes. U.S. Part 432 can use live-weight-killed mass-normalized limits. These metrics cannot be combined without explicit conversion and boundary review.

DECISION INTERPRETATION

Use a KPI dictionary covering yield, co-product capture, by-product acceptance, blood/fat capture, water, wastewater load, energy, refrigeration, rendering and verified destination. Tag every external comparator as legal limit, BAT-AEPL, research result or industry report.

CONTROL ACTION

Lock KPI definitions before trend and peer comparison.

REQUIRED RECORDS

Numerator; denominator; species; process scope; period; product state; source/evidence type; exclusions.

AUDIT / ESCALATION TRIGGER

Escalate benchmark charts that place unlike denominators or legal/BAT/research values on one scale without explanation.

MPR-036 | Sources: C02, C04 | Claim: claim_meat001_p36_core
 EU BAT examples: cattle 116-240, pigs 65-370, chickens 170-490 kWh/t carcass; wastewater 1.85-3.90, 0.70-3.50, 1.45-6.30 m³/t carcass respectively, yearly-average scope.

True-value and recovery-economics model

KEY

The value of a material stream is the net value of the highest lawful, technically qualified route - not the gross price of the most attractive theoretical product.

TECHNICAL BASIS

True value should include product/co-product revenue, avoided raw material or treatment, collection/segregation cost, refrigeration/heat, rendering energy, quality testing, storage, transport, regulatory handling, reject risk and destination fees. Wastewater source control can create value through avoided treatment load even when the captured material has little sale price.

DECISION INTERPRETATION

Build route-specific economics and separate measured cash flows from avoided-cost estimates. Include downgrade probability and rejected mass. Do not assign revenue to material that lacks a qualified receiving specification or market.

CONTROL ACTION

Create a stream opportunity register ranked by risk-adjusted annual value.

REQUIRED RECORDS

Mass; route; price/fee; quality acceptance rate; handling; energy; testing; transport; avoided treatment; CAPEX; uncertainty.

AUDIT / ESCALATION TRIGGER

Escalate projects whose business case assumes 100 percent acceptance or a market route that is not contracted/qualified.

MPR-037 | Sources: C04, C05, C11 | Claim: claim_meat001_p37_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

30/60/90-day plant improvement program

KEY

Rapid improvement starts with mass and water measurement, sanitary route control and source exclusion before major capital treatment projects.

TECHNICAL BASIS

Days 1-30: freeze definitions, verify scales/meters, map product/co-product/by-product/water interfaces, classify streams, quantify drain sources and benchmark species/process metrics. Days 31-60: improve blood/fat/solids capture, correct route segregation, characterize rendering balances, validate retained-water and water-use data, sample wastewater sources and rank economics. Days 61-90: implement controls, qualify downstream routes, optimize rendering/refrigeration/wastewater settings and verify accepted mass and destination.

DECISION INTERPRETATION

Prioritize high-value/high-load interfaces where one control improves yield and wastewater simultaneously. Capital projects should follow measurement and source-control evidence, not precede it.

CONTROL ACTION

Launch a cross-functional plant program with production, QA/food safety, rendering, utilities, EHS and finance owners.

REQUIRED RECORDS

Mass/water baseline; route matrix; source-load map; action register; SOP changes; receiver evidence; KPI results; financial verification.

AUDIT / ESCALATION TRIGGER

Escalate programs that report tonnage diverted without showing the lawful final route and accepted usable output.

MPR-038 | Sources: C01, C04, C05 | Claim: claim_meat001_p38_core
 Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Controlled source register A

KEY

The principal legal and BAT sources must be verified against current official text before technical review.

TECHNICAL BASIS

Register A contains current EPA Part 432 status, eCFR legal text, the EPA final-action development document, EU slaughter/rendering BAT and EU animal-by-product law/implementing rules.

DECISION INTERPRETATION

Use EPA/eCFR for U.S. federal wastewater law, EU 1069/2009/142/2011 for EU sanitary classification/processing, and Decision 2023/2749 for EU BAT technical evidence. Do not transpose one jurisdiction to another.

CONTROL ACTION

Freeze official locators, effective/current versions and claim mappings.

REQUIRED RECORDS

URL; locator; jurisdiction; current date; source class; supported claim IDs; archive reference.

AUDIT / ESCALATION TRIGGER

Escalate any legal amendment or status change found in the September 3 sweep.

MPR-039 | Sources: C01, C02, C03, C04, C05, C06 | Claim: claim_meat001_p39_source_control
Applicability is source-, jurisdiction-, process- and evidence-boundary specific.

Controlled source register B and methodological notes

FSIS retained-water/reuse controls, current USDA data and rendering research must remain clearly separated from industry or legacy context.

C01 - EPA Meat and Poultry Products Effluent Guidelines

Tier: 1. Use: Current U.S. MPP regulatory status; 40 CFR Part 432 scope; withdrawal of 2024 proposal.
<https://www.epa.gov/eg/meat-and-poultry-products-effluent-guidelines>

C02 - 40 CFR Part 432 - Meat and Poultry Products Point Source Category

Tier: 1. Use: Current U.S. legal effluent limitations and subcategory structure.
<https://www.ecfr.gov/current/title-40/chapter-I/subchapter-N/part-432>

C03 - EPA Development Document for Final Action on the MPP Point Source Category

Tier: 2. Use: Technical/process background to the 2025 final withdrawal action; not a source of withdrawn proposed requirements.
https://www.epa.gov/system/files/documents/2025-09/mpp-development-document_final-action.pdf

C04 - Commission Implementing Decision (EU) 2023/2749 - Slaughterhouses and animal by-products BAT conclusions

Tier: 2. Use: Slaughter/rendering water, energy, wastewater, air emissions and BAT techniques.
https://eur-lex.europa.eu/eli/dec_impl/2023/2749/oj/eng

C05 - Regulation (EC) No 1069/2009 - Animal by-products and derived products

Tier: 1. Use: EU Category 1/2/3 classification and permitted use/disposal framework.
<https://eur-lex.europa.eu/eli/reg/2009/1069/oj/eng>

C06 - Commission Regulation (EU) No 142/2011 - Implementing Regulation for animal by-products

Tier: 1. Use: EU implementing requirements and processing methods for animal by-products.
<https://eur-lex.europa.eu/eli/reg/2011/142/oj/eng>

C07 - 9 CFR 441.10 - Retained water

Tier: 1. Use: U.S. retained-water protocol, unavoidable retention and labeling/validation requirements.
<https://www.ecfr.gov/current/title-9/chapter-III/subchapter-E/part-441/section-441.10>

C08 - FSIS Update - 416.2(g): Water supply and water, ice, and solution reuse

Tier: 1/2. Use: Official FSIS guidance interpreting 9 CFR 416.2(g).
<https://www.fsis.usda.gov/guidelines/1999-0003>

C09 - FSIS Water Reuse Questions and Answers

Tier: 2. Use: Supplemental water-reuse interpretation; guidance only.
<https://www.fsis.usda.gov/guidelines/2005-0005>

C10 - FSIS Sanitation Performance Standards Compliance Guide

Tier: 2. Use: Sanitation and water-supply/reuse implementation context.
<https://www.fsis.usda.gov/inspection/compliance-guidance/sanitation-performance-standards-compliance-guide>

C11 - USDA ARS - Characteristics of North American Meat & Bone Meal

Tier: 3. Use: 19-facility MBM composition/process dataset; supports variability, not universal rendering yield.
<https://www.ars.usda.gov/research/publications/publication/?seqNo115=187032>

C12 - USDA ERS Livestock and Meat Domestic Data

Tier: 2. Use: Current U.S. sector statistics; updated August 27, 2026.
<https://ers.usda.gov/data-products/livestock-and-meat-domestic-data>

C14 - North American Renderers Association - Rendering Industry LCA Data for GFLI project status

Tier: 4. Use: Industry primary-data project context; not controlling law or a universal yield source.
<https://nara.org/wp-content/uploads/2024/10/Sustainability-Committee-Marty-Heller-GFLI-project-status-update.pdf>

C15 - IFC Environmental, Health, and Safety Guidelines for Meat Processing

Tier: 2/legacy. Use: Legacy GIP context for source control, by-products and high-strength streams; use cautiously.
<https://www.ifc.org/content/dam/ifc/doc/2000/2007-meat-processing-ehs-guidelines-en.pdf>

C16 - IPCC 2019 Refinement - Volume 5 Waste, industrial wastewater

Tier: 2. Use: Wastewater methane and nitrous-oxide accounting context.
<https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol5.html>

METHODOLOGICAL NOTES

1. No universal rendering yield. The manuscript defines facility yield equations but deliberately omits a sector-wide fat/meal yield range until a comparable primary dataset exists.
2. Sanitary classification precedes economics. EU animal-by-product categories are used only for EU legal discussion; non-EU facilities require their own applicable classification system.
3. Retained water remains visible. Product/yield comparisons separate biological material from process-water retention wherever the applicable data allow.
4. BAT values retain original denominators. Slaughter energy/water ranges are species-specific and rendering values use raw-material tonnes. They are not universal limits.
5. U.S. 2024 proposal is excluded from current law. The 2024 MPP proposed revision was withdrawn on August 28, 2025. Any technical data from the rulemaking record are labeled as technical background only.
6. Recovery requires final evidence. Collection or shipment is not counted as verified resource value without receiving-route acceptance and usable output/destination evidence.