

Table S1. Timeline of sustainable ICU interventions by stakeholder group (quick, medium, long term)

Time-frame	Clinician actions	Administrator actions	Policymaker actions
Quick (3-6 months)	- <i>Energy at bedside:</i> switch off/dim idle monitors, lights, computers; use power-saving modes and daylight where feasible. - <i>Waste segregation:</i> strict separation (sharps, infectious, recyclables); avoid “red-bagging” clean packaging. - <i>Reduce disposables:</i> bring only necessary items to bedside; prefer reusable options where infection-control permits (e.g., reusable gowns/linens, sterilizable instruments). - <i>High-impact agents:</i> avoid/phase down high-GWP inhaled agents (e.g., desflurane)	- <i>Enable segregation:</i> install clearly labelled bins at point-of-use; align waste contractor routes; train housekeeping on ICU protocols. - <i>HVAC/energy tuning:</i> minor set-point optimisation within safe limits; ensure equipment power management; quick LED swaps in high-use areas; start sub-metering where feasible. - <i>Procurement quick start:</i> select “low-regret” substitutions (recycled-content paper, reduced packaging, reusable alternatives); avoid overstocking rooms (“cart-to-room” stocking). - <i>Support staff:</i> formalise ICU sustainability	- <i>Rapid guidance:</i> issue professional society checklists / national advisories for sustainable ICU practices. - <i>Early incentives:</i> small grants/awards for green QI; support pilot projects (waste segregation, reusables, low-carbon anaesthesia). - <i>Policy nudges:</i> targeted phase-down of high-emission practices (e.g., volatile agent restrictions), minimum procurement standards, and

	where applicable; rationalise high-flow oxygen and unnecessary gas use. - <i>Green team & education:</i> appoint ICU sustainability champions; short micro-teach sessions/posters; begin simple unit metrics (waste/bed-day, key consumables).	committee, provide protected time and small pilot budget; perform a baseline audit (1–2 week waste/energy snapshot).	reporting prompts to create early momentum.
Medium (6–18 months)	- <i>Low-value care QI:</i> lead de-implementation projects (reduce routine daily labs/imaging; rationalise ABGs), with outcome monitoring. - <i>Protocol integration:</i> embed sustainability into order sets (lab frequency defaults, imaging indications, POCUS-first pathways where appropriate). - <i>Reuse/reprocess expansion:</i> introduce regulated device	- <i>Formal ICU Green Plan:</i> set SMART targets aligned with hospital strategy (e.g., reduce regulated medical waste by X%; recycling rate by Y%; energy intensity by Z%). - <i>Energy upgrades:</i> broader LED rollout, smart controls, occupancy sensors, equipment upgrades; documented HVAC optimisation and preventive maintenance. - <i>Procurement criteria:</i> add environmental	- <i>Standards & reporting:</i> integrate sustainability into accreditation/quality frameworks; require basic reporting (waste, energy, procurement indicators). - <i>Funding mechanisms:</i> grants/low-interest loans for retrofit projects (HVAC, metering,

	reprocessing where permitted; standardise reusable device pathways with sterile services. - <i>Culture & feedback:</i> incorporate sustainability into orientation/competencies; monthly feedback dashboards (“this month’s waste reduction / cost savings / safety indicators”).	scoring/life-cycle thinking in tenders; inventory management to reduce expiry and unused “opened-not-used” waste. - <i>Waste stream optimisation:</i> expand recycling (clean plastics/PVC streams where feasible), compost organics where services exist; regular “red-bag audits” with staff retraining. - <i>Engagement:</i> recognition programs and visible dashboards; celebrate milestones; share savings reinvested into care.	renewables, waste infrastructure). - <i>Sector targets:</i> interim emissions-reduction milestones for healthcare; harmonise with national climate commitments. - <i>Innovation support:</i> fund collaboratives and implementation research networks to share best practices and validate safety/clinical outcomes.
Long (>18 months)	- <i>Embed into training & standards:</i> include sustainable critical care in curricula, professional competencies, and guideline updates. - <i>Clinical innovation</i>	- <i>Green infrastructure:</i> major retrofit/new build towards ultra-efficient or net-zero ICUs (heat recovery, insulation, low-energy ventilation, renewables, smart building controls). - <i>Decarbonised energy supply:</i>	- <i>Regulation & building codes:</i> mandate green standards for new hospitals/ICUs and major renovations; enforce emissions caps/efficiency

	<i>leadership</i>: clinicians act as sustainability leads/advisors; participate in procurement and policy committees to ensure alignment with safety. - <i>Care redesign</i>: adopt mature tele-ICU/remote monitoring models where appropriate to reduce transfers and duplication; continuous improvement cycles linking outcomes + carbon + cost.	transition hospital electricity/thermal energy to clean sources; on-site solar + storage for resilience. - <i>Circular supply chains</i>: vendor take-back programs, remanufactured/reprocessed devices, packaging return loops; aim toward near-zero waste operations. - <i>Institutionalise governance</i>: executive KPIs, annual sustainability reporting, permanent committees and budget lines to maintain gains beyond leadership turnover.	requirements. - <i>Net-zero mandates</i>: formalise healthcare net-zero targets (including supply chain) with accountability mechanisms. - <i>Global collaboration</i>: support WHO / international networks to share benchmarks and enable LMIC adoption of sustainable technologies. - <i>Adaptive policy</i>: continuous evaluation for unintended consequences; revise standards based on safety/outcomes and evolving technology.
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Actions are synthesised from published life-cycle assessments, professional society guidance, de-implementation studies, and health-system decarbonisation frameworks [28,30,31,35,44].