BUILDING RESILIENCE, EFFICIENCY, AND SUSTAINABILITY IN FRAGILE CONTEXTS

BUILDING TOMORROW'S HEALTHCARE: HOW CLIMATE-RESILIENT INFRASTRUCTURE STRENGTHENS HEALTH SYSTEM RESILIENCE AND QUALITY OF CARE

CONTEXT AND CHALLENGE (LEBANON & RHUH)

Lebanon's Health System at the Crossroads

- Hospitals face **economic, climate, and conflict pressures**.
- RHUH is Lebanon's largest public hospital and key referral center.
- ICRC's engagement in RHUH evolved from urgent repair to **strategic resilience planning**.
- Since 2016, co-financed by Avina Stiftung (2016-2019), AFD from 2019 & KSRC 2022 to date.

Challenge: Ensuring that essential medical services — surgeries, emergency care, dialysis, and intensive care — could continue safely despite fuel shortages, heatwaves, or infrastructure failure.

CLIMATE-SMART PROGRAMS AND OPERATIONS

The Altered Crisis

The climate crisis is altering the nature and severity of humanitarian crises.

Climate-Smart Programs

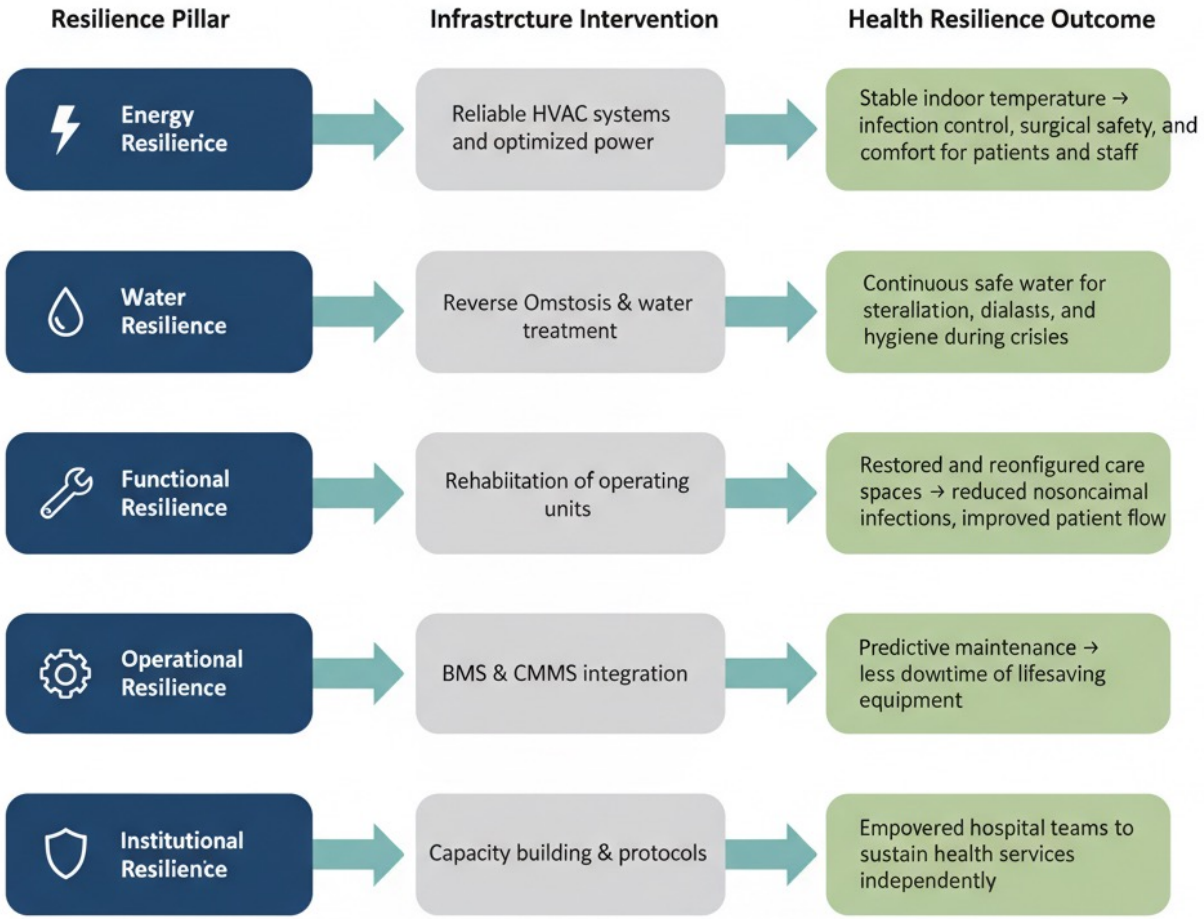
Designed to reduce long-term risks and vulnerabilities by using climate info across timescales.

Forward-Looking Planning

Planning is not only based on past/current risks but also prepares for future changes and variability.

Integrated Resilience

Integrating resilience to climate shocks directly into every project design.



ICRC'S SYSTEMS APPROACH TO RESILIENT HEALTH INFRASTRUCTURE

Resilience: *The capacity to to sustain quality health services before, during, and after crises — ensuring infection prevention, patient safety, and continuity of essential care*

Five Interconnected Pillars:

1. **Energy Resilience**
2. **Water Resilience**
3. **Functional Resilience**
4. **Operational Resilience**
5. **Institutional Resilience** –

RESILIENT BY DESIGN: CLIMATE INTELLIGENCE IN HEALTH PROJECTS

Integrating Climate Intelligence in Health Projects

- Used **2030–2040 projections** in HVAC, water, and energy designs.
- RHUH HVAC , Water treatment systems, BMS for **adaptation & mitigation** to lower emissions and strengthen resilience.

Measured Impact: 25% less energy, 20% less water, reduced diesel/water trucking.

RHUH: SYSTEMS INTEGRATION FOR HEALTH FACILITY RESILIENCE

HVAC System

Intervention

Chillers with heat recovery

Resilience Benefit

95% reduction of HVAC-related service disruptions in operating theatres.

Water Systems

Intervention

Dual-source (municipal + seawater RO)

Resilience Benefit

Strengthened infection prevention and control through consistent water quality.

RHUH: SYSTEMS INTEGRATION FOR HEALTH FACILITY RESILIENCE

BMS Integration

Intervention

Power, fuel, and water monitoring

Resilience Benefit

Improved energy reliability, ensuring constant power for lifesaving equipment.

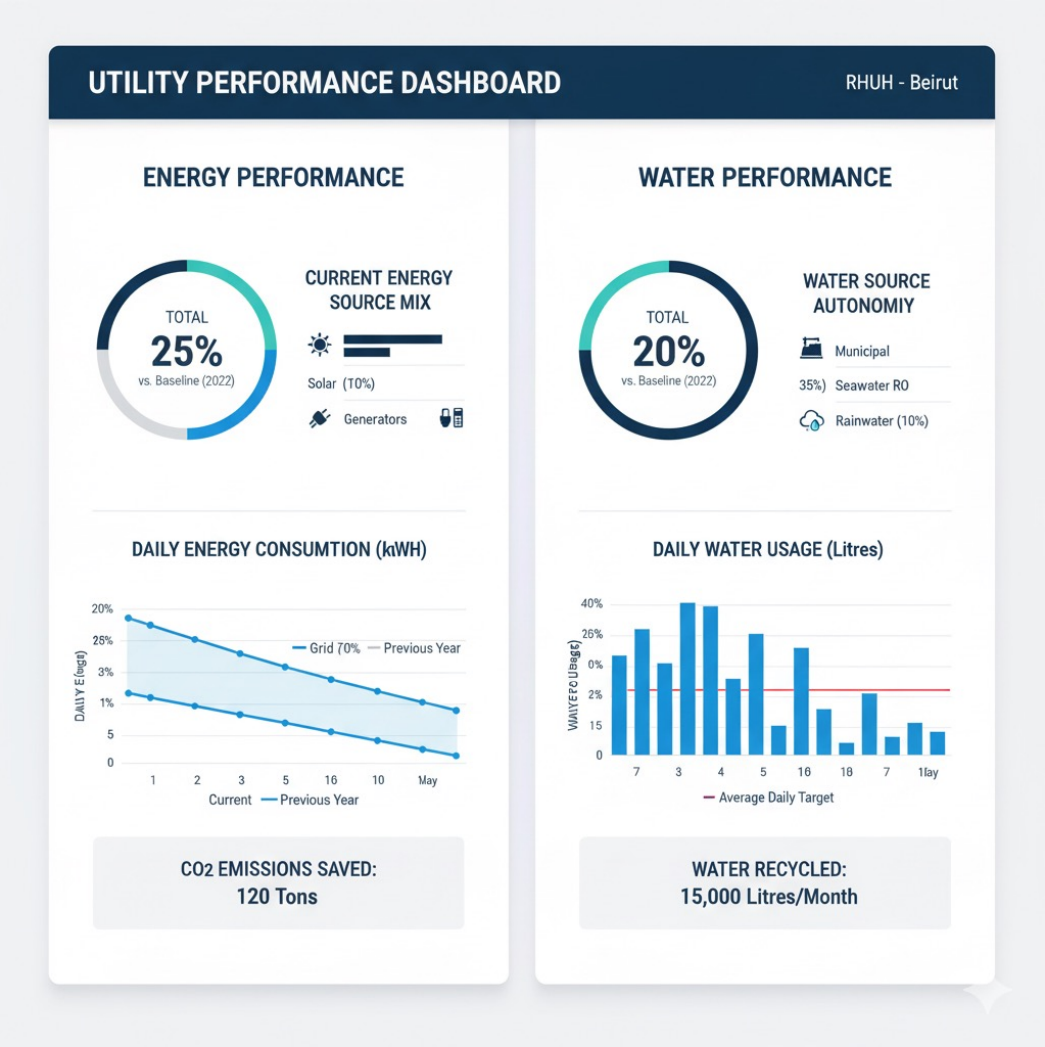
Boilers & Pumps

Intervention

Alternating Hydronic pumps for redundancy

Resilience Benefit

Continuous hot-water supply for sterilization and sanitation.



OPERATIONAL INTELLIGENCE FOR SYSTEM RESILIENCE

Operational Outcomes:

- BMS-driven real-time monitoring of energy & water. To inform data-driven decision-making for resilience.
- Improved energy reliability, ensuring constant power for lifesaving equipment
- Optimized fuel and water consumption, prolonging clinical operations during crises

Organizational Learning:

- RHUH is now a **CLIM reference site** for ICRC
- Framework replicated in all design, monitoring, and reporting tools.

BRHI: FROM REHABILITATION TO A RESILIENCE BLUEPRINT - HEALTH INFRASTRUCTURE RESILIENCE TOOLBOX

- **Building Resilience in Health Infrastructure (BRHI) Initiative** — ETH Zürich & ICRC
- Moved beyond traditional risk analysis to assess **system performance under crisis**.
- Developed tools from ICRC intervention at RHUH:
  - **Rapid Resilience Assessment (RRA)**
  - **Hospital-Wide Resilience Assessment** .
  - **Mass-Casualty Preparedness Tool**
- The tools not only identify technical gaps but also predict how crises affect patient care, helping hospitals prepare to protect essential health functions."

ICRC BRHI Tool Focal point :

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TRIPOLI GOVERNMENTAL HOSPITAL (TGH): REPLICATING THE MODEL SCALING CLIMATE-SMART DESIGN

Applied RHUH lessons to HVAC, BMS, and water systems. Ensures reliable operations, and sustained infection control through proven, resilient system designs.

Used 2030–2040 climate projections for system sizing. Safeguards essential health services by anticipating future heat and energy stresses

15–20-year HVAC lifespan → reduced lifecycle emissions. Lowering operating costs and emissions while securing consistent thermal comfort and air quality for patients and staff.

Impact Pathway: RHUH → TGH → Tebnine & Marjayoun Hospitals in South Lebanon.

THE WAY FORWARD

- The Health Infrastructure Resilience Toolbox (Phase I) is complete and now entering global adaptation and pilot testing to enable future institutional rollout.
- Deploy CLIM Indicators programing across other contexts.
- Continual Strengthening of local partnerships to develop resilience to **climate adaptation**

Focus

Bridging climate-adapted infrastructure interventions with resilient health outcomes — ensuring that every investment delivers safer, cleaner, and more reliable healthcare.