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Quantifying the Impact of Emergency Energy Conservation Measures over two winters: Evidence from Geneva's Response to the 2022-2024 Energy Crisis

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Crisis Context & Objectives



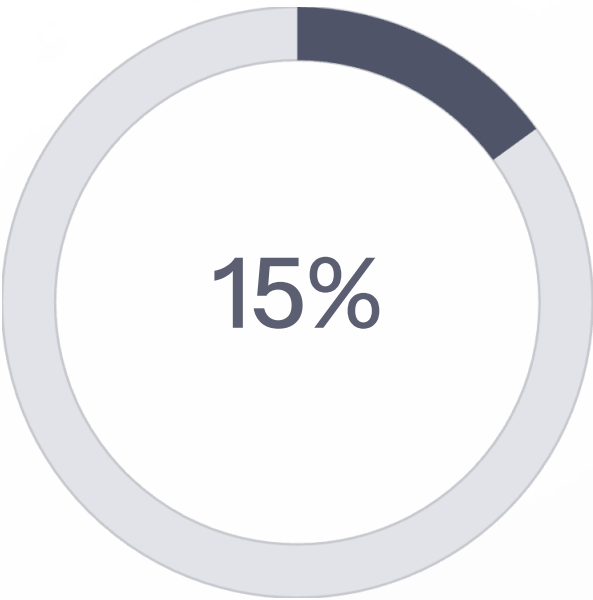
The Challenge

Switzerland faced extreme vulnerability due to 100% gas import dependency and no domestic storage.

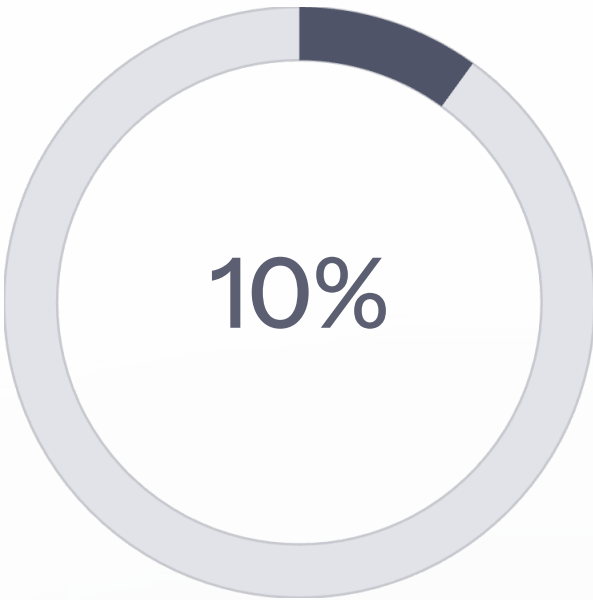


The Goal

Reduce energy consumption while maintaining economic activity.



Reduction in natural gas consumption.



Reduction in electricity consumption.



Six-Pillar Conservation Strategy



Temperature Mandates

20°C in offices/schools, 17°C in sports facilities, 23°C in healthcare.



Heating Delays

Start heating season October 15+ based on weather conditions.



Night/Weekend Setbacks

Temperature reductions in non-residential buildings during off-hours.



Hot Water Cuts

Reduced or eliminated hot water distribution in administrative buildings.



Pool Temperature

Reduced public swimming pools to 27 °C.



Lighting Reduction

Curtailed nighttime lighting and reduced street lighting intensity.

Comprehensive Data Integration



Energy Data Sources

- Hourly gas consumption data
- Quarter-hourly electricity data
- Customer-level consumption records
- Sector-specific usage patterns

External Variables

- Temperature, solar radiation, wind
- Working days vs weekends/holidays
- Economic activity indicators
- Building thermal dynamics

Qualitative insights from surveys and interviews with building managers and facility operators provided additional context.

Two-Stage Analytical Framework

1

Stage 1: Baseline Calibration

Used pre-crisis data (2021-2022) to establish normal consumption patterns under varying weather and activity conditions.

2

Stage 2: Conservation Quantification

Applied models to intervention periods using actual conditions to predict consumption without measures, then calculated savings.

Methodologies included multilinear regression for gas, ARIMA for electricity, and XGBoost machine learning for complex institutional data.



Overall Results

Gas Savings Progression 🔥



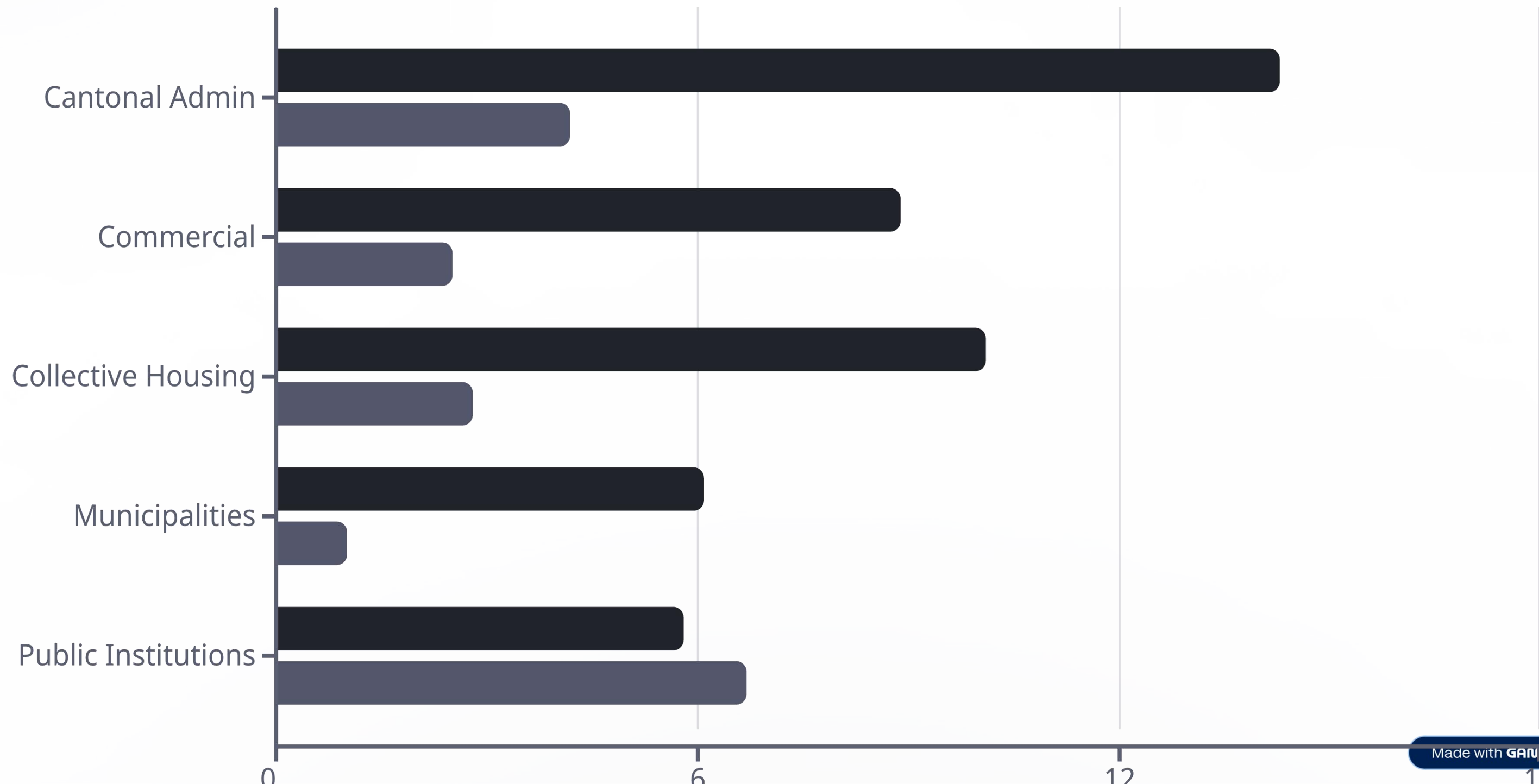
Electricity Savings Progression ⚡



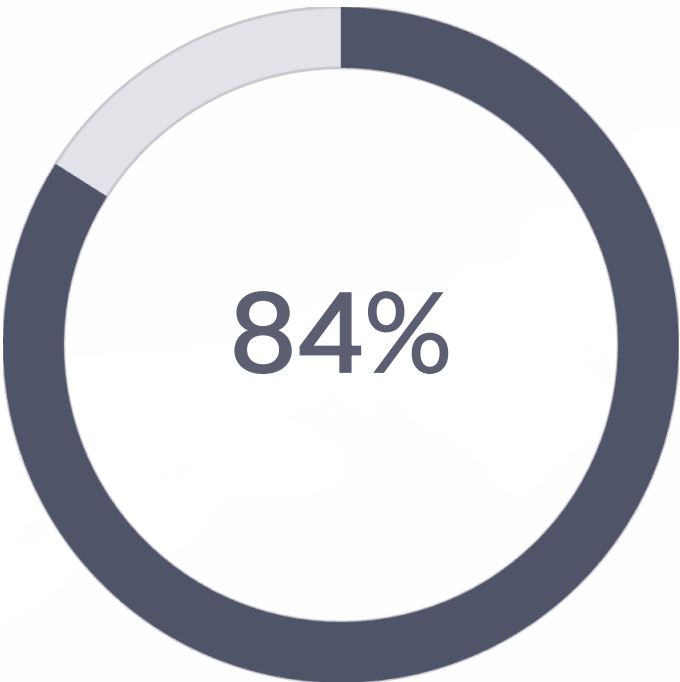
Ambitious Targets

Despite progress, results fell short of ambitious 15% gas and 10% electricity conservation targets. Continued effort is needed to bridge the remaining gap.

Sectoral Breakdown of Savings

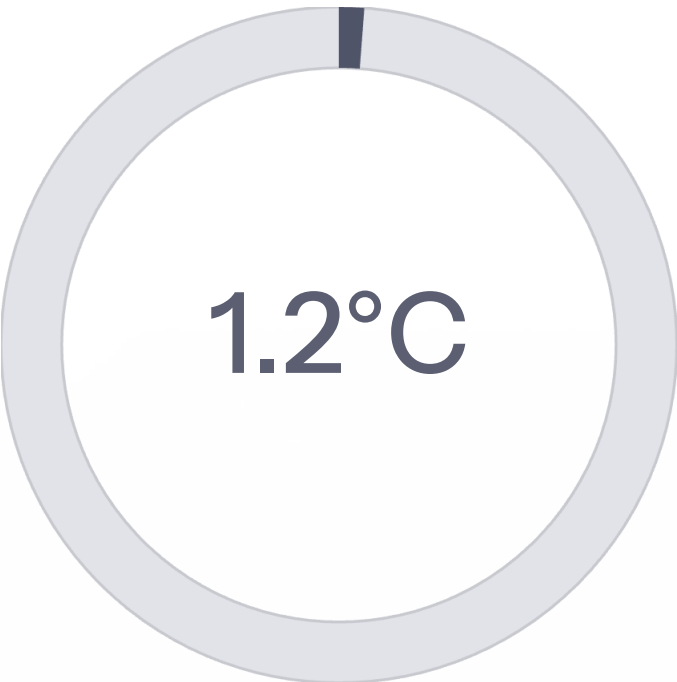


Temperature: The Game Changer



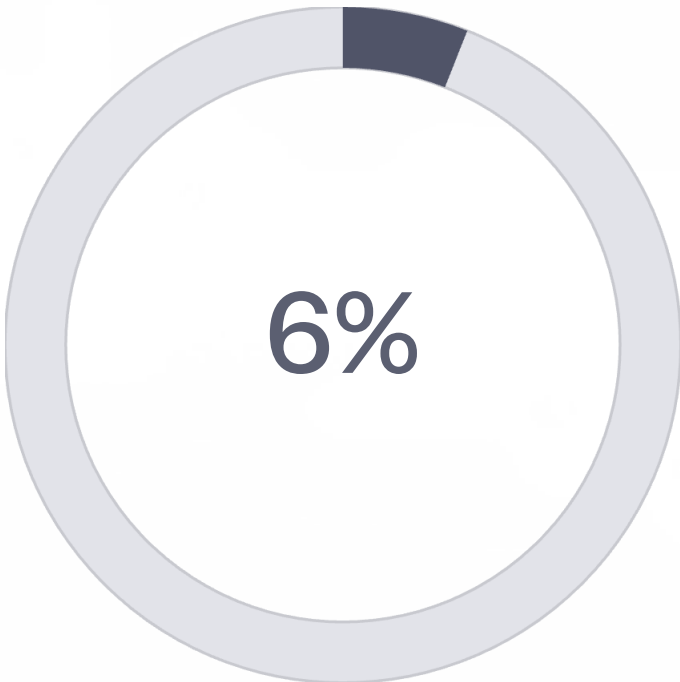
Temperature Impact

Of total gas savings achieved through systematic temperature reduction alone



Average Reduction

From 21.8°C baseline to 20.6°C during 2023-2024 winter



Heating Delay

Additional savings from postponing heating season start

The coordinated 20°C heating standard emerged as the most effective single intervention, with high stakeholder acceptance.



Implementation Challenges

Technical Constraints

Outdated heating systems lacking modern controls and uneven thermal distribution in older buildings.

Human Factors

Conservatism among heating technicians anchored in pre-existing practices.

Coordination Complexity

Diverse stakeholders with varying technical capacities, resources, and priorities.

Phased implementation and targeted communication strategies eventually mitigated many issues, but highlighted needs for technical upgrades.

Blueprint for Future Energy Security

Key Success Factors

Stakeholder collaboration, systematic temperature standards, and comprehensive monitoring systems.

Policy Recommendations

Modernized technical regulations, enhanced coordination frameworks, and sustained public communication.

Future Applications

Valuable guidance for demand-side management and climate commitment compliance.

Geneva's experience demonstrates that significant energy savings are achievable through coordinated emergency measures, offering a compelling model for future energy security initiatives.



Thank You

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