RETOUCH NEXUS
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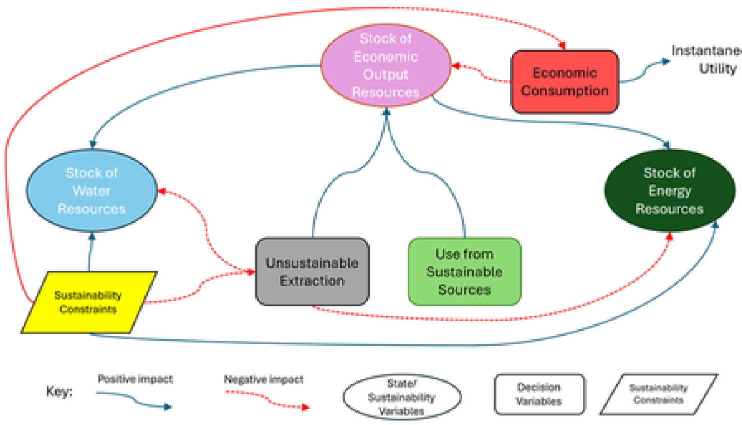
The RETOUCH NEXUS project promotes a cross-sectoral Water–Energy–Food–Ecosystems (WEFE) Nexus approach to support a resilient EU water economy. It ensures that water governance considers ecological, social, and economic dimensions, fostering coherence and effectiveness across sectors and governance levels.

# Policy brief | Upscaling of water governance Instruments | Water and energy sustainability in small island economies

This policy brief examines methodological approaches to scaling economic instruments and models for water governance.
Case studies are illustrative, and broader application is possible through context-specific analysis.

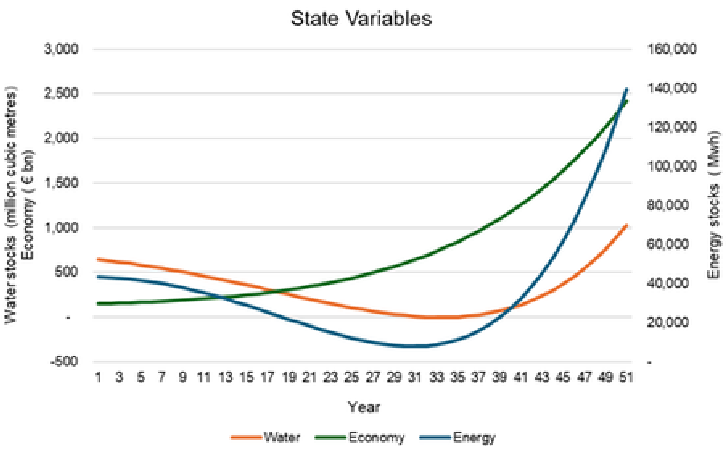
**Introduction:** desalination and wastewater treatment are energy-intensive processes that generate trade-offs between water and energy security. Economic and population growth can further aggravate the depletion of these resources, undermining long-term development. How should policymakers invest in sustainable water and energy sources, to foster growth and avoid critical resource thresholds?

**Modelling Approach:** dynamic modelling tracks key sustainable and unsustainable resource stocks (water, energy, and capital), feedback loops, and constraints through a system of equations. A production function links economic output to inputs used. Running Monte Carlo simulations over 50 years, we study the impact of the output share reinvested in sustainable resources, extraction rates caps, and pricing instruments.




*Conceptual flow diagram.*

## RETOUCH NEXUS CASE STUDIES - LESSONS LEARNED




*Dynamic behavior of simulated state variables.*

## RETOUCH NEXUS CASE STUDY

Malta faces significant water scarcity compared to other EU members, relying on energy-intensive desalination to meet its water needs. As a result, economic activity depends on both energy and water inputs, sourced from a mix of sustainable and non-sustainable systems. Given its limited land availability to support population needs, ecosystems, energy generation, and food production, Malta illustrates the complex trade-offs within the Water–Energy–Food–Ecosystem (WEFE) nexus.

The simulations show that economic growth becomes potentially unsustainable within 3 decades. Malta's existing Water Table stakeholder platform and Inter-Ministerial Committee provide a governance foundation, but their scope needs to expand from the current water-energy focus to a full WEFE nexus approach.

## Indicators (data requirements and resulting insights)

- Dynamic sustainability trajectories: stock levels of water, energy, and economic capital over time.
- Sustainable-to-unsustainable resource use ratios.
- Full-cost recovery ratios for water services (financial + resource + environmental costs).
- WEFE integration metrics: cross-sector policy coherence indicators.

## Governance mechanisms

- Inter-Ministerial Committee (IMC) for cross-sectoral water policy implementation.
- National Water Table stakeholder platform (government, utilities, NGOs, private sector) – to be expanded to full WEFE scope.
- Centralised administration advantage: Malta's small size enables effective coordination, but formalisation is needed as WEFE scope broadens.

## Implications for WEFE Nexus framework

- Water and energy sustainability are deeply coupled in island systems; pricing instruments must reflect this interdependence.
- Without deliberate reinvestment policy, economic growth leads to resource depletion within a generation.
- Expanding the model to include food and ecosystem components will strengthen WEFE policy coherence.

## Potential Economic Instruments

- Stepwise water tariffs with high financial cost recovery (via economic regulator REWS).
- Full-cost recovery pricing incorporating resource and environmental costs (currently only qualitative).
- Renewable energy subsidies integrated with water pricing (solar-powered desalination).
- Irrigation subsidies and tariffs for reclaimed/second-class water.

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## SCALING OUT

TO INCREASE IMPACT BY REPLICATING A MODEL IN SIMILAR CONTEXTS, PROVIDING FLEXIBILITY, RESILIENCE, AND COST-EFFECTIVE GROWTH, OFTEN FOCUSING ON SHARED FEATURES.

### MODELLING STRATEGY

Dynamic model for water–energy–economy interactions

The methodology can be applied to other small island developing states or water-stressed city-regions with similar water–energy coupling. The core model structure (state variables, production function, sustainability constraints) is portable; coefficients and data inputs need recalibration.

**Example:** Apply to other Mediterranean islands (Cyprus, Crete, Sardinia, Balearic Islands) or water-stressed coastal cities dependent on desalination (e.g., Barcelona, Almeria, coastal Gulf states).


*Scaling out general framework.*

**Assumptions & potential Risks:**

- Need to fine-tune equations for each context.
- Data availability may be limited.
- Outsourced model development requires proper documentation for transferability.

**Mitigation measures:**

- Develop a step-by-step calibration manual.
- Prepare a minimum data requirements template specifying variables, units, time horizons, and data sources.
- Ensure transparency and comparability across applications.

## SCALING UP

TO INCREASE THE COVERAGE, SIZE, CAPACITY, SCOPE, OR OUTPUT OF A MODEL TO A WIDER CONTEXT, ESSENTIALLY MAKING IT BIGGER AND MORE EFFECTIVE. IT'S ABOUT GROWING SUBSTANTIALLY, NOT JUST LINEARLY, TO PROVIDE MORE COMPREHENSIVE INSIGHTS.


*Scaling up general framework.*

### ECONOMIC INSTRUMENT

Comprehensive WEFE pricing and investment framework

Scaling up means integrating additional policy domains: renewable energy subsidies, agricultural/irrigation policy, ecosystem protection measures. The model transitions from energy–water–economy to a full WEFE nexus framework including local food production and ecosystem components.

**Example:** Expanding Malta's model to explicitly include agricultural water allocation, ecosystem water requirements (groundwater-dependent terrestrial ecosystems), and renewable energy investment scenarios.

**Assumptions & potential Risks:**

- Model complexity increases.
- More detailed data inputs required.
- Current Excel-based platform may become limiting.

**Mitigation measures:**

- Transition from Excel to R or Python.
- Maintain user-friendly interface.
- Modular design allowing incremental expansion.

## Conclusions / Final Remarks

- **Hidden risks:** Energy-intensive water supply can mask long-term depletion in water-scarce regions.
- **Mainstream constraints:** Water sustainability indicators should be integrated into economic and territorial planning as binding constraints, not ancillary environmental considerations.
- **Assess long-term compatibility**: Dynamic modelling can support policymakers in testing whether current development trajectories are consistent with long-term water security goals.

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