

Module 1

Climate Change Adaptation and Mitigation

COOPERATION FOR SUSTAINABLE ENERGY AND CLIMATE ACTIONS PLANNING AND MONITORING IN BSB

STEP2CleanPlan BSB00004

•Purpose of the Program Main goal:

- Empowering Local Government (LG) executives with knowledge, skills and tools for the design, implementation and monitoring of policies and actions that enhance the resilience of local societies to climate change.
- Strengthening the capacity of local authorities to respond to the environmental, social and economic challenges of climate change, in line with national and European commitments (e.g. European Green Deal, National Energy and Climate Plan).

- **Focus on resilience:** Development of strategies for adaptation to climate risks, such as floods, heat waves and droughts, which particularly affect Greece due to its geographical location.
- Mitigation of greenhouse gas emissions through local actions, such as promoting sustainable urban mobility and energy efficiency.

- **Adaptability to different levels of experience:** The program covers basic and advanced concepts, allowing for the participation of executives with diverse backgrounds, from entry-level employees to experienced environmental policy makers.
- It provides practical tools and examples for application in small municipalities (e.g. island municipalities) and large regions (e.g. Attica, Central Macedonia).

- **Connection with national and European goals:** Supports the implementation of the National Climate Change Adaptation Strategy (NCCAS) and the Climate Change Adaptation Strategy (CCAS), which aim to reduce CO2 emissions and enhance climate resilience.
- It is aligned with the European Green Deal, which provides for climate neutrality by 2050 and a 55% reduction in emissions by 2030.

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•Thematic sections:1. Climate Change Adaptation and Mitigation:

- Introduction to the scientific basis of climate change, with emphasis on local climate risks (e.g. floods in lowland areas, heat waves in urban centers).
- Analysis of national and European policies, such as the Renewable Energy Directive 2018/2001 and the EU Strategy for Adaptation to Climate Change.
- Practical actions: Designing adaptation measures, such as flood control projects or early warning systems.

- 2. Sustainable Urban Mobility and Energy Efficiency:** Education on strategies to reduce emissions from transportation, such as promoting bike lanes, electric vehicles, and public transportation.
- Energy efficiency in municipal buildings and infrastructure, with an emphasis on technologies such as solar panels, LED lighting and smart energy management systems.
 - Example: The Municipality of Thessaloniki implements the program **SUMP** (Sustainable Urban Mobility Plan), aiming to reduce emissions from transport by 20% by 2030.

•3. Greenhouse Gas Emissions Assessment and Reporting:

Learning emission inventory methods based on international standards, such as **Greenhouse Gas Protocol**.

- Use of digital tools and platforms to monitor and report emissions, e.g. software such

as **Covenant of Mayors Reporting Platform**.

- Practical exercises: Writing environmental performance reports for municipal authorities.

- Program objectives:** Strengthening the capacity of local authorities to design and implement policies that are aligned with the National Climate Change Strategy.
- Interconnecting science, technology and policy to develop integrated solutions at the local level.
- Strengthening cooperation between local authorities, citizens and local bodies to promote sustainable practices.

•Expected Results Understanding scientific and institutional frameworks:

- Learners gain a deep understanding of the scientific concepts of climate change, such as the increase in average temperature (+1.1°C globally, IPCC 2023) and the impacts at the local level (e.g. 30% increase in heat waves in Greece, 2000-2020).
- Familiarity with national policies (e.g. ESPKA, Law 4936/2022) and European guidelines, such as the EU Strategy for Adaptation and Fit for 55.

•Expected Results Understanding scientific and institutional frameworks:

- Example: Understanding the obligation of Local Authorities to submit Sustainable Energy and Climate Action Plans (SECAP) under the Covenant of Mayors.

- **Identifying climate risks and planning actions:** Ability to identify local climate risks, such as floods in Thessaly (damage estimate: €2 billion, 2023) or heat waves in Athens.
- Developing skills for designing adaptation measures, e.g. creating green corridors or water management systems.
- Practical application: Designing local adaptation plans, such as the creation of shaded public spaces in island municipalities.

- **Use of inventory and energy efficiency tools:** Learning greenhouse gas emission inventory techniques using tools such as **CIRIS** (City Inventory Reporting and Information System).
- Implementation of energy efficiency technologies, e.g. installation of smart energy meters in municipal buildings, with energy savings **20-30%**.
- Sustainable urban mobility planning, e.g. expansion of pedestrian or cycle paths, such as in the Municipality of Chania (10 km of new cycle paths, 2023).

- **Exploitation of digital media and data:** Use of digital platforms, such as **Copernicus Climate Data Store**, for access to climate data and support for local policies.
- Integrating data from smart cities (smart cities), e.g. sensors for monitoring air quality or energy consumption.
 - Example: The Municipality Trikala uses the platform **Smart Trikala** for environmental data management, improving energy efficiency by 15%.

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- **Planning actions based on indicators and good practices:**

Development of performance indicators (KPIs) to evaluate environmental policies, e.g. CO2 emission reduction or recycling rate.

- Implementation of good practices from European municipalities, such as the program **Zero Waste Cities**, which achieved a 30% waste reduction in Ljubljana.

- Practical exercise: Creating a local action plan to reduce waste by 20% in small municipalities.

- **Developing collaborative strategies:** Strengthening cooperation with citizens, energy communities and local bodies to implement climate actions.
 - Example: Energy communities in Greece (e.g. Public Relations Karditsa) produce **5 MW** from renewable sources, reducing energy costs for members by 25%.
- Implementation of participatory processes, such as public consultations, for the formulation of local policies.

•Communication and reporting of environmental performance:

- Learning techniques for writing environmental performance reports, according to international standards, such as **Global Reporting Initiative(GRI)**.
- Development of communication skills to present environmental achievements to citizens, investors and international organizations.
- Example: The Municipality of Heraklion, Crete publishes annual environmental performance reports, attracting funding from the NSRF for green projects.

•Additional Dimensions and Connection to Circular Economy Integrating circular economy:

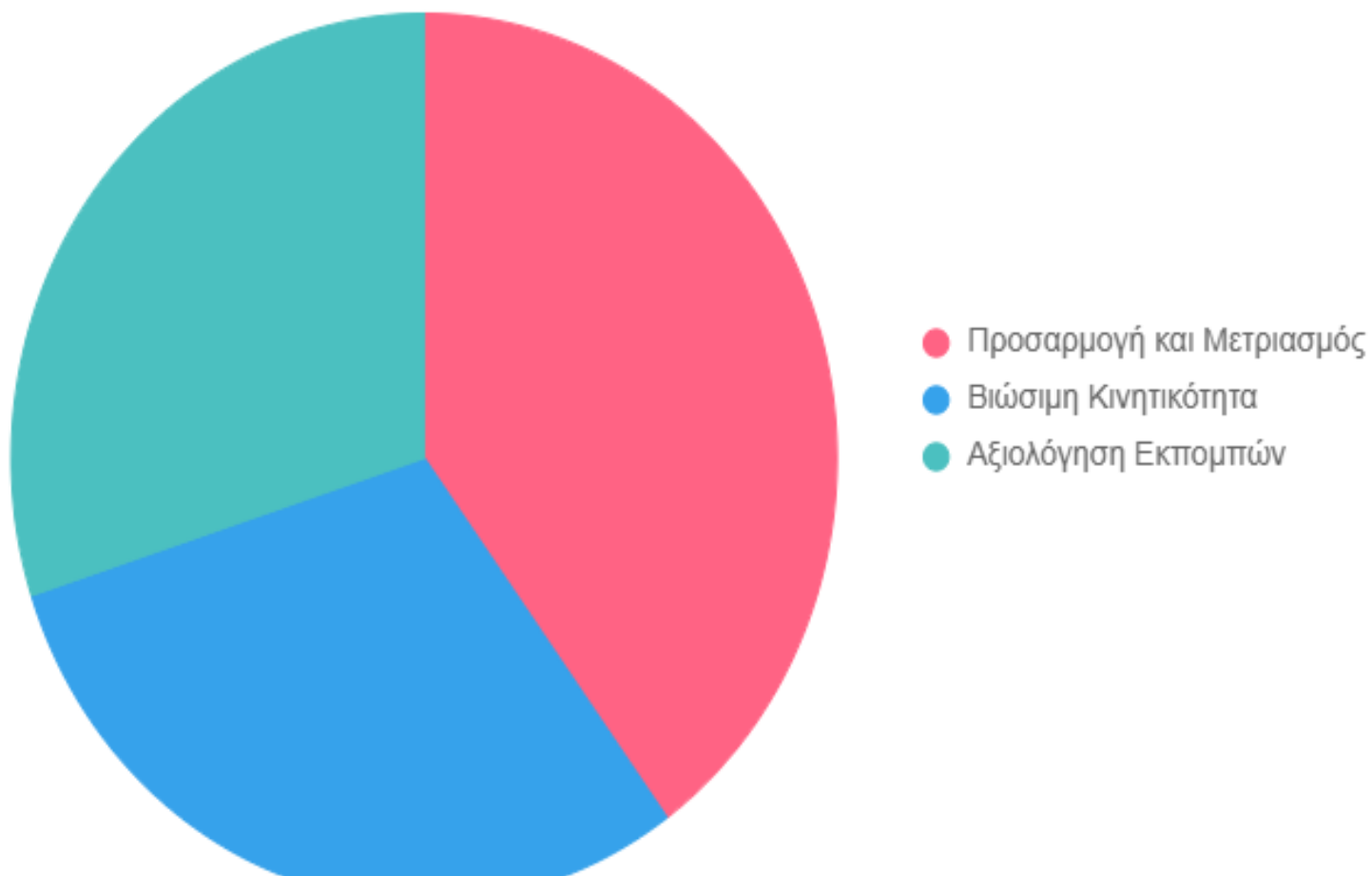
- The program can be enriched with training in circular practices, such as material reuse and waste management. biowaste, which enhance climate resilience.
 - Example: The utilization biowaste for biogas production, as in the program **BIOREGIO** "Regional circular economy models and best available technologies for biological streams" ("Regional circular economy models and best available technologies for bio-streams" of the Region of Central Macedonia, reduces emissions by 10%.

- **Financing opportunities:** Training of executives in the utilization of European funds (e.g. Horizon Europe, Recovery Fund) for financing climate projects.
- Example: The program **LIFE** finances adaptation projects in Greece, such as the restoration of wetlands in Lake Karla, at a cost **€15 million** and reduction flood risks by 30%.

- **International examples:** In Copenhagen, the program **Climate Plan2025** includes training of local government executives to reduce emissions through sustainable mobility and energy efficiency, resulting in a 61% reduction in emissions (2012-2022).
- In Barcelona, the **ClimateEmergencyPlan** incorporates emissions inventory tools and participatory processes, reducing waste by 15% through circular practices.

- **Economic and social impact:** Strengthening the local economy through the creation **5,000-10,000 jobs** in areas such as waste management and energy efficiency (ESDKO estimate, 2023).
- Improving the quality of life through the reduction of air pollution and the enhancement of urban greenery.

Κατανομή Μαθησιακών Αποτελεσμάτων ανά Θεματική Ενότητα



Pie (pie chart) showing the distribution of learning outcomes per thematic unit (Adaptation and Mitigation, Sustainable Mobility, Emissions Assessment). The percentage distributions (40%, 30%, 30%) are estimates based on a balanced emphasis across the three units.

•1.1 Scientific and Institutional Map of Climate Change: Basic Concepts and Policies for Adaptation in the EU and Greece

- Main goal:** Familiarization of participants with the scientific concepts, policy directions and tools related to climate change adaptation and mitigation, with an emphasis on implementation at the Local Government (LG) level.
- Providing a comprehensive theoretical and institutional framework for understanding climate change at the global, European and national levels, so that executives can design and implement local strategies.

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Introduction to the scientific principles of climate change, such as the increase in average global temperature (+1.1°C since pre-industrial times, IPCC 2023) and its impacts in Greece (e.g. 30% increase in heat waves from 2000-2020).

Analysis of European and national policies, such as the EU Climate Change Adaptation Strategy and the EU Climate Change Strategy, which aim to enhance resilience and reduce CO2 emissions. Strengthening the capacity of local authorities to implement adaptation and mitigation strategies, such as the creation of green infrastructure or the promotion of renewable energy sources.

- **Expected Outcomes of Unit 1 Recognition and understanding of scientific principles of climate change:**
 - Trainees gain knowledge of basic scientific principles, such as the role of greenhouse gases (CO₂, CH₄) in global warming and the impacts in Greece (e.g. 20% increase in extreme weather events in the period 2000-2020).

•Expected Outcomes of Unit 1 Recognition and understanding of scientific principles of climate change:

- Understanding climate models and projections, such as the IPCC estimate of a temperature increase of 1.5-2°C by 2050 without mitigation measures.
- Practical application: Analysis of climate data from **Copernicus Climate Data Store** for the assessment of local impacts, e.g. heat waves in Attica or floods in Thessaly.

- **Analysis of institutional directions and policies:** Familiarity with the European framework, such as the EU Adaptation Strategy (2021) and the package **Fitfor 55**, which aims to reduce emissions by 55% by 2030.
- Understanding the national framework, including Law 4936/2022 on the transition to climate neutrality and the ESPKA, which provides for 13 regional adaptation plans.
- Example: Application of **Covenant of Mayors** from 350 Greek municipalities, committed to reducing emissions by 40% by 2030 through Sustainable Energy and Climate Action Plans (SECAP).

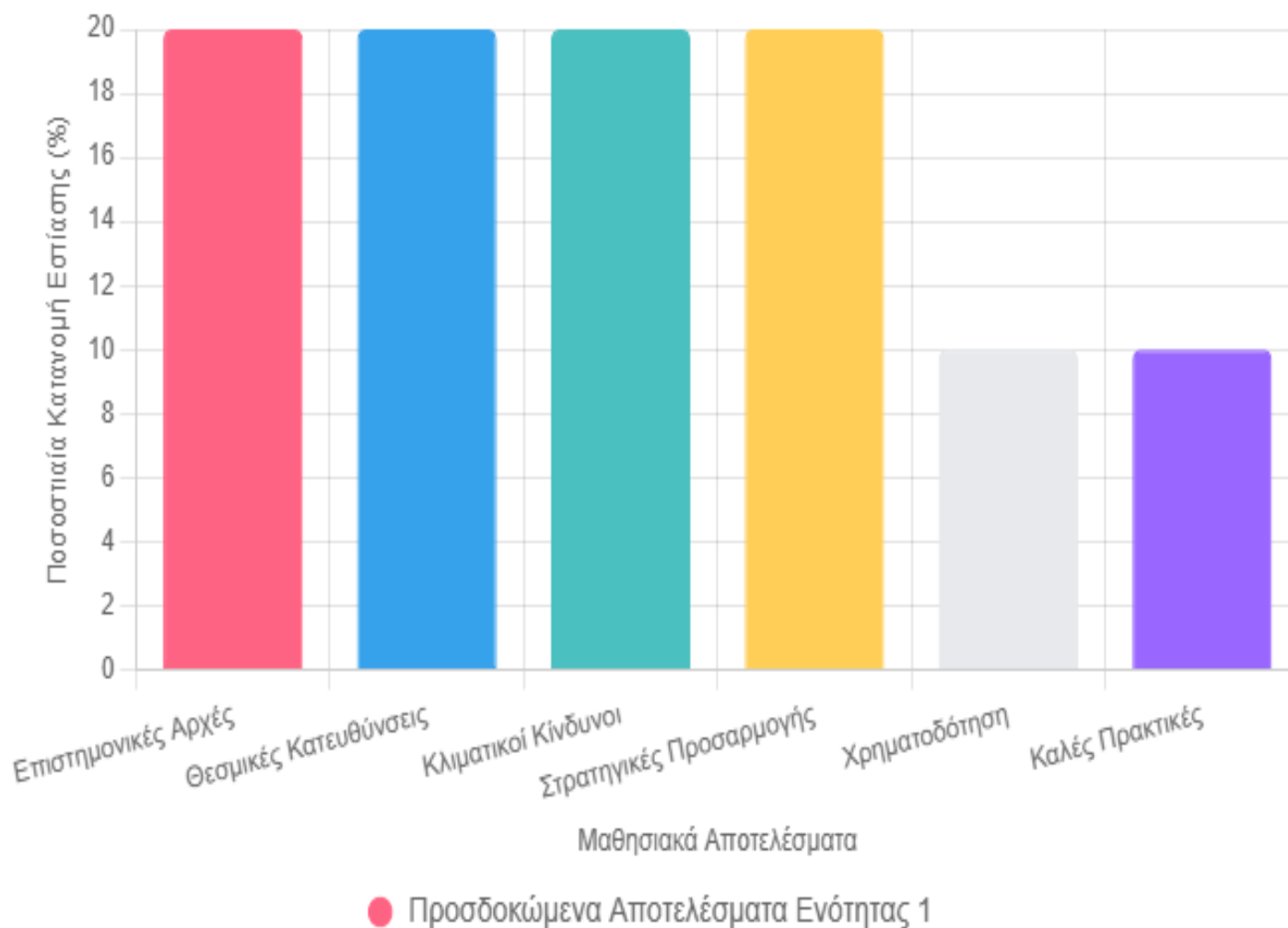
- **Identification and assessment of climate risks and vulnerability:** Develop skills to identify local climate risks, such as floods, heat waves, forest fires and coastal erosion, which particularly affect Greek regions.
- Learning vulnerability assessment methods, such as the use of risk indicators (e.g. population exposure to floods, estimate: 15% of residents in coastal areas, Ministry of Environment and Natural Resources 2023).
- Practical exercise: Mapping climate risks at a local level, e.g. identifying vulnerable areas in the Municipality of Chios due to sea level rise.

- **Contribution to the design of local adaptation and resilience strategies:** Training in the design of adaptation measures, such as the creation of green corridors, the strengthening of flood protection infrastructure or the installation of early warning systems.
- Strengthening resilience through mitigation measures, such as promoting renewable energy sources (e.g. photovoltaics in municipal buildings) and reducing energy consumption.
- Example: The Municipality of Heraklion, Crete, implements the program **LIFEGreen**, which includes planting 10,000 trees to reduce urban temperatures by 1.5°C.

- **Identifying sources of financing for adaptation projects:** Familiarity with European and national financial instruments, such as the **LIFE** (€5.4 billion for 2021-2027), the **Horizon Europe** (€95.5 billion), the NSRF, and the Recovery Fund.
- Training in writing proposals to apply for funding, e.g. for energy upgrade or water management projects.
- Example: The Region of Central Macedonia secured **€20 million** from the NSRF for adaptation projects, such as the restoration of wetlands in Axios, reducing the risk of floods by 25%.

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Κατανομή Προσδοκώμενων Αποτελεσμάτων Ενότητας 1



Bar chart(bar chart) indicating the relative weight of each learning outcome (scientific principles, institutional directions, climate risks, strategies, financing, good practices). The percentage distributions (20% for the four main categories, 10% for financing and good practices) are estimates based on the balanced emphasis of the module.

•Introduction and Purpose

- Effective understanding and management of climate change at the local government level requires familiarity with basic concepts, terms and scientific principles.
- ORsubsectionIt serves as a starting point for the program, creating a common frame of reference for professionals with different levels of experience.
- Knowledge of terminology and scientific bases enhances the ability to assess risks, plan actions and communicate with scientific and institutional bodies.

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• **Climate Change: Definition and Key Characteristics** It is defined in the United Nations Framework Convention on Climate Change (UNFCCC) as a long-term change in the Earth's climate due to natural or, mainly today, anthropogenic causes.

- It is connected with hyperconcentration of greenhouse gases in the atmosphere, which causes overheating, affecting:
 - The water cycle.
 - Weather phenomena.
 - Biodiversity.
 - Human activity.

- **Man-made causes:** Burning fossil fuels (coal, oil, natural gas) for energy and transportation.
 - Deforestation, which reduces natural CO₂ absorption.
 - Intensive agriculture and livestock farming, which releases methane and nitric oxides.

- **Scientific evidence:** Global temperature has increased by $\sim 1.1^{\circ}\text{C}$ since the pre-industrial era (IPCC).
- The intensity and frequency of extreme events (heat waves, floods, droughts) is increasing.

•Local consequences:

- Change in the seasonality of rainfall.
- Change in irrigation and water supply needs.
- Increased risk of fires and floods.
- Pressure on infrastructure (water supply, sewage, transport networks).
- Climate change requires strategic planning and coordination from local government, as it is a crisis of governance, public health, infrastructure and social cohesion.

- **Climate Variability (Climate Variability)** It refers to natural, short-term or medium-term climate fluctuations (months to decades).
- It includes deviations from average climatic conditions, without external influence, due to the natural functioning of the atmosphere and ocean systems.

- **Examples:** El Niño phenomenon, El Niño (ENSO) and La Niña, which affect rainfall, storms and droughts worldwide.
 - Seasonal changes (e.g. mild or very cold winters).
 - Multi-year fluctuations due to solar activity or volcanic eruptions.

- **Importance of separation from climate change:** Volatility causes extreme events, but does not constitute long-term change.
- Local authorities need to distinguish temporary fluctuations from systematic changes for strategic adaptation.

•Climate Neutrality (Climate Neutrality)

- Achieving a balance between greenhouse gas emissions and their absorption, with zero net emissions.
 - It is achieved through:
 - Reducing emissions to the maximum possible extent.
 - Offsetting actions (e.g. tree planting, investment in carbon sequestration).
 - EU goal: Climate neutrality by 2050.

- **Weather vs. Climate Weather:** Short-term atmospheric conditions (temperature, precipitation, wind) at a specific place and time (e.g. "will it rain tomorrow?").
- **Climate:** Average value and variation of these conditions over decades (e.g. "our region has a Mediterranean climate").
- The distinction is critical for understanding data, forecasting, and adaptation strategies at the local level.

• **Basic Climate Change Theories & Pioneering Scientists Greenhouse Effect:**

- Natural phenomenon that maintains the Earth's average temperature at +15°C instead of -18°C.
- Anthropogenic deterioration due to greenhouse gas emissions (GHGs) causes overheating.
 - **Greenhouse gases:**
 - CO₂: From burning fossil fuels, deforestation, industry.
 - CH₄: From agriculture, waste, wetlands.
 - N₂O: From fertilizers, agricultural combustion.
 - Fluorinated compounds: From industry, air conditioners, refrigerants.

- Impacts:** Disruption of the hydrological cycle, extreme temperatures, rising sea levels, weakening of ecosystems and agricultural productivity.

- Pioneers:**

- Jean-Baptiste Fourier(1824): He hypothesized that the atmosphere keeps the Earth warmer.
- JohnTyndall(1860): He demonstrated that water vapor and CO₂ absorb thermal radiation.
- Svante Arrhenius(1896): Calculated the effect of CO₂ on temperature, predicting overheating.

•**Anthropogenic Causation:** Climate change is mainly caused by human activities (burning of fossil fuels, deforestation, industry).

•**Pioneers:**

- Guy Stewart Callendar(1938): Linked CO₂ increase to temperature rise.
- Charles David Keeling(1958): Created the CurveKeeling, showing a continuous increase in CO₂.
- IPCC (1988-present): Gathers global scientific consensus.

• **Climate Feedback (Climate Feedback):** Small changes are amplified or attenuated through natural mechanisms (e.g. melting ice, water vapor, methane from tundra).

• **Pioneers:**

- James Hansen (1980s): Highlighted the importance of feedback.
 - IPCC: Quantify mechanisms feedback through modeling.
 - NASA, NOAA, Hadley Centre: They developed feedback models.
- Wallace Broecker: Introduced terms "climate system" and "thermal salt traffic".

•**Energy Balance Theory:** Climate depends on the balance of incoming solar and outgoing infrared energy.

•**Pioneers:**

- James Hansen and Stephen Schneider: They analyzed the disruption of the balance by emissions.
- IPCC: Bases climate models on this view.

•**Natural Causes and Long-Term Cycles:** The climate in the past changed due to solar radiation, volcanic activity, orbital cycles (Milankovitch).

•**Pioneers:**

- Milutin Milankovitch(1920s): Explained glacial periods with astronomical cycles.
- Modern scientists: They show that current change is mainly anthropogenic.

•**Energy Balance & Disorders:** The addition of greenhouse gases disrupts the balance of incoming and outgoing energy.

•**Pioneers:**

- James Lovelock: He created the Gaia theory, viewing the Earth as a self-regulating system.
- Meteorologists and physicists: They show the disruption through climate models (GCMs).

•Naturalvs.Anthropogenic Changes:

- The climate has always changed, but the current warming is faster and anthropogenic.

•Pioneers:

- Milutin Milankovitch: Developed the theory of orbital circles.
- Modernclimatologists: Comparepaleoclimaticdata with current changes.

• **Climate Scenarios and Indicators – Role of the IPCC** The IPCC is the leading international scientific organization for assessing climate change, providing a basis for global policy.

• **Emission Scenarios (RCPs):**

- RCP2.6: Emissions reduction scenario (target $<2^{\circ}\text{C}$).
- RCP4.5/RCP6.0: Moderate scenarios with limited mitigation policies.
- RCP8.5: Scenario «business as usual» without serious interventions.

•Socioeconomic Scenarios (SSPs):

- They depict climate change in relation to social, political and technological developments.
- Combined with RCPs for planning local strategies.

•Critical Index: +1.5°C:

- Limit of the Paris Agreement (2015) and the IPCC.

Critical Index: +1.5°C:

- Overshooting leads to:
 - Mass migrations.
- Destruction of ecosystems (coral reefs, polar glaciers).
 - Disturbances in agriculture and water supply.
- Current policies lead to an increase of 2.4–2.7°C, indicating a need for urgent action.

- **Historical Development of Climate Science** It starts with Jean-Baptiste Fourier (1824), who proposed that the atmosphere retains heat.
- Svante Arrhenius (1896): Calculated the effect of CO₂ on temperature.
- 20th century: Developments in computer technology, satellites, sensors and databases.
- IPCC established (1988): Issues repeated consensus reports on the severity of the phenomenon.

•Key Concepts: Adaptation, Mitigation, Resilience Adaptation:

- Strategic response to reduce the consequences of climate change, protecting societies, infrastructure and ecosystems.
 - **Examples in local government:**
 - Construction of flood control projects, sewerage upgrade.
 - Sustainable agricultural practices.
 - Emergency plans for heat waves, fires, droughts.
- Review of spatial plans, promotion of green areas (parks, green roofs).

•Requirements:

- Local data and forecasts.
- Involvement of communities and institutions.
- Coordination of services (technical, social, environmental).
- It is a dynamic process of continuous monitoring and adjustment.

•**Mitigation:** Policies, actions and technologies to limit emissions or enhance natural sinks for carbon (e.g. forests, wetlands).

•**Examples in local government:**

- Energy upgrading of public buildings and schools.
 - Photovoltaics in municipal buildings.
- Sustainable urban mobility (bike paths, pedestrians, low-emission transport).
- Waste management with material recovery and composting.

•Features:

- It brings long-term benefits, often not immediately visible.
- It requires investment and collaboration with the private sector.
- It is linked to the Covenant of Mayors and the European Green Deal.
 - Essential for stabilizing the global climate.

• **Durability (Resilience):** Ability of a system (city, society, infrastructure) to absorb, adapt and recover from climate impacts.

• It extends to:

- Social cohesion and citizen awareness.
- Decision-making ability and administrative preparation.
- Psychological and institutional adaptability after crises.

•**Data:**

- Preventive planning and emergency plans.
 - Training of executives and citizens.
- Cross-sectoral cooperation (environment, health, transport, civil protection).
 - Vulnerability assessment to identify vulnerable sectors/groups.
- Result of successful adaptive governance for development through crises.

•Specialized Terms for Local Government

- Vulnerability (Vulnerability):** Degree of exposure and inadequate preparation of a system/population to climate impacts, with social, economic and environmental factors.
- Climate Risk (Climate Risk):** Combination of probability of a climate event (e.g. heat wave, flood) and consequences for infrastructure, population, environment.
- Decarbonization(Decarbonization):** Reduce/eliminate CO₂ emissions through transition to renewable energy sources in energy, transport, buildings.
- Climate Neutrality (Climate Neutrality):** Greenhouse gas emission and removal balance for zero net emissions.

- **Emissions Register (Emissions Inventory):** Tool for recording/monitoring emissions by sector (energy, waste, transport) for policy making.
- **Climate Change Action Plan:** Strategic document with risk analysis, objectives, measures, indicators, timelines and financing.
- **Urban Heat Island:** Higher temperatures in urban environments due to construction, lack of greenery and thermal storage of materials.

- **Participatory Design:** Involvement of citizens, institutions and local groups for socially acceptable and effective measures.
- **Analysis Vulnerability:** Systematic identification of vulnerable groups/areas for prioritization adaptation measures.
- **Climate Governance:** Institutions, processes and decision-making mechanisms for climate policy at local, national, supranational levels.

•Conclusion

- Scientific knowledge is the basis for adaptation and mitigation strategies.
- For local government executives, understanding phenomena, mechanisms and forecasts is essential for:
 - Documented action plans.
 - Communication of risks and solutions with citizens and agencies.
 - Attracting financial tools based on climate indicators and scenarios.

- **European Institutional Directions** The EU is a global leader in climate policy, with ambitious legislation and action frameworks.
- **European Green Deal (2019):**
 - Strategic roadmap for a sustainable, circular, climate-neutral economy by 2050.

- Includes:
 - Energy system reform with RES and energy efficiency.
 - Clean transport (electricity, railways).
 - Sustainable agriculture and biodiversity ("From farm to fork").
- Just transition with a Just Transition Fund for coal-dependent regions.
 - Framework for individual legislative initiatives.

- **European Climate Law (2021, EU Regulation 2021/1119):** Legally binding climate neutrality target by 2050.
- Intermediate target: Reduce emissions by $\geq 55\%$ by 2030 (compared to 1990).

- Establishment of a European Scientific Council for Climate to:
 - Progress monitoring.
 - Providing advice.
 - Policy consistency assessment.
- Mechanism «Climate Check» for evaluating national policies and NECPs.
- It is associated with the package "Fit for 55" and long-term planning for a just transition.

• **Package «Fitfor 55" (2021):** Legislative package to reduce emissions by $\geq 55\%$ by 2030.

• **Axles:**

- Extension of EU ETS to road transport and buildings, with a reduction in emission allowances.
 - Energy Tax Review to eliminate fossil fuel advantages.
- Social Climate Fund to support vulnerable households and businesses.
 - Reinforcement NECPs with monitoring mechanisms.

•Other measures:

- Target $\geq 40\%$ RES by 2030.
- Increased energy efficiency.
- Carbon Border Adjustment Mechanism (CBAM).
- Promotion of electric mobility and charging infrastructure.
- Strengthening the LULUCF Regulation for natural CO₂ absorptions.
- It introduces a clean, energy-efficient, socially just development model.

• **EU Strategy on Adaptation to Climate Change (2021):** Approved as a follow-up to the 2013 strategy, with an emphasis on integration and action.

• **Axles:**

- Local/regional adaptation through Mission Adaptation program (target: 150 resilient areas by 2030).
 - Use of digital tools (Climate-ADAPT) for data, indicators, good practices.
 - Nature-based solutions (NbS): Wetlands, urban trees, green infrastructure.
 - Social justice: Inclusion of vulnerable groups, gender equality, participatory governance.

•Goals:

- Smart adaptation with better data.
- Systemic adaptation in all sectors.
- Faster implementation of measures.
- Strengthening international cooperation for vulnerable countries.
 - It complements mitigation policies and links climate policy with social/territorial cohesion.

- **National Strategies and Institutional Framework in Greece** Greece is aligning with European goals for climate neutrality and adaptation.
- **National Energy and Climate Plan (NESEK, 2019, revision 2024):**
 - Basic design for decarbonization, RES, energy efficiency, security of supply.

•Goals:

- Reduction of emissions by 55% by 2030 (compared to 1990).
 - 80% RES in electricity generation by 2030.
- Delignification until 2028 with RES, storage, green hydrogen.
 - Climate neutrality by 2050.
- It is submitted to the EU, includes consultations with stakeholders.

• **Law 4936/2022 – Greek Climate Law:** First comprehensive climate law, harmonized with the EU.

• **Points:**

- Climate neutrality by 2050.
- Intermediate targets: -55% emissions by 2030, -80% by 2040.
- Sectoral policies: Electrification of municipal fleets, ban on oil burners from 2025, climate targets per Ministry.
- Regional Climate Plans and Climate Neutrality Plans for cities >100,000 inhabitants.
- Monitoring mechanism with annual report by the Ministry of National Education and Research and the National Committee.

- **National Strategy for Adaptation to Climate Change (ESPKA, 2016, revision 2023):**

- Institutional framework for addressing the impacts of climate change.
- It is evaluated every five years, revised with recommendations from the National Council.

- **Latest developments (2023–2024):**

- Inclusion of Athens and Thessaloniki in the "100" mission Climate-Neutral and Smart Cities by 2030".
- Development of local/regional climate plans with research institutions and local authorities.

•Latest developments (2023–2024):

- Approval of Regional Adaptation Plans (PESPKA) for 13 Regions, with actions for agriculture, forests, infrastructure, health, tourism.
- Creation of digital platforms for recording risks and vulnerability indicators (with National Observatory, NAA, ELSTAT).

•Projected developments until 2030:

- Strengthening financing for adaptation through European/national resources.
 - Educational programs to raise awareness among citizens.
 - Integrating adaptation into municipal/regional development strategies.
- Development of innovative tools for decision-making and implementation of measures.

•Institutional and Legal Framework (Summary)

- ESEK (2019/2023)**: National energy and climate planning, regulatory basis.
- Law 4936/2022**: First climate law, binding.
- ESPKA (2016, revision)**: Adaptation at regional level, Joint Ministerial Decree.
- PESPKA(2019–2023)**: Action plans by Region, regional policy, Joint Ministerial Decrees & Government Gazettes.

•Role of Local Government (LG)

- Critical role in the implementation of climate policy, as an institutional level close to citizens.

- **Dimensions: Covenant of Mayors:** Commitment of municipalities to emission reduction and resilience through SDAEEP (energy saving, RES, sustainable mobility, risk management).
- **Targeted measures:** Waste management (recycling, composting), electric mobility, energy infrastructure upgrade.
- **Local adaptation strategies:** Contribution to PESPKA and creation of local projects with the Ministry of Education, Culture and Sports and research institutions.

- Financial tools:** Access to Green Fund, NSRF 2021–2027, Recovery Fund, LIFE, Horizon Europe.

- Participatory governance:** Encouraging participation of citizens, institutions, scientific communities for transparency and acceptance.

- **Trends and challenges:** Use of digital tools (GIS, modeling risk, monitoring indicators).
 - Need to strengthen the administrative capacity of small municipalities for submitting/implementing plans.
 - Simplifying access to funding and technical support from the State and the EU.

•1.2 Climate Risk, Vulnerability Analysis and Planning for Resilience and Mitigation at Local Level

- Introduction and Meaning** Climate change is accelerating, making it necessary to systematically assess its impacts at the local level.
- Municipalities are the first recipients of consequences, such as:
 - Extreme weather events.
 - Thermal stress.
 - Floods.

- Municipalities are called upon to develop targeted resilience policies.
- The analysis of climate risk, vulnerability and vulnerability is a critical planning tool for:
 - Understanding existing and future threats.
 - Designing socially just interventions.
 - Strengthening resilience and sustainable development.
- It is based on scientific climate change scenarios (RCP and SSP) to project possible future developments.
- Understanding these tools is a key prerequisite for effective planning.

Practical Tools for Risk, Vulnerability and Vulnerability

- Methodologies have been developed to support local authorities in designing resilience policies:
 - **RVA (Risk and Vulnerability Assessment– Risk and Vulnerability Assessment)**
 - Key step for local adaptation plans (e.g. SDAEK/SECAP).
 - Includes:
 - Identification of natural hazards (floods, droughts, heat waves, fires) based on geography and historical data.

Practical Tools for Risk, Vulnerability and Vulnerability

- Methodologies have been developed to support local authorities in designing resilience policies:
 - Exposure assessment: Physical or social systems at risk (e.g. schools, hospitals, road networks, housing).
 - Vulnerability Analysis: Grade vulnerability systems or groups (e.g. elderly people without access to cooling during heatwaves).
 - Assessment of adaptive capacity: Institutional, technical, social capabilities of the municipality to respond.

•Application:

- Used inPESPKA, LIFE projects,Horizon.
- Instructions fromCovenantofMayorsand ECB.
- BEI (Baseline Emission Inventory– Reference Emissions Inventory)**
 - Records CO₂ emissions at a local level for:
- Highlighting main sources of emissions (municipal lighting, transport, private buildings).
 - Establish a base year (e.g. 2005, 2010) for monitoring progress.
- Guiding policy priorities (energy upgrading, sustainable transport).

•Use:

- Necessary for joining the Covenant of Mayors.
 - It is linked to SDAEK/SECAP.
- Compatible with IPCC standards, uses toolsMyCovenant Platform.
- Climate-ADAPT & Urban Adaptation Support Tools**
- Climate-ADAPT:** Official EU portal for climate change adaptation, includes:
 - Vulnerability and risk maps (RCP4.5, RCP8.5).
 - Good practices, guides, case studies.
- Vulnerability indicators in health, infrastructure, agriculture, coastal areas.

- **Urban Adaptation Support Tools:** Tool for municipalities with instructions for:
 - Risk analysis.
 - Hierarchy of vulnerabilities.
 - Selection of adaptive interventions.
 - Monitoring and evaluation of measures.
- **Use:** Ideal for medium/small municipalities without scientific support.

Vulnerability and Vulnerability Indicators: Analysis and Application

- A fundamental tool for climate risk analysis, they capture:
 - Who and where are most affected?
- Physical exposure and social, economic, spatial parameters.

• **Socioeconomic Indicators** They are related to social/economic vulnerability, e.g.:

- Percentage of elderly people (>65 years old): Vulnerable to heat waves, reduced mobility, chronic diseases.
- Poverty/income level: Limited resources for protection (e.g. insulation, air conditioning).
 - Education/access to information: Affects risk understanding and response.
 - Access to services (health, transportation): Increases risk if it is limited.

• **Example:** In Athens, West Attica has higher vulnerability indicators due to low income and limited access to health services (NAA, 2023).

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•Health Indicators They focus on healthcare vulnerability, e.g.:

- Chronically ill (respiratory, cardiovascular): Vulnerable to extreme temperatures, pollution.
 - Diseases exacerbated by climate change:
 - Heatstroke during heat waves.
 - Respiratory problems in areas with poor air quality.
- Mental health: Affected by natural disasters (floods, fires).

•Urban Vulnerability Indicators

- They highlight physical/structural vulnerability urban environment,
e.g.:

- Building density: Increases thermal stress.
- Lack of greenery/shading: Intensifies the risk of heat island.
- Poor construction quality: Buildings without insulation intensify the effects.
- Urban microclimate: Urban morphology affects air flow, heat accumulation.
- UHI index (Urban Heat Island):** Depicts temperature differences of urban/semi-urban areas, guides urban revitalization measures (e.g. planting, water features).

- **Synthetic Indices** They combine individual indicators for an overall vulnerability score, e.g.:
 - **Climate Vulnerability Index(CVI)**: Combines exposure, vulnerability, response capacity.
 - **Environmental Justice Index**: Focuses on a fair distribution of environmental pressures.
 - **Index for Risk Management (INFORM)**: Application for natural/man-made disasters.

•**Use:**

- Mapping of vulnerable zones (neighborhood, municipal unit).
- Comparison of areas within/between municipalities.
- Decision support for resource allocation.

- **EU application:** ESPON Programme Climate provides risk/vulnerability maps for regions, a basis for local analyses.

- **Significance and Political Relevance** They facilitate targeted Planning:

Identification of vulnerable groups/areas.

- They support social justice: They ensure inclusion of vulnerable populations.
- Basis for documentation of funding requests (LIFE, NSRF, Recovery Fund).

RCP and SSP Scenarios: What They Are and Why They Matter

- Essential for assessments of future climate conditions, they combine:
 - **RCP (Representative Concentration Pathways):** Greenhouse gas concentration levels.
 - **SSP (Shared Socioeconomic Pathways):** Socioeconomic developments.
 - They were developed by IPCC, a basis for climate impact models.

• **RCP scenarios** They describe greenhouse gas concentrations up to 2100, with radiation pressure (W/m^2).

• They focus on shows, not political/social models.

• **Categories:**

- **RCP2.6:** $+2.6 \text{ W/m}^2$, $+1.5\text{--}1.8^\circ\text{C}$, large emission reduction (Agreement Parisian).
 - **RCP4.5:** $+4.5 \text{ W/m}^2$, $+2.0\text{--}2.7^\circ\text{C}$, moderate stabilization, mild policies.
- **RCP6.0:** $+6.0 \text{ W/m}^2$, $\sim +3.0^\circ\text{C}$, moderate delayed effect, technology dependence.
 - **RCP8.5:** $+8.5 \text{ W/m}^2$, $+4.3\text{--}5.0^\circ\text{C}$, high growth without climate policies.
- **Use:** RCP4.5 realistic for planning, RCP8.5 for assessing extreme impacts.

• **SSP Scenarios** They describe socioeconomic developments (economy, inequality, education, technology, cooperation).

• **Categories:**

- **SSP1 – Sustainable Development:** Low inequality, green technologies, cooperation (RCP2.6).
 - **SSP2 –Semi-Realistic Route:** Current trends, average trajectory (RCP4.5).
 - **SSP3 – Regional Competitiveness:** Low cooperation, poverty, nationalism (RCP6.0/RCP8.5).
- **SSP4 – Inequalities:** Social bipolarity, technological elite, vulnerable groups (RCP6.0).
 - **SSP5 – Fossil Fuel Development:** High growth, climate indifference (RCP8.5).

- **Importance for Local Government Risk and Vulnerability Analysis:**
Identification of risk evolution (floods, heat waves) under RCP4.5vs.RCP8.5.
- **Creating Local Scenarios:** Linking natural hazards with social/economic parameters (SSP).
- **Designing Resilient Measures:** Selection of measures effective in various conditions («no regrets», «robust").
- **Funding Claim:** Provides documentation to proposals for LIFE, NSRF, Recovery Fund.

Conclusion

- Local government must design resilience policies that withstand uncertainty.
 - RCP/SSP are predictive planning tools, they enhance strategic resilience.
- Their integration enables scientifically based planning to protect citizens and resources.

Use of RCP and SSP in Local Climate Planning

- RCP/SSP have direct application at a local scale for SDAEK/SECAP and resilience plans.
 - **From Global Scenarios to Local Conditions**
 - RCP: Alternative emissions pathways, warming levels up to 2100.
 - SSP: Socioeconomic framework for climate action.
 - They are combined in models for:
 - Temperature, rainfall.
 - Frequency/intensity of extreme events (heat waves, floods, droughts).
 - Impacts on crops, health, ecosystems.

- **Translation into Local Politics** They are introduced into tools such as:
 - **RVA:** Models intensity/likelihood of risks with RCP/SSP.
- **Vulnerability Indicators:** They examine the social dimension of SSP for vulnerable groups.
 - **GIS Tools:** Visualize impacts (e.g. 1/100 year flood, RCP8.5, SSP3).

- **Application Examples FloodRisk:** Flood probability assessment (RCP4.5vs.RCP8.5) for infrastructure location.
- **Urban Heat Island:** Design tree planting if SSP shows an increase in elderly people.
- **Health Infrastructure:** Strengthening heat wave programs (air-conditioned spaces, volunteers) if SSP indicates vulnerable populations.

•Advantages

- Realistic planning with scientific data, even with limited resources.
- Policy evaluation: Testing the effectiveness of measures in different circumstances.
- Resilience to uncertainties: Selecting solutions that are effective in multiple scenarios.

•Connection with Funding

- Increases financial eligibility (LIFE, Horizon Europe, Recovery Fund).
- Demonstrates strategic depth and alignment with EU goals for resilience/fairness.

Local Planning for Resilience and Climate Action

- Cities are on the front lines of the climate crisis, it is required:
 - Risk management.
 - Adaptation strategies with sustainability/viability.
- **Action Plans (SDAEK, SECAP):** Tools for integrating adaptation/mitigation measures.
- They require cooperation between agencies, citizen participation, and use of data/tools.

Steps and Methodologies for Writing Resilience Plans

•1. Risk and Vulnerability Assessment

- Cornerstone of strategic planning.
- Identification of areas/sectors with higher risk.
 - Includes:
- Physical infrastructure (buildings, networks, road network).
- Socioeconomic status (vulnerable groups: elderly, poorer).

- Tools:** RVA for identifying vulnerable areas (e.g. urban areas with lowvegetation cover, coastal zones).
- Combination with climate trend data and RCP/SSP for probabilities/impacts.

- **Strategy Composition** Targeted, flexible adaptation strategies.
 - They include mitigation/adaptation measures, based on:
 - Current situation.
 - Future risks.
 - Integrate **Nature-based Solutions(NbS)**, e.g.:
 - Drainage upgrades, green roofs for flooding.
 - Durable materials/technologies for infrastructure.

- **Citizen Consultation and Participation** Fundamental to success.
 - Ensures reflection of local community needs/concerns.
 - It helps understand social, economic, and cultural differences.
- **Methods:** Open meetings, referendums, online platforms, collaboration with organizations.
- It increases transparency, acceptance, and willingness to implement.

• **Definition of Strategic Indicators** They provide measurable data for achieving goals and effectiveness of measures.

• **Indicative Indicators:**

- Energy efficiency (reduction of consumption in public buildings).
 - Infrastructure resilience (resistance to extreme events).
 - Biodiversity (reforestation rate, green areas).
- Health/well-being (rate of deaths/diseases from climate factors).

•**Financing and Implementation**Critical for the success of measures.

•**Sources:**

- European programs (Green Fund, LIFE, Recovery Fund).
 - National programs (NSRF).
- Collaboration with the private sector (sponsorships, partnerships).
- Collaboration with entrepreneurs, NGOs, universities for innovative solutions.

•Review and Update

- Plans must be flexible, adaptable to new developments.
- Regular review with monitoring of indicators, feedback from communities/institutions.

•

•Case Study: Municipality's SDAEK Patras

•Risk and Vulnerability Assessment

- Coastal municipality with industrial/commercial activity.
- Analysis of extreme phenomena (temperature increase, rainfall change).
- Infrastructure/population vulnerability assessment with RVA.

• **Strategy Composition** It focuses on:

- Reduction of greenhouse gas emissions.
- Strengthening infrastructure resilience.

• **Actions:**

- Energy upgrading of municipal buildings.
 - Promotion of RES.
 - Sustainable urban mobility.
- Use NbS, adapted to local needs.

•Citizen Consultation and Participation

- Dialogue with citizens/businesses to understand needs.
- It ensures strategies that respond to local realities.

•Definition of Strategic Indicators

- Indicators to monitor:
 - Energy efficiency.
 - Infrastructure resilience.
 - Biodiversity.
 - Citizens' health.

•Financing and Implementation

- Funding from Green Fund, Recovery Fund, NSRF.
- Collaboration with private sector/organizations for implementation.

•Review and Update

- Regular monitoring, feedback from citizens/authorities.
- Adaptation to new scientific/local developments.

Sustainable Energy and Climate Action Plans (SECAPs) and SECAPs SDAEK

- Strategic tools for reducing CO₂ emissions, energy efficiency.
 - **Goals:**
 - Reducing emissions through energy efficiency, RES.
 - Energy upgrading of municipal buildings.
 - Sustainable transportation (public transport, cycling, electric mobility).
 - Waste management (recycling, composting, energy recovery).
 - Promotion of RES (solar, wind, geothermal).
- It requires cooperation between authorities, citizens, businesses, and continuous monitoring.

•ECAPs

- They combine energy transition with climate resilience.

•Data:

- Strengthening public transport (electricity, low emissions).
 - Improving energy networks (resilience, efficiency).
- Support for local RES production, energy communities.
 - Disaster protection with NbS.
- Enhancement of biodiversity and ecosystem services.
- They incorporate mitigation/adaptation, require continuous evaluation.

•Steps for compiling a SECAP/SDAEK Risk and Vulnerability Assessment:

Analysis of emissions, risks, vulnerability.

- Strategic Planning:** Actions to reduce emissions, RES, resilience.
- Citizen/Agency Inclusion:** Consultation for acceptance/support.
- Definition of Indicators:** Measuring success, monitoring progress.
- Financing/Implementation:** Resources from European/national programs, private sector.
- Revision/Update:** Adaptation to new developments/needs.

Case Study: Municipality Grosseto, Italy

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•Risk and Vulnerability Assessment

- Preparation of BEI with IPCC guidelines and Global Covenant of Mayors.
- Provides a comprehensive picture of emission sources, end-user perspective.

•Strategic Planning

- Mitigation plan with:
 - Energy efficiency.
 - Use of RES.
- Infrastructure improvement.
- Focuses on CO₂ reduction, sustainable energy.

•Citizen/Agency Inclusion

- Creating an Alliance for Climate Neutrality.
- Encourage participation of social groups/organizations.
- Strengthening acceptance/support of actions.

•Definition of Indicators

- Indicators for assessing the effectiveness of mitigation/adaptation measures.
- They allow for adaptation of strategies.

• **Financing and Implementation**

- Resources from European/national programs.
- Utilization of available resources for implementation.

• **Review and Update**

- Commitment to continuous review of SECAP.
- Adaptation to new developments, needs, conditions.

•1.3 Financial Tools and Good Practices of Local Government for Climate Adaptation and Mitigation

•**Introduction and Importance of Financing** The successful implementation of climate adaptation and resilience strategies depends on adequate and targeted financing.

- Municipalities and regions are called upon to implement complex actions, such as:
 - Infrastructure upgrade.
 - Flood control projects.
 - Early warning systems.
- Local resilience strengthening programs.

- Actions require resources that often exceed the capabilities of local government.
- Access to financial tools (European, national, private) is crucial.
 - The tools vary in:
 - Targeting.
 - Eligibility criteria.
 - Maturity of projects.
 - Monitoring requirements.

- Critical success factors: Proper planning.
 - Good technical preparation.
 - Collaboration with other bodies.

Overview of Available Funding Programs

•1. NSRF (Partnership Agreement for the Development Framework)

- Main source of EU co-funded actions.
- It covers a wide range of interventions, including climate adaptation.

- Through thematic and regional operational programs, the following are financed: Flood control and drainage projects.
- Improvement of green infrastructure (e.g. greenways, urban forests).
 - Energy upgrading of public buildings.
- Upgradewater supplyand sewage systems in areas of high climate risk.

•NSRF 2021–2027 Targeting:

- Key tool for EU cohesion policy in Greece.
- Policy Objective 2: Promoting a greener Europe through:
 - Adaptation to climate change.
 - Disaster risk prevention.
- Strengthening resilience with Nature-based Solutions(NbS).
 - Energy upgrading of public buildings.

•Eligibility:

- Beneficiaries: First and Second Degree Local Authorities, public bodies, legal entities under public law.

•Good Practices:

- Region of Western Greece: Funded coastal protection and flood protection projects, strengthening resilience to climate risks.

- **LIFE Programme (EU LIFE Programme)** Key EU financial tool for environment and climate.
 - The sub-LIFE program Climate Actions supports:
 - Pilot adaptation projects in urban and rural environments.
 - Actions to restore natural ecosystems to protect against natural hazards (e.g. floods, erosion).
 - Development of local adaptation plans (e.g. SECAPs).
 - Integrating adaptation into public policies and plans.

- **Eligibility:**

- Beneficiaries: Public authorities, NGOs, private companies.

- **Good Practices:**

- WorkUrbanProof: Developed tools to support municipalities for climate adaptation, strengthening resilience.

- **Special Feature:** Emphasis on innovation and replicability in other regions.

- **Green Fund** Ministry of Environment and Energy: Supports actions in municipalities and regions with a focus on:
 - Viability.
 - Environmental protection.
 - Climate resilience.

- Thematic axis “Climate Change” finances:
 - Local adaptation plans.
 - Studies and technical support for climate projects.
 - Plantings, water projects, urban cooling interventions.
 - Development of microclimate monitoring systems.
- It functions as a pre-financing "bridge" for the maturation of applications for European programs.

- **Targeting:** Promoting environmental protection and climate resilience through:
 - Local adaptation plans.
 - Plantings and water works.
 - Urban cooling interventions.

•Eligibility:

- Beneficiaries: First and Second Degree Local Authorities, public bodies, legal entities under public law.

•Good Practices:

- 2024: 12.5 million euro financial program for municipalities of Thessaly, strengthening resilience after natural disasters.

•HorizonEurope Targeting:

- Main EU programme for research and innovation.
- Tackling climate change and promoting sustainable development.

•Eligibility:

- Beneficiaries: Research institutions, universities, public authorities, businesses.

•Good Practices:

- Municipality of Vari-Voula-Vouliagmeni: Participation in the AI4Gov project to develop climate adaptation decision-making tools with artificial intelligence.

•Recovery and Resilience Fund (Greece 2.0) Targeting:

- National Recovery Plan “Greece 2.0” includes investments and reforms for:
 - Green transition.
 - Digitization.
- Strengthening economic resilience.

•Eligibility:

- Beneficiaries: Public bodies, private businesses, local authorities.

•Good Practices:

- It supports private investment through low-interest loans, strengthening sustainable entrepreneurship.

•Interreg Targeting:

- It promotes cross-border cooperation to address common challenges, including climate change.

•Eligibility:

- Beneficiaries: Public authorities, NGOs, research institutions.

- Good Practices:** Interreg Greece-Cyprus Program: Funded projects to enhance resilience to climate risks through joint actions and exchange of know-how.

• **Interreg VI-A Greece–Cyprus 2021–2027** It focuses on cooperation between Crete, the South/North Aegean Regions and Cyprus.

• **Goals:**

- Environmental protection and adaptation to climate change through:
 - Energy efficiency.
 - Reducing greenhouse gas emissions.
- Strengthening resilience with green infrastructure.

- Promoting social and economic development:
- Strengthening culture, sustainable tourism, social economy.
- Strengthening security and social inclusion:
- Support for the integration of refugees and immigrants.
- First Invitation:** December 15, 2023 – January 31, 2024.

• **Interreg VI-A Greece-Italy 2021-2027** Budget: 106.1 million euros.

• Strengthens cooperation between:

- Region of Western Greece (Aetolia-Acarnania, Achaia, Ilia).
- Ionian Islands Region (Zante, Corfu, Kefalonia, Lefkada).
- Epirus Region (Arta, Thesprotia, Ioannina, Preveza).
- Apulia Region, Basilicata, Calabria (Italy).

•Priorities:

- Smart and competitive region: Development of research, innovation, advanced technologies.
- Low-emission green development: Energy efficiency, RES, sustainable mobility.
- Sustainable tourism and cultural heritage: Protection of natural/cultural heritage.

•**First Invitation:** October 20, 2023.

• **Interreg conclusions** Interreg VI-A programmes offer opportunities for:

- Climate adaptation.
- Energy transition.
- Social cohesion.

• Beneficiaries (local authorities, NGOs, research institutions) can implement actions to:

- Durability.
- Sustainable development.

- Required:
 - Strategic planning.
 - Collaboration between agencies.
- Focus on innovative, sustainable solutions.

Examples of Approved Projects

•1. ADAPTO (Interreg Europe)

- **Period:** 2024–2028.
- **Region:** Cyprus and other European regions.
- **Coordinator:** BDI – Business Development Institute.
 - **Goals:**
 - Development of climate change adaptation policies at local/regional level.
 - Exchange of experiences and best practices for resilience strategies.
- Promoting intergovernmental cooperation and participation of policymakers.

•Activities:

- Educational workshops for local authorities and bodies.
- Development of political tools for local action plans.
- Adaptation strategies based on real needs and risk data.

•Expected Results:

- Improving institutional capacity for designing adaptation policies.
- Creating political templates (policy briefs).
- Reinforcementcross-sectoralcooperation.

- **MPA-ADAPT (Interreg MED) Period:** 2016–2019.
- **Region:** Mediterranean (Greece, Spain, Italy, Croatia, Albania).
- **Coordinator:** MEDPAN (Mediterranean Marine Protected Areas Network).

•Goals:

- Development of adaptation strategies for marine protected areas (MPAs).
- Assessment of ecosystem vulnerability and common pressures (global warming, sea level rise).
- Development of guidelines for MPA management under climate change.

•Activities:

- Pilot implementation of monitoring tools in selected marine areas.
 - Training of protected area managers.
- Creation of risk and vulnerability assessment methodologies.

•Results:

- Creation of an “adaptation framework” for MPA.
- Common methodological tool for area managers.
- Policy and action proposals to strengthen marine resilience.

•**ADRIADAPT (Interreg ADRION) Period:** 2019–2021.

•**Region:** Adriatic–Ionian (Italy, Croatia, Slovenia, Greece, Albania, Montenegro).

•**Coordinator:** CMCC (Center Euro-Mediterranean you Changes Climatics, Italy).

•**Goals:**

- Improving the capacity of cities/regions to respond to climate change.
 - Providing tools and data for designing resilient strategies.
- Development of an information platform for public/private bodies.

•Activities:

- Development of an online knowledge platform.
 - Pilot actions in cities (Split, Ravenna, Patras).
- Organization of seminars and participatory workshops.

•Results:

- Electronic database with scientific tools and action plans.
 - Exchange of experiences between partners.
 - Integrating adaptation into local policies.

- **Project Conclusions** The projects show how targeted interventions are financed and implemented:
 - **ADAPTO**: Strengthens policy cooperation and intergovernmental exchange.
 - **MPA-ADAPT**: Focuses on ecological resilience of marine ecosystems.
 - **ADRIADAP**: Supports local authorities with knowledge and technical tools.
- Local government is a crucial pillar of climate policy, close to citizens' needs and the impacts of climate change.
- Evaluating good practices inspires and facilitates the replication of successful models.

Analysis and Categorization of Good Practices

- Successful local government practices for climate adaptation are classified into:

1. Physical Resilience and Infrastructure

- Interventions in public spaces, infrastructure, networks to reduce disaster risks (floods, heat waves).
 - Development of green infrastructure (green roofs, urban forests).

2. Water Resources and Biodiversity Management

Upgrading of drainage systems,
natural streams, riparian zones.

- Protection of wetlands and ecosystems with adaptive value.

•3. Energy Upgrading and Emission Reduction

- Energy efficiency improvement programs in public/private buildings.
- Sustainable mobility and low-emission travel applications.

•4. Citizen Participation and Social Resilience

- Information, participation and education programs on climate change.
- Support for vulnerable populations to climate phenomena.

Examples of Successful Interventions by Municipalities

•1. Municipality of Larissa (Greece) – Green Corridors and Urban Resilience

- **Frame:** Participation in the URBACT project “Food Corridors” for city networks that design nutrition plans, enhancing sustainability and resilience.

- **Interventions:**
 - Development of green corridors connecting urban/suburbanspaces.
 - Promoting sustainable urban agriculture and local food production.
 - Strengthening biodiversity and ecological connectivity.

- **Results:** Improving air quality and reducing temperatures locally.
- Strengthening social cohesion through citizen participation.
- Increasing accessibility to green spaces.

•2. Municipality of Athens (Greece) – Program “Cool Athens” for Heatwaves” Frame: LIFE Programme “Cool Athens” to deal with the effects of heat waves.”

•Interventions:

- Categorization of heat waves based on risk, sending warning messages.
 - Creating an application for navigating cool routes.
- Extended operating hours “Cool Centers” and support for vulnerable groups.

- **Results:** Reduction in energy demand by 15% during the summer months.
 - Improved quality of life, reduced heat stress.
 - Enhanced resistance to extreme temperatures.
 - .

•3. Municipality of Rome (Italy) – Natural Solutions for Flooding

Frame: LIFE Programme –UrbanAdaptfor natural flood control solutions.

•Interventions:

- Upgrading of Tiber riverside areas with high water absorption areas.
 - Implementation of green infrastructure for managementrainwaters.
- Strengthening biodiversity and ecological connectivity.

- **Results:** Reduction of flash flood risk by 30%.
- Improving quality of life and urban environment.
- Strengthening resilience to climate change.

•4. Municipality of Copenhagen (Denmark) – Heavy Rainfall

Management Plan Frame: After the 2011 floods, a comprehensive heavy rainfall management plan (CloudburstManagementPlan).

•Interventions:

- Configuring roads as temporary rainwater conduits.
- Construction of underground tanks and water storage areas.
- Implementation of green infrastructure and parks for water absorption.

- **Results:** Reduction of flood damage, saving millions of euros.
- Increase in property value, improvement in quality of life.
- Strengthening resilience to climate change.

• **Conclusion Examples** They show the diversity and effectiveness of urban interventions for climate change.

• Keys to success:

- Incorporating natural solutions.
 - Active citizen participation.
 - Utilization of financial tools.

- Good practices demonstrate that adaptation can be:
 - Efficient.
 - Innovative.
 - Socially fair.
- Inspiration from successful examples strengthens municipalities' capacity to act by:
 - Local adaptation.
 - European perspective.

Introduction of Monitoring and Evaluation Indicators

- A critical prerequisite for measuring the effectiveness of interventions and improving policy adaptation.
 - Indicators offer measurable data for:
 - Progress documentation.
 - Social/environmental impact assessment.
 - Identification of adaptation needs.

•Indicative Indicators:

- Reduction of heat island effect (°C).
- Number of citizens in awareness-raising actions (% of population).
- Annual water/energy savings in municipal buildings (m³ or kWh).
- Green area per inhabitant (m²/person).

- **Useful Tools:** GIS for monitoring spatial changes.
- Covenant of Mayors Reporting Framework (MyCovenant).
- SECAP Monitoring Tools for recording/evaluating measures.

Interconnection with Municipal Development Strategy

- Climate adaptation actions must be aligned with municipal development planning for:
 - Funding support.
 - Acceptance.
 - Political synergy.

•Interconnection Points:

- **SUMP:** Development of cycle paths, green routes.
- **SVAP:** Green projects that strengthen the local economy.
- **Local Spatial Plans:** Promotion of green infrastructure in urban areas.

- **Example:** Water absorption park can: Improve biodiversity.
 - It functions as a magnet for residents.
 - Increase the attractiveness of the area for investment.

Economic Dimension – Costs and Benefits

- Economic impact documentation is critical for decision-making, especially in municipalities with limited resources.
 - Estimates should combine:
 - Environmental benefits.
 - Social benefits.
 - Economic cost.

•Examples:

- Replacementstreet lightingwith LED: Reduce bills by 40-60%.
- Green roof in a school: Reduction in cooling costs up to 25%.
- Rainwater absorption infrastructure: Reducing flood damage, saving resources.

•Tools:

- CBA (Cost-BenefitAnalysis) for cost/benefit assessment.
- EUUrban Adaptation Support Toolsfor small municipalities.

Funding Tools and Sources

- Finding funding is a timeless challenge.
- Familiarity with technical assistance sources and tools is required.

• Main Sources:

- Recovery and Resilience Fund (RRF).
- NSRF 2021–2027 (Regional & Sectoral Programs).
- LIFE Programme (Environment & Climate Action).
 - HorizonEurope (Green innovation).
- URBACT IV, Interreg Europe (Intermunicipal Partnerships).

•Support Platforms:

- JASPERS (for mature projects).
- EYDEP (Special Emergency Management Service).
- EASME (European Agency for SMEs).

•Localization – “Not everything for everyone”

- The solutions are not suitable for every municipality.

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- Climate adaptation must take into account:
 - Local climate data (island) vs.. semi-mountainous area).
- Administrative/technical capacity (small municipalities need inter-municipal partnerships).
- Availability of ecosystems/space (actions adapted to natural elements).
-
- **Example:**
 - Mountainous municipality: Investment in the protection of forest ecosystems.
 - Coastal municipality: Emphasis on anti-erosion dams.

Cross-sectoral Collaboration & Participatory Governance

- Successful implementation of interventions requires synergies within a municipality and with citizens.

•Internal Collaboration:

- Department of Technical Services & Environment: Joint infrastructure planning.
- Social Structures: Protection of vulnerable populations from heat waves.

•Participatory Approaches:

- Citizen consultations on green projects.
- Climate action councils with NGOs, schools, clubs.
- Co-creation workshops (e.g. green participatory budgeting).

•Example:

- Barcelona Municipality: Citizen involvement in the design of parks for a thermal island.

Good Strategic Planning Practice

- Systematic preparation of municipalities for the utilization of financial tools (e.g. NSRF 2021–2027) is a leading practice.
 - Successful municipalities are distinguished by:
 - Structured preparation.
 - Cross-sectoral cooperation.
 - Administrative maturity.

Nine Steps to Prepare for NSRF

- **1. Municipality Information and Commitment – Designation of Responsible Persons**
 - Understanding of the framework of the program period by executives/elected officials.
 - Actions:
 - Informative seminars, workshops.
 - Cooperation with Managing Authorities, P.E.A.S.
 - Definition of involved services (Programming, Technical, DEYA).
 - Collaboration with the Financial Service for fund management.
 - **Target:** Internal mobilization, clear distribution of roles.

- **Monitoring Program Specialization** Monitoring the specialization of Sectoral and Regional Operational Programs.
- Identification of eligible projects and planning of actions in real time.
- **Target:** Timely knowledge of invitations and eligible expenses.

•**Prioritization of Needs – Link to Business Plan**

- It is based on:
 - Local development strategy.
 - Business plan and sectoral plans (SVAP, SVAK).
- Identification of priorities and interventions of high added value.
- Target:** Targeted, documented project design.

• **Funding Opportunity Assessment** Comparing area needs with program opportunities.

• Questions:

- Which actions are eligible?
 - Are there thematic priorities that match a local vision?
- **Target:** Identifying projects with high chances of funding.

- **Selection of Specific Projects** Preparation of a priority list of projects.
 - Selection of mature or strategically important projects.
 - **Target:** Focus on feasible and beneficial projects.

• **Preparation of Studies – Technical Maturity** Proposal success depends on project maturity:

- Ready studies and permits.
 - Legality of space/property.
 - Clear budget, technical specifications.
- **Target:** Completeness of the file, eligibility expenses.

- **Systematic Invitation Monitoring** Constant vigilance for new invitations from:
 - Sectoral Programs (Ministry of Education, Ministry of Interior).
 - Regional Programs (P.E.).
- **Target:** Immediate response, file preparation.

• **Drafting and Submission of Proposals** Submit proposals with:

- Completion of a Technical Operation Sheet (TDS).
 - Collection of supporting documents.
 - Securing signatures.
- Possible help from external consultants.

• **Target:** Complete, high-quality, on-time submission.

- **Monitoring the Evaluation Process** Monitoring the evaluation process.
 - Response to questions/clarifications from the Managing Authority.
 - Preparation for signing the Integration Decision.
- **Target:** Successful completion of a process, integration of an act.

In conclusion

- Successful preparation for NSRF requires:
 - Political commitment.
 - Executive readiness.
 - Technical maturity.
 - Continuous monitoring of opportunities.
- Strengthening resource absorption capacity through:
 - Creation of a project team within a municipality.
 - Utilization of technical assistance.
- Developing partnerships with local authorities or specialized bodies.

1.4 Basic Principles and Strategies for Climate Change Mitigation

Introduction to Climate Change Mitigation

•Definition:

- Climate change mitigation includes actions to reduce or limit greenhouse gas emissions (AtTh), such as carbon dioxide (CO₂), methane (CH₄) and hypooxide of nitrogen (N₂O).
- Goal: Stabilizing the global climate and limiting global warming.

- **Meaning:** Addressing the greatest environmental challenge of the 21st century.
- Protecting health, ecosystems, the economy and social cohesion.
- Reducing risks from extreme weather events (e.g. heat waves, floods).

•Pillars of addressing climate change:

- Mitigation:** Emission reduction and enhancing carbon sequestration.

- Adjustment:** Strengthening resilience to climate impacts.

•Need for coordinated action:

- International level: Agreements such as the Paris Agreement (2015).

- National level: National plans and legislation (e.g. NSEK in Greece).

- Local level: Role of Local Government Organizations (LGOs).

•Application areas:

- Energy, transportation, buildings, industry, agriculture, land use, urban planning.

- **Basic Principles of Climate Change Mitigation**
 - **Decarbonization:**
- **Definition:** Drastic reduction in the use of fossil fuels (coal, oil, natural gas) and transition to renewable energy sources (RES).
 - **Practical applications:**
 - Installation photovoltaic and wind farms.
 - Development of hydroelectric and geothermal units.
 - Research and use of hydrogen as an alternative fuel (e.g. green hydrogen).
 - Offshore wind installations for higher efficiency.

•Examples:

- Denmark covers >50% of its electricity from wind energy.
- Greece aims for 80% RES in the energy mix by 2030 (ESEK).

•Challenges:

- High initial cost of investments in RES.
- Need to upgrade energy distribution networks.
- Resistance from traditional energy sectors (e.g. lignite).

•Opportunities:

- Creation of thousands of jobs in the renewable energy sector.
- Reducing dependence on fossil fuel imports.
- Improving air quality and reducing pollution.

•**Global importance:** Core of the EU Green Deal and the Paris Agreement.

•**Energy Efficiency:Definition:** Reducing energy consumption through technological innovations and improved practices.

•**Practical applications:**

- Use of energy-efficient devices (e.g. LED, class A+++ air conditioners).
- Energy upgrading of buildings (insulation, double glazing, heat pumps).
- Implementation of energy management systems (BEMS) in buildings and industries.
- Energy efficiency standards in vehicles and industrial processes.

•Examples:

- "I Save" program in Greece for energy upgrading of homes.
- Energy efficient appliances with EU labels (A+++, A++).

•Challenges:

- Limited consumer awareness of energy-efficient choices.
- High cost of upgrading old infrastructure.
- Need for financing for small and medium-sized enterprises (SMEs).

•Opportunities:

- Reduced operating costs for households and businesses.
 - Reducing pressure on energy networks.
- Strengthening business competitiveness through savings.

•**Global importance:** Critical for achieving energy efficiency goals (e.g. Fit for 55).

• **Circular Economy: Definition:** Minimizing waste through reuse, recycling and re-importation of materials in production.

• **Practical applications:**

- Recycling of plastics, metals, paper and organic waste.
 - Composting for management of biowaste.
- Designing products with a longer life cycle (e.g. reusable packaging).
 - Models «sharing economy» (e.g. sharing cars, tools).

•Examples:

- Recycling 50% of municipal waste in the EU by 2030 (Green Deal target).
- Plastic bottle return programs in supermarkets (e.g. Germany).

•Challenges:

- Insufficient recycling infrastructure in many areas.
- Low environmental awareness in some societies.
- Need for legislative incentives and sanctions.

•Opportunities:

- Reducing dependence on virgin materials (e.g. metals, oil).
 - Creation of new business models (e.g. recycling companies).
 - Strengthening local economies through waste management.
- Global importance:** A key element of the EU's circular economy.

•**Land Use Changes:Definition:** Protecting and restoring natural ecosystems to sequester carbon and reduce emissions.

•**Practical applications:**

- Reforestation and restoration of forests, wetlands and grasslands.
- Implementation of sustainable agricultural practices (e.g. organic farming, agroforestry).
 - Creation of urban parks, green roofs and vertical gardens.
- Soil management to increase organic matter (carbon sequestration).

•Examples:

- Reforestation program in Greece after the 2021 fires.
- "4 per 1000" initiative to increase carbon in the soil.

•Challenges:

- Competition between agriculture, urban development and natural ecosystems.
- Limited funding for ecosystem restoration.
- Climatic impacts on vulnerable areas (e.g. droughts).

•**Opportunities:**

- Strengthening biodiversity and ecosystem resilience.
- Improving quality of life in urban areas.
- Reducing risks from natural disasters (e.g. floods).

•**Global importance:** Critical for CO₂ sequestration and nature protection.

• **Use of Innovation and Digital Technology: Definition:** Use of advanced technologies to optimize energy and emissions management.

• **Practical applications:**

- AI for energy demand forecasting and consumption optimization.
 - Smart grids (smart grids) for efficient energy distribution.
 - Blockchain for transparent emissions trackingAtTh.
- IoTfor automated management of buildings, transportation and industries.

•Examples:

- Smart energy meters in households (e.g. PPC in Greece).
- GIS for mapping emissions in urban areas.

•Challenges:

- High cost of developing and adopting technologies.
- Need for staff training in new technologies.
- Cybersecurity and data protection issues.

•**Opportunities:**

- Increased energy and resource efficiency.
- Scaling solutions globally.
- Strengthening transparency and accountability.

•**Global importance:** Enhances the accuracy and effectiveness of mitigation measures.

Mitigation Strategies in Various Sectors

1. Energy:

1. Meaning: Responsible for the largest percentage of emissions worldwide.

2. Strategies:

1. Investment in RES (solar, wind, hydroelectric, geothermal).
2. Phase out lignite and coal with worker support (just transition).
3. Development of interconnected networks and storage technologies (e.g. batteries).

•Examples:

- Greece: Delignification by 2028, 80% RES by 2030 (ESEK).
- Germany: Energiewende for transition to RES.
- Challenges:** High cost, technical difficulties, social resistance.
- Opportunities:** Job creation, energy independence, cleaner air.

•**Transportation:Meaning:** Significant source of emissions, especially in urban centers.

•**Strategies:**

- Promotion of electromobility (EV, electric buses, trains).
 - Expansion of zero-emission public transport.
- Creation of cycle paths, pedestrian paths and low emission zones (LEZ).

•Examples:

- Greece: "I Drive Electric" program for EV subsidy.

- Copenhagen: >50% of residents use bicycles for daily commute.

- Challenges:** Insufficient charging network, high EV costs, resistance to changing habits.

- Opportunities:** Reduction of pollution, improvement of quality of life, reduction of traffic congestion.

•**Buildings:Meaning:** Responsible for a significant percentage of energy consumption (heating, cooling, lighting).

•**Strategies:**

- Energy upgrade (insulation, double glazing, heat pumps).
- Design of passive buildings with minimal energy needs.
- Use of smart systems (smart thermostats, IoT sensors).

•Examples:

- Greece: "I Save" program for housing.

- EU: Nearly Zero Energy Buildings (NZEB) standard for new buildings.

- Challenges:** High renovation costs, lack of technical expertise.

- Opportunities:** Reduction of energy costs, improvement of comfort, increase in property value.

•**Industry:Meaning:** Heavy industries (cement, steel) produce high emissions.

•**Strategies:**

- Adoption of low-emission technologies (e.g. electric furnaces, CCS).
- Development of alternative materials (e.g. green cement, hydrogen in steelmaking).
- Transition to RES for powering industrial units.

•Examples:

- EU: Innovation Fund for decarbonizing industries.

- ArcelorMittal: Pilot projects with hydrogen in the steel industry.

- Challenges:** High cost of technologies, technical difficulties, global competition.

- Opportunities:** Innovation, emission reduction, enhanced competitiveness.

•**Agriculture and Land Use:Meaning:** Emissions from fertilizers, livestock farming and deforestation.

•**Strategies:**

- Reducing the use of nitrogen fertilizers through precision agriculture.
 - Implementation of organic farming and agroforestry.
- Reforestation and soil restoration for CO₂ sequestration.

•Examples:

- "4 per 1000" initiative to increase organic carbon in the soil.

- Greece: Reforestation in burned areas (e.g. Evia, Attica).

- Challenges:** Competition for land use, limited funding.

- Opportunities:** Enhancing biodiversity, improving soil productivity.

Role of Local Government Organizations (LGOs)

•**Meaning:** Local authorities are close to citizens and manage local resources and infrastructure.

•**Responsibilities:**

- Design of local climate plans (e.g. SUMP).
- Energy upgrading of municipal buildings.
- Promotion of public transport and cycling infrastructure.

- Waste management and promotion of recycling.

•Examples:

- Municipality of Athens: Implementation of low-emission zones and green roofs.
- Municipality of Trikala: Smart city pilot programs with IoT.

•Challenges:

- Limited funding and technical expertise.
- Need for cooperation with national and international bodies.

•Opportunities:

- Improving quality of life at the local level.
- Attracting investment in green projects.
- Strengthening the local economy through sustainable practices.

- **Policy Framework**
 - **European Level:**
 - **European Green Deal:**
 - Goal: Climate neutrality by 2050.
 - Investments in RES, circular economy, green transport.
 - **Fitfor 55:**
 - Reduce emissions by 55% by 2030.
 - Measures: EU ETS revision, CBAM, promotion of electromobility.
- **Covenant of Mayors:** Commitment of thousands of local governments to local climate plans.
 - Support for mitigation and adaptation.

•National Level (Greece):National Climate Law (Law 4936/2022):

- Binding targets for emission reduction.
- Obligations for local authorities and businesses.

•NECP (National Energy and Climate Plan):

- Targets: 80% RES,delignificationuntil 2028.
- Boosting electromobility and energy efficiency.

•Ministry of Interior:

- Financial tools (e.g. Recovery Fund).
- Technical support for local authorities and businesses.

•Local Level:Net PlansZero:

- Climate neutrality target by 2030 in pioneering municipalities.
 - Examples: Municipalities of Athens, Thessaloniki,Trikala.

•Program 100Climate-Neutral Cities:

- Greek municipalities participate in a European program for zero footprint.

•Inter-municipal collaborations:

- Exchange of good practices and know-how.
- Examples: City networks for sustainable mobility.

Local Implementation of International Goals: NetZero2030

•Strategies:

- Mapping local emissions using GIS and indicators.
- Development of local climate plans with a horizon of 2030.
- Use of technologies (AI,IoT) for energy, transport and pollutant management.
- Participatory processes for transparency and accountability.

•Examples:

- Municipality of Chania: Program for zero emissions through RES and cycling infrastructure.
- Municipality of Larissa: Implementation of SUMP for sustainable urban mobility.

•Challenges:

- Limited resources and technical support in small municipalities.
- Need to raise awareness among citizens to change behaviors.

•Opportunities:

- Strengthening local resilience and quality of life.
- Attracting European funds for green projects.
- Creating model zero-footprint cities.

Conclusion

- **Basic principles:** Decarbonization, energy efficiency, circular economy, land use changes, and use of digital technology constitute the framework for climate change mitigation.
- **Application areas:** Energy, transport, buildings, industry and agriculture require tailored strategies.

Conclusion

- **Role of local government:** Critical for the local implementation of measures through urban planning, energy upgrading and awareness-raising.
- **Policy framework:** The Green Deal, the Fit for 55, the National Climate Law and the National Energy Strategy guide efforts at European and national levels.
- **NetZero2030:** Local governments can align with international goals through local plans, technology and participatory processes.

1.5 Promotion of Renewable Energy Sources and Energy Efficiency in Municipalities

Introduction to the Promotion of RES and Energy Efficiency in Municipalities

•Meaning:

- Climate change is a critical challenge of the 21st century, affecting the environment, society and economy.
- Municipalities are key pillars for reducing greenhouse gas emissions (AtTh) and adaptation to climate change.
 - Promoting RES and energy efficiency enhances energy autonomy and reduces the environmental footprint.

- Goals:** Contribution to national and European climate goals (e.g. Green Deal, climate neutrality by 2050).
- Reduction of energy costs and CO₂ emissions.
- Creating jobs and strengthening the local economy.

•Challenges:

- Limited funding and technical expertise.
- Bureaucratic obstacles and lack of citizen awareness.

•Opportunities:

- Financial tools (EXOIKONOMO, NSRF, Interreg, Recovery Fund).
- Collaborations with private entities and local communities.
- Legislation for energy communities (Law 4513/2018, Law 5037/2023).

Strategies for Promoting RES and Energy Efficiency

1. Local Energy Communities:

1. Definition:

1. Cooperative schemes for the production, storage and distribution of clean energy, based on Law 4513/2018 and Law 5037/2023.
2. Municipalities, citizens, businesses and local bodies participate.

•**Practical applications:**

- Installation photovoltaic parks on municipal lands.
- Small wind turbines or biomass units for local energy production.
- Energy distribution via microgrids (microgrids).

•**Examples:**

- **Municipality Trikala:** Energy community for supplying municipal buildings with solar energy.
- **Municipality of Agios Dimitrios:** Promoting citizen participation in energy communities.

- **Benefits:** Reduction of energy costs for municipalities and citizens.
 - Strengthening energy autonomy and resilience.
 - Promoting social participation and environmental awareness.

•Challenges:

- High initial investment cost.
- Complex legislative framework.
- Need for technical support and training.

•Solutions:

- Funding from European programs (e.g. Interreg, LIFE).
- Collaborations with private entities and technical consultants.

•Energy Renovations of Buildings:Definition:

- Upgrading municipal buildings (schools, administrative centers, cultural facilities) to reduce energy consumption.

•Practical applications:

- Thermal insulation of walls and ceilings.
- Replacement of frames with double or triple glazing.
- Installation of high-efficiency cooling-heating systems (e.g. heat pumps).
- Use of RES (e.g. photovoltaics, solar water heaters).

•Examples:

- Municipality of Athens:** Energy upgrading of schools with geothermal pumps and photovoltaics.
- Municipality of Thessaloniki:** Renovation of municipal buildings with a 40% reduction in consumption.

•Benefits:

- Reduction of operating costs up to 60% (CRES studies).
- Improving living and working conditions.
- Contribution to the standard Almost Zero Energy Buildings (nZEB).

•Challenges:

- High initial cost and need for specialized studies.
- Limited access of small municipalities to financing.

•Solutions:

- Financing through the National Strategic Reference Framework (NSRF), Recovery Fund and EXOIKONOMO.
- Collaboration with technical consultants for studies.

•SAVE Programs:Definition:

- National funding program for energy upgrading of buildings, with an emphasis on municipal buildings.

•Practical applications:

- Thermal insulation reinforcement and replacement of heating systems.
 - Installation of RES (e.g. photovoltaic, solar systems).
 - Use of smart energy management systems (BEMS).

•Examples:

- Municipality of Thessaloniki:** Inclusion of buildings in EXOIKONOMO with a 40% reduction in consumption.
- Municipality of Larissa:** Upgrading primary schools with subsidies.

•Benefits:

- Subsidies that cover a large part of the costs.
- Reduction of CO₂ emissions and energy costs.
- Strengthening the local economy through construction projects.

•Challenges:

- Bureaucracy and delays in approving applications.
- Need for technical expertise to submit proposals.

•Solutions:

- Support from technical consultants and CRES.
- Staff training for submitting applications.

•Modernization of Municipal Lighting:Definition:

- Replacing conventional lighting with LED technologies and smart systems.

•Practical applications:

- Replacing mercury or sodium lamps with LEDs.
 - Installation of motion sensors and timers.
- Use of RES (e.g. photovoltaics) to power lighting.

•Examples:

- Municipality of Piraeus:** Replacing 80% of lighting with LEDs, saving 50–70%.
- Municipality of Chania:** Implementation of smart lighting systems in public spaces.

•Benefits:

- Reduction of energy consumption up to 70% (CRES studies).
- Reduced maintenance costs and improved safety.
- Enhancement of the aesthetics of public spaces.

•Challenges:

- High initial installation cost.
- Need for technical support for maintenance.

•Solutions:

- Financing through the ELEKTRA program.
- Collaborations with private companies for technological support.

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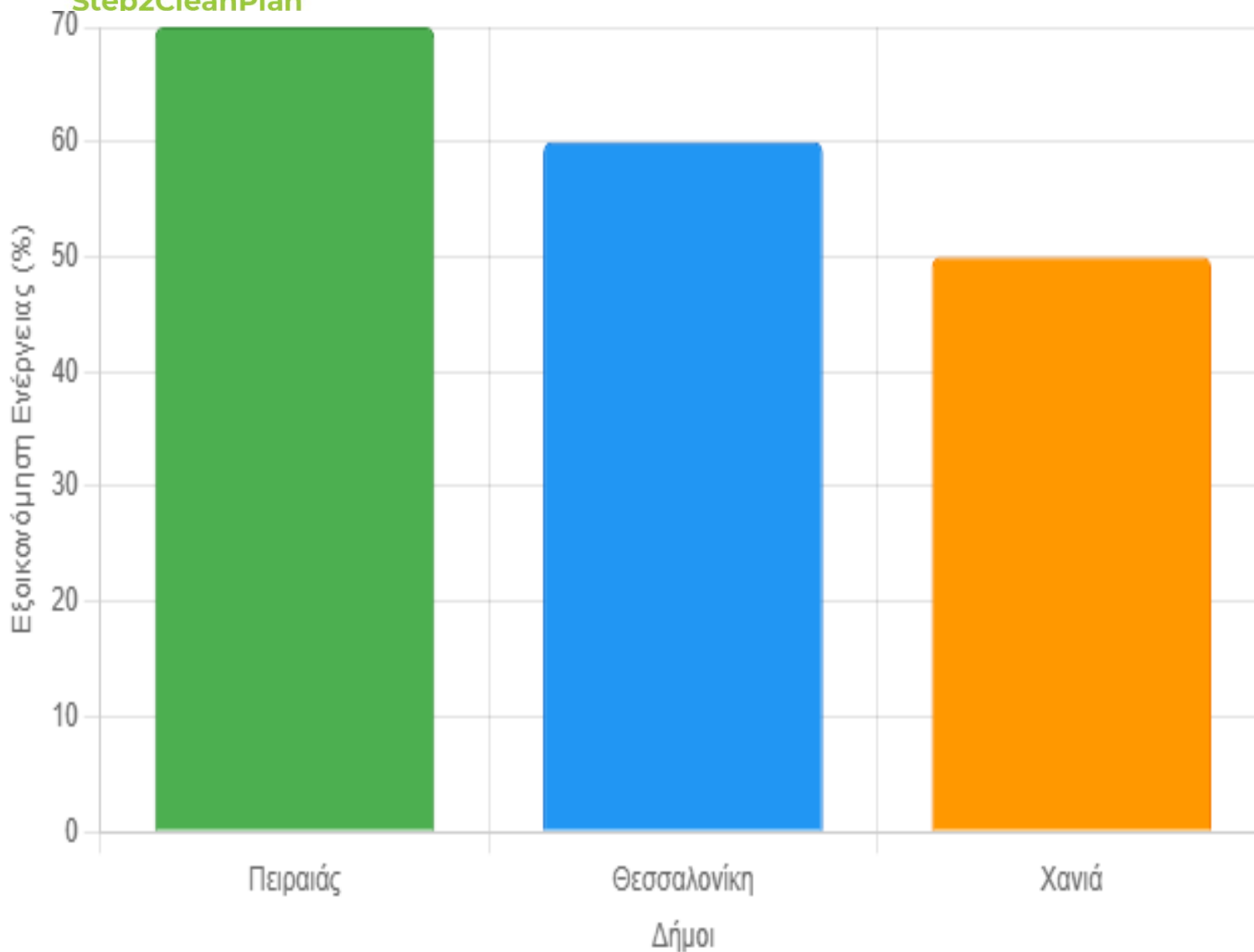


Chart:
Energy Saving
by LED Lighting:

•Low Cost Actions with High Benefit:Definition:

- Simple measures with minimal cost that offer significant environmental and economic benefits.

•Practical applications:

- Awareness campaigns for energy saving in buildings and households.
 - Adjusting thermostats and using timers.
 - Regular maintenance of equipment (e.g. air conditioners, boilers).
- Promotion of cycling and walking through cycle paths and pedestrian paths.

•Examples:

- Municipality of Chania:** Campaigns in schools to reduce consumption by 15%.
- Municipality of Athens:** Creation of bike lanes and pedestrian paths in the center.

•Benefits:

- Minimum implementation cost.
- Immediately measurable results (e.g. reduction in consumption).
- Strengthening environmental awareness among citizens.

•Challenges:

- Need for continuous information and citizen participation.
- Limited long-term effect without combination with other measures.

•

•Solutions:

- Strengthening communication campaigns through social media.
- Collaboration with schools and local clubs.

Water Resources Management and Reduction of Water Consumption

Meaning:

- Climate change is exacerbating water scarcity, droughts and water quality degradation.
- Municipal services (irrigation, cleaning, buildings) consume a significant proportion of water.
- Leaks in water supply networks reach up to 40% in some municipalities (Ministry of Water, Energy and Water Resources).
- Water management is linked to energy efficiency, as pumping and processing require energy.

- **Challenges:** Old hydraulic infrastructure with high losses.
 - Limited funding for modernization.
 - Lack of awareness about saving water.
- Need for harmonization with national and European guidelines.

•Technologies and Actions:Smart Irrigation Systems:

- Use of humidity sensors and meteorological data.
- Automated systems for customized watering.
- **Example:** Municipality of Heraklion, Crete, reduction of water consumption by 30%.

•Leak Detection Systems:

- Acoustic sensors and telemetry for early detection.
- **Example:** Municipality of Larissa, saving thousands of m³ of water annually.

•Water Recycling and Reuse:

- Rainwater collection for irrigation or cleaning.
- Grey water treatment for non-potable uses.

•**Example:** Municipality of Chania, rainwater tanks for gardens.

- **Energy Efficient Pumping Technologies:** Replacement of old pumps with high efficiency ones.
 - Use of RES (e.g. photovoltaics) for pumping stations.
- **Example:** Municipality of Rhodes, photovoltaics at pumping stations.
 - .

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Μείωση Κατανάλωσης Νερού από Έξυπνα Συστήματα Ποτίσματος

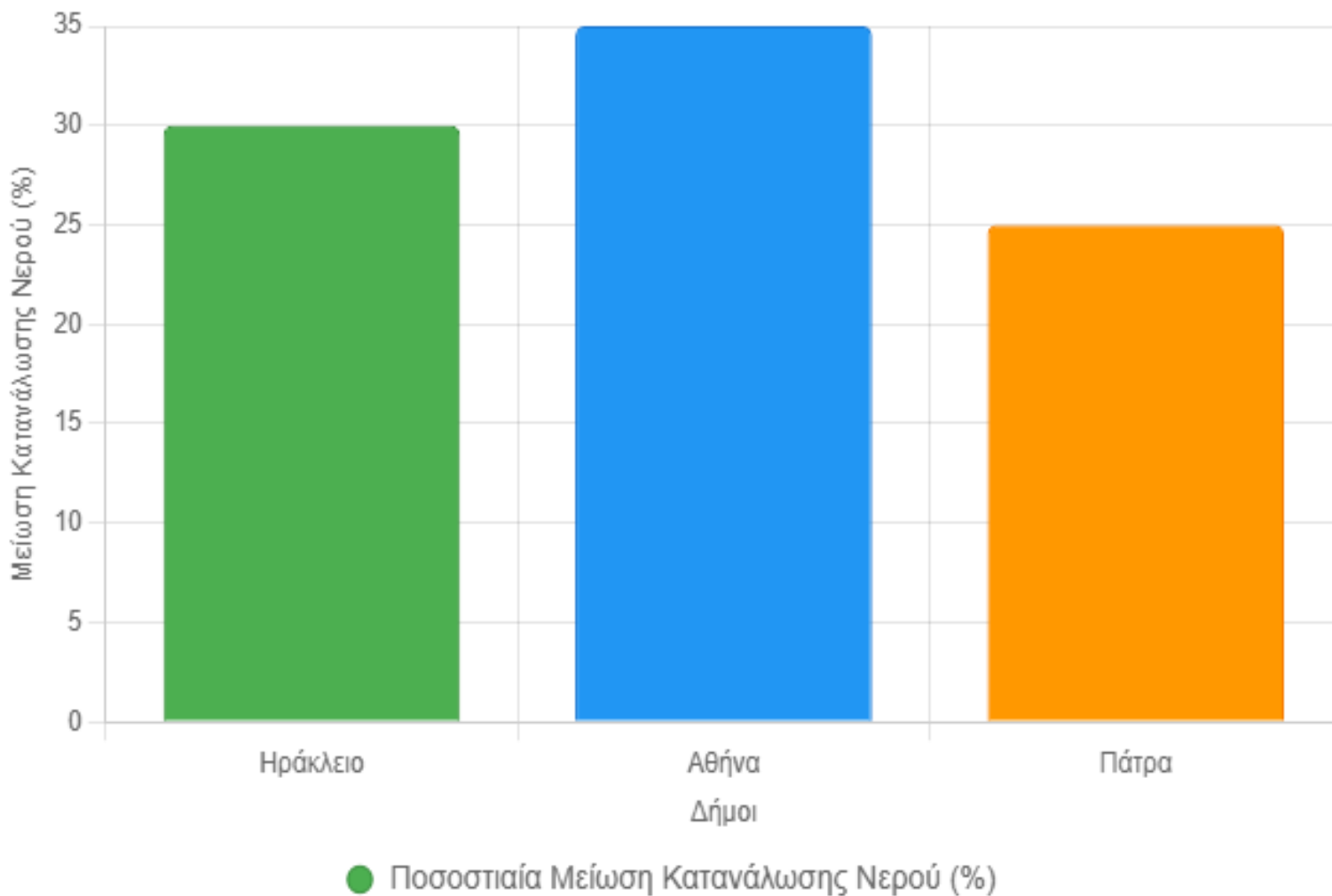


Chart: Reduction in
Water Consumption
from Smart Irrigation
Systems:

•Benefits:

•Environmental:

- Conservation of water resources and reduction of pressure on springs.
- Reduction of energy footprint from pumping and processing.
-

•Finance:

- Saving water and energy costs.
- Reduction of network maintenance costs.

•Social:

- Strengthening environmental awareness.
- Improving quality of life through the preservation of green spaces.

•Challenges:

- High initial cost for installing technologies.
- Lack of specialized personnel for maintenance.
- Need for harmonization with the legislative framework.

•Solutions:

- Funding from European programs (Interreg, LIFE).
- Personnel training through collaborations with CRES.
- Integrating actions into Sustainable Energy and Climate Action Plans (SECAPs).

- **Application Examples:**
 - **Municipality of Athens:** Smart irrigation systems in parks with sensors.
 - **Municipality of Patras:** Telemetry to reduce leaks by 25%.
 - **Municipality of Corfu:** Rainwater tanks for irrigation.

Connection to Energy Efficiency

•Water-energy relationship:

- The pumping, treatment and distribution of water require significant energy.
 - Reducing water consumption leads to lower energy demand.

•Strategies:

- Use of RES to supply pumping stations and water supply systems.
 - Integrating water saving technologies into WASH plans.

•Financing:

- NSRF, Recovery Fund, Interreg for coastal municipalities.
 - Collaborations with CRES and private entities.

Conclusion

• **Role of municipalities:** Critical for promoting RES, energy efficiency and sustainable water management.

• **Strategies:**

- Energy communities for local clean energy production.
- Building renovations and SAVE programs to reduce consumption.
 - Modernization of lighting with LED and smart systems.
 - Low-cost actions for immediate results.
- Water saving technologies (smart irrigation, telemetry, recycling).

•Benefits:

- Environmental: Reducing CO₂ emissions and conserving water resources.
- Economics: Cost savings and strengthening the local economy.
- Social: Improving quality of life and raising awareness among citizens.

•Prospects:

- Utilization of financial tools and partnerships.
- Integrating actions into local climate plans (SDAEK).
- Municipalities can be models of sustainable development, contributing to climate neutrality goals.

1.6 Circular Economy and Local Policies for Sustainable Resource and Waste Management

Introduction to Circular Economy and Sustainable Waste Management

•Definition of Circular Economy:

- A development model that promotes the reduction, reuse and recycling of materials.
- Goal: Minimize waste, protect the environment and preserve the value of materials.

•Importance for Local Government:

- Municipalities manage a large volume of municipal waste (5.2 million tons annually in Greece, ELSTAT).
- They implement prevention, recycling and reuse policies, influencing consumer habits.
- They contribute to reducing the environmental footprint and saving resources.

•Policy Framework:

•

- European:** Green Deal, Circular Economy Action Plan, 60% municipal waste recycling target by 2030.
- National:** National Waste Management Plan (NWMP) 2020-2030, target 55% recycling by 2025.

•Challenges:

- Low recycling rate in Greece (21% in 2022, compared to 48% in the EU).
 - Lack of infrastructure, limited funding, low citizen awareness.
 - Complex legislative framework and bureaucracy

•Opportunities:

- Funding from NSRF, Interreg, LIFE, Horizon Europe, Recovery Fund.
 - Job creation and innovation through local initiatives.
 - Strengthening social cohesion through citizen participation.

- **Circular Economy Initiatives in Municipalities**
 - **Recycling:**
 - **Definition:**
 - Recovery of materials (paper, plastic, glass, metals) for reuse in production.
 - **Practical Applications:**
 - Expansion of sorting at source with separate collection of waste streams.
 - Installation of recycling corners in public spaces (parks, squares).
 - Strengthening Recyclable Materials Sorting Centers (KDAY).
 - Awareness campaigns for proper waste sorting.

•Examples:

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- Municipality of Vari-Voula-Vouliagmeni:** Source sorting program with four streams, recycling rate 35%.
- Municipality of Heraklion, Crete:** Underground recycling bins for better aesthetics and efficiency.
- Benefits:**
 - Reduction of waste in landfills.
 - Saving raw materials and energy.
 - Creation of jobs in recycling units.

•Challenges:

- Insufficient infrastructure in small/remote municipalities.
- Low citizen participation due to lack of information.
- Need for continuous training and motivation.

•Solutions:

- Funding from NSRF and LIFE for infrastructure.
- Educational programs in schools and local communities.

•Composting:Definition:

- Conversion of organic waste (food scraps, branches) into soil conditioner material.

•Meaning:

- Organic waste constitutes ~40% of municipal waste in Greece.
 - Reduces methane emissions from landfills.

•Practical Applications:

- Free or subsidized housingcompostersfor households.
- Community composting stations in parks or municipal facilities.
- Separate collectionbiowastewith brown bins (ESDA).

•Examples:

- Municipality of Athens:** Distribution of household goodscompostersand community stations in neighborhoods.
- Municipality of Chania:** Collectionbiowastefrom restaurants and compost production for gardens.

•Benefits:

- Reduction of waste volume by 30–40%.
- Production of quality compost for parks and agriculture.
- Strengthening environmental awareness.

•Challenges:

- Need for citizen education on proper composting.
- Limited spaces for community composting.
- Initial infrastructure costs.

•Solutions:

- Funding from Interreg and NSRF.
- Collaboration with agricultural cooperatives for the use of compost.

•Reuse:Definition:

- Reusing products before they become waste, extending their lifespan.

•Practical Applications:

- Reuse Centers for donation/exchange of items (furniture, clothing, appliances).
 - Repair workshops (bicycles, electronics, furniture).
- Collaborations with businesses for reusable packaging.

•Examples:

- Municipality of Thessaloniki:** "Reuse Corners" for household items.
- Municipality of Kifissia:** Furniture repair workshops, reduction of bulky waste.

•Benefits:

- Reduction of waste production and consumption of raw materials.
 - Support for small repair businesses.
- Social support through free items to vulnerable groups.

•Challenges:

- Low citizen participation due to lack of awareness.
- Need for infrastructure and education.

•Solutions:

- Information campaigns through schools and social media.
- Funding from Horizon Europe for pilot projects.

•Green Markets:Definition:

- Supply of products/services with a low environmental footprint (e.g. ecological cleaning products, recycled materials).

•Practical Applications:

- Sustainability criteria in procurement tenders (Directive 2014/24/EU).
- Preference for local products to reduce transportation emissions.
- Staff training on environmental criteria.

•Examples:

- Municipality of Piraeus:** Green purchases for paper and cleaning products.
- Municipality of Rhodes:** Use of recycled materials in municipal buildings.

•Benefits:

- Reducing the environmental footprint of municipal services.
- Promotion of sustainable products and local businesses.

•Challenges:

- Higher initial cost of green products.
- Lack of know-how and need for harmonization with legislation.

•

•Solutions:

- Support from the Ministry of Energy and Renewable Energy and Central Renewable Energy Resources for technical guidance.
- Funding from the National Strategic Reference Framework for Green Procurement.

•Waste Prevention:Definition:

- Reducing waste production through changes in consumer habits and municipal practices.

•Practical Applications:

- Campaigns to reduce single-use plastics.
- Zero waste programs (zero waste) at municipal events.
- Incentives (e.g. reductions in municipal fees) for waste reduction.

•**Examples:**

- Municipality of Syros-Ermoupolis:** Program «Zero Waste» with reusable materials at festivals.
- Municipality of Agios Dimitrios:** Fee discounts for recycling and composting.

•**Benefits:**

- Reduction of waste management costs.
- Strengthening environmental awareness.
- Contribution to national/European goals.

•Challenges:

- Need for a long-term change in mentality.
- Limited participation without incentives.

•Solutions:

- Strengthening incentives through municipal policies.
- Collaboration with NGOs and schools to raise awareness.

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Κατανομή Αστικών Αποβλήτων στην Ελλάδα (2022)

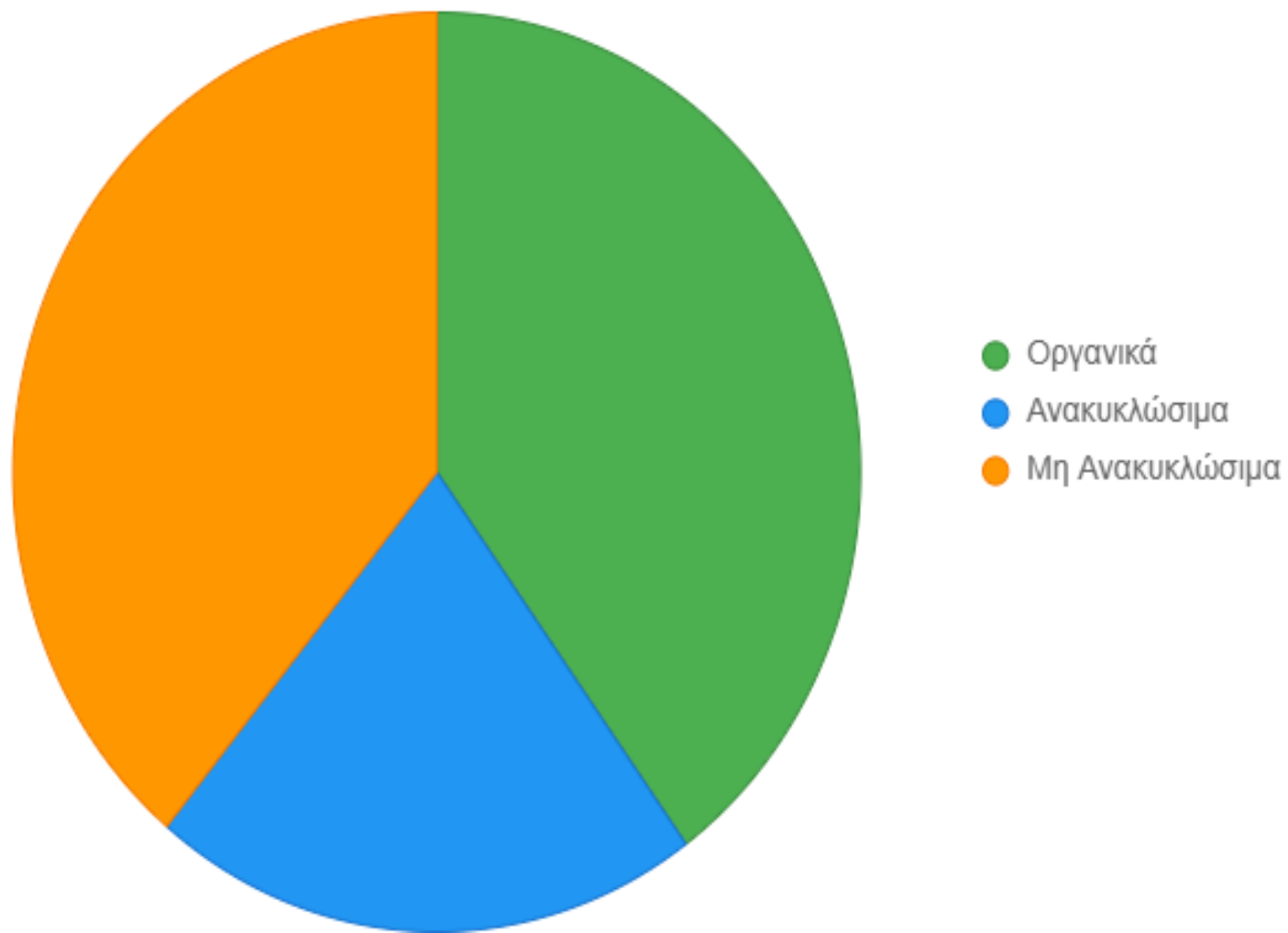


Chart: Distribution of
Municipal Waste in
Greece (2022)

- **Electronic and Hazardous Waste Management**

- **Meaning:**

- **Electronic Waste (WEEE):**

- They contain valuable materials (copper, gold, rare earths) and toxic substances (lead, mercury).
 - Production: ~200,000 tons per year in Greece (EEAA, 2022).
 - Recycling rate: 40%, against a target of 65% by 2030.

- **Electronic and Hazardous Waste Management**

- **Hazardous Waste:**

- Batteries, chemicals, and expired medicines threaten the environment and health if not managed properly.
 - Sub-managed due to lack of infrastructure.

- **Frame:**

- Directive 2012/19/EU on WEEE, REACH Regulation on hazardous materials.
 - 2020-2030 NRW: Strengthening recycling and safe disposal.

- **Challenges:** Insufficient collection points and specialized facilities.
 - Low awareness among citizens about proper disposal.
 - High transportation and processing costs.
 - Complex legislative framework.

•Actions and Technologies:Special WEEE Collection Points:

- Fixed or mobile points ("Recycling Corners") for electrical appliances.
- Collaboration with systems (Appliance Recycling S.A., Photocycling).

•Hazardous Waste Collection:

- Bins for batteries, medicines, chemicals in municipal buildings/pharmacies.

•Awareness Campaigns:

- Information through schools, events, social media.

•

•Digital Tools:

- Applications to inform citizens about collection points/days.

•Collaborations with Businesses:

- Material recovery and safe disposal of hazardous substances.

- **Application Examples: Municipality of Athens:** Bins for batteries/devices, recycling 10 tons of WEEE annually.
- **Municipality of Thessaloniki:** Mobile WEEE collection units and hazardous waste collection days.
- **Municipality of Rhodes:** Pilot program for WEEE in tourist areas.
- **Municipality of Chalandri:** "Recycling Corner" and student education.

•**Benefits:Environmental:**

- Reduction of soil/water pollution from toxic substances.
- Saving 80% of raw materials through WEEE recycling.

•**Finance:**

- Savings from material recovery and reduction of landfill disposal.
 - Creation of jobs in recycling units.

•**Social:**

- Public health protection.
- Strengthening environmental awareness.

•Challenges:

- Lack of infrastructure in small municipalities.
- Low citizen participation due to lack of access/information.
- High processing costs.

•Solutions:

- Funding from NSRF, LIFE, Interreg.
- Collaboration with approved collective systems.
- Education through schools and NGOs.

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Ποσοστά Ανακύκλωσης ΑΗΗΕ σε Ελληνικούς Δήμους (2022)

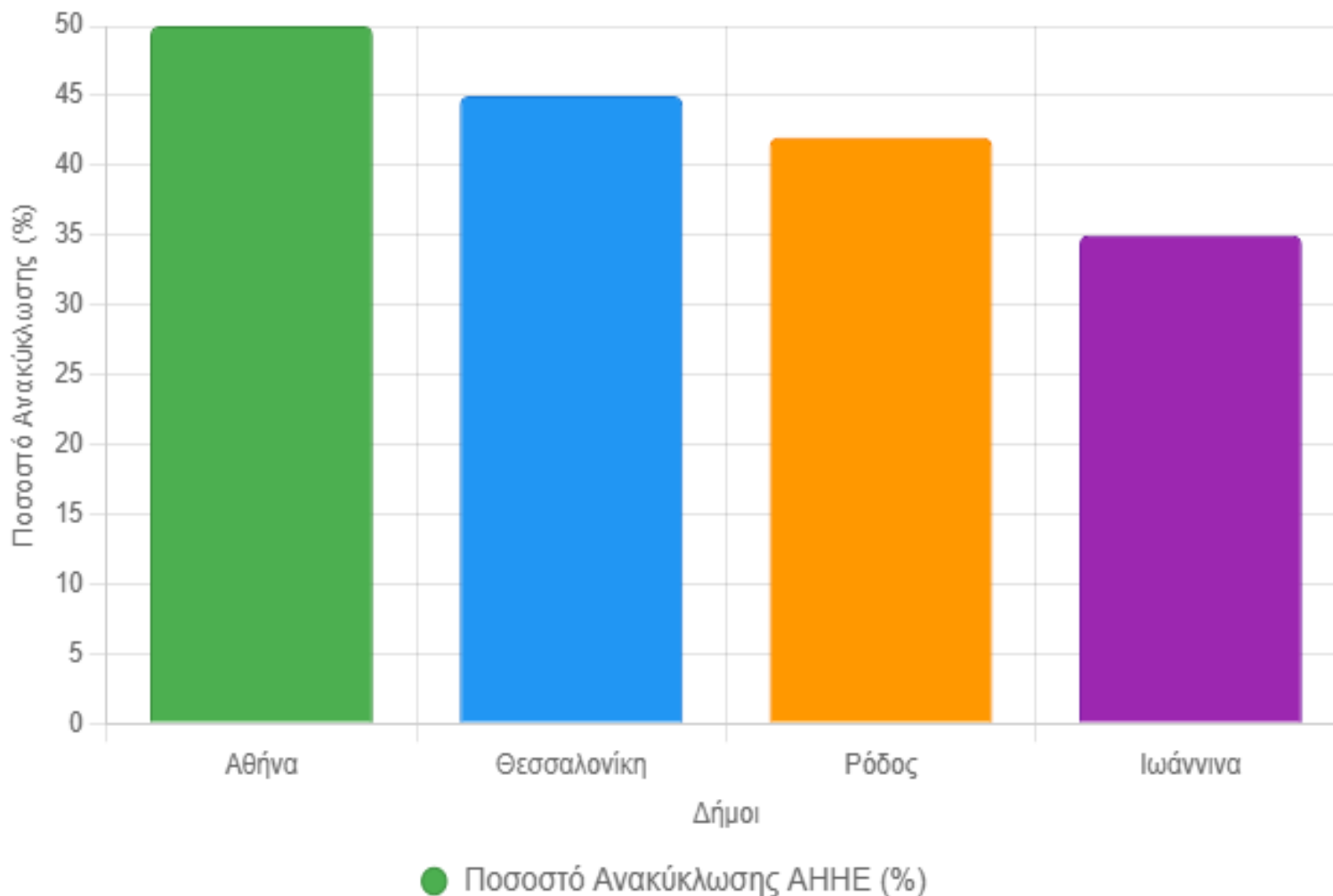


Chart: WEEE
Recycling Rates in
Municipalities
(2022):

Connection to the Circular Economy

•Contribution:

- WEEE and hazardous waste management recovers valuable materials, reducing dependence on primary resources.
- It strengthens closed cycles of material use, a key element of the circular economy.

•Integration into Designs:

- They are included in Sustainable Energy and Climate Action Plans (SDAEK).
- Supported by programs such as Interreg NEXTBlackSeaBasin, especially in coastal areas.

Connection to the Circular Economy

•Financing:

- NSRF, LIFE, Recovery Fund for infrastructure and awareness.
- Collaborations with collective systems (e.g. Appliance Recycling S.A.).

Conclusion

•Role of Municipalities:

- Central pillars for implementing a circular economy through waste management.
- They influence consumer habits and promote sustainable practices.

•Initiatives:

- Recycling, composting, reuse, green shopping, waste prevention.
- Special management of WEEE and hazardous waste for material recovery and health protection.

•Benefits:

- Environmental:** Reduction of waste, emissions and pollution.

- Finance:** Saving resources, creating jobs.

- Social:** Enhancing awareness and quality of life.

•Prospects:

- Utilization of financial tools (NSRF, LIFE, Interreg).

- Collaboration with citizens, businesses, NGOs for integrated solutions.

- Municipalities can be models of sustainable development, contributing to the goals of the Green Deal and the ECHR.

•Summary

- Central Role of Local Government:** Local Government Organizations (LGOs) are on the front lines of the battle against climate change, addressing its impacts and implementing solutions with multiple benefits.
- As the closest institutions to citizens, municipalities manage local resources, infrastructure and services, making them ideal for promoting sustainable practices.
- The module highlighted the importance of local authorities as catalysts for achieving national and European climate goals, such as the Green Deal and climate neutrality by 2050.

•Main Findings of the Unit:

- ReallyExamples:** Successful initiatives were presented, such as energy communities (e.g. MunicipalityTrikala), EXOIKONOMO programs (e.g. Municipality of Thessaloniki), lighting modernization (e.g. Municipality of Piraeus), and water management (e.g. Municipality of Heraklion).
- Tested Tools:** Methods such as source sorting, composting, green purchasing, and the use of digital technologies (e.g. smart irrigation systems) were analyzed.

•Main Findings of the Unit:

•**Organized Methodologies:** The need to adapt good practices to local specificities (e.g. geography, population, economy) and integrate them into long-term plans, such as Sustainable Energy and Climate Action Plans (SECAPs), was highlighted.

•**Multidimensional Approaches:** Mitigation strategies (e.g. RES, energy efficiency), circular economy (e.g. recycling, reuse), and sustainable resource management (e.g. water, waste) were examined.

•Critical Success Factors: Citizen Mobilization:

- The participation of residents is essential for the success of actions, such as recycling (e.g. Municipality of Vari-Voula-Vouliagmeni) or composting (e.g. Municipality of Athens).
- Awareness campaigns, educational programs in schools, and incentives (e.g. discounts on municipal fees in the Municipality of Agios Dimitrios) enhance participation.

- **Securing Financing:** Programs such as NSRF, Interreg, LIFE, Recovery Fund, and EXOIKONOMO provide critical resources for infrastructure and actions.
- Examples: ELEKTRA funding for LED lighting (Municipality of Piraeus) and Interreg for WEEE management (Municipality of Rhodes).

•Cooperation between Services and Agencies:

- Collaboration between municipal services, the private sector, NGOs, and national/European bodies (e.g. CRES, Ministry of Energy and Mineral Resources) enhances efficiency.
- Examples: Collaboration with Photocycling for WEEE (Municipality of Athens) and with agricultural cooperatives for composting (Municipality of Chania).

- **Measurement and Evaluation of Results:** The use of indicators (e.g. recycling rates, energy savings, water consumption reduction) and digital tools (e.g. GIS, telemetry) allows progress to be monitored.
- Examples: Reduction of water consumption by 30% in the Municipality of Heraklion and recycling of 50% WEEE in the Municipality of Athens.

•Challenges and Solutions:

•Challenges:

- Limited funding and technical expertise, especially in small municipalities.
 - Low environmental awareness and citizen participation.
- Bureaucracy and complexity of legislation (e.g. for energy communities, WEEE).

•Challenges and Solutions:

•Solutions:

- Utilization of European programs and technical support from CRES/Ministry of Energy and Infrastructure.
- Strengthening education and communication through social media and local events.
- Inter-municipal collaborations for the exchange of good practices (e.g. Covenant of Mayors).

- **Conclusion:** The success of local governments in addressing climate change depends on their ability to combine innovative ideas with practical implementation, citizen participation, and resource utilization.
- Through organized methodologies, collaborations, and measurable results, municipalities can become models of sustainable development, contributing decisively to the climate neutrality and resilience of local communities.
- Module 1 is a trigger for further action, calling on local authorities to lead the transition to a more sustainable future with vision, collaboration, and commitment.