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Abbreviations and Acronyms

ABMEE	Agency Brasov for Management of Energy and Environment
AD	Anaerobic digestion
ANRE	Autoritatea Nationala de Reglementore in Domeniul Energiei (Romanian Energy Regulatory Authority)
CO_2	Carbon dioxide
CoMo	Covenant of Mayors office
EC	European Commission
ESCO	Energy Service Company
EU	European Union
Gcal	Gigacalories
GHG	greenhouse gas(es)
IUDP	integrated urban development plans
JASPERS	Joint Assistance to Support Projects in the Regions
LCA	Life cycle analysis
MOT	Ministry of Transport
MRDAP	Ministry of Regional Development and Public Administration
MSW	Municipal solid waste
NAM	(Romania) National Administration of Meteorology
NEMS	National Emergency Management System
NOx	Nitrogen Oxides
OP	Operating Program
SEAP	Sustainable Energy Action Plan
SO_2	Sulfur dioxide
SUMP	Sustainable Urban Mobility Plan
TRACE	Tool for the Rapid Assessment of City Energy
UN	United Nations
WTE	Waste-to-Energy

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Executive Summary

Background

Cities have long held a central place of importance in society as hubs of commerce, culture, and political power. Because of climate change, however, the clustering together of large numbers of people and high levels of economic activity also creates vulnerabilities. Some will be found directly within a city: people living and working in coastal areas or in river floodplains may be subject to the impacts of sea level rise or extreme rainfall events that put their lives or businesses at peril. Urban climate change can also take other forms, however, including situations where impacts occurring far outside of a city can affect systems (e.g. water or energy supply) essential to life within the city.

In some parts of the world, central governments are taking note, requiring cities to take action to ensure the economic engine of their country is not harmed. With the support of international NGOs providing technical support, many local authorities are also becoming more engaged, concerned about long-term impacts facing their city or cognizant of the fact that some climate mitigation actions can actually result in cost savings, making the city more economically competitive.

In Romania, where the urbanization rate is roughly 55%, the Government of Romania has commissioned this Advisory Services report from the World Bank to explore how to operationalize an urban climate strategy within the structure of the European Union's new 2014-2020 Operating Program. This report presents the results for the rapid assessment of the current state of (and opportunities for improved) urban climate planning in Romania; what is known about how cities in Romania contribute to climate change; and how cities in Romania will be affected by climate change. To complete this rapid assessment, the World Bank team relied on an extensive literature review and in-person, semi-structured interviews with more than two dozen central and local government officials, private sector experts, academics, and civil society organizations knowledgeable about climate change topics in Romania. The depth of this rapid assessment was necessarily limited by the short time frame available to carry out the research, and by data gaps on local climate planning activities, local GHG emission levels, and the climate risks faced by cities around Romania.

This rapid assessment nonetheless found sufficient information to allow the team to develop a portrait of the current state of urban climate efforts in Romania, and identify gaps that can be addressed through improved planning practices, policy changes, or capital investments. EU Operating Program funds for the 2014-2020 period can be instrumental in supporting these changes, which are presented as recommendations at the conclusion of each section of the report.

The Current State of Urban Climate Knowledge and Planning in Romania

Globally, cities are estimated to be responsible for 70% of global greenhouse gas (GHG) emissions, but little is known about the contribution of urban areas to Romania's current emissions picture. There is a similar dearth of knowledge about how Romanian cities will be affected by climate change, as there has been very little research undertaken to statistically 'downscale' global climate models to provide a more granular, local picture of how the climate will change in the coming decades. Of course, national level climate studies do exist, projecting that Romania will get warmer (with strong regional differences) and that both drought and extreme rainfall events are to become more commonplace in the coming century, again with strong regional differences. Such information does little to help a local authority assess what specific actions they should take going forward, however. This knowledge gap could be remedied if the National Administration of Meteorology were to receive funding support to carry out climate risk studies for each large urban area around the country. Such work would allow existing disaster planning efforts to broaden their scope in an informed manner, addressing a wider range of risks that could affect a given city.

In the case of the carbon mitigation side of the equation, more information is known. For example, as of September 2013, there were 60 communities (representing roughly 5 million people) from around Romania that have signed up to the 'Covenant of Mayors', a European Commission-supported initiative aimed at promoting sustainable energy use in cities. Each community is required to develop an action plan within a year of signing up for the Covenant program. The 30 Romanian communities submitting their plans thus far have heavily emphasized actions focused on improving energy efficiency in buildings and addressing local transport problems. Other climate-related planning work is taking place in seven Romanian cities where the World Bank has supported local energy efficiency planning efforts. These analyses similarly place a big emphasis on addressing local building energy use and transport issues. It would be helpful if EU Operating Program funds were made available to broaden the focus and quality of this work, and to expand the number of cities where such plans have been prepared.

In other words, there is considerable work to be done in Romania on urban climate planning matters. Specific policy interventions and investments the Government of Romania should consider for the 2014-2020 EU Operating Program period are as follows, broken out into near- and longer-term action items:

High Priority/Near-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Integrated planning	Integrate climate change topics into IUDPs	Policy oversight	High
	Require cities applying for Operating Program support to prepare comprehensive climate plans meeting certain minimum quality requirements	Policy oversight	High
	Provide training for local authority staff on how to prepare comprehensive integrated local climate plans.	Training/ education	High
	Provide financial/resource support to the "Covenant Club" and other technical assistance organizations focused on local climate, energy efficiency, or transport planning, etc.	Education/ training	High
Technical studies	Fund research downscaling global climate models to provide more localized assessments of climate impacts in different regions, enabling local	Research & analysis	High

	authority planners to assess their city's vulnerability to future climate shocks		

Medium and Long-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Integrated planning	Establish university curricula to train future environmental and urban planners on local climate planning.	Education/ training	Low
	Provide planning grants to local authorities to support the preparation of comprehensive, integrated local climate action plans.	Planning support	Medium
	Provide greater access to data sources relevant to comprehensive integrated local climate planning efforts	Planning support/ research & analysis	Medium
Technical studies	Fund LIDAR surveys and other analyses that support the development of highly granular, building scale assessments of flooding and other types of climate risk in the 20 largest cities around Romania.	Research & analysis	Medium
	Support/require the use of broader GHG emission inventories (such as the GPC -- Global Protocol on Community Scale GHG Emissions) at the local level, to ensure more comprehensive assessments than those employed by the Covenant of Mayors.	Policy/ oversight	Medium
Public education	Establish public education programs to expand general awareness of climate change and local climate planning issues	Education/ training	Low

Urban Transport Sector

Romania's transport sector is responsible for 11.8% of the country's greenhouse gas emissions, a rate lower than the EU average, but one that is growing quickly. Car ownership rates in Romania are similarly low compared to the rest of the EU, but they too are on the rise, suggesting that as the Romanian economy grows, car usage will grow as well.

Narrowing the geographic focus, there is little hard information about the urban transport situation in Romania as it relates to climate change. Several World Bank sponsored energy efficiency studies indicate that traffic congestion is a big problem in many cities, giving rise to GHG and other emissions from cars stuck in traffic. Many cities have public transport systems (including buses, trams and trolleys), but declining ridership makes it difficult for system operators to finance those upgrades which might bring riders back to the system. Taxis are plentiful in most Romanian cities, but many of the vehicles are old and not fuel-efficient, mirroring the make-up of the nation's vehicle fleet. Some cities have an age limit for taxi vehicles, but this varies significantly from city to city. Finally, the pedestrian and cycling infrastructure varies greatly in quality and quantity between different towns and cities, and within different city areas.

A national General Transport Master Plan (GTMP) is currently under development but it does not cover urban transport investment and policy interventions. This is because responsibility for

urban transport investment generally sits with the municipalities in Romania, under the aegis of the Ministry for Regional Development and Public Administration, rather than with the Ministry of Transport, which has responsibility for the development of the GTMP. Sustainable urban mobility plans (SUMPs) will be developed for the seven growth pole cities and Bucharest/Ilfov by the end of 2014, but such plans should also be developed for other cities around the country.

Climate change is expected to have several impacts on urban transport systems across Romania, although the exact nature of these impacts will naturally be very localized. Higher temperatures and more frequent heat waves (particularly in the south and south-east of Romania) are likely to cause problems with road and rail infrastructure. Asphalt roads may become soft and deform under the weight of vehicles, causing traffic restrictions to be put in place, particularly for heavy vehicles. Railway lines may also buckle under high temperatures, which can again lead to speed and usage restrictions, while higher temperatures can affect the thermal expansion of bridge joints affecting bridge operation and increasing maintenance costs. Higher temperatures and heat waves are likely to cause discomfort and possible safety risk to rail and other transport passengers in cities, requiring improved ventilation at Metro stations, and improved ventilation or air conditioning on trains, metro trains, trams, trolleybuses and buses. Intense rainfall and flash floods may damage rail, road and waterborne transport infrastructure, rendering some systems temporarily non-operational.

Despite all of these potential impacts, however, concerns about climate change are not likely to be the key driver of urban transport policies or investment decisions. Instead, local co-benefits – such as reduced traffic congestion or improved air quality – are much more likely to drive the development of transport policies.

Near-Term/High Priority urban transport sector policy interventions and Operating Program-supported investments the Government of Romania should consider going forward include:

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Road transport	Study fiscal measures that may influence vehicle purchase and use choices	Research/analysis	High
Urban Transport	Prioritize integrated urban planning	Research/analysis	High
	Support development of sustainable urban mobility plans (SUMPs) in the largest cities around Romania	Research/analysis	High
	Study on the potential role of 'hard' demand management measures to address congestion and emissions in the most congested Romanian cities.	Research/analysis	High
	Undertake Bus Rapid Transit feasibility studies in cities where the SUMP indicates this is likely to provide a cost-effective solution to urban mass transit.	Research/analysis	High
	Invest in urban public transport in accordance with the framework provided by the SUMPs.	Direct investment	High
	Invest in cycling and walking infrastructure, in accordance with the framework provided by the SUMPs.	Direct investment	High
	Establish a pilot project to demonstrate and test the feasibility, costs and benefits of urban freight	Direct investment	High

	consolidation centers.		
	Establish pilot projects on alternative fuels for buses and other urban fleet vehicles	Direct investment	High
	Extend the metro system in Bucharest to provide a more complete network, with specific projects in line with the GTMP prioritization process.	Direct investment	High
	Implement intelligent urban transport systems, in line with priorities established in these areas by the SUMPs.	Direct investment	High
	Study the vulnerability of urban transport infrastructure and systems to changed climate conditions in all Romanian cities. Draw up city-wide adaptation plans based on the risk assessment.	Research/analysis	High
	Implement heat resilience infrastructure measures on local rail and tram tracks.	Direct investment	High
	Implement improved ventilation and/or air conditioning at enclosed metro or rail stations.	Direct investment	High
	Introduce improved ventilation and/or air conditioning in public transport vehicles to allow passengers to travel in reasonable comfort during high temperature periods.	Direct investment	High
	Implementation of flood resilience measures for new and existing transport infrastructure	Direct investment	High

Urban Energy Sector

In Romania, the energy sector is responsible for 70% of all greenhouse gas (GHG) emissions. Power and heat generation and non-transport fuel use contribute to three quarters of this total. GHG emissions from this sector have been declining, due to huge contractions in the economy and through energy efficiency improvements.

Among EU27 countries, Romania has the lowest per-capita energy consumption. Per capita consumption of electricity is particularly low, but significant growth in electricity demand is already occurring, driven mainly by the residential and commercial sectors. Some of this growth is occurring as households move away from their reliance on district heating. Overall, the number of households connected to district heating, mostly in large, urban apartment buildings, declined from 2.2 million to 1.4 million between 1990-2012.

The European Union sets the framework for the sustainable energy policies of its member states. The overarching long-term goal is the commitment to reduce greenhouse gas (GHG) emissions 80-95% below 1990 levels by 2050, through investments in energy efficiency and low-carbon and smart energy infrastructure. Over the medium-term, the EU's energy and climate policy is focused on the so-called 20-20-20 targets that were adopted in 2007: by 2020, GHG emissions should be 20% below 1990 levels; renewables should reach a share of 20% of final energy consumption; and primary energy consumption should be reduced by 20%, compared with the projected baseline. Romania is likely to meet all three targets, reflecting a huge contraction of its otherwise carbon intensive economy.

High level energy policies (e.g. market regulation, pricing policies, etc.) are the province of the Romanian government, while local authorities are responsible for public service infrastructure provision and the oversight of buildings within their territory. Local energy planning is required for all municipalities with more than 20,000 inhabitants. Some municipalities are very interested and active in energy efficiency/GHG issues, as exemplified by their voluntary participation in the EU's Covenant of Mayors Program.

Energy markets around Romania have been partially liberalized. The power sector follows the model of liberalized wholesale and retail markets. Electricity production is unbundled from transmission, giving residential consumers the right to switch suppliers. Since this program started in 2007, however, few have done so because regulated prices are well below free market rates. Natural gas and district heating rates also remain heavily subsidized. Regulated electricity and gas prices for non-households are scheduled to be fully liberalized by January 2014 and January 2015, respectively, and regulated electricity and gas prices for households will be liberalized by January 2018 and January 2019, respectively. The current price support schemes for district heating are expected to remain in place for the foreseeable future.

From an urban perspective, the most important issues are energy prices and the Romanian government's inability to deal with the ailing district heating sector. District heating systems are a prominent feature of many Romanian cities, but their use is declining. The 300 systems operating in 1995/96 had declined in number to 100 by 2011, of which 83 are in urban areas. In 16 of the 31 district heating systems with more than 10,000 customers, the number of customers has dropped by more than 50%. In many cities, district heating has become a serious drain on public finances because tariffs for residential consumers are highly subsidized, on average by 50%.

Service quality, cost, and concern over high pollution levels are among the primary reasons for declining demand. Most of the old inefficient cogeneration units and heat-only boilers have still not been upgraded or replaced with modern generation equipment, nor are they equipped with adequate burning equipment, resulting in SO_2 and NO_X emissions that exceed EU norms. With an average of 275 tons of CO_2 per Gcal, Romania's district heating producers rank among the most polluting service suppliers in the EU. Heat distribution networks suffer an average of 30% heat and water losses, compared to 5-10% for newer networks. As a result of those inefficiencies, the cost of district heating is about 18-20% higher than in some other EU countries.

High priority urban energy sector policy interventions and Operating Program-supported investments the Government of Romania should consider going forward include the following. Longer term action items are also noted here:

High Priority/Near-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
District heating system efficiency	Conduct strategic reviews of local district heating systems to establish the most efficient and cost-effective heat supply options strategy. Focus initial investment efforts on a few selected cities where district heating is deemed economically viable and competitive compared with distributed alternatives, and local governments are committed to sector reforms	Research/analysis	High

Institutional environment	Implement electricity and natural gas price liberalization as scheduled.	Policy oversight	High
	Abolish all price subsidies; introduce targeted subsidies for low-income families in the form of cash payments within the social protection system.	Policy oversight	High
	Promote tariff reform, including consumption-based billing at the dwelling level.	Policy oversight	High

Medium and Long-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Building retrofits	Conduct reviews of public buildings to identify poor energy performers	Research/analysis	Medium
Institutional environment	Unify district heating regulation under one regulator.	Policy oversight	Medium
	Consider additional policies to "protect" district heating systems in areas where it is already supplied and cost-effective, such as requiring that new buildings connect to the district heating system or that existing buildings cannot disconnect and choose an alternative heat source. (The Heat Law already allows this in municipalities where investments in district heating rehabilitation/ modernization have taken place.)	Policy oversight	Medium
	Establish accreditation/certification procedures for ESCOs to enhance their credibility among consumers.	Policy oversight	Medium
Project Finance	Provide investment support for ultra-high-efficiency cogeneration.	Direct investment	Medium
	Establish a dedicated energy efficiency revolving fund for the public sector to address some of the critical financing and implementation constraints faced by municipal public entities while also helping to nurture and develop Romania's nascent ESCO market. Such a fund may be seeded by a combination of EU funds and government grants and could potentially attract private financing if proven successful.	Direct investment	Medium

Urban Solid Waste Sector

Collectively, the GHG emissions associated with municipal solid waste disposal in Romania total approximately 2% of the country's overall emissions. The majority result from the country's overwhelming reliance on landfilling as its primary waste management strategy. Organic waste entombed in a landfill decays anaerobically, produces methane, a GHG with 25 times the heat trapping potential of carbon dioxide. Unless the landfill is designed to capture the methane via a series of pipes embedded in the garbage, the gas will slowly leak out of a landfill for many years, including long after a landfill is formally closed. Very few landfills in Romania have the ability to capture or flare this gas, meaning most methane is released directly to the atmosphere.

Thanks to extensive EU Operating Program support during the 2007-2013 period, Romania's EU-mandated efforts to close and replace poorly managed solid waste dumpsites with sanitary landfills are well underway, but efforts to address existing methane leakage are unclear. The Romanian Government can keep this situation from becoming even more problematic going forward, ramping up efforts to divert organic waste material discarded in cities into alternative waste processing methods such as composting or anaerobic digestion (AD). Both techniques prevent the release of methane into the atmosphere, while simultaneously creating either a useful soil nutrient amendment and/or energy that can replace fossil fuels.

The EU accession agreement has already established a timetable for this to be achieved, requiring 65% of all biodegradable waste generated in Romania to be diverted from landfills by 2020. Romania's performance thus far is relatively weak, but achieving this target and other recycling requirements could cut solid waste GHG emission levels by 50% or more. To succeed, cities around Romania will likely have to engage in some type of separate collection of waste materials or otherwise support the development of facilities focused on organic waste processing and markets ready to consume the resulting high quality soil amendment. There are several city-based programs around the world that can serve as models for these efforts.

Less clear is the impact that climate change will have on solid waste facilities and programs around Romania; more work must be undertaken to analyze this issue.

High priority urban waste sector policy interventions and Operating Program-supported investments the Government of Romania should consider going forward include the following. Several longer term action items are also listed here:

High Priority/Near-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Climate change awareness/ preparedness	Support efforts to promote expanded County/Local Authority knowledge on the link between climate change and solid waste management operations	Education/ training	High
	Provide training for waste facility operators on climate-sensitive design and operations	Education/ training	High
	Fund research downscaling global climate models to provide more localized assessments of climate impacts in different regions, enabling solid waste facility operators to analyze the vulnerability of their operation to future climate shocks	Research/analysis	High
	Require solid waste system operators to prepare climate action plans for their operation.	Policy oversight	High
Organics and recyclables management	Continue to finance solid waste management upgrades (including composting facilities, anaerobic digestion facilities, and recycling programs) in towns/cities/regions to ensure compliance with relevant EU directives.	Direct investment	High

Medium and Long-Term Action Items

Sectoral	Policy Proposal	Type of Policy	Priority

Focus		Initiative	
System economics	Conduct studies on tariff levels to assess the extent to which they successfully support the 'polluter pays principle'	Policy oversight	Medium
	Conduct and publish studies on organics management practices deployed to date to assess cost effectiveness of different approaches.	Policy analysis/ oversight	Medium
	Conduct assessment on cost savings potential of collection vehicle replacement, route optimization, or switch to alternative transport methods	Research/analysis	Medium
Climate change awareness/ preparedness	Establish university curricula to train future civil/solid waste engineers on climate sensitive waste system design and operations	Education/ training	Low
Organics and recyclables management	Fund waste composition studies in cities and counties that have deployed backyard composting bins to assess the extent to which such programs are effective at diverting organic waste.	Policy oversight	Medium
	Establish public education programs to promote waste prevention, reuse, composting, and recycling.	Education/ training	Low
	Provide subsidies to provide households with backyard composting bins	Direct investment	Low
	Study feasibility of use of wastewater treatment network and facilities to process organics waste	Research/analysis	Low
	Analyze the effectiveness of recycling collection services at tower blocks, which are difficult to serve, seeking to identify the best program models across Romanian cities.	Research/analysis	Medium
	Convene conferences/training programs for waste system operators and local authority officials on "best practice" solid waste management strategies around Romania	Education/ training	Medium

Urban Water Sector

Like the solid waste sector, urban water supply and treatment systems contribute very little to Romania's overall urban GHG emissions picture, totaling roughly 2.34% of overall GHG emissions in 2009.

There is nonetheless room for improvement in terms of the efficiency of utility operations, reducing current high water loss levels and reducing methane emissions from wastewater treatment facilities. Some system upgrades have occurred during the 2007-2013 Operating Program period, when a sizable amount of funds were allocated to help Romania address its historically poor surface and ground water quality. Significant gains have been made at these new facilities, but much work remains to be done, meaning water system upgrades should continue as a high investment priority in the next Operating Program. At the same time these investments are being pursued for environmental quality and cost efficiency reasons, these system upgrades deliver climate change mitigation benefits at little or no additional cost.

More significant concerns arise in terms of protecting Romania's urban water supply and treatment network from the impacts of climate change. Romania's water supply picture is already relatively poor compared to most other countries in Europe, with some parts of the country already enduring supply constraints during the summer. This situation is likely to get worse going forward. Climate impact studies looking at future hydrological conditions in three of the country's 11 river basins project the demand-supply gap in these regions is expected to be manageable for the next 15-20 years, but significant demand reduction measures or new supply capacity will be needed after that. Additional research is needed in the other water basins, to provide a comprehensive picture of the challenges certain cities might face in decades to come.

Other investments may be necessary to reduce the impacts on the distribution and treatment systems. Localized climate impact studies will be necessary to help identify the specific threats facing these systems.

High priority urban water sector policy interventions and Operating Program-supported investments the Government of Romania should consider going forward include the following. Recommendations that can be implemented over a longer time frame are also identified here:

High Priority/Near-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
General	Convene/support efforts to promote expanded IDA/Local Authority knowledge on climate-sensitive water system design and operations	Education/ training	High
	Provide training for water system operators on climate-sensitive design and operations	Education/ training	High
	Fund research downscaling global climate models to provide more localized assessments of climate impacts in different water basins/regions, enabling improved long term water supply and water utility operations planning.	Research/analysis	High
	Require water utilities/ROCs to prepare climate action plans for their operation	Policy oversight	High
	Provide technical assistance funds to support analysis of climate-related vulnerabilities in local water systems and development of an action plan to address these challenges	Technical assistance	High
	Continue to finance water supply, distribution, and treatment system upgrades in towns/cities/regions to ensure compliance with relevant EU water quality and service coverage requirements. System upgrades should focus on maximizing efficiency improvements and minimizing GHG releases through improved gas management and sludge treatment. Upgrades should also focus on maximizing climate resilience of these systems.	Direct investment	High

Medium and Long-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
General	Establish university curricula to train future civil/water system engineers on climate sensitive water system design and operations	Education/ training	Low
Water Demand	Develop/promote building code changes designed to reduce on-site water demand.	Policy oversight	Medium
	Establish public education programs to reduce on-site water use	Education/ training	Low
	Provide subsidies to households to replace high water demand appliances with more efficient models	Direct investment	Low
	Incentivize/require IDAs/water utilities/ROCs to establish subsidy programs to replace high water demand consumer appliances with more efficient models	Policy oversight	Medium
	Incentivize/require IDAs/water utilities/ROCs to install meters at the dwelling/user level, improving the ability to charge consumers based on their actual level of water demand.	Policy oversight	Medium
Wastewater Systems	Require IDAs/ROCs/water utilities to eliminate 'combined sewer overflow' designs wherever system expansion is being pursued, reducing the overall amount of material that must be processed on a regular basis, cutting energy demand.	Policy oversight	Medium

Conclusion

Approaching climate change from an urban perspective places boundaries around the topic that are different than the national or sectoral orientation traditionally applied to the topic. The use of urban boundaries changes the conversation in meaningful ways, because the impacts on a specific economy, piece of infrastructure, or neighborhood become much more tangible.

In the 2014-2020 Operating Program period, the Romanian Government has an excellent opportunity to target the mitigation and adaptation needs of cities across the country. Some of these funds would necessarily represent a continuation of initiatives from the prior programming period, but efforts should necessarily prioritize the energy and transport sectors. These are the two largest contributors to Romania's overall GHG emissions picture, and they face greater vulnerabilities as a result of climate change. The solid waste and water also require continued attention, however, to ensure that Romania achieves the environmental gains and other accession commitments it made when joining the European Union several years ago. Efforts targeting these sectors can still be positioned as climate-related investments, helping satisfy Romania's obligation to spend no less than 20% of its operating program funds on climate-focused activities.

This report has also highlighted significant data and planning gaps that must be addressed. Little is known about the GHG emission profile of most Romanian cities, or the specific climate risks these cities will face in the coming decades. Using EU Operating Program funds to support such analyses would provide the foundation for comprehensive planning activities essential to the future of Romania's cities. To the maximum extent possible, these climate plans should be woven

into any long term economic and spatial development strategies that central and regional government officials are already pursuing. Doing so is critical to ensure that Romania does not lock its cities into a high carbon pathway, or that policies and investments made today will not place future economic activity or lives at risk once the impacts of climate change become more manifest.

Section 1: Viewing Climate Change through an Urban 'Lens' – A New Way of Structuring Climate Action Plan Development

1.1 Background

1. Cities have long held a central place of importance in society as hubs of commerce, culture, and political power. Current global urbanization trends – such as the fact that more than 50% of the world's population now resides in urban areas – speak to the desirability of cities on many different levels.

2. There are consequences of this trend, however. Although cities provide economic opportunity for many, in some cases serving as economic engines for entire countries, daily life and commerce occurring in cities also result in high levels of greenhouse gas emissions (GHG) which contribute to global climate change. In 2013, the Global Energy Assessment estimated that 76% of total global primary energy use occurs in urban areas[1], while climate-focused city networks like the C40 regularly claim that urban-related GHG emissions represent roughly 70% of global totals.

3. As the impacts of climate change appear to be growing more unavoidable given the lack of global agreement on how to achieve deep GHG emission cuts, the clustering together of large numbers of people and high levels of economic activity also creates vulnerabilities. Some will be found directly within a city: people living and working in coastal areas or in river floodplains may be subject to the impacts of sea level rise or extreme rainfall events that put their lives or businesses at peril. World Bank researchers recently estimated that coastal flooding losses in the 136 largest coastal cities around the globe will increase from $6 billion/year in 2005 to $1 trillion or more *every* year by 2050 as a result of climate change.[2] Another analysis prepared by the Potsdam Institute for the World Bank found that climate change impacts will also vary widely from city to city, leaving some cities under water while others must endure crippling drought, losing access to water for power generation or the local drinking water supply.[3]

4. Urban climate change can also take other forms, however, including situations where impacts occurring far outside of a city can create risks to those within the city. An excellent example of this occurred in August 2013, when a drought-exacerbated wildfire in the mountains of California shut down a hydropower facility owned by San Francisco municipal government. San Francisco is located 260 km away from the dam site, but the impacts of the fire were felt directly and

[1] GEA, 2012. *Global Energy Assessment - Toward a Sustainable Future*. International Institute for Applied Systems Analysis, Vienna, Austria and Cambridge University Press, Cambridge, UK

[2] Hallegatte S, Green C, Nicholls RJ, and J Corfee-Morlot. "Future flood losses in major coastal cities" *Nature Climate Change* 3, 802–806 (2013)

[3] Schellnhuber HJ; Hare B; Serdeczny O; Schaeffer M; Adams S; Baarsch F; Schwan S; Coumou D; Robinson A; Vieweg M; Piontek F; Donner R; Runge J; Rehfeld K; Rogelj J; Perette M; Menon A; Schleussner CF; Bondeau A; Svirejeva-Hopkins A; Schewe J; Frieler K; Warszawski L; Rocha M. *Turn down the heat : climate extremes, regional impacts, and the case for resilience.* Washington DC ; World Bank. 2013.

immediately: the local authority was forced to buy electricity on the open market, driving up the local authority's electricity expenditures by $600,000 in the first week alone.[4]

5. As these facts collectively imply, addressing climate change at a city level is a complex but necessary undertaking for most countries. Part of the challenge arises from the fact that the evidence base justifying action can be elusive. Few countries have undertaken comprehensive assessments of the contribution cities make to national GHG emissions. Similarly, few countries have comprehensive assessment of the impacts climate change might impose on their cities either positively or negatively.

6. In addition, there is the question of who must take action to reduce emissions or promote climate resilience within a city. Local authorities do enjoy significant policymaking and regulatory powers, but there are limits to this power. Sometimes, central government stakeholders or the private sector must play a more prominent role if a city is to minimize both its greenhouse gas emissions and its climate vulnerabilities. A common problem is how to pay for the changes necessary within a city; in some cases efficiency gains may more than offset the cost. At other times, however, quantifying the benefits of action can be elusive. Finally, the breadth of planning action that must be taken is necessarily broad, encompassing many sectors that are often treated as standalone policy silos – transportation, energy, or water systems, for example – making the planning and implementation challenge more daunting both institutionally and budgetarily.

7. To look at climate change through an urban 'lens' is thus to impose different boundaries around the issue, both from a policymaking and analytic perspective. There has been considerable work undertaken around the world to explore what cities can do to address climate change, but as noted above, there are few national level analyses that do this. The Romanian government is to be applauded for its decision to address climate change from this vantage point.

8. This report is an outgrowth of the Government of Romania's request that the World Bank provide Advisory Services on climate change, including operationalizing its climate strategy in terms relevant to the European Union's new 2014-2020 Operating Program. This report is a deliverable under Component B of the Advisory Services (*Support the Preparation of the Climate Change-related Actions under the 2014-2020 Operational Programs*.) This report presents the results for the rapid assessment of the urban sector, seeking to inform the Government's effort to identify urban GHG reduction and climate resilient policy and investment activities that can be carried out under the auspices of operational programs. As background to these recommendations, the report also discusses:

a. The current state of urban development and governance in Romania
b. What is known about how cities in Romania contribute to climate change, and how cities in Romania will be affected by climate change.
c. Global best practice on city-level climate planning, and how this stacks up with the current level and type of climate planning underway in Romania.
d. Strategies the Romanian government can pursue to support the development of more comprehensive city-level climate planning efforts around the country.

[4] Malik NS. "Power Gains in California as Wildfires Cut Access to Hydropower" *Bloomberg Businessweek*. August 26, 2013.

9. Because the urban sector is a spatially (rather than topically) bounded sector, the report also necessarily looks at climate change mitigation and adaptation/resilience in four key urban infrastructure-focused sectors: energy, transport, water, and waste. The energy and transport discussions synthesize the urban-relevant portions of the larger standalone energy and transport reports prepared under this Advisory Services project. The water and waste sectors generate a relatively small amount of GHG emissions, but progress made during the last programming period (2007-2013) to meet basic health and environmental protection goals simultaneously delivered carbon mitigation benefits. Work upgrading these operations in cities around Romania will continue, to ensure compliance with EU accession requirements, so the goal of this report is to explore whether urban climate 'lens' provides new insights to this work.

10. Each section of the report concludes with recommendations on specific steps the Romanian government should pursue to improve the local climate policy or market landscape, or programmatic activities that could potentially be supported by EU structural fund allocations.

1.2 Research Methods and Limitations of this Analysis

11. To complete this rapid assessment, the World Bank team relied on an extensive literature review and in person semi-structured interviews with more than two dozen central and local government officials, private sector experts, academics, and civil society organizations knowledgeable about climate change topics in Romania. Recommendations included at the conclusion of each section were based on input provided by many of those interviewed for this report, the team's knowledge of international best practice, and the team's efforts to provide a strategic framework that will enhance Romania's urban climate change planning efforts over both the short and long term.

12. As this report frequently notes, the analysis was limited by the short time frame available to carry out the research (June through October 2013). The term's analysis was also hampered by significant data gaps on local climate planning activities; local GHG emission levels; the climate risks faced by cities around Romania; and waste and water system upgrades carried out under the 2007-2013 Operating Program. In many cases, the underlying analytic work does not exist, or it has not been compiled and made available in published form. Although the team did include some native language speakers, language barriers may also have affected the team's ability to examine the full array of information available via the internet.

13. In the case of GHG emissions data, some information was available from cities participating in the Covenant of Mayors program, but the methods used to comply with that program do not present a comprehensive portrait of local emission sources, making the data unusable for this analysis. This is not necessarily the fault of local authorities, but instead is a function of the approach endorsed by the EU's Covenant of Mayors program, the developer of this methodology. [See Section 1.5 for more information on this topic.]

14. Finally, the timing of the work created some challenges because work occurred concurrently with the Romanian Government's development of operating program recommendations for the next programming period. This timing overlap made it difficult for the team to consistently contribute to the process and keep track of strategies under consideration by the Romanian government for inclusion in the final OP submission to the EU.

1.3 Urbanization and Urban Governance in Romania – A Brief Overview

15. Officially, the urbanization rate in Romania is roughly 55%, a level that is somewhat low compared to other parts of Europe. This rate has remained fairly constant for the past two decades, thus mirroring the situation in many other Eastern European countries shifting from a centrally planned economy to free market conditions.

16. As other recent research by the World Bank has pointed out, however, Romania has been suburbanizing, with the areas immediately around major cities growing by 300,000 even as there has been significant migration out of the country entirely. Because central government demographers still categorize some of these regions outside the urban core as rural, this shift has not yet made its way into the official population statistics.[5] If this were done, the urbanization rate could rise to 65.2%, the level cited in the World Bank's 2009 World Development Report.[6]

17. Population losses and location shifts manifest themselves in changing densification rates in Romania's growth pole cities. As seen in Table 1, density levels in these cities are declining across the board, in some cases by as much as 48%.

Table 1.1: Changes in Population in Growth Pole Cities 1992-2012
Source: World Bank (forthcoming) *Enhanced Spatial Planning as a Precondition for Sustainable Urban Development.* p 12

	Population Density in Built Up Areas (people/hectare)			Change in density
	1992	*2002*	*2012*	*1992-2012*
Brasov	101	73	52	-48.4%
Bucaresti	104	90	70	-32.7%
Cluj-Napoca	76	67	58	-23.6%
Constanta	84	71	56	-33.7%
Craiova	76	65	47	-37.6%
Iasi	95	77	62	-34.6%
Ploiesti	83	76	61	-26.7%
Timisoara	69	60	55	-20.6%

18. Densification changes are mirrored by increases in the built up area in these cities.

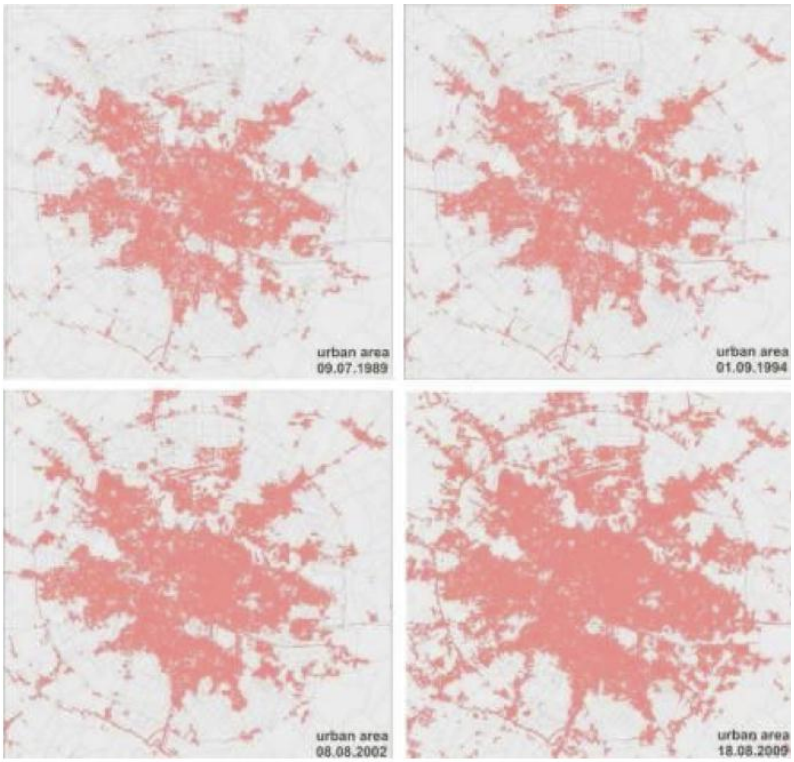
[5] World Bank (forthcoming). *Competitive cities: Reshaping the Economic Geography of Romania*. Washington DC.
[6] World Bank (2009). *World Development Report 2009: Reshaping Economic Geography.* Washington, D.C.

Table 1.2: Changes in Built Up Area of Growth Pole Cities 1992-2012
Source: World Bank (forthcoming) *Enhanced Spatial Planning as a Precondition for Sustainable Urban Development.* p 15

	Built Up Area of Selected Cities (in hectares)			Change in Built Up Area
	1992	*2002*	*2012*	*1992-2012*
Brasov	3,511	3,928	4,360	24.2%
Bucaresti	20,251	21.497	23,955	18.3%
Cluj-Napoca	4,295	4,410	5,346	24.5%
Constanta	4,258	4,382	4,566	7.2%
Craiova	4,045	4,628	5,152	27.4%
Iasi	3,596	3,966	4,224	17.5%
Ploiesti	3,039	3,120	3,238	6.5%
Timisoara	4,920	5,130	5,568	13.2%

19. Figure 1.1 shows how suburbanization trends have played out in the Bucharest region over the past several decades.

Figure 1.1: Expansion in Built Up Areas around Bucharest 1989-2009
Source: Advanced Studies and Research Center (Bucharest) cited in World Bank (forthcoming) *Enhanced Spatial Planning as a Precondition for Sustainable Urban Development.*



Source: Advanced Studies and Research Center, Bucharest

20. Planning activity in cities and urban regions is largely governed by Law 350/2001 which seeks to balance social and economic development across the country. The law also seeks to manage

natural resources, protect the environment, rationalize land use patterns in and around cities, and provide coherence to planning activities being carried out by different jurisdictions (local authorities, counties, etc.), each of whom have different, yet occasionally overlapping, sets of responsibilities.

21. Since 2008, national urban policy has also focused around three different types of 'growth poles' that are to serve as economic engines for Romania. Growth poles are divided into (1) seven large urban centers (plus Bucharest) and their areas of geographic and economic influence; (2) 'urban development poles' consisting of 13 municipalities and towns, and (3) smaller urban centers consisting of towns over 10,000 inhabitants.

22. The growth pole concept identifies a single local authority at the nucleus of the region that is to work collaboratively with other territorial administrative units in its vicinity. Integrated urban development plans (IUDPs)[7] must be developed for each of these regions, elaborating both a local vision and a specific set of projects, timeline, budget, and financing sources designed to deliver that vision.

23. IUDPs must cover at least two of the three priority investment areas:

a. Rehabilitation of urban infrastructure and improvement of urban services, including urban transport
b. Development of a sustainable business environment, and
c. Rehabilitation of social infrastructure, including social housing, and improvement of social services

24. Although they may share common themes, Integrated Urban Development Plans vary widely from city to city, reflecting unique needs and local policy and political preferences.[8] It goes beyond the ability of this rapid assessment project to characterize these plans; gauge the extent to which each of these plans reflect the critical infrastructure needs of the region; gauge the extent to which full deployment of these strategies would provide significant climate mitigation and/or adaptation benefits; or explore the nature of the underlying analysis or political environment that leads local authorities to identify projects as priority investments. What is worth noting, however, is the intent to coordinate planning activity across jurisdictions on topics that are highly germane to a climate planning conversation. A key question, therefore, is the extent to which these IUDPs can be leveraged to achieve different urban climate goals. This topic will be taken up below.

1.4 What we know about how Romanian Cities Contribute to Climate Change, and how Climate Change may affect Romanian Cities

[7] The concept of IUDPs was established under the EU Regio's Regional Operating Program Axis 1, seeking to ensure comprehensive, integrated plan development rather than sector-specific approaches.
[8] For example, see *Planul Integrat de Dezolvotare Urbana – Polul de Crestere Brasov* available at http://www.esponusespon.eu/dane/web_usespon_library_files/694/20110317231022_development_strategy_for_bma_extract_from_iudp_brasov.pdf

25. It is increasingly recognized that cities can benefit from an inventory that details how GHG emissions are generated in their city. This inventory is primarily designed to serve as the fact base upon which a climate mitigation strategy can be crafted. If every city in the world had such an inventory, it would be an easy exercise to estimate the collective contribution that daily life and economic activity clustered in cities makes to the global GHG emissions picture. That is unfortunately not the case.

26. It is a similar situation in Romania. Many cities round the country have prepared some form of emissions inventory, but this number pales in comparison to the total number of analyses that would be necessary to give us a clear sense of the level of GHG emissions that Romanian cities generate in aggregate. Such a number would be powerful, giving the Romanian government information on the extent to which cities should be targeted for assistance; isolate which sectors are the greatest contributors to the problem; and identify which cities are most in need of assistance because of their high rate of emissions.

27. The World Bank team made an initial attempt to extrapolate a Romanian urban GHG emissions estimate using information provided by several dozen cities that have submitted Sustainable Energy Action Plans to the EU's Covenant of Mayors program, as these plans must include an emissions inventory. Upon review of these inventories, however, it was clear that they were unusable for this purpose because Covenant rules give cities wide latitude in determining which sectors to include in their inventory. Some of the inventories submitted thus far are very narrowly written, ignoring sectors over which the local authority has limited control, such as local industrial activity. Including these sectors in the emissions inventory would add greatly to local emission totals, although how much these numbers would change in total is unclear.

28. Limited information is also available on the climate impacts side of the equation, particularly at the individual city scale.

29. Several national level climate trends have been identified in the draft Romanian Climate Change Adaptation Strategy[9]:

a. Romania is warming, with strong regional differences. Average winter temperatures will increase at a faster rate in the Carpathians than in the rest of the country, while summer high temperatures will tend to increase more in the south and southeast than in the north.
b. Overall rainfall levels will diminish in the summer, particularly in the south and southeast, giving rise to concerns by national water authorities that these regions may be unable to meet their future water needs.[10] At the same time, however, extreme rainfall events are expected to grow both in frequency and intensity, leading to flash flooding.

30. Under ideal circumstances, these types of detailed climate change impact projections would be developed for individual cities or urban areas. Table 1.3 shows how downscaled climate

[9] Romania Ministry of Environment and Climate Change. *Draft Final Climate Change Adaptation Strategy for Romania*, 21 November 2011.
[10] Personal communication with Dr. Vasile Pintilie, General Director *National Agency of the Romanian Waters (NARW*). June 2013.

models can project climate impacts at the local level. These projections[11] were prepared by university-based climate researchers partnering with the City of New York, and these impact estimates have served as the basis for New York City's highly regarded adaptation strategy released in 2013.

31. To date, the National Meteorology Administration (NAM) has had insufficient resources to statistically downscale global climate models to provide highly granular information on temperature, precipitation, and other climate trends for different parts of the country. (The city of Arad did finance such a study by NAM, but this appears to be the exception rather than the rule.) Academic researchers have also prepared a climate impacts study of Baia Mare City[12], but this too is a rare case.

Table 1.3: Climate Impact Projections at the City Scale: the case of New York City
Source: City of New York/New York City Panel on Climate Change 2013

NPCC 2013 Climate Projections						
Chronic Hazards		**Baseline (1971-2000)**	**2020s**		**2050s**	
			Middle Range (25th - 75th percentile)	High End (90th percentile)	Middle Range (25th - 75th percentile)	High End (90th percentile)
Average Temperature		54 °F	+2.0 to 3.0 °F	+3.0 °F	+4.0 to 5.5 °F	6.5 °F
Precipitation		50.1 in.	+0 to 10%	+10%	+5 to 10%	+15%
Sea Level Rise[1]		0	+4 to 8 in.	+11 in.	+11 to 24 in.	+31 in.
Extreme Events		**Baseline (1971-2000)**	**2020s**		**2050s**	
			Middle Range (25th - 75th percentile)	High End (90th percentile)	Middle Range (25th - 75th percentile)	High End (90th percentile)
Heat Waves and Cold Events	Number of days per year at or above 90°F	18	26 to 31	33	39 to 52	57
	Number of heat waves per year	2	3 to 4	4	5 to 7	7
	Average duration (days)	4	5	5	5 to 6	6
	Number of days per year at or below 32°F	72	52 to 58	60	42 to 48	52
Intense Precipitation	Days per year with rainfall exceeding 2 inches	3	3 to 4	5	4	5
Coastal Floods at the Battery[1]	Future annual frequency of today's 100-year flood	1.0%	1.2% to 1.5%	1.7%	1.7% to 3.2%	5.0%
	Flood heights from a 100-year flood (feet above NAVD88)	15.0	15.3 to 15.7	15.8	15.9 to 17.0	17.6

Source: NPCC; for more details, see *Climate Risk Information 2013*.

[1] Baseline period for sea level rise projections is 2000-2004.

32. Information like this has value because it can be married to LIDAR survey data or cadaster maps to provide very detailed estimates of where problems might occur under different climate

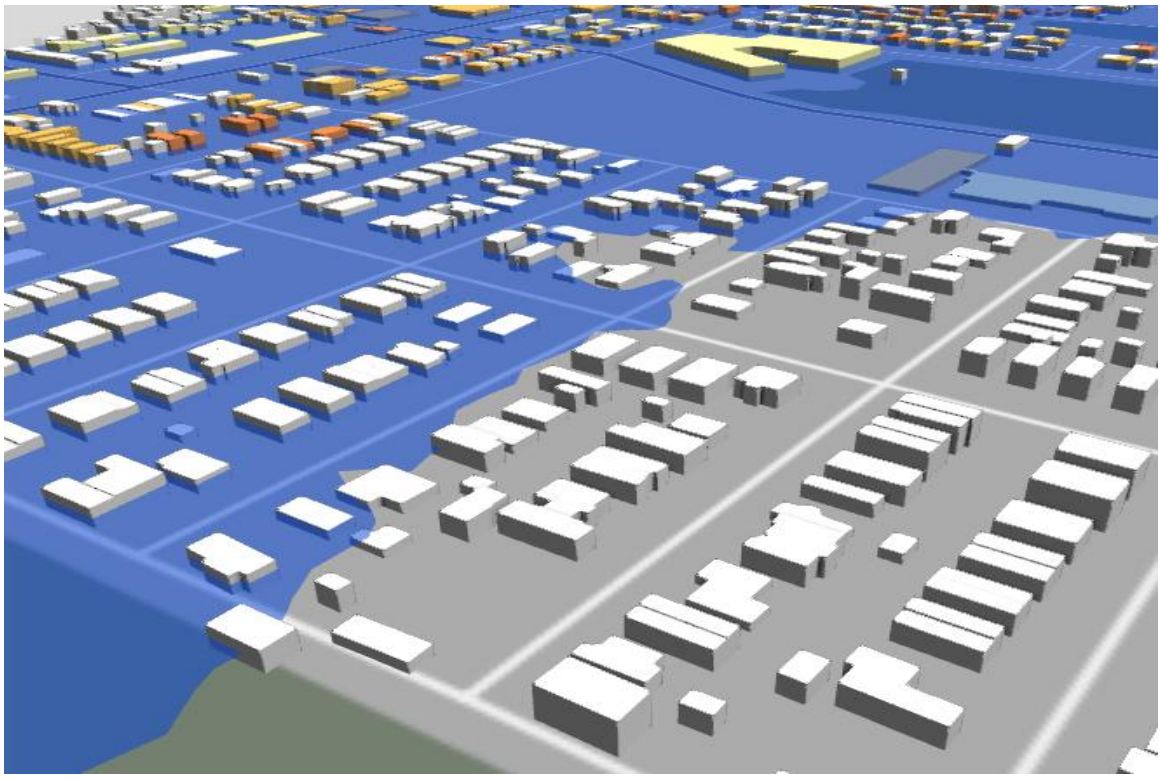
[11] City of New York (2013) *A Stronger, More Resilient New York*. Office of Long Term Planning and Sustainability.
[12] Sima M, Micu D, Dragota CS, and S Mihalache. "Climate services for an urban area (Baia Mare City, Romania) with a focus on climate extremes." EGU General Assembly, Vienna, April 7-12 2013.

conditions. Figure 1.2 displays how future flood risk projections can be converted into highly detailed estimates of the risk facing individual buildings in a city.

33. Understanding change in the length or intensity of heat waves can be particularly important in cities, which already experience higher temperatures due to the 'urban heat island' effect, a situation where short wave thermal radiation is retained in paved surfaces and buildings, increasing ambient temperatures. The lower incidence of natural features (trees, etc.) that cool the air in urban areas through evapotranspiration also exacerbates the problem. In Bucharest, for example, the temperature difference in the city center in mid-summer averages +2.9°C compared to the periphery, and was approximately +3.8°C during the July 2007 heat wave heat that killed nearly 20 people across the country.[13]

Figure 1.2: Example of flood map developed using climate impact projections and local land use/buildings data

Source: Larson J and A Shaw. "New Maps and a New Plan for New York." *ProPublica.* June 12, 2013. Viewed at http://projects.propublica.org/nyc-flood/lofi



34. Depending on data availability, maps might also be developed that use census data to identify neighborhoods that have large numbers of elderly people or other populations that might be at risk during extreme heat events. Protocols can then be put in place to target those

[13] Cheval S., Dumitrescu A, and A Bell. "The urban heat island of Bucharest during the extreme high temperatures of July 2007." *Theoretical Applied Climatology* (2009) 97:391-401.

neighborhoods for extra assistance or attention during heat waves, much as was done in many European cities following the deadly 2003 heat wave.[14]

1.5 Urban Climate Planning as a National Policy Focus

35. Efforts to address climate mitigation and adaptation/resilience concerns in cities have grown exponentially both in stature and frequency around the world in recent years. The genesis of these plans varies. Some cities seek to address local health or environmental concerns, or pursue strategies that enhance the attractiveness and economic competitiveness of their city. Greenhouse gas reductions or enhanced resilience to the impacts of climate change are a fortuitous but not essential side benefit of these plans. Other cities are taking action because the public and/or local politicians wish to take action in the absence of any global agreement on how to address the problem.

36. For the most part, cities engaging in climate planning are doing so of their own volition, for the reasons cited above. There are some instances, however, where central governments are stepping in to require action at the local level. In the Philippines, for example, the Climate Change Act of 2009 established strong requirements for municipalities across the country, noting that local government units "shall be the frontline agencies in the formulation, planning and implementation of climate change action plans in their respective areas."[15] Specific requirement of the law include:

a. Municipal and city governments must consider climate change adaptation as one of their regular functions.
b. Provincial government is to provide technical assistance, enforcement and information management in support of municipal and city climate change action plans.
c. Local government units must regularly update their respective action plans to reflect changing social, economic, and environmental conditions and emerging issues.
d. Local government units must mobilize and allocate necessary personnel, resources and logistics to effectively implement their action plans.
e. It is the responsibility of national government to extend technical and financial assistance to local government units for the implementation of their plan.
f. Local government units are expressly authorized to appropriate funds from its annual revenue allotment to implement local climate plans.

37. In other parts of the world, urban climate plan requirements are taking a slightly different form. The Republic of Korea's Framework Act on Low Carbon, Green Growth was passed in 2010, requiring central government, local governments, and other designated public institutions to establish energy savings and GHG emissions reduction targets.[16] In addition, each year agencies

[14] WMO/WHO (2010) *Heat Waves and Health: Guidance on Warning System Development*. World Meteorological Organization/World Health Organization.
[15] Republic of the Philippines. (2009) *Republic Act No. 9729: Climate Change Act of 2009.*
[16] Korea Ministry of Government Legislation (2013). *Framework Act on Low Carbon, Green Growth 2013*. Available at http://www.law.go.kr/lsEfInfoP.do?lsiSeq=136548#0000 (*in Korean*).
English version of the Act (2010) available at

and institutions subject to the law must report GHG emissions and energy consumption levels and cities and provinces are required to establish a "Low Carbon Green Growth Local Action Plan" every five years, which is to include an analysis of previously implemented actions, their updated vision and strategy, and expected results. The plan must also assign implementation responsibilities to the relevant local authorities.[17]

38. In France, the Environmental Code requires regular reporting on greenhouse gas emissions from the State, regions, counties, cities, and municipalities with more than 50,000 inhabitants. The report is made public and must be updated at least every three years. Each region's president is responsible for the coordination of data collection and consistency of assessments across localities. [18]

39. Thus far, Romanian climate policy has not adopted such a specific urban climate focus, or embraced specific urban climate planning tenets like those described above. This is a situation the Romanian Government may wish to reconsider.

40. For example, the 5th National Communication on Climate Change[19] (dated 2010) is largely silent on the type of local level climate planning work that should occur, emphasizing instead the types of high level sectoral policy or infrastructure changes that are necessary to reduce GHG emissions or mitigate some of the climate impacts expected in Romania. These changes include resizing stormwater systems; expanding the level of permeable surfaces in cities; changing market rules to promote renewables deployment; and developing and implementing green building guidelines so as to make buildings more climate friendly from both a mitigation and adaptation perspective. It was also suggested that training programs be established to improve the knowledge of Romanian architects about climate change issues.

41. More recently, Romania's National Climate Change Strategy (2012-2020) identified steps that must be taken to enhance climate resilience around the country. Initiatives or strategies were identified for the buildings, transport, and water sectors, among others. The project also identified which stakeholders (generally Romanian ministries) must take the lead in driving this work. The specific role local authorities are to play was not clear, although some references were made to their role in increasing public awareness about climate change adaptation. The report did conclude by noting, however, that "the adaptation component from National Climate Change Strategy will be overtaken and continuously improved at the local level of public administration, through specific measures relevant to the geo-politic, economic circumstances, local public needs and in the same time local administrative bodies will develop action plans on climate change."[20]

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http://www.uncsd2012.org/content/documents/South%20Korea%20Framework%20Act%20on%20Low%20Carbon%20Green%20Growth%202010.pdf.

[17] Korea Ministry of Government Legislation (2013). *Low Carbon, Green Growth Enforcement Ordinance 2013*. Available at http://www.law.go.kr/lsEfInfoP.do?lsiSeq=136548#0000 (*in Korean*).

[18] Legifrance (2010). *The Environment Code Book II 2010*. Available at http://www.legifrance.gouv.fr/affichCode.do;jsessionid=6BF79D3551FFCEDEA36769D983A22104.tpdjo14v_2?cidTexte=LEGITEXT000006074220&idSectionTA=LEGISCTA000022494483&dateTexte=20130829&categorieLien=id#LEGISCTA000022494483 (*in French*).

[19] Romania Ministry of Environment and Forests. *Romania's Fifth National Communication on Climate Change under The United Nations Framework Convention on Climate Change*. January 2010

[20] Romania Ministry of Environment and Climate change. *Romania's Adaptation Component of the National Climate Change Strategy (Final Draft Version).* Undated.

42. There are, of course, other policy and planning initiatives in place that lend themselves to climate planning activities in Romania, particularly on the low carbon side of the equation. The Integrated Urban Development Plans required for growth pole cities and urban development poles all necessarily focus on transport and other major infrastructure systems, discussing what must be done to bring them into compliance with EU standards for safety and environmental quality. Energy efficiency is another common theme in these plans, through the National Energy Efficiency Strategy (GD 163/2004), the National Strategy Regarding the Thermal Power Supply of Cities (GD 882/2004), and Government Ordinance 22/2008. Some of these laws place responsibility for action squarely on local authority agendas.

43. In terms of climate adaptation/resilience, planning activity has largely been driven by disaster management requirements established under the Ministry of Administration and Internal Affairs (Ministerial Order 160/2007 and 1474/2006), which allocate responsibilities for different types of emergency situations. The National Emergency Management System (NEMS) administered by the Ministry is responsible for the provision of human, material and financial resources in order to prevent and manage all types of emergency situations, not just those that are climate-related. The NEMS is comprised by a network of government bodies, which are divided according to their specific area of expertise and the resources available to them (Government Decision no. 2288/2004). The institutions that support the NEMS on climate change related topics are:

a. Ministry of Internal Affairs: fires, failure of public utilities.
b. Ministry of Regional Development and Public Administration: landslides.
c. Ministry of Economy: major failure of electricity transmission lines, failure of hydro-technical works, landslides and land collapses.
d. Ministry of Environment and Climate Change: extreme meteorological phenomena, river and coastal pollution, failure of hydro technical works, floods and forest fires.
e. Ministry of Agriculture and Rural Development: drought, hail, pest invasions and pandemics.
f. Ministry of Health: epidemics and pandemics.
g. Ministry of Transport: heavy snowfalls, glazed frost and ice jams on Danube River.

44. Prevention and management of emergency situations occurs at the county and prefecture level, with local authorities having responsibility for local level emergency management and prevention. Local authorities are required to have hazard and risk maps for their territorial-administrative units but these are reportedly incomplete, inconsistent, out of date, or simply not available for some cities. The extent to which these plans account for the full array of climate impacts anticipated across Romania is unclear. Part of the challenge arises from how climate change is treated from a planning perspective – as purely an emergency response issue, or as something that can be planned for and adequately addressed over time through capital investment and policy changes.

1.6 Best Practice Urban Climate Planning and the Current Situation in Romanian Cities

45. There is much work going on in cities around the world that relates to climate mitigation and adaptation planning, although these efforts vary widely in scope and quality. Generally speaking,

more attention has been focused on low carbon planning rather than adaptation/resilience, although this is beginning to change.

46. City-focused NGOs (e.g., ICLEI Local Governments for Sustainability, C40 Cities Climate Leadership Group) or city-focused environmental accords (such as the Durban Adaptation Charter and the Urban Environmental Accords) are playing a key role in supporting this work, providing networking opportunities or technical assistance and guidance on how to proceed with climate planning at the local level. As these entities have grown in prominence, so too has their political clout and involvement in global climate negotiations. Technical guidance materials are now widely available, addressing issues from either a very narrow or broad perspective. (See Table 1.4 for an example of some of the more noteworthy documents of this type.)

Table 1.4
Examples of Urban Climate Planning Technical Assistance Materials

Overarching urban climate planning guidance

- UH Habitat & IIED (2012) Developing Local Climate Change Plans: A guide for Cities in Developing Countries. Cities and Climate Change Initiative Tool Series

Topical guidance

- UN Habitat, UNEP and ICLEI (2009) Sustainable Urban Energy Planning: A handbook for cities and towns in developing countries
- ICLEI (2011) Adapting Urban Water Systems to Climate change: A handbook for decisionmakers at the local level
- World Bank (2011) Guide to Climate Change Adaptation in Cities.

Urban climate planning case studies

- World Bank (2013) The Rio de Janeiro Low Carbon City Development Plan.

47. It is difficult to summarize the totality of urban climate planning experience around the world, but 'ideal' plans and planning processes tend to exhibit the following characteristics:

a. *Comprehensive scope of coverage*: the best urban climate plans are multi-dimensional (meaning they address both climate change mitigation and adaptation/resilience), multi-temporal (covering short, medium, and long term time frames), and multi-sectoral (covering all relevant infrastructure systems or policy priority areas, including energy, transport, water and waste systems; land use planning; industrial activity; and climate 'governance')
b. *Plans are evidence based*: the best plans include an analysis of how GHG emissions are generated in a city, and detail how climate change may manifest itself in the future, relying on a statistical downscaling of multiple global climate models to provide a range of impact estimates relevant to a specific city or metro region. As shown above in Figure 1.2, this information can be combined with cadaster maps to provide very detailed estimates of where problems might occur under different climate conditions.
c. *Broad stakeholder participation* – Most cities engaged in comprehensive climate planning seek the benefit of broad stakeholder participation, involving local/regional/central government representatives, business/industry representatives, community participants, experts from local universities, and occasionally, outside technical experts or consultants who bring specialized knowledge on different planning or implementation issues. Such broad engagement greatly enhances the level of knowledge and resources brought to bear on these issues, increasing the prospects for buy-in because many issues that could prove contentious are dealt with early in the process, rather than after the plan is completed. It is particularly important that multiple tiers of government be represented, because as was noted earlier, some key systems or decisions are outside of the decisionmaking realm of the local authority. This does not guarantee that all issues will be resolved in the favor of

the local authority, but it does increase central or regional government's awareness of local concerns, and can influence future funding availability.

d. *Mayor-led or endorsed*: Many cities argue the best results are achieved when the team responsible for coordinating the climate planning effort resides directly within the Mayor's office, giving the planning team direct access to key decisionmakers. At a minimum, the mayor or other key local leaders should publicly endorse this process to provide the political support the planning team will need to convince others of the seriousness of the endeavor.

e. *Integration with other planning strategies*: Similarly, the best results are achieved if the climate plan is not treated as a standalone strategy, but rather is systematically integrated into other relevant local strategies, such as the local transport plan, waste plan, or water strategy. Some cities have gone so far as to integrate climate goals or metrics into their regular management reporting system to ensure progress is continuously monitored.

48. A good deal of the local climate planning work that has occurred in Romania has been carried out by cities and towns that are signatories to the Covenant of Mayors, a European Commission-supported initiative aimed at promoting sustainable energy use in cities. There is a formal sign-up process, managed by the Covenant of Mayors Office (CoMo) in Brussels, where a local authority commits to developing and implementing a Sustainable Energy Action Plan (SEAP) within a year of signing on to the program. A baseline emissions inventory must be prepared to enable subsequent monitoring of progress towards reductions in energy use. Although there is a suggested plan format, as was noted earlier, local authorities have great latitude in terms of which sectors or strategies they choose to focus on in their SEAP. Technical assistance in preparing and delivering the plan is available from the CoMO and the Joint Research Center of the European Commission.[21]

49. As of September 6, 2013, there are 60 communities[22] around Romania that have signed on to the Covenant, collectively representing a population of roughly 5 million people. Signatory communities include Bucaresti District 1, Timisoara, Cluj, Brasov, Ploiesti and Arad. The majority of signatories are much smaller, however, with 25 of the 60 signatories having populations of less than 10,000.

50. To date, thirty of these cities have submitted their SEAP, the majority of which are available for review online. Program rules state that the SEAP must be approved by a city's municipal council and then uploaded to the Covenant website for review by the CoMo. A template is used to ensure to ensure the data is submitted in a standardized format, and to allow for review by the EC's Joint Research Centre, which is looking for inaccurate or inappropriate assumptions. Once the plan is 'approved' by the CoMo, then the city must report annually on its progress toward the SEAP goals.

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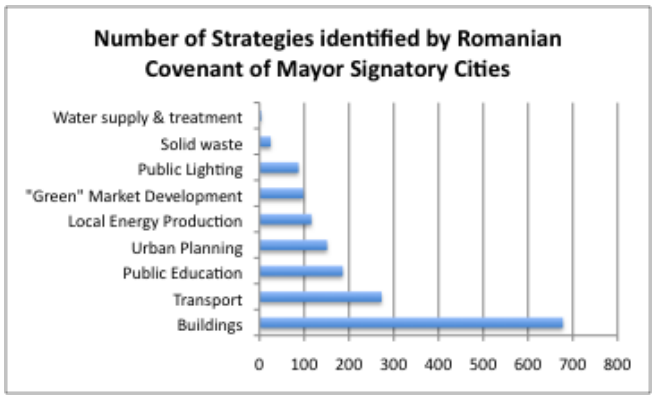
[21] For more information about the Covenant of Mayors Program, see http://www.covenantofmayors.eu/index_en.html

[22] Covenant of Mayors. Signatories. Reviewed online at http://www.covenantofmayors.eu/about/signatories_en.html?q=Search+for+a+Signatory...&country_search=ro&population=&date_of_adhesion=&status= on September 6, 2013.

Figure 1.3: Energy strategies detailed by Romanian Signatories to the Covenant of Mayors in their Sustainable Energy Action Plans (as of July 2013)
Source: World Bank analysis of Covenant of Mayors database



51. The contents of all 29 plans submitted as of July 2013 were scanned to gain a sense of where local authorities were choosing to prioritize their energy planning efforts. As Figure 1.3 clearly shows, the vast majority of the strategies listed in these plans fall into the buildings and transport sectors, two sectors that typically dominate local energy use.

52. Within these categories, the strategies most commonly mentioned in the sustainable energy action plans included:

a. Buildings
    i. Refurbishment/thermal rehabilitation of municipal public buildings, including schools
    ii. Energy audits of public buildings and the issuance of energy performance certificates that meet EU requirements
    iii. Thermal rehabilitation of residential buildings (i.e. tower blocks)
    iv. Installation of photovoltaics on municipal buildings
b. Transport
    i. Modernization of the public transport system
    ii. Improved transport/local mobility planning
    iii. Creation of bike rental network

53. The City of Brasov's Agency for the Management of Energy and Environment (ABMEE) serves as the hub of the "Covenant Club" in Romania, which was established to support signatories by providing a platform to exchange ideas and information. The Club also seeks to provide a communal voice on legislative and policy matters in Romania.[23] ABMEE also serves as home to Energy Cities Romania, a consortium of the energy policy managers in Romanian cities.

54. Other climate-related planning work is taking place in seven Romanian cities where the World Bank's Tool for the Rapid Assessment of City Energy (TRACE)[24] has been deployed to support local

[23] Netcom. *Networking the Covenant of Mayors – Romania: Feedback from the ground on the Covenant of Mayors implementation*. January 2012.
[24] For more information about TRACE, see https://www.esmap.org/TRACE.

energy efficiency planning efforts. TRACE is designed to help local authorities assess their energy use in six key sectors under their control: water, waste, transport, public street lighting, buildings, and the power and heat sector. Cities can benchmark their energy performance against peer cities in each of these categories, receive guidance on which sectors should be prioritized for action, and evaluate which specific policy or technology interventions might be most appropriate in their city. An expert consultant working with local authority staff on data collection and analysis typically carries out a TRACE analysis, but it can be deployed independently by cities with some expertise on energy efficiency matters.

55. Given TRACE's efficiency focus, it does not address a full range of options that cities may consider to lower carbon emissions, such as the use of renewable energy technology or other fuel switching strategies. TRACE is also most useful in addressing sectors over which a local authority has the greatest control – the public bus system, for example, rather than private automobiles – but many TRACE analyses do adopt a broad perspective about the types of energy actions necessary in a city.

56. The three Romanian TRACE studies published thus far (Cluj-Napoca[25], Ploiesti[26], and Brasov[27]) and the four other draft studies (Constanta, Craiova, Iasi, and Timisoara) all spend a significant amount of time talking about transport issues (including high rates of private vehicle ownership, the old age/inefficiency of both public and privately owned vehicles, parking availability, etc.) and buildings (the shift away from district heating connections to building-based thermal systems, the lack of thermal insulation in buildings, etc.) compared to other sectors. The TRACE studies do not ignore these sectors – for example, each of the three published reports note the district energy systems in those cities have a high rate of heat loss compared to many other cities – and the reports each conclude with several recommendations the local authorities are encouraged to explore in greater depth. As Table 1.5 makes clear, there is considerable overlap in terms of the recommendations but also several recommendations that are unique to each city.

[25] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Cluj-Napoca, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.
[26] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Ploeisti, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.
[27] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Brasov, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.

Table 1.5: Key recommendations from three Romanian city TRACE studies
Source: World Bank 2013

Brasov	Cluj-Napoca	Ploiesti
--	--	Energy efficiency strategy and action plan
Promotion of non-motorized modes of transport	Promotion of non-motorized modes of transport	Promotion of non-motorized modes of transport
Public transportation development	Public transportation development	Public transportation development
--	Traffic flow optimization	--
--	Traffic restraint measures	Traffic restraint measures
Parking restraint measures	Parking restraint measures	Parking restraint measures
Buildings benchmarking	Buildings benchmarking	--
Municipal buildings audit & retrofit	Municipal buildings audit & retrofit	Municipal buildings audit & retrofit
--	City-wide integrated lighting assessment	--
--	Street lighting audit and retrofit	--
Street lighting timing	Street lighting timing	Street lighting timing
District heating network maintenance and upgrade	District heating network maintenance and upgrade	District heating network maintenance and upgrade
Active water leak detection and pressure management	--	--

57. There are no comparable studies or initiatives detailing the work of local and regional authorities in terms of adapting to climate change; this is a huge gap that the Romanian government should focus on going forward.

1.7 Recommendations

58. There is considerable evidence from around the world that cities are recognizing the value of local climate planning, for both short- and long-term competitiveness reasons. The fact that 60 cities and towns from around Romania have signed up for the Covenant of Mayors program also speaks to the fact that planning activities of this type can deliver immediate energy cost savings benefits to a city, freeing up scarce resources to be spent on other pressing public needs.

59. The efforts by countries as diverse as Korea, France, and the Philippines to require local climate planning through national policy directives also serves to remind us, however, of the national economic and social implications of effective city-level climate planning. The Romanian Government's goal of using the 2014-2020 Operating Programs to recalibrate Romania's national climate strategy is thus highly strategic, creating an opportunity to use a spatial – rather than topical – construct to frame the climate change conversation around the country.

60. The experience gained to date through local disaster planning efforts, participation in the Covenant of Mayors, and the seven TRACE studies provides a helpful starting point for this work. Much more should be done to ensure that these efforts are integrated, however, cutting across

traditional geographic, sectoral and ministerial boundaries. The Integrated Urban Development Plans required by MDRAP are a potential vehicle to build on in this regard, given their broad focus. It would be relatively easy to identify specific climate-change related topics that must be included in any IUDPs going forward. Some type of quality control system would likely be required to ensure that any climate-focused discussion is comprehensive in its coverage, evidence based, and reflective of inputs from a broad array of stakeholders. The Covenant of Mayor's strategy of having outside experts evaluate each plan to ensure a minimum level of quality is an interesting model the Government of Romania should consider for its own IUDP process.

61. There is also value in having individual cities develop their own climate strategy, however. A regional strategy would not contain the level of granularity necessary to address all climate-related concerns in an individual city. In this case, the SEAP and TRACE studies are more relevant models, although their focus must necessarily be broadened to cover adaptation/resilience topics in an in-depth manner. Comprehensive emission inventories and climate risk studies should be required as essential building blocks of these plans.

62. Capacity building strategies will be necessary if this approach is to succeed, providing local authority staff with both the tools and information they need to develop effective, workable plans. The good news is that between the World Bank, the European Commission, different city networks, and other academic and consulting resources in Romania and elsewhere around the continent, there is considerable support available that can be leveraged for this purpose.

63. Of particular relevance is the fact that in 2014, the World Bank and several international partners are commencing work on a program to train and accredit individuals attaining certain minimum knowledge on how to prepare a citywide emission inventory, citywide climate risk analysis, and comprehensive city-scale climate change action plan. By establishing this program, the Bank and its partners seek to increase the overall level of human capital available to assess the challenges facing a city and work on solutions to these challenges. The Romanian Government is encouraged to actively monitor the rollout of this strategy, and work with the Bank and other partners to promote awareness of this program and support those officials interested in pursuing accreditation.

64. Near and long-term policies and investments that should be considered to advance this agenda include:

High Priority/Near-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Integrated planning	Integrate climate change topics into IUDPs	Policy oversight	High
	Require cities applying for Operating Program support to prepare comprehensive climate plans meeting certain minimum quality requirements	Policy oversight	High
	Provide training for local authority staff on how to prepare comprehensive integrated local climate plans.	Training/ education	High
	Provide financial/resource support to the "Covenant Club" and other technical assistance organizations focused on local climate, energy efficiency, or transport planning, etc.	Education/ training	High

Technical studies	Fund research downscaling global climate models to provide more localized assessments of climate impacts in different regions, enabling local authority planners to assess their city's vulnerability to future climate shocks	Research & analysis	High

Medium and Long-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Integrated planning	Establish university curricula to train future environmental and urban planners on local climate planning.	Education/ training	Low
	Provide planning grants to local authorities to support the preparation of comprehensive, integrated local climate action plans.	Planning support	Medium
	Provide greater access to data sources relevant to comprehensive integrated local climate planning efforts	Planning support/ research & analysis	Medium
Technical studies	Fund LIDAR surveys and other analyses that support the development of highly granular, building scale assessments of flooding and other types of climate risk in the 20 largest cities around Romania.	Research & analysis	Medium
	Support/require the use of broader GHG emission inventories (such as the GPC -- Global Protocol on Community Scale GHG Emissions) at the local level, to ensure more comprehensive assessments than those employed by the Covenant of Mayors.	Policy/ oversight	Medium
Public education	Establish public education programs to expand general awareness of climate change and local climate planning issues	Education/ training	Low

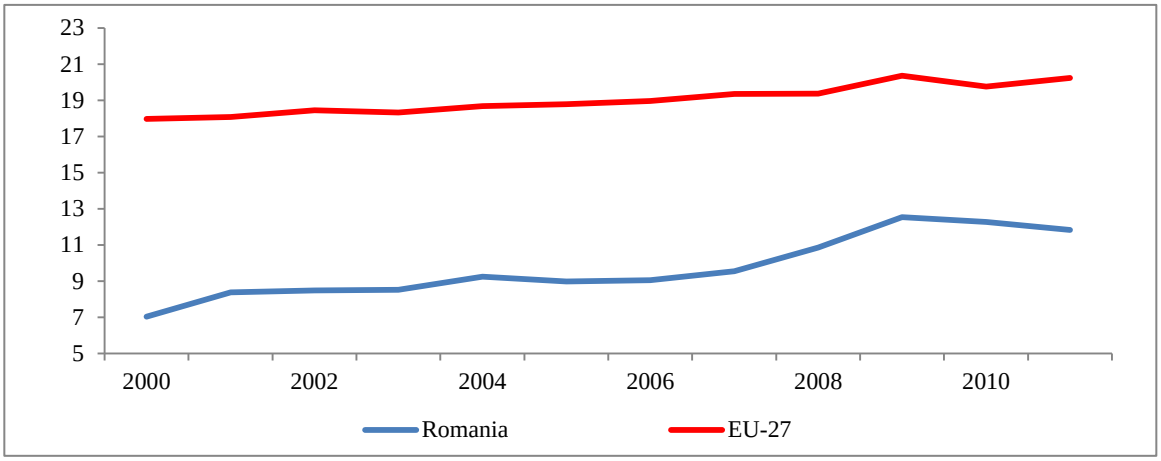
Section 2: Urban Transport Sector Analysis

(Note: this is a summary of the urban-relevant sections of the standalone Transport Sector analysis prepared by the World Bank Transport team)

2.1 Overview

65. Romania's transport sector is responsible for 11.8% of the country's greenhouse gas emissions, a rate lower than the EU average, but one that is growing more quickly. (See Figure 2.1) Road transport is the source of the great majority of GHG emissions in the transport sector, responsible for 93 percent of domestic transport emissions.[28] This is a similar proportion to the EU-27 average of 94 percent.

Figure 2.1: Transport GHG Emissions as a Percentage of Total GHG Emissions in Romania
Source: EEA



66. Although car mode share in Romania is at a similar level to the EU average, the car ownership rate in Romania is the lowest in the EU at 201 cars per 1000 inhabitants in 2010,[29] but has grown significantly in recent years, up from 150 cars per 1000 inhabitants in 2004.[30] Experience across the world suggests that as the Romanian economy grows, it will continue to grow in future.

67. Other information on the urban transport situation across Romania is extremely limited. The TRACE studies cited earlier in Section 1 have yielded some information, as do the Sustainable Energy Action Plans prepared by various Romanian towns and cities as part of the Covenant of Mayors program. In addition, the World Bank held an initial discussion meeting with the Executive Director for Transport in the Municipality of Bucharest on challenges and ambitions in Bucharest.

[28] European Environment Agency data, as at June 2013.
[29] Energy, transport and environment indicators. *Eurostat Pocket Books 2012 Edition*. European Commission.
[30] *Study on Strategic Evaluation on Transport Investment Priorities under Structural and Cohesion funds for the Programming Period 2007-2013. Country Report Romania* by Ecorys for European Commission DG Regio, 2006.

While not comprehensive, this information does paint a picture of the urban transport scene in Romania:

a. *Modal split* -- There is limited reliable information on modal split in many Romanian cities, making it difficult to assess the current transport-related GHG emission levels in individual Romanian cities, or the proportion of total transport-related emissions that occur in urban vs. rural areas of Romania.
b. *Traffic congestion*. The TRACE studies in Brasov,[31] Cluj-Napoca[32] and Ploiesti[33] all identified traffic congestion as a problem issue; local government officials in Bucharest also consider congestion a significant problem.[34] Congestion, with the resulting start-stop nature of the driving cycle it imposes on vehicles, significantly increases greenhouse and other gaseous emissions from road traffic.
c. *Parking.* With the rapid growth in ownership and use of private vehicles since Romania started the transition to a market economy, the supply of designated parking spaces in Romania's cities has come under pressure and the number is often inadequate to meet demand. This often leads to "informal" parking arrangements, with vehicles parking on footways, cycle tracks and public spaces as well as on every available meter of legitimate roadside parking space. As well as causing difficulties for pedestrians, cyclists and other road users, this also adds to the congestion problems noted above. Management of parking in some Romanian cities is rudimentary or non-existent, with little or no enforcement of parking regulations, nor is there any attempt to use parking restraint through charging or enforcement of restrictions as a demand management tool. In other cities such as Brasov and Cluj-Napoca, new parking management systems are taking hold that allowing drivers to pay for parking meters with their mobile phones, but their effectiveness has yet to be assessed.
d. *Public transport*. Many cities around Romania have public transport systems. In Bucharest, there is a metro system (operated by Metrorex, a state-owned company), a tram network, trolley buses, and an extensive bus network, all of which are operated by RATB, an operating company overseen by the Municipality of Bucharest. In other Romanian cities and towns, public transport tends to consist of buses, minibuses, trolley buses and trams operated by the city or a private concessioner. The city of Brasov took the decision in 2005 to abandon its tram line due to the prohibitive cost of upgrading and maintaining it; it now focuses on buses and trolley buses. Cluj-Napoca has upgraded its tram system, while other cities have similar system upgrade plans but lack funding to implement them. Part of the challenge facing many of these systems is declining ridership levels. In Ploiesti, for example, public transport patronage fell from 7 million trips per month in 2011 to 6.7 million in 2012. Some cities are making concerted efforts to reverse this trend through modernization of infrastructure and services, although lack of funding remains a serious constraint. In

[31] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Brasov, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.
[32] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Cluj-Napoca, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.
[33] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Ploeisti, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.
[34] Bucharest - sustainable mobility case study. Mihaila Raducu, Goteborg University, 2010.

Brasov, the municipally-owned operating company renewed its bus fleet with 109 new vehicles in 2006.

e. *Taxis, pedestrian and cycling infrastructure.* There is a plentiful supply of taxis in most Romanian cities, but many of the vehicles are old and not fuel-efficient, mirroring the make-up of the national vehicle situation. Some cities have an age limit for taxi vehicles, but this varies significantly (e.g., Brasov has an age limit of five years, while in Cluj-Napoca the age limit is 12 years). Pedestrian and cycling infrastructure varies greatly in quality and quantity between different towns and cities, and within different city areas. Good cycling infrastructure exists in some cities but it generally does not form a coherent network, and is often poorly maintained. Parking on cycle lanes is also a problem, reducing their usability further. Efforts to improve walking and cycling facilities were reported in the Brasov, Cluj, and Ploesti TRACE studies, and mention is made of encouraging these modes in other city Sustainable Energy Action Plans.[35] Strategies include lengthening the cycle lane network, installing self-service bicycle docking stations, and establishing pilot bike-sharing schemes.

2.2 Policy Environment

68. There are several formal documents adopted by the EU that are relevant to Romania's transport sector. Key among them is the European Commission White Paper "*Roadmap to a Single European Transport Area: Towards a competitive and resource efficient transport system"* adopted in March 2011.[36] The White Paper focuses on assuring sustainable mobility for people and goods with a strong emphasis on contributing to a very ambitious greenhouse gas emission target set for the EU as a whole. Because the White Paper covers all forms and aspects of transport, the goals are necessarily wide ranging, but there is one goal specifically focused on cities, namely, that by 2050 there be no new conventionally-fuelled cars in cities

69. Interim goals included in the White Paper relevant to cities focus on: (a) developing and deploying new and sustainable fuels and propulsion systems; (b) optimizing the performance of multimodal logistic chains, including by making greater use of more energy-efficient modes; and (c) increasing the efficiency of transport and of infrastructure use with information systems and market-based incentives.

70. A second key document is a European Commission position paper that specifically sets out its views on the main transportation challenges faced in Romania and on funding priorities.[37] As part of this report, the EC called for the promotion of sustainable urban mobility plans (SUMPs) based on low-carbon transport modes for urban areas; investment in the necessary infrastructure and accessible rolling stock to deliver those plans, and institutional support to improve local transport management. The position paper also highlighted the need for attention to climate adaptation strategies and capacity building policies, including the modification of technical standards, and the

[35] Sustainable Energy Action Plan of Vaslui 2011-2020. Municipality of Vaslui, 2009.
[36] European Commission (2011), *White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*. Brussels, March 28, 2011, COM (2011) 144 final.
[37] Position of the Commission Services on the development of Partnership Agreement and programs in Romania for the period 2014-2020. European Commission, Ref. Ares (2012)1240252 - 19/10/2012.

need to improve governance and service delivery by tackling the current shortage of civil engineers trained in transport planning.

71. The scope of EU cohesion funds will remain largely similar to the current period, with support for investments to comply with environmental standards, promoting energy efficiency and the use of renewable energy; investments in the Trans European Transit Network, and urban and low-carbon transport systems. The Integrated Territorial Initiative discussed earlier in Section 1 is also expected to be a key instrument to implement transport programming, allowing member states to implement Operational Programs in a cross-cutting way and to draw on funding from several priority axes of one or more Operational Programs. This is particularly relevant in the case of sustainable urban transport, given the need to link transport to other regional development goals.

72. At the national level, the Romanian Ministry of Transport (MOT) expects to complete a new 20-year General Transport Master Plan (GTMP) for the country by the end of 2013. As well as guiding what goes into the 2014-2020 Operational Program, the GTMP is intended to provide "an integrated strategy for the national transport system", including short, medium and long-term transport investment programs and policy measures. As a key part of the development process a National Transport Model has been developed, to help objectively appraise options and give a solid basis for the GTMP. The model will be maintained and updated on an ongoing basis following completion of the GTMP; it is also recognized that the GTMP itself will need to be a "living document" with periodic updates to reflect changing circumstances and challenges.

73. A preliminary draft of the GTMP, dated August 19, 2013, presented a set of proposed objectives for the Master Plan projects, including achieving transport economic efficiency; minimizing negative environmental impacts; giving priority to modes of transport which are more energy efficient and have lower emissions; and producing a safer transport system. It also sets out a funding objective which is partly about producing more efficient pricing for transport and partly about deliverability given likely constraints on transport funding from various national, EU, and private sector sources. From a climate change perspective, the sustainability objective relates to mitigation of climate change, although climate change is not specifically mentioned.

74. From an urban perspective, the most important fact is that the GTMP does <u>not</u> cover urban transport investment and policy interventions. This is because responsibility for urban transport investment generally sits with the municipalities in Romania (with the exception of the Bucharest metro network), under the aegis of the Ministry for Regional Development and Public Administration. MRDAP is also responsible for regional, local and county roads that link the towns, cities and villages of Romania.

75. The need for Master Plans to guide urban transport strategies and investment has been identified by both the Government of Romania and by the European Commission. The terms of reference have been drafted for studies to develop SUMPs for the seven growth pole cities and Bucharest/Ilfov. The European Bank for Reconstruction and Development will play a key role in procuring consultants to undertake the studies, in support of MRDAP. JASPERS (Joint Assistance to Support Projects in the Regions) will provide technical support as appropriate. In parallel with the studies, the World Bank will support spatial planning and integrated development planning for the growth poles and also continue to assist the Metropolitan Transportation Authority Bucharest.

76. The objectives of the SUMPs, as stated in the draft terms of reference, include:

a. Reduce air and noise pollution, greenhouse gas emissions and energy consumption;
b. Improve resilience of transport networks to extreme weather and natural events in line with "adaptation to climate change" EU policies.

77. The appraisal process and criteria used in developing the eight SUMPs are not defined at this stage, although they would be expected to include consideration of climate change issues in line with the above objectives. A challenge for the client and the consultants appointed to undertake the studies will be to ensure that the appraisal process and criteria used in each of the eight cities are comparable. It is not clear at this stage how this will be achieved. The appraisal process and criteria should ideally be compatible with those used in the development of the GTMP, in order that there is consistency between urban transport strategy and general transport strategy on the national networks. The outputs of the SUMP studies are likely to be available towards the end of 2014.

2.3 Options for Controlling Transport GHG Emissions

78. A good way of thinking of mechanisms to reduce emissions in the urban transport sector is the avoid-shift-improve (A-S-I) strategy, which focus on *avoiding* growth of CO_2 emissions through urban development strategies that reduce the need for travel in passenger vehicles; *shifting* transport to modes with lower emissions (e.g., shifting passenger traffic from private vehicles to buses, rail or metro, and shifting freight from truck to rail); and *improving* vehicles efficiency and traffic management policies.

79. The set of policies aimed at dealing with A-S-I can be broadly considered to be prices, regulations, and investments. Some policies fall squarely within the control of local authorities; others are necessarily established or administered at the national/ministerial level. The full transport sector report goes into this policy discussion at greater depth, and also includes a discussion of fuel pricing, vehicle fuel economy or emission standards, freight, road/highway, air travel, and inland waterway policies that will likely have some impact on urban travel or economic activity. These discussions are far less relevant than the policies summarized here, however:

a. Road pricing instruments -- Road pricing theory argues that the socially optimal amount of transport in total and by mode requires that users pay the full social cost of his/her trip at the margin or marginal social cost pricing.[38] Some of the pricing policy options commonly employed by policy makers wishing to contain the growth of the modal share of vehicles in cities include congestion pricing in a targeted cordon zone, toll road pricing, high-occupancy vehicle and toll lanes, and parking policies, all of which can make mass transit more economically appealing.

b. Changes in urban form -- As noted in Section 1, urban form affects daily travel patterns and thus the amount of annual vehicle kilometers travelled**.** In many ways, the relationship between transport and urban form is mutually reinforcing, in the sense that transportation investment decisions influence spatial patterns of

[38] Richard Martin Humphreys (2011) *A Short Primer on Road User Charging*. Policy Note prepared for the Albanian Government. Europe and Central Asia Transport Division, World Bank.

development, which in turn influence patterns of travel, and these in turn influence future transport investment decisions and investments. Clearly, changing what can be a "vicious circle" requires addressing urban development and planning issues, which will set the transport demand needs for decades to come. The bottom line is that once a country has developed an urban form characterized by extensive urban sprawl, it becomes exceedingly difficult to control GHG emission growth. This is because low-density development where there is separated land use makes a passenger vehicle the only efficient transport option. Developing more compact, transit served urban cities could reduce transport energy needs by up to three-quarters.

2.4 Impact of Climate Change on Transport Systems

80. Climate change is expected to have a significant impact on urban transportation, affecting the way transportation professionals plan, design, construct, operate, and maintain different transportation systems. Decisions taken today, particularly those related to the redesign and retrofitting of existing infrastructure, or the design of new transportation infrastructure, will affect how well the system adapts to climate change far into the future. Focusing on the problem now should help avoid costly future investments and disruptions to operations. To date, however, research on how climate change will impact transportation is scarce, particularly in a Romanian context.[39]

81. Higher temperatures and more frequent heat waves (particularly in the south and south-east of Romania) are likely to cause problems with road and rail infrastructure. Asphalt roads may become soft and deform more under the weight of vehicles, causing traffic restrictions to be put in place, particularly for heavy vehicles. This issue is already recognized by the Romanian national roads company, which uses adjusted material standards and design norms in vulnerable areas to cope with higher temperatures and minimize deformation. Nonetheless, restrictions on weight as well as time of travel (during the day) are sometimes imposed on trucks during the summer period to reduce road deterioration when the asphalt is soft.

82. Railway lines also buckle under high temperatures, which can again lead to speed and usage restrictions, while higher temperatures can affect the thermal expansion of bridge joints affecting bridge operation and increasing maintenance cost. Higher temperatures and heat waves are likely to cause discomfort and possible safety risk to rail and other transport passengers, requiring improved ventilation at stations (e.g., Metro stations) and improved ventilation or air conditioning on trains, metro trains, trams, trolleybuses and buses. This will be important if these modes are to remain attractive in competition with private cars, in which air conditioning is becoming more common.

83. Rail, road and waterborne transport infrastructure are potentially vulnerable to the effects of more intense rainfall and increased frequency of flash floods, which can render can render tunnels non-operational and disrupt traffic. It may precipitate tunnel failure and damage tunnel power supply, ventilation, and other utilities. Bridge abutments, piers, road and rail embankments and riverbanks are potentially vulnerable to flash floods unless measures are taken to protect them.

[39] Infrastructure Canada, *Adapting Infrastructure to Climate Change in Canada's Cities and Communities,* December 2006

Flooding will also result in the erosion and scouring of bridge supports, and an increase in precipitation will increase the risk of failure of cuttings and retaining walls located at and around tunnel portals. Runoff from increased precipitation levels will also affect stream flow and sediment delivery in some locations, with potentially adverse effects on bridge foundations. Intense rainfall can also have adverse impacts on road safety, although in some areas a reduction in icy and snowy days may counterbalance this on an annual basis.

84. Road and rail traffic on bridges are vulnerable to strong winds associated with extreme storm events. The structural integrity of long span bridges may also be jeopardized by strong winds,[40] leading to bridge closure and failure in extreme cases.

85. Temperature variations, particularly extreme heat and heat waves, will affect transport construction projects. Extreme heat will create unfavorable working conditions for workers, and inhibits certain types of construction activities. For example, high temperature, low humidity and high wind are factors that reduce the setting times and strength of concrete. Nevertheless, warming temperatures can bring some benefits, particularly in colder areas of the country. Warmer temperatures could translate into a longer construction season and improved cost efficiencies, in addition to reducing winter road salt and chemical use, and their accompanying adverse environmental impacts.

2.5 Recommendations

86. The full Transport Sector report provides a much broader perspective on the range of sectoral-focused GHG emission reduction and climate adaptation strategies the Romanian government should consider going forward. This discussion is limited to those topics likely to prove most relevant from an urban context, although that does not mean that these necessarily fall under the purview of a local authority.

87. One point is quite clear, however -- concerns about climate change are not likely to be the key driver of urban transport policies or investment decisions. Instead, local co-benefits – such as reduced traffic congestion or improved air quality – are much more likely to drive the development of transport policies.[41] Looking at congestion levels in a city like Bucharest and trends toward increased motorization, the issue is as much a classic problem of transport and urban planning as it is a GHG emission problem. Co-benefits can motivate discussions on improved transport policies that are also low carbon or climate resilient strategies.

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Road transport	Study fiscal measures that may influence vehicle purchase and use choices	Research/analysis	High
Urban Transport	Prioritize integrated urban planning	Research/analysis	High
	Support development of sustainable urban mobility plans (SUMPs) in the largest cities around Romania	Research/analysis	High

[40] Wilson and Burtwell, *Prioritizing Future Construction Research and Adapting to Climate Change: Infrastructure,* February 2002

[41] James Leather and the Clean Air Initiative for Asian Cities Center Team (2009), *Rethinking Transport and Climate Change*, Asian Development Bank Development Working Paper Series No.10, December 2009.

	Study on the potential role of 'hard' demand management measures to address congestion and emissions in the most congested Romanian cities.	Research/analysis	High
	Undertake Bus Rapid Transit feasibility studies in cities where the SUMP indicates this is likely to provide a cost-effective solution to urban mass transit.	Research/analysis	High
	Invest in urban public transport in accordance with the framework provided by the SUMPs.	Direct investment	High
	Invest in cycling and walking infrastructure, in accordance with the framework provided by the SUMPs.	Direct investment	High
	Establish a pilot project to demonstrate and test the feasibility, costs and benefits of urban freight consolidation centers.	Direct investment	High
	Establish pilot projects on alternative fuels for buses and other urban fleet vehicles	Direct investment	High
	Extend the metro system in Bucharest to provide a more complete network, with specific projects in line with the GTMP prioritization process.	Direct investment	High
	Implement intelligent urban transport systems, in line with priorities established in these areas by the SUMPs.	Direct investment	High
	Study the vulnerability of urban transport infrastructure and systems to changed climate conditions in all Romanian cities. Draw up city-wide adaptation plans based on the risk assessment.	Research/analysis	High
	Implement heat resilience infrastructure measures on local rail and tram tracks.	Direct investment	High
	Implement improved ventilation and/or air conditioning at enclosed metro or rail stations.	Direct investment	High
	Introduce improved ventilation and/or air conditioning in public transport vehicles to allow passengers to travel in reasonable comfort during high temperature periods.	Direct investment	High
	Implementation of flood resilience measures for new and existing transport infrastructure	Direct investment	High

Section 3: Energy Sector Analysis

(Note: this is a summary of the urban-relevant sections of the standalone Energy Sector analysis prepared by the World Bank Energy team)

3.1 Overview

88. In Romania, the energy sector is responsible for 70% of all greenhouse gas (GHG) emissions. Power and heat generation and non-transport fuel use contribute to three quarters of this total. GHG emissions from this sector have been declining, due to huge contractions in the economy and through energy efficiency improvements.

89. Coal-fired thermal plants provide roughly one third of the country's electricity supply, a level significantly higher than other EU countries. The share of hydro, wind, solar and nuclear power is growing, however.

90. Electricity and natural gas prices are both below EU average levels. Natural gas prices are the lowest of any EU country due to regulatory distortions.

91. Among EU27 countries, Romania has the lowest per-capita energy consumption. Per capita consumption of electricity is particularly low, but significant growth in electricity demand is already occurring, driven mainly by the residential and commercial sectors. Some of this growth is occurring as households seek to move away from their reliance on district heating. Overall, the number of households connected to district heating, mostly in large, urban apartment buildings, declined from 2.2 million to 1.4 million between 1990-2012.

3.2 Institutional Environment

92. The European Union sets the framework for the sustainable energy policies of its member states. The overarching long-term goal is the commitment to reduce greenhouse gas (GHG) emissions 80-95% below 1990 levels by 2050, through investments in energy efficiency and low-carbon and smart energy infrastructure. Over the medium-term, the EU's energy and climate policy is focused on the so-called 20-20-20 targets that were adopted in 2007: by 2020, GHG emissions should be 20% below 1990 levels; renewables should reach a share of 20% of final energy consumption; and primary energy consumption should be reduced by 20%, compared with the projected baseline. Romania is likely to meet all three targets, reflecting a huge contraction of its otherwise carbon intensive economy.

93. The Romanian government has primary responsibility for energy regulatory matters (over both power and district energy systems) through ANRE, and national buildings policies which can influence energy efficiency efforts. The latter is the province of the Ministry of Regional Development and Public Administration. Local authorities are responsible for public service infrastructure provision and oversight of buildings within their territory. Local energy planning is required for all municipalities with more than 20,000 inhabitants; some municipalities are very interested and active in energy efficiency/GHG issues, as exemplified by their voluntary participation in the EU's Covenant of Mayors Program.

94. Energy markets around Romania have been partially liberalized. The power sector follows the model of liberalized wholesale and retail markets. Electricity production is unbundled from transmission, giving residential consumers the right to switch suppliers. Since this program started in 2007, however, few have done so because regulated prices are well below free market rates. Natural gas and district heating rates also remain heavily subsidized. Regulated electricity and gas prices for non-households are scheduled to be fully liberalized by January 2014 and January 2015, respectively, and regulated electricity and gas prices for households will be liberalized by January 2018 and January 2019, respectively. The current price support schemes for district heating are expected to remain in place for the foreseeable time.

95. National energy laws most directly relevant to urban areas include:

a. Energy performance of buildings directive for public and residential buildings
b. Local energy planning required in municipalities with more than 20,000

90. From an urban perspective, the most important issues are energy prices and the Romanian government's inability to deal with the ailing district heating sector. These systems are generally owned by municipal authorities, but the buildings they serve (which must also be retrofitted) are privately owned. Substantial amounts of financing are needed, spread out over a long period of time. There is also a need for improved coordination to ensure actions are taken in a complementary manner. This coordination is frequently missing due to inadequate staffing levels, and due to the fact that the staff lacks experience on EE issues in particular.

3.3 District Heating in Romanian Cities – A Rapid Assessment

91. District Heating systems are a prominent feature of many Romanian cities, but their use is declining. The 300 systems operating in 1995/96 had declined to 100 by 2011, of which 83 are in urban areas. The customer base of these systems has declined over time from 2.2 million apartments in 1990 to 1.4 million by 2012. In 16 of the 31 district heating systems with more than 10,000 customers, the number of customers has declined by more than 50%. In many cities, district heating has become a serious drain on public finances because tariffs for residential consumers are highly subsidized, on average about 50%.

92. Service quality, cost, and concern over high pollution levels are among the primary reasons for declining demand. Most of the old inefficient cogeneration units and heat-only boilers have still not been upgraded or replaced with modern generation equipment, nor are they equipped with adequate burning equipment, resulting in SO_2 and NO_X emissions that exceed the EU norms. With an average of 275 tons of CO_2 per Gcal, Romania's district heating producers rank among the most polluting service suppliers in the EU. Heat distribution networks suffer an average of 30% heat and water losses, compared to 5-10% for newer networks. As a result of those inefficiencies, the cost of district heating is about 18-20% higher than in some other EU countries.

3.4 Recommendations

High Priority/Near-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
District heating system efficiency	Conduct strategic reviews of local district heating systems to establish the most efficient and cost-effective heat supply options strategy. Focus initial investment efforts on a few selected cities where district heating is deemed economically viable and competitive compared with distributed alternatives, and local governments are committed to sector reforms	Research/analysis	High
Institutional environment	Implement electricity and natural gas price liberalization as scheduled.	Policy oversight	High
	Abolish all price subsidies; introduce targeted subsidies for low-income families in the form of cash payments within the social protection system.	Policy oversight	High
	Promote tariff reform, including consumption-based billing at the dwelling level.	Policy oversight	High

Medium and Long-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Building retrofits	Conduct reviews of public buildings to identify poor energy performers	Research/analysis	Medium
Institutional environment	Unify district heating regulation under one regulator.	Policy oversight	Medium
	Consider additional policies to "protect" district heating systems in areas where it is already supplied and cost-effective, such as requiring that new buildings connect to the district heating system or that existing buildings cannot disconnect and choose an alternative heat source. (The Heat Law already allows this in municipalities where investments in district heating rehabilitation/ modernization have taken place.)	Policy oversight	Medium
	Establish accreditation/certification procedures for ESCOs to enhance their credibility among consumers.	Policy oversight	Medium
Project Finance	Provide investment support for ultra-high-efficiency cogeneration.	Direct investment	Medium
	Establish a dedicated energy efficiency revolving fund for the public sector to address some of the critical financing and implementation constraints faced by municipal public entities while also helping to nurture and develop Romania's nascent ESCO market. Such a fund may be seeded by a combination of EU funds and government grants and could potentially attract private financing if proven successful.	Direct investment	Medium

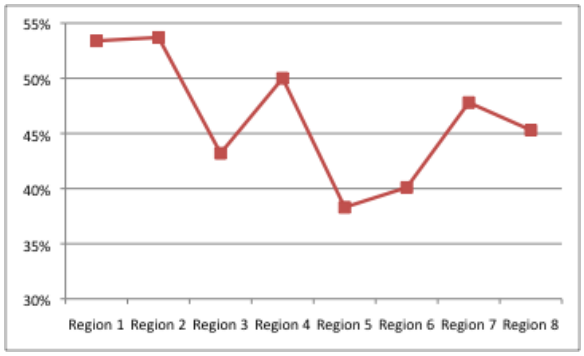
Section 4: Urban Solid Waste Sector Analysis

4.1 Overview

93. In 2009, 6.94 million tons of municipal solid waste[42] was collected in Romania.[43] Collectively, the GHG emissions associated with Municipal Solid Waste disposal in Romania total approximately 2.5 Gg of CO_2 equivalent, or 2% of the country's overall emissions.[44]

94. On a per capita basis, municipal solid waste generation levels in Romania amount to roughly 365 kg/person/year,[45] which puts Romania at the low end of the spectrum compared to other members of the EU. Urban waste generation levels are higher than levels in rural areas: at one point residents of urban areas in Romania were reported to generate approximately 0.9 kg/person/day, compared to approximately 0.4 kg/person/day in rural areas.[46] Total annual waste generation have changed quite a bit over the past few years, however, so it is unclear if the difference has between the two has increased or decreased.

Figure 4.1: Fraction of local waste stream composed of organic materials



95. Overall, roughly 46% [47] of Romania's municipal waste stream consists of biodegradable material (also known as organic waste), although this ranges from 38-54% in different parts of the country, according to the last available estimates. (See Figure 4.1). This is a fairly commonplace situation in lower- and middle-income countries as there tends to be less consumer spending that would produce higher levels of product or packaging waste.

96. The majority of the emissions resulting from the solid waste management sector are associated with the country's overwhelming reliance on landfilling as its primary waste management strategy, totaling nearly 99% in 2011.[48] Organic waste entombed in a landfill decays anaerobically, producing methane gas, a GHG with 25 times the heat trapping potential of carbon dioxide. Unless the landfill is properly designed, capturing or flaring the methane via a series of

[42] According to the Romanian National Waste Plan, municipal solid waste is defined as waste from households, commercial establishments, institutions, municipal services (including street cleaning and waste from parks, markets and gardens), and construction and demolition debris.
[43] United Nations Economic Commission for Europe, *Environmental Performance Reviews – Romania (Second Review)*. United Nations. 2012. p 124
[44] Ministry of Environment and Climate Change, *Romania's Greenhouse Gas Inventory 1989-2011: National Inventory Report*. May 2013. P 756.
[45] Eurostats 2013. See *env_wasmun* dataset. Last updated July 4, 2013. Retrieved July 19, 2013.
[46] Altudori A (undated). *Integrated Municipal Solid Waste Management in Romania. Case Study – Region 8 – Bucharest – Ilfov*.
[47] Ministry of Environment and Climate Change (2013) *Romania's Greenhouse Gas Inventory 1989-2011: National Inventory Report*. P 772
[48] Eurostat. "In 2011, 40% of treated municipal waste was recycled or composted, up from 27% in 2001." News release. 4 March 2013.

pipes embedded in the landfill, the gas will slowly leak out of a landfill for many years, including long after a landfill is formally closed. Very few landfills in Romania have the ability to capture or flare this gas, meaning most methane is released directly to the atmosphere.

97. As part of the EU accession agreement, Romania has agreed to close down 238 poorly managed solid waste dumpsites and replace them with sanitary landfills, some of which are expected to have gas recovery systems installed. The current status of these plans are unclear, although the team was unable to find any information detailing the level of landfill gas recovery currently occurring around the country.

98. Aside from gas capture, one way to eliminate methane generation problems at landfills is to segregate biodegradable waste at its point of generation, diverting this material into alternative waste processing methods such as composting or anaerobic digesters (AD). Composting organic waste not only prevents the production of methane, it also can create a useful material that can be land applied, returning nutrients to the soil. Composting does release CO2, but because that CO2 was originally sequestered in the plant matter, composting organic waste does not add any net CO2 to the atmosphere. Sending organic waste to anaerobic digesters produces methane, but the closed nature of the system means the gas is completely captured, available for use as a power or heating source, displacing fossil fuel sources. Waste-to-energy (WTE) facilities, where the waste material is combusted (and power can be generated as a byproduct of the combustion process), are another increasingly common waste management technique capable of delivering GHG emission reductions, although generally at a much higher cost.[49]

99. The exact level of GHG savings achieved by a WTE facility will also depend on the carbon-content of the electricity that is displaced by this new power generation source. For example, GHG savings can be high if electricity from a WTE facility is displacing electricity from a coal-fired plant; if GHG-free hydro-electricity is being displaced, however, emission levels may actually increase. There are several WTE facility proposals currently under consideration in Romania, including in Timisoara (150,000 Mg/a), Bucharest (750,000 Mg/a capacity) and Brasov (150,000 tonnes/annum). A fourth facility is also currently in an early stage of development in Northeast Romania with a capacity of 300,000 Mg/annum.[50] At this time, it is unclear what impact these facilities might have on national GHG emission levels, or when/if they will actually become operational.

100. Some GHG emissions also arise from the collection vehicles used by municipal authorities or private waste haulers to transport waste materials, recyclables, and compostables from homes and businesses to local transfer stations or disposal facilities. Although these emissions will tend to be small compared to the emissions arising from methane generated by organic waste buried in a landfill, this is an area easily remedied by local authorities. Strategies to reduce collection-related emissions can include vehicle replacement, route optimization (to minimize vehicle miles traveled), the use of intermediate waste transfer stations, or a switch to low-emission forms of transport – such as rail – if the waste or recyclable materials are to be transported long distances. These solutions may also deliver significant cost savings benefits to a local authority.

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[49] Hoornweg D and P Bhada-Tata. *What a Waste: A Global Review of Solid Waste Management*. World Bank. 2012.

[50] Tartiu V, "Selective collection of municipal waste in Romania: Characteristics and Challenges" *Management Research and Practice,* Vol 3, Issue 3 (2011) pp 53-62.

4.2 Policy Environment

101. Romania's accession into the EU has resulted in sizable changes in solid waste management practices across the country over the past 10 years, including a heightened focus on regional and local solid waste planning.

102. The First National Waste Management Strategy of Romania was released in 2004, covering the period through 2013. Regional Waste Management plans for all eight Romanian regions were issued in 2006, while county councils are responsible for complying with the regional strategies via county-level waste management plans. County councils also have the remit for managing disposal and waste transfer facilities, so landfill closures are their direct responsibility. Solid waste collection is handled as a municipal government function, by private haulers, and through public-private partnerships established by the municipality..

103. All solid waste plans are currently designed to help implement the requirements of key EU directives, including the Waste Framework Directive ((2008/98/EC) which establishes the basic tenets of EU waste policy; the Landfill Directive (1999/31/EC) which mandates the closure of old uncontrolled dump sites and the diversion of biodegradable waste from landfills (1999/31/EC); and the directive requiring the increased diversion of recyclable material (2006/12/EC). Achieving full compliance with these various directives will reportedly cost €1.8 billion, or approximately €25-30 million per county. Given that European Regional Development Funds 2007-2013 under OP Environment Axis 2 (Development of Integrated Waste Management Systems and Rehabilitation of Historically Contaminated Sites) would provide only approximately half that amount (€0.93 billion), the funding gap is significant. Difficulty drawing down these funds due to weak institutional capacity exacerbates this problem even further. [51]

104. All relevant EU directives are being pursed, although the closure of over old municipal landfills and illegal dumpsites appears to be proceeding at a significantly faster pace than others.[52] Progress is particularly slow for the diversion of both recyclable and biodegradable materials: by 2020 Romania is required to achieve a level of 50% recycling of municipal solid waste; currently this level stands at <1% nationally. Some argue that this number should increase fairly rapidly in the next few years, as more and more municipalities roll out local recycling programs.[53] The EU Landfill Directive requires member states to reduce the biodegradable fraction of the waste stream entering landfills over time; in Romania, 25% of all biodegradable MSW must be diverted from landfills by 2010 (compared to 1995 baseline data); 50% by 2013; and 65% by 2020.

105. Although the recycling industry (collection + markets) has ramped up relatively quickly, Romania's performance to date on biodegradable MSW collection and processing appears less

[51] World Bank (2011) *Solid Waste Management in Bulgaria, Croatia, Poland and Romania. A cross-country analysis of sector challenges towards EU harmonization*. World Bank Europe and Central Asia Region (ECSSD).
[52] Almasi AM, *Municipal Waste Management in Romania*. European Environment Agency. February 2013.
[53] Almasi AM, *Municipal Waste Management in Romania*. European Environment Agency. February 2013.

successful. A 2013 European Environmental Agency report[54] looking at municipal waste management in Romania noted discrepancies between publicly reported data and circumstances on the ground. In 2009, for example, the Romanian National Environmental Protection Agency reported the country had reduced the amount of biodegradable waste being landfilled by 25% compared to 1995 levels, thus satisfying the 2010 EU Landfill Directive requirement. This information was contradicted, however, by the fact that at that time there were no functioning mechanical biological treatment facilities in Romania capable of processing biodegradable waste, so the genesis of such significant tonnage reduction was unclear. Eurostats drew similar conclusions, first reporting 'organic recycling' (composting and other biological treatment) estimates in 2006, and noting that levels had changed very little by 2010, totaling just a fraction of 1% of the country's solid waste output. Most of this amount was attributed to households composting waste for their own purposes,[55] rather than via any large mechanized facility.

Table 4.1: Volume of Organic Waste Collected for Composting in Romania 2004-2009
Source: United National Economic Commission for Europe. *Environmental Performance Reviews – Romania (Second Review)*. 2012

Year	Tons of Biodegradable Waste Collected
2004	5,900
2005	8,003
2006	7,149
2007	17,554
2008	49,138
2009	18,145

106. A 2012 United Nations Environmental Performance Review offered a slightly more optimistic portrait of the organics scene, noting that 60 composting facilities had been established around the country with a combined capacity of 166,000 tons/year, although as of 2009, just 18,145 tons of biodegradable waste was reportedly collected.[56] (This number has varied rather widely over time, however, as shown in Table 4.1, and concerns have been expressed about the accuracy of this data. For instance, these numbers are recognized as artificially low figures, given that some unknown quantity of materials collected from farms or park maintenance companies may be handled by entities outside of the formal waste reporting system.)

107. One issue about which little is known is the quality of the compost material being produced by these facilities. One waste hauler interviewed for this report expressed interest in procuring a bio-digester, with the intent of running the vast majority of the waste they collect through the system. Such a strategy achieves significant volume reduction, converting any biodegradable material (including paper) into a soil-like substance, but one so contaminated with plastic and other waste materials that there would be no market for this product. The only options would be

[54] Almasi AM, *Municipal Waste Management in Romania*. European Environment Agency. February 2013
[55] Almasi AM, *Municipal Waste Management in Romania*. European Environment Agency. February 2013
[56] United Nations Economic Commission for Europe, *Environmental Performance Reviews – Romania (Second Review)*. United Nations. 2012.

to dump it in a landfill or possibly use it as cover material at the landfill, assuming it could meet EU landfill cover standards. Local authorities must keep this fact in mind when designing their program, ensuring that the composting operation only handles clean, source-separated materials free of most contaminants.

108. Limited information is available on solid waste collection fees charged by municipalities or their contracted service provider, and the extent to which they are sufficient to allow for full cost recovery of existing services, facility closures, and the investments needed to achieve full compliance with EU directives. Rate setting is carried out by local authorities that set the tariffs in accordance with a methodology developed by ANRSC Order No. 109 of 2007. An analysis conducted by the World Bank of solid waste management practices in Romania and other new EU member countries raised concerns that tariffs were too low to cover recurring costs, and were often influenced by local authority concerns about the public's low willingness to pay for these services.[57]

109. In northeastern Romania, an analysis of the solid waste situation for the Bacau region highlighted the tremendous diversity of fees charged to both households and businesses for waste collection services. (See Table 4.2) Because fees are generally charged on a flat €/person/month basis, there is no incentive to reduce the volume of waste generated; moreover, such a system is predicated upon an accurate assessment of the number of individuals per household. One waste hauler interviewed for this report expressed concern that the official population estimates used by the municipality dramatically undercounted the number of individuals receiving waste services from the company.

Table 4.2: Waste Management Tariffs, Bacau Region (2010)

Source: European Union (2010) *Establishment of Waste Network for Sustainable Solid Waste Management Planning and Promotion of Integrated Decision Tools in the Balkan Region (BALKWASTE) LIFE07/ENV/RO/686: Action 3--Evaluation of waste infrastructure in Region 1 North-East, Romania. Bacău, December 2010 2nd Revision*

Municipality/ Service Provider	Tariff	Value	Measurement Unit
Bacau *SC SOMA SRL*	Collection, transport, landfilling – population	1,20	€/person/mo.
	Collection, transport, landfilling	17.94	€/month
Botosani *SC URBANSERV SA*	Landfilling	2,68	€/m^3
	Collection and transport of waste for economic	7,74	€/m^3
Iasi *SC SALUBRIS SA*	Collection, transport, landfilling – population in flats	1,05	€/person/mo.
	Collection, transport, landfilling – population in houses	1,20	€/person/mo.
Piatra Neamt *SC BRANTNER SA*	Separately collected waste from population	0,69	€/person/mo.
	Mixed waste from population	0,82	€/person/mo.
	Separately collected waste from companies and institutions	7.14	€/m^3
	For mixed waste from firms and public	10,12	€/m^3
	Landfilling of separately collected waste	2,85	€/m^3
	Landfilling of mixed waste	4,46	€/m^3
	Collection, transport, landfilling of waste from public places	13,88	€/m^3
	Collection, transport, landfilling of waste from public places	13,88	€/m^3
	Collection, transport, landfilling of waste from companies	14,66	€/m^3

[57] World Bank (2011) *Solid Waste Management in Bulgaria, Croatia, Poland and Romania. A cross-country analysis of sector challenges towards EU harmonization*. World Bank Europe and Central Asia Region (ECSSD).

	and public		
Suceava *SC DIASIL SERVICE SRL* *SC TEST PRIMA SRL* *SC ROSAL GRUP SRL* *SC FLOR CONSTRUCT SRL*	For population	0,6	€/person/mo.
	For companies	1,1	€/person/mo.
Vaslui *SC GOSCOM SA*	Collection, transport, landfilling	11,60	€/m^3

4.3 Modeling the Impact of Expanded Biodegradable and Recyclable Waste Capture and Processing in Urban Areas in Romania

110. One way to estimate the GHG emission impact of different waste management practices is through Life Cycle Assessment (LCA), a modeling strategy that calculates the environmental impacts of alternative collection or waste processing scenarios. A range of LCA models have been developed over the years, including the WARM model developed by the US EPA.[58] LCAs rely on tonnage figures extrapolated from waste composition studies that sort through material generated in different locations around the country. In Romania, there are slight differences in national waste composition estimates and those reported for urban areas such as Bucharest, where high rates of contamination appear to decrease the amount of recyclable or compostable materials that can be captured for further use. (See Table 4.3)

Table 4.3: Waste Composition Estimate (National vs Bucharest))
Source: Romanian Ministry of Environment and Climate Change. "Generarea si Gestionarea Desurilor in Anul 2010". Viewed at www.anpm.ro/upload/85633_generarea_2010_site.pdf.

Waste Material	National	Bucharest
Organic	*56%*	*50%*
Paper	*10%*	*6%*
Plastic	*10%*	*5%*
Glass	*4%*	*2%*
Metal	*2%*	*1%*
Wood	*2%*	*0%*
Other	*15%*	*36%*

111. In the lifecycle analysis below, GHG emission levels are compared under a variety of waste diversion scenarios:

a. *Baseline rate*: Greenhouse gas emissions attributable to the Romanian solid waste sector are calculated based on current national waste generation levels, composition data, and disposal practices. Projections are also made based on urban waste generation and composition estimates for Romanian cities.[59]

[58] For more information, see http://epa.gov/epawaste/conserve/tools/warm/index.html
[59] Note: These estimates differ from the numbers reported at the beginning of this section because of differences in the data used and the modeling approach. The purpose of this analysis is to explore the scale of GHG emission impacts that can be achieved under different diversion level scenarios, compared to some baseline level.

b. *Alternative scenario 1*: Emission impacts are modeled assuming Romania (or urban areas in Romania) achieve compliance with EU 2020 recycling and biodegradable diversion targets (i.e., 50% recycling rate for glass/plastic/metals, and 65% diversion of biodegradable materials (which we interpreted as tree waste and other organics, generally food waste))

c. *Alternative Scenario 2*: Emission impacts are modeled assuming Romania (or urban areas in Romania) achieves diversion levels similar to those of San Francisco (USA), whose solid waste program was recently recognized as the best in the world by the Cities Climate Leadership Awards program.[60] San Francisco successfully diverts nearly 75% of its paper waste, 82% of glass packaging waste, 48% of metal, and 28% of organic waste generated by households.[61]

112. The impact on GHG emission levels under the two alternative diversion scenarios are rather impressive. Achieving EU diversion targets for organics and recyclable materials delivers a 67% reduction in waste-related GHG emissions. The lion's share of the reductions come from diverting food waste to a composting program; paper recycling also delivers a significant emissions bump. Attaining a San Francisco-level of performance – meaning higher-than EU-required recycling diversion rates and a solid-but-still-not-EU quality organics diversion rate – still cuts emission levels in half. A more comprehensive analysis, using a different LCA model that can account for avoided emissions for electricity purchases displaced by the AD unit's methane combustion, would be required to assess whether pursuing anaerobic digestion rather than composting would deliver better or worse outcomes.

[60] CityClimateLeadershipAwards.com (2013) *Winners*. Viewed at http://cityclimateleadershipawards.com/category/winners/

[61] Personal communication with Kevin Drew, Residential and Special Projects Zero Waste Coordinator, San Francisco Department of Environment. July 24, 2013.

Table 4.4: Life Cycle Analysis of Increased Urban Organic Waste Diversion Rates.
Source: Original calculations by World Bank

Baseline Tonnage and GHG Emission levels

Commodity	Tonnes Recycled	Tonnes Landfilled	Tonnes Composted	MTCO2E	% share of GHG emissions
Glass	0	180,000	NA	6,987	0.2%
PET	0	240,000	NA	9,316	0.2%
Food Scraps	NA	1,590,000	0	2,268,020	53.7%
Branches	NA	90,000	0	6,661	0.2%
Mixed Paper	0	330,000	NA	446,055	10.6%
Mixed Metals	0	90,000	NA	3,493	0.1%
Mixed MSW	NA	480,000	NA	1,485,878	35.2%
Total	*0*	*3,000,000*	*0*	***4,226,409***	

Scenario 1: EU Diversion Targets

Commodity	Tonnes Recycled	Tonnes Landfilled	Tonnes Composted	MTCO2E	Estimated change in GHG levels from Baseline	% share of GHG reductions
Glass	90,000	90,000	NA	-21,539	-28,525	1%
PET	120,000	120,000	NA	-128,347	-137,662	5%
Food Scraps	NA	556,500	1,033,500	589,520	-1,678,500	59%
Branches	NA	31,500	58,500	-9,232	-15,893	1%
Mixed Paper	165,000	165,000	NA	-357,417	-803,472	28%
Mixed Metals	45,000	45,000	NA	-177,054	-180,548	6%
Mixed MSW	NA	480,000	NA	1,485,878	0	0%
Total	*420,000*	*1,488,000*	*1,092,000*	***1,381,809***	***-2,844,600***	
				Total emission reduction from Baseline	***67.3%***	

Scenario 2: San Francisco Performance Levels

Commodity	Tonnes Recycled	Tonnes Landfilled	Tonnes Composted	MTCO2E	Estimated change in GHG levels from Baseline	% share of GHG reductions
Glass	147,600	32,400	NA	-39,795	-46,781	2%
PET	33,600	206,400	NA	-29,230	-38,545	2%
Food Scraps	NA	1,144,800	445,200	1,544,974	-723,046	33%
Branches	NA	90,000	0	6,661	0	0%
Mixed Paper	247,500	82,500	NA	-759,153	-1,205,208	55%
Mixed Metals	43,200	46,800	NA	-169,832	-173,326	8%
Mixed MSW	NA	480,000	NA	1,485,878	0	0%
Total	*471,900*	*2,082,900*	*445,200*	***2,039,503***	***-2,186,906***	
				Total emission reduction from Baseline	***51.7%***	

4.4 Solid Waste Program Options Focused on Emission Reductions

113. Compared to 10-15 years ago, Romania has made significant strides in the development of policies, market structures, and collection networks designed to capture and divert recyclable commodities from the waste stream. Between 2000 and 2010, the size of the workforce devoted to the waste sector has doubled in Romania.[62] There are now more than 1000 companies countrywide licensed to collect recyclable packaging waste.[63] Monitoring strategies are also in place to more systematically document the level of recycling diversion achieved. The UN's 2012 environmental review generally lauds these changes, although it notes that significant challenges remain if Romania is to achieve the diversion levels required by different EU Directives.

114. Several factors will likely play a key role influencing that amount of GHG emissions that can be reduced through the urban solid waste system. Most involve national policy mandates or recommendations encouraging regions, counties, and cities to establish certain types of waste processing facilities, collection rules and systems, or pricing policies that incentivize waste prevention and waste diversion into reuse, recycling, or composting programs. Many of these options are complementary, and would logically be more effective if implemented concurrently.

[62] United Nations Economic Commission for Europe, *Environmental Performance Reviews – Romania (Second Review)*. United Nations. 2012.
[63] United Nations Economic Commission for Europe, *Environmental Performance Reviews – Romania (Second Review)*. United Nations. 2012.

a. *Waste prevention and material reuse*: one of the most cost effective waste management strategies is waste prevention, where consumers are encouraged to take account of the products they buy to ensure (1) they are necessary, (2) they are minimally or appropriately packaged, and (3) if they are no longer needed but are still in working condition, that they are sold or given away for others to reuse. The Green Dot and Eco Embellage program in other parts of Europe have done a good job at forcing manufactures to think about product packaging, but more consumer education would be helpful across Romania.

b. *Source separation requirements:* Source separation requirements force waste generators to self-segregate waste materials into a different collection container or system. Such requirements generally result in cleaner, higher value commodities, the sale of which can help offset the cost of a separate, possibly duplicative, collection system. It is also possible to price collection services at different rates, imposing higher fees for residual "waste" materials than for recyclable or organic materials segregated into different containers.

   Romania already has many source separation rules in place for different packaging materials and hazardous waste, although the separate collection of organics still does not appear to be commonplace. In areas with very high volumes of recyclables or organic materials, such materials may actually become the dominant focus of local waste collection efforts, lessening the need for frequent collection of residual waste materials. In 2011, for example, the City of Portland, Oregon, cut the frequency of trash collection to every-other-week, maintaining weekly collection service only for household food and yard waste collected together in a single container. Because food waste is traditionally the material that attracts rodents or other vectors, households are incentivized to maximize diversion into their organics waste bin. Capture rates have increased accordingly, with the city reporting collection levels three times what had originally been anticipated,[64] generating sizable programmatic cost savings for the municipality. Systems of this type would generally be established by local authorities, working in partnership with the public or private waste collection networks under their direct purview.

c. *Development of new organics processing facilities*: Source separation rules presume the availability of composting facilities and anaerobic digestion facilities as alternative disposal sites. Composting can be done indoors or outdoors, involving either highly technical or very simplistic turning equipment to speed the decomposition of the organic material. Sophisticated facilities often have trained staff that monitor the temperature or moisture content of the organic material, trying to optimize conditions to speed the conversion of organic waste into a useful humus-like material that can be sold or given to farmers or gardeners for land-application. Anaerobic digestion facilities tend to be much more costly to build and operate, but they break down the waste in just a few days (versus several weeks for a composting facility), siphoning off the methane generated during the decomposition process in a fully-enclosed chamber for use by homes, businesses, or industry. Some facilities combust the methane on site, generating electricity that can be sold back into the local power grid.

[64] Millman J, "Portland puts new twist on waste collection" *Wall Street Journal*, June 27, 2012.

The decision of which approach to pursue will fall under the purview of regional and county authorities in Romania, who have responsibility for disposal facility operations. The decision will largely be a function of the availability of land, the presence of markets for the product(s) produced by these facilities, and available human and financial resources. The FARMAGAS program funded by the EC/Intelligent Energy Europe, which seeks to promote the use of anaerobic digestion for agricultural/farm wastes in Romania, may provide some helpful insights here. There is currently no comparable program supporting the development of AD programs for food or other organic waste from urban areas in Romania, and this may be an area where the Romanian government could take action. One potential partner is the Romanian Association of Biomass and Biogas – ARBIO[65], a trade group recently formed to advance the development of AD projects across the country.

Reflecting on the compost quality issue noted earlier, the Romanian government may wish to establish some type of output-based subsidy program for several years. Only compost exceeding some minimum quality standard would be eligible for the subsidy, encouraging facility operators to promote the development of source-separated organics collection networks to minimize contamination. Subsidies could be provided just long enough to both build consumer demand for high quality compost, and allow operators and haulers to establish the routes and education programs capable of delivering high quality material.

d. *Disposal bans*: A strategy highly complementary to these other policies would be material disposal bans designed to ensure that specific waste materials are diverted to alternative (and often safer) disposal alternatives. Bans can focus on hazardous materials, or materials that may be more problematic from a management perspective, such as organic materials that slowly decompose within a landfill, forming leachate or methane. The EU landfill directive does not explicitly require that organics be completely banned from landfills, instead simply requiring that less material be managed there. Many cities and countries around the world have taken this extra step, however, as way of ensuring these materials are managed either at the point of generation, or via more specialized facilities better suited to handling high moisture content organic material. For example, the Netherlands banned organic waste from landfills in 1998[66], while Austria took similar action in 2004.[67] At the city level, Metropolitan Vancouver will ban food and compostable organic waste from local landfills effective 2015.[68] In 2008, Buenos Aires passed a law banning organic waste from landfills effective 2020,[69] giving the region considerable time to develop alternative disposal options, collection networks, and pricing strategies. In Romania, these policies could be imposed at either a national, regional, or county level.

Bans also play a "market making" role, seeking to ensure that valuable commodities remain available for recycling or reuse rather than being incinerated or buried in a landfill.

[65] For more information, see www.arbio.ro
[66] European Environment Agency, *Municipal Waste Management in the Netherlands*. 2013
[67] European Environment Agency, *Municipal Waste Management in Austria*. 2013
[68] Ban on disposing food and compostable organics. Metro Vancouver website. See http://www.metrovancouver.org/services/solidwaste/businesses/organicsban/Pages/default.aspx
[69] Goldstein N, "Zero Waste in Buenos Aires" *BioCycle*, 49(6) June 2008.

Such bans typically have complementary policies aimed at supporting the development of specialized handling/processing facilities, or extended phase-in dates, to ensure that waste generators (or their haulers) can find appropriate disposal alternatives. Recent experience in Hong Kong, where new food waste processing facilities have been little used, highlights the problems that can arise if insufficient attention is focused on these complementary market-development activities.[70]

e. *Alternative collection modalities*: Cities with newer sewage treatment facilities may consider using their existing sewage system as a means of transporting and ultimately processing food waste discarded by households or restaurants. Such a strategy requires the waste generator to install a food waste macerator in their sink that grinds the food down into small particles that can be transported through the regular sewage pipe. Material is processed at the sewage treatment facility, where methane gas can be captured for power generation or the resulting sewage sludge can be composted for eventual land application. There is growing interest in this technique, and a growing body of life cycle analysis concluding there can be financial or environmental advantages to this strategy in many cities.[71] [72] In Stockholm, for example, the local water board eliminated a tax associated with installation of waste collection equipment after concluding it could be beneficial in terms of helping the sewage treatment system generate additional biogas.[73] In the UK, two counties (Worcestershire and Herefordshire,) began subsidizing the purchase of garbage disposal units by local householders after research found lower waste management costs would offset the cost of the subsidy within three years.[74]

The extent to which this option would be appropriate in a Romanian city context will depend heavily on the age and sophistication of the city's sewage treatment facilities and pipe network, and the purchase and installation cost of the disposer. The latter may be too expensive for low-income households, but the price would potentially be offset over time through reduced spending on waste collection fees.[75] Whether there are carbon reduction benefits occurring from this type of switch will depend heavily on the nature of the sewage treatment facility, including whether it composts the sewage sludge, or captures the methane gas generated by the waste material during the sewage treatment process.

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[70] For more information, see http://www.scmp.com/lifestyle/family-education/article/1218410/dealing-hong-kongs-food-waste

[71] Local Government Association (UK), *The Potential of Food Waste Disposal Units to Reduce Costs: A Literature Review*. 2012.

[72] The Chartered Institution of Water and Environmental Management. *Food Waste Disposers -- Policy Position Statement*. 2011.

[73] Anna Gustafsson, "Slopad avgift för avfallskvarn" (Abolition of fee for waste disposer). *SvD NYHETER*. Viewed at http://www.svd.se/nyheter/stockholm/slopad-avgift-for-avfallskvarn_1646675.svd

[74] Brat I, "Going global by going green" *Wall Street Journal*. February 26, 2008.

[75] In Romania, implementation of this strategy would require collaboration between a municipality and its sewage treatment system operator. To the extent the water system is privatized, it may be more logistically or financially difficult to implement this program because the financial benefits may accrue to the solid waste system operator or customer, while the costs may accrue to the wastewater treatment system operator or customer.

4.5 Cost Estimates of Recycling and Composting Diversion

115. There is no readily available local data on the cost of alternative waste system options in Romania. Going forward, it would be helpful if the Romanian government worked with regional and local authorities to compile and publish capital and operating costs information on different types of solid waste management facilities that have opened during the past several years.

116. Some international data sources exist that provide very broad cost ranges for different solid waste treatment options. The World Bank's 2012 *What a Waste* report published data showing composting facilities are generally are very cost competitive with landfilling operations, with anaerobic digestion facilities costing slightly more to build and operate. One thing not factored into these estimates is the value of the compost or gas/electricity that can be sold by composting and anaerobic digestion facilities. These revenue streams can dramatically offset or possibly even exceed the costs, generally giving them a significant cost advantage over a straight landfilling strategy. For example, depending on the quality of the end-product, compost can be sold for up to $100/ton;[76] local rules regarding the sale of energy from independent power production facilities of this type will determine their revenue potential.

Table 4.5: Estimated Solid Waste Management Costs (Note: yellow shading indicates the category for Romania)
Source: Hoornweg & Bhada-Tata (2012) *What a Waste: A Global Review of Solid Waste Management*. World Bank Urban Development Series Knowledge Papers.

	$/tonne			
	Low Income Countries	Lower Middle Income Countries	Upper Middle Income Countries	High income countries
Collection	20-50	30-75	40-90	85-250
Sanitary Landfill	10-30	15-40	25-65	40-100
Open Dumping	2-8	3-10	n/a	n/a
Composting	5-30	10-40	20-75	35-90
Waste-to-Energy/ Incineration	n/a	40-100	60-150	70-200
Anaerobic Digestion	n/a	20-80	50-100	65-150

117. The Bacau Region solid waste analysis[77] provided some Romania-specific cost estimates for new composting facilities in different counties, although the operating capacity of these facilities was not always noted. Having that information would have allowed us to compare the price on a cost per tonne basis with other waste management strategies:

[76] Hoornweg D and P Bhada-Tata (2012) *What a Waste: A Global Review of Solid Waste Management*. World Bank Urban Development Series Knowledge Papers.
[77] European Union (2010) *Establishment of Waste Network for Sustainable Solid Waste Management Planning and Promotion of Integrated Decision Tools in the Balkan Region (BALKWASTE) LIFE07/ENV/RO/686: Action 3--Evaluation of waste infrastructure in Region 1 North-East, Romania. Bacău, December 2010 2nd Revision*

Table 4.6: Composting Facility Construction Costs in Region 1 (Northeast) Romania
Source: European Union (2010) *Establishment of Waste Network for Sustainable Solid Waste Management Planning and Promotion of Integrated Decision Tools in the Balkan Region (BALKWASTE) LIFE07/ENV/RO/686: Action 3--Evaluation of waste infrastructure in Region 1 North-East, Romania. Bacău, December 2010 2nd Revision*

County	Composting facility construction cost	Capacity of facility
Onesti	€2,860,000	--
Bacau	€4,700,000	1,100 tonnes/year
Iasi	€2,250,000	--

118. The same report[78] also noted a goal of distributing backyard composting bins to households in several counties as a way of addressing organic waste on-site. Again, although cost information was provided, the number of households to receive the bins was not noted in the report.

Table 4.7: Program Costs for Backyard Composting Systems in Region 1 (Northeast) Romania
Source: European Union (2010) *Establishment of Waste Network for Sustainable Solid Waste Management Planning and Promotion of Integrated Decision Tools in the Balkan Region (BALKWASTE) LIFE07/ENV/RO/686: Action 3--Evaluation of waste infrastructure in Region 1 North-East, Romania. Bacău, December 2010 2nd Revision*

County	Cost of Backyard Composting bins	# of households to receive bins
Bacau	€2,690,000	--
Suceara	€5,107,968	--
Vaslui	€1,681,088	--

4.6 Preparing the Romanian Solid Waste System to Adapt to Climate Change

119. It is difficult to speak in specifics about how waste systems across Romania may be affected by climate change, because the specific risks faced by waste disposal facilities or collection systems will be very local in nature. The World Bank[79] and others have identified several issues that could arise, however, linked to specific climate change risks. The Romanian government and regional authorities may wish to require that municipalities include climate adaptation considerations in their local solid waste management plan, as a way of mitigating these risks.

a. *Flood Damage*: whether due to sea level rise or extreme rainfall events, flooding can create several problems at existing solid waste facilities. Composting facilities in low-lying areas may be completely destroyed by floodwaters. Excess water can saturate or erode the slopes at landfills, exposing previously-covered waste, causing small landslides at poorly engineered facilities, damaging methane gas collection equipment or overwhelming leachate collection systems. In the US, solid waste rules require all new

[78] European Union (2010) *Establishment of Waste Network for Sustainable Solid Waste Management Planning and Promotion of Integrated Decision Tools in the Balkan Region (BALKWASTE) LIFE07/ENV/RO/686: Action 3--Evaluation of waste infrastructure in Region 1 North-East, Romania. Bacău, December 2010 2nd Revision*
[79] World Bank, *Guide to Climate Change Adaptation in Cities*. 2011.

solid waste facilities to be located in areas outside of the 100-year floodplain; facilities also cannot be located in geologically unstable areas. New facilities in Romania should similarly be located in areas out of harm's way to the maximum extent possible, while existing or closed facilities should be examined to assess whether some type of landscaping or other engineered design elements could protect the facility from damage.

b. *Collection Containers*: flooding can also delay the collection of waste material following extreme weather events, or wash away material set out on the curb for collection, potentially contributing to vector problems, contamination of populated areas, or other public health risks. The use of sturdier, more water resistant collection containers may help reduce this problem, but it is unlikely to eliminate it altogether.

c. *Storm Debris*: in areas heavily damaged by climate change-related extreme weather events, the volume of waste materials may increase dramatically, requiring emergency pickups or temporary staging areas to help store or process all of the waste material. Local or regional authorities may wish to identify areas that can used for this purpose, and prepare contingency collection strategies on how to move or manage this material.

Academic and trade literature is generally silent on these topics, meaning there are few best practice examples from other cities we may point to that speak to the cost savings or avoided damages resulting from proactive planning.

One area that may be underappreciated is the role that inadequate waste collection practices can play in exacerbating climate change-related flooding problems in cities. In Bandur Lampang, a city of 800,000 in Indonesia, the city focused on the development of a new solid waste plan as a key element of their climate adaptation strategy. Uncollected waste materials clogged local rain culverts, leading to heavy flooding every time it rained. By establishing improved waste collection and litter prevention procedures, the city expects to reduce the incidence of flooding, delivering a range of economic and health benefits to local residents.[80]

4.7 Recommendations

120. Investments in solid waste system improvements have been an important priority of Axis 2 of the OP Environment program for the past 6 years, but as was noted above, the task ahead remains both extensive and expensive. In particular, the move to get organics out of the landfills creates opportunities for the development of new commodity markets, producing a soil amendment that can return nutrients to agriculture lands and marginal soils in a natural way rather than relying on chemical fertilizers. Diverting organic waste to composting systems can also deliver climate mitigation benefits, although the impacts are quite small compared to other sectors. Nonetheless, the Romanian Government is encouraged to continue to expand its solid waste program efforts because of the multitude of benefits that can be achieved around the country.

[80] Asian Cities Climate Change Resilience Network. *ACCCRN City Projects*. May 2013. P 20.

121. Less clear is the need to address the impacts of climate change on solid waste facilities and programs around Romania. This is a relatively new area, and there may be value on engaging in some research and planning initiatives to ensure that problems will not arise in the future. Solid waste facilities have historically been located in marginal lands, which might make them vulnerable to floods driven by extreme rainfall events.

122. Because this analysis was not focused on the overall logic and structure of Romania's solid waste planning efforts, we did not extensively engage on issues associated with tariff structures, which do appear to be problematic. Romania's use of the polluter-pays principle is to be applauded, but the current tariff structure, which appears to be based on a very low, flat fee per individual per month, does not fully support this principle. Moving more toward a volume or weight based-approach, which is common in many parts of the world, would aid in truly shifting the cost burden on those individuals responsible for the highest levels of waste generation, giving them an economic incentive to reduce. Moreover, a revised tariff structure, which prices waste materials differently than valuable commodities (such as recyclable material or source-separated organic waste), can also incentivize households to maximize their diversion of those materials of intense focus by the European Commission.

123. In our recommendations below, we include these and other suggestions the Romanian Government should consider, seeking to build local capacity, reduce economic inefficiency, and grow green jobs focused on harvesting valuable commodities from the local waste stream.

High Priority/Near-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
Climate change awareness/ preparedness	Support efforts to promote expanded County/Local Authority knowledge on the link between climate change and solid waste management operations	Education/ training	High
	Provide training for waste facility operators on climate-sensitive design and operations	Education/ training	High
	Fund research downscaling global climate models to provide more localized assessments of climate impacts in different regions, enabling solid waste facility operators to analyze the vulnerability of their operation to future climate shocks	Research/analysis	High
	Require solid waste system operators to prepare climate action plans for their operation.	Policy oversight	High
Organics and recyclables management	Continue to finance solid waste management upgrades (including composting facilities, anaerobic digestion facilities, and recycling programs) in towns/cities/regions to ensure compliance with relevant EU directives.	Direct investment	High

Medium and Long-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
System economics	Conduct studies on tariff levels to assess the extent to which they successfully support the 'polluter pays principle'	Policy oversight	Medium
	Conduct and publish studies on organics	Policy analysis/	Medium

	management practices deployed to date to assess cost effectiveness of different approaches.	oversight	
	Conduct assessment on cost savings potential of collection vehicle replacement, route optimization, or switch to alternative transport methods	Research/analysis	Medium
Climate change awareness/ preparedness	Establish university curricula to train future civil/solid waste engineers on climate sensitive waste system design and operations	Education/ training	Low
Organics and recyclables management	Fund waste composition studies in cities and counties that have deployed backyard composting bins to assess the extent to which such programs are effective at diverting organic waste.	Policy oversight	Medium
	Establish public education programs to promote waste prevention, reuse, composting, and recycling.	Education/ training	Low
	Provide subsidies to provide households with backyard composting bins	Direct investment	Low
	Study feasibility of use of wastewater treatment network and facilities to process organics waste	Research/analysis	Low
	Analyze the effectiveness of recycling collection services at tower blocks, which are difficult to serve, seeking to identify the best program models across Romanian cities.	Research/analysis	Medium
	Convene conferences/training programs for waste system operators and local authority officials on “best practice” solid waste management strategies around Romania	Education/ training	Medium

Section 5: Water Sector Analysis

5.1 Overview

124. Compared to most other European countries, Romania's freshwater resources are relatively scarce. Although the Danube delivers massive quantities of water along its long Romanian border, water resources elsewhere in the country have been characterized as poor, with Romanians enjoying an average of just 2,660m^3 water/person/year, compared to a European average of 4,000m^3/person/year.[81] More recent long run average statistics published by Eurostats peg Romania's supply at closer to 2,000m^3/person/year.[82]

125. The Carpathian Mountains in central Romania exert significant influence on the country's fresh water resources, with the topography creating or influencing weather patterns that affect water availability in the 11 water basins around the country. The water supply is also uneven from a temporal perspective, with the heaviest rainfall occurring in the summer months. There are however, natural variations from year to year, a situation that is expected to become more prominent due to climate change. There are 400 dams in Romania which capture runoff in the mountains, providing flood control protection and balancing water supply availability over the course of the year. The dams are also used to generate hydropower.

126. The dams are one key element of the Romanian water system's most noteworthy feature – its high level of reliance on surface waters. Of the 125 billion cubic meters of freshwater resource available across Romania each year, approximately 93% is from surface sources—primarily the Danube and inland rivers—with the remaining 7% supplied by groundwater sources.[83] Given that interior rivers are supplied primarily by snow and rainfall, Romania's water supply is highly dependent on weather systems, creating some vulnerability to extreme events and any long-term shift in meteorological patterns. This may have a disproportionate effect on certain cities and regions around Romania.

5.2 Water Policy and Market Environment

127. Water supply policy, or the allocation of water between competing uses (industry, agriculture, households, etc.) during both wet years and times of drought, is the responsibility of the National Water Administration "Romanian Waters" (*Apele Romane*), a unit of the Ministry of Environment and Climate Change. During drought periods, current policy prioritizes water for human consumption, then animals and ecosystem protection, and then other purposes.[84]

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[81] Romania Ministry of Environment and Sustainable Development. (2007) *Sectoral Operational Program – Environment 2007-2013*.
[82] EuroStats. (2012) *Water Statistics. Source data for tables and figures (MS Excel). Water.Statistics.YB2013.xls* viewed at http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Water_statistics.
[83] European Environment Agency (2010). Freshwater (Romania). Viewed at: http://www.eea.europa.eu/soer/countries/ro/soertopic_view?topic=freshwater
[84] Personal communication with Dr. Vasile Pintilie, ANWR, June 2013.

128. Quality concerns are guided by the original EU Accession Agreement mandating compliance with the Urban Wastewater Directive (1991/271/EC), the European Commission's water framework directive (2000/60/EC), the Groundwater Directive (Directive 2006/118/EC) and Environmental Quality Standards Directive (Directive 2008/105/EC) have all been the key drivers of water treatment and delivery policy in Romania over the past decade. The directives focus on the need for protection from industrial effluent emissions and the biological quality of surface and groundwaters, specifying threshold concentrations for certain pollutants. Waters exceeding these levels are considered to lack 'good ecological status.' Currently 80% of the water bodies in Romania are listed as good status, although there are big regional differences. For example, in the Somes Tisa river basin (where Cluj-Napoca, Baia Mare, and Satu Mare are located), 93% of the water bodies are in good condition, whereas in the Arges Vedea basin (where Pitesti is located), just 7% of the water bodies are rated as good quality.

129. The EU directives have been operationalized through GD 188/2002 (urban wastewater treatment) and Law No. 458/2002 (drinking water quality). The 2008 National Strategy for Sustainable Development established key deadlines for expanded access to drinking water and improvements to wastewater management infrastructure and quality in Romania. Specific policy targets include providing 70% of the population with access to formal water distribution networks by 2015, and 100% of agglomerations with a population of over 2000 to have access to formal wastewater treatment networks by 2018. Currently, only 50% of Romanians have access to sewage systems; of those with access, 90% live in cities.[85] (Numbers drop off considerably in rural areas, where only 33% of rural households are connected to formal water supply networks, while 10% of rural households have access to modern sewage networks and treatment facilities.[86]) Even among those cities and towns with sewage treatment, the quality is somewhat suspect, with the UN Economic Commission for Europe estimating that only around 25% of all wastewater is appropriately treated, with 35% insufficiently treated and 40% not treated at all.[87]

130. To comply with the various EU directives, Romania will need to build more than 2000 wastewater treatment plants by 2018.[88] The 2007-2013 Environment SOP estimated that compliance with the various directives would total €9.5 billion, divided between €5.7 billion for wastewater treatment and €3.8 billion for sewerage systems.[89] The 2007-2013 SOP established water system improvements as Priority Axis 1, allocating nearly 60% (€2.8 billion Euros) of the total OP funds available for water system upgrades; the Romanian government provided another €490 in funding for this same purpose. The European Bank for Reconstruction and Development has been an important ally on many upgrade projects, establishing a €200 million co-financing initiative that can cover up to 15% of the project capital cost.[90] Additional financing may be provided by local authorities, or via water and wastewater tariffs collected by the system

[85] European Environment Agency (2010). Freshwater (Romania). Viewed at: http://www.eea.europa.eu/soer/countries/ro/soertopic_view?topic=freshwater
[86] European Environment Agency (2010). Freshwater (Romania). Viewed at: http://www.eea.europa.eu/soer/countries/ro/soertopic_view?topic=freshwater
[87] Source: UN Economic Commission for Europe (2012). *Environmental Performance Reviews – Romania. Second Review*. Environmental Performance Reviews Series No. 37.
[88] Global Water Intel (2014) *Global Water Market 2014. Chapter 56. Romania*
[89] Romania Ministry of Environment and Sustainable Development. (2007) *Sectoral Operational Program – Environment 2007-2013*.
[90] Global Water Intel (2014) *Global Water Market 2014. Chapter 56. Romania*

operator. More funding will be required under the new 2014-2020 Operating Program to achieve these goals.

131. Before 1990, water utilities were operated at the county level, generally as part of a large centralized utility providing multiple public service functions (water, waste, energy, etc.). After that date, however, Romania began a push to decentralise management of the water system, consistent with constitutional preferences that sought to return significant responsibilities to local authority control. One of the problems with decentralization, however, was the fact that small and medium sized towns were unable to attract financing from international financial institutions, leading to a lack of investment and gradual decline in the quality of these systems.[91]

132. A solution came in the form of Law No. 215/2001, which allowed local authorities to band together form an Inter-Community Development Association (IDA), issue a common tender, and delegate management of their water systems to a Regional Operating Company (ROC). The municipalities retain ownership of their systems, although the ROC can also be structured as a public-private partnership with shared ownership, as is done in Bucharest and Ploesti. The ROCs receive operating licenses from the National Authority for Regulation of Public Municipal Services (ANSRC), a unit of the Ministry of Regional Development and Public Administration (MRDAP). The regulatory agency has the ability to control prices and establish service level expectations to ensure compliance with EU rules. The legal framework covering water and sewer utilities are laid out in Law No. 326/2001, Law No. 51/2006, GD No. 32/2002, Law No. 241/2006 and GD No. 246/2006.

133. The overall result of these policies has been a dramatic reorganization of the water sector, shifting away from a highly fragmented system into one characterized by greater regionalization of water operations. There are now 44 ROCs operating in Romania, some of which are water-supply only entities, while others also operate wastewater treatment facilities.

134. The prices charged for water in Romania represent a balance between two goals – the need to cover the full system cost, including the repayment of loans and system expansion – and a goal of keeping prices affordable. Currently, the government caps tariffs at 4% of the income of the poorest 10% of households.[92] There is nonetheless fairly wide variability in pricing across Romania [see Table 5.2], including within the same service territory, where cities in adjacent towns may pay different rates for water and wastewater services. There is currently a goal of rate harmonization within each ROC service territory, and progress is occurring slowly but steadily.

[91] Vinke-de Kruijf J, Dinica V, and DCM Augustijn. "Reorganization of water and waste water management in Romania: from local to regional water governance" *Environmental Engineering and Management Journal*. Sept/Oct 2009, Vol 8, No. 5, 1061-1071.
[92] Global Water Intel (2014) *Global Water Market 2014. Chapter 56. Romania*

Table 5.2: Romania Water Tariffs
Source: National Regulatory Authority for Public Utility Services, 2011

	Water Supply costs	Wastewater Treatment costs
Average tariff (all Romania)	2.49 RON/m^3	1.33 RON/m^3
Highest tariff	3.10 RON/m^3 (S.C. Aquserve S.A. Tulcea)	2.60 RON/m^3 (S.C. Compania de Apa Arad S.A.)
Lowest tariff	1.37 RON/m^3 (S.C. Aparegio Gorj S.A. Targu Jiu)	0.29 RON/m^3 (S.C. Secom S.A. Drobeta Turnu Severin)

135. Overall, tariffs have increased in the past ten years, but industry observers nonetheless note that absent EU support, tariffs are still too low to cover current system costs.[93] Part of the problem is undoubtedly the high rate of 'non-revenue water", which is water that enters the distribution network but is never paid for by customers either due to theft or leakage from pipe network. In 2007 19 utilities in Romania self-reported their non-revenue water rate to a global dataset (IB-NET) operated in collaboration with the World Bank. On average, these utilities reported a non-revenue water rate of just over 40%, placing them at the high end of the spectrum compared to other eastern European countries.[94] [See Table 5.3]

Table 5.3: % of utility non-revenue water (2007)
Source: World Bank analysis of IB-NET benchmarking data self-reported by utilities

	Average non-revenue water	Total # of utilities self-reporting
Bosnia-Herzegovina	59.3%	20
Czech Republic	19.7%	23
Hungary	25.4%	20
Poland	21.4%	36
Romania	40.2%	19

136. One of the issues that may affect revenue levels is the ability of utilities to adequately meter usage by customers. There is no systematic documentation about the current level of water metering in place in cities across Romania, or the granularity of the metering capacity. Although presumably meters have been installed as part of the system upgrade projects funded by the 2007-2013 Operating Program, no information is published about the extent of this work.

137. The need for more widespread and granular metering is obvious. One now-outdated 2007 study of the situation in Pitesti noted that metering was commonplace across the city, but it was

[93] Global Water Intel (2014) *Global Water Market 2014. Chapter 56. Romania*
[94] Source: International Benchmarking Network for Water and Sanitation Facilities (IB-NET) database. Viewed at www.ib-net.org in September 2013. 2007 was selected as the analysis year because that maximized the number of utilities represented in the database across these five countries. The 17 utilities reporting 2010 data averaged 43.4% non-revenue water, meaning rates had climbed slightly since 2007.

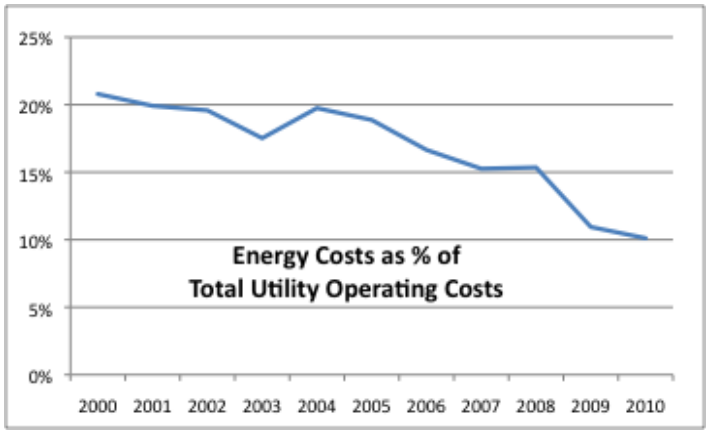
frequently done at the building, rather than individual dwelling scale.[95] This limited the ability of the local water utility to use the tariff system to hold users accountable for high rates of water use, since the price impact is not fully borne by those responsible for high rates of use. That same report noted that some unknown number of customers had illegal connections to the water and wastewater system, eliminating any chance of holding them financially accountable for their use of these systems. This echoes another study documenting the situation in Bucharest prior to the year 2000, noting that water consumption was typically not metered but rather assessed on the basis of estimated household consumption rates, especially in apartment blocks.[96]

5.3 Linking Water Supply and Treatment Systems to Climate Change

138. Compared to sectors like buildings and transport, water systems tend to receive comparatively little attention in either city or national level climate mitigation plans. Arguably this lack of attention to the link between water systems and climate change is proportional to the relatively small extent to which water supply and treatment systems contribute to overall urban GHG emissions. That's not to say the links don't exist, however. On the carbon mitigation side, energy demand for the extraction, pre-treatment, and distribution and wastewater treatment can contribute to greenhouse gas emissions, although given the paucity of data, there is no clear way of knowing how significant these are.

139. While there is limited data available on the energy performance of water utilities, the 19 Romanian utilities self-reporting to the global IB-Net database appear suggest that energy expenditures are declining, although the way the data is reported does not make clear whether energy costs are actually declining, or whether other costs are increasing. [See Figure 5.1] We assume it is the former, because utility officials interviewed for this project made clear that controlling energy costs is a priority because it affects their bottom line.

Figure 5.1: Energy Costs as a percentage of Total Utility Operating Costs
Source: IB-NET.org. *Indicator 13.2 Electrical Energy Costs vs Operating Costs.* Viewed September 13, 2013



[95] Morris G, Kis A, and M Dumitru (2007) *Water Tariffs and Related Management Reforms in the Pitesti, Romania Water Utility: Recent History and Future Prospects. Final Report.* UNDP/GEF.
[96] World Bank (2002) *Implementation Completion Report (TF-20515; SCL-40790) on a Loan in the Amount of US$25.0 million to Romania for a Bucharest Water Supply Project*. June 24, 2002

140. Energy efficiency studies carried out by a World Bank team in Brasov, Cluj-Napoca, and Ploiesti have noted the amount of energy required to both produce potable water and treat wastewater in these cities compares rather favorably to other cities included in the Bank's TRACE benchmarking database. In particular, the wastewater treatment systems in Brasov and Ploiesti are among the best performers of the cities in the TRACE database,[97] [98] [99] perhaps a testament to the recent system upgrade projects in those cities which replaced water pumps, captured methane gas and reused it on site, etc.

141. One area where more is known at an aggregate level is the issue of GHG releases from wastewater treatment facilities. According to the last national GHG inventory, a total of approximately 2538 Gg_{CO2e} of methane and 627 Gg_{CO2e} of Nitrous Oxide are released from industrial and commercial/residential wastewater treatment facilities around Romania every year.[100] Collectively, this amounts to a total of 2.34% of all GHG releases in Romania.

142. Emissions are generated as the biological material in the sewage breaks down. In fully enclosed pipes or treatment systems, anaerobic decomposition of the waste results in methane generation; in aerobic processes, CO2 is produced through the breakdown of organic matter in the activated sludge process and through the primary clarifiers. Nitrous Oxide is associated with the degradation of nitrogen components in the wastewater (e.g. urea, nitrate, and protein), and it may be released during the de-nitrification process at a treatment facility, or in the water receiving the effluent released by the facility. Solutions may include designing or redesigning a system to enable the capture and flaring of the gases; or the use of aerobic wastewater treatment facilities involving activated sludge or filter bed treatments.

143. There is little published information available on the design of, or existing GHG management practices at wastewater treatment facilities around Romania, so it is difficult to speak to how easy it will be to modify facilities to further minimize emissions. It is clear that as part of the water system upgrade investments being pursued in many cities, gas capture and combustion is frequently a goal of the new facility designs so they become partly energy self-sufficient.

144. Climate studies looking at future hydrological conditions have been prepared for three of the 11 river basins (Buzau Ialomita, Arges-Vedea, and Mures), each of which are expected are expected to see sizable decreases in mean annual flow volumes. For example, in the Buzau Ialomita basin, the mean annual flow is expected to decline by 15-20% during the period 2021-2050, jumping to 30-40% for the period 2070-2100. The demand-supply gap is expected to be manageable for the next 15-20 years, but significant demand reduction measures or new supply capacity will be needed after that. In the Arges-Vedea and Mures river basins, mean annual flows

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[97] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Cluj-Napoca, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.
[98] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Ploeisti, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.
[99] Romania Regional Development Program/World Bank ESMAP, *Improving Energy Efficiency in Brasov, Romania – TRACE City Energy Efficiency Diagnostic Study*. 2013.
[100] Romania Ministry of Environment and Climate Change. (2013) *Romania's Greenhouse Gas Inventory 1989-2011: National Inventory Report.*

are expected to decline 10-15% for the period 2021-2050, potentially hampering river navigability on the Mures and lower Danube rivers.

145. Adapting water systems to climate change is a topic of growing interest around the world, largely because of the implications it may hold for water availability. In Romania, the Jiu, Arges-Vedea, Buzau-Ialomita, Siret, Prut-Barlad, and Dogrogea water basins already face supply reliability during the summer months, especially in dry years. Some of the larger cities in these regions include Craiova (Jiu), Pitesti (Arges-Vedea), Buzau (Buzau Ialomita), Bacau (Siret), Iasi (Prut-Barlad), and Constanta (Dobrogea). The Dobrogea system is the most severely affected, with 95% of the water supply for Constanta obtained from ground water.

146. Climate change may also have impacts on the distribution and treatment systems. Drought or extreme heat events can change the temperature of surface waters, leading to algae growth that clogs intake or outflow pipes. Drought can cause shifts in the soil, cracking pipes buried underground. Power supplies may fail during extreme heat events, preventing proper operation of pumping stations or treatment facilities.

147. Flooding can overwhelm wastewater treatment facilities, which typically are in low-lying areas adjacent to waterways where the treated water is ultimately released. Depending on the way the stormwater system is designed in a city – combined with the sewage system or handled separately – heavy rainfall events can also overwhelm the design capacity of a wastewater treatment system. In such instances, raw sewage is typically released to adjacent waterways, undermining the investments made to prevent this from occurring.

148. Climate resilient water system designs generally include the following features to address these problems:

Table 5.4: Strategies to Increase Water System Resilience

Source: Based partly on ICLEI (2011): *Adapting Urban Water Systems to Climate Change: A handbook for decisionmakers at the local level*

Category	Strategy	Responsible agency/party in Romania
Water supply	Create additional storage capacity to ensure water availability during periods of drought	• This is generally not a local authority responsibility, but would require action and significant investment by Apele Romane
	Repair leaks in distribution system to minimize water losses, stretching the available supply	• Water utility operator • Increased oversight by ROC and/or National Authority for Regulation of Public Municipal Services (ANSRC),
	Promote demand reduction strategies to reduce water dependency and lessen the impact of reduced supply availability	• Local authority via building code changes focused on on-site water use (e.g. flow restrictors, on-site grey water reuse) or other rules related to water use for landscaping, etc. • Water utility operator via installation of water meters tracking usage at the dwelling (rather than building) level.
Wastewater management	Harden system assets to protect from flooding impacts (e.g. natural	• Local water utility

	or constructed barriers to prevent floodwater infiltration; installation of backup power supply; elevation of key system assets out of harm's way, etc.)	
	Promote demand reduction strategies to reduce water dependency and lessen the amount of wastewater ultimately generated	• Local authority via building code changes (e.g. flow restrictors, enable use of greywater systems in buildings)
Stormwater management	Redesign stormwater management system to eliminate commingling of rainwater runoff with sewage destined for wastewater treatment plants	• Local water utility • ROC/local authority
	Promote green building design (green roofs) and other public landscaping design to increase the amount of permeable surfaces in a city (e.g. porous paving, swales, increased public greenspace)	• Local authority via building code changes and land use planning practices

5.4 Cost of Alternative System Designs

149. There is no systematic answer to the question of how much various system changes would cost a local authority. Projects are rarely carried out in isolation, meaning distribution system upgrades are typically procured at the same time wastewater treatment facilities are upgraded, and projects frequently target improvements in multiple cities or towns. Three projects recently completed in Romania involve the following system changes and costs:[101] [102] [103]

[101] European Union DG Regio (2011) *Raising the bar for water and wastewater systems*. Viewed at http://ec.europa.eu/regional_policy/projects/stories/pdf.cfm?sto=2334&lan=7&country=RO

[102] European Union DG Regio (undated) *Extension and the rehabilitation of water and wastewater systems in Cluj – Salaj Counties area*. Viewed at http://ec.europa.eu/regional_policy/projects/stories/details_new.cfm?pay=RO&the=72&sto=1598&lan=7&region=ALL&obj=ALL&per=2&defL=EN

[103] European Union DG Regio (2011) *Improving water supply and wastewater treatment in Prahova county*. Viewed at http://ec.europa.eu/regional_policy/projects/stories/details_new.cfm?pay=RO&the=72&sto=2496&lan=7&region=ALL&obj=ALL&per=2&defL=EN

Table 5.5: Recent Water System Upgrade Projects in Romania
Source: EU DG Regio

System Operator ---------- Communities Served by System Upgrade ---------- Total Project Cost	Population affected by System Upgrade	Description of System Upgrade (Obtained from DG-Regio project descriptions)
Regional Operating Company: S.C Compania de Apa Oltenia SA Craiova, Calafat, Bailesti, Filiasi, Segarcea, Dabuleni, Bechet, Ciupercenii, Vechi, Poiana Mare, Tunarii Vechi and Calarasi. Total project cost = € 150,281,399	Targets 389 600 inhabitants of the region. Sewerage connection rate after completion of the project: 93.7% Drinking water connection rate after completion of the project: 99.8%	Project involves rehabilitation and extension of water sources, water transmission pipes, reservoirs and the distribution network (including pumping stations) in Calarasi, Dabulenu and Bechet. It will also cover the construction of a sludge storage platform in Craiova; the reconstruction of the wastewater treatment plant in Filiasi; the upgrade of the wastewater treatment plant in Calafat and Ciupercenii Vechi; the rehabilitation of the well field and rehabilitation of the chlorination plant in Bailesti and Poiana Mare; and the construction of a wastewater treatment plant in Segarcea.
Regional Operating Company: S.C. Compania de APA Somes S.A.(CASSA) Cluj-Napoca, Zalau, Dej, Gherla, Simleu Silvaniei, Jibou, Huedin and Cehu Silvaniei Total project cost = € 196,911,998	Targets 500 000 inhabitants of the region. Sewerage connection rate after completion of the project: 79% Drinking water connection rate after completion of the project: 96%	Project includes the rehabilitation of groundwater sources; the extension of 22 km of transmission pipelines and the replacement of 19km of transmission pipelines; the replacement and construction of 143 km of new distribution pipelines; the rehabilitation of one drinking water treatment plant and 14 water reservoirs. The project also involves the rehabilitation and extension of 120 km of sewers lines, the construction and rehabilitation of 30 pumping stations and the rehabilitation of eight wastewater treatment plants.
Regional water company: Hidro Prahova Câmpina, Breaza, Sinaia, Baicoi, Mizil, Valenii de Munte, Plopeni and Urlati. Total project cost = € 146,234,623	Targets 167,000 inhabitants of the region. Sewerage connection rate after completion of the project: 91% Drinking water connection rate after completion of the project: 96%	Project involves new water supply intake in the river; 21 km of new transmission network; 36 km of new and upgraded distribution network; 14 new pumping stations; and 12 new and rehabilitated water pre-treatment plants. On the wastewater side, the project will construct 280 km of new sewerage network; 25 km of new pressure pipes; 76 new wastewater pumping stations, and seven new and upgraded wastewater treatment plants.

150. Demand reductions strategies designed to reduce customer water usage tend to be relatively low cost, and would generally fall directly upon the consumer, although the Romanian government could subsidize the cost to ensure widespread uptake of low flow technology equipment such as toilets or washing machines, or rainfall capture systems that can cut landscaping water costs at homes. Utilities might also be encouraged to provide subsidies to households to install more efficient water-using devices, as reductions in use could delay or eliminate the need to expand or upgrade local supply capacity.

5.5 Recommendations

151. Over the past 10 years, great progress has been made in extending and improving the coverage and quality of Romania's water supply and treatment systems. These gains have largely been driven by the EU accession agreement obliging Romania to bring these systems up to much higher performance standards.

152. Going forward, pressure will remain to deliver gains in regions where system upgrades have yet to occur**.** ***Although urban water systems do not have the same level of climate impact of other sectors such as urban transportation, energy, and buildings, water system upgrades should be continued as a high investment priority*****.** At the same time these investments are being pursued for environmental quality and cost efficiency reasons, these system upgrades deliver climate change mitigation benefits at no significant additional cost. For this reason, the Romanian Government should position these projects as climate-related investments. Doing so would help satisfy Romania's obligation to spend no less than 20% of its operating program funds on climate-related investments.

153. Other steps the Government should consider are described below.

High Priority/Near-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
General	Convene/support efforts to promote expanded IDA/Local Authority knowledge on climate-sensitive water system design and operations	Education/ training	High
	Provide training for water system operators on climate-sensitive design and operations	Education/ training	High
	Fund research downscaling global climate models to provide more localized assessments of climate impacts in different water basins/regions, enabling improved long term water supply and water utility operations planning.	Research/analysis	High
	Require water utilities/ROCs to prepare climate action plans for their operation	Policy oversight	High
	Provide technical assistance funds to support analysis of climate-related vulnerabilities in local water systems and development of an action plan to address these challenges	Technical assistance	High
	Continue to finance water supply, distribution, and treatment system upgrades in towns/cities/regions to ensure compliance with relevant EU water quality and service coverage requirements. System upgrades should focus on maximizing efficiency improvements and minimizing GHG releases through improved gas management and sludge treatment. Upgrades should also focus on maximizing climate resilience of these systems.	Direct investment	High

Medium and Long-Term Action Items

Sectoral Focus	Policy Proposal	Type of Policy Initiative	Priority
General	Establish university curricula to train future civil/water system engineers on climate sensitive water system design and operations	Education/ training	Low
Water Demand	Develop/promote building code changes designed to reduce on-site water demand.	Policy oversight	Medium
	Establish public education programs to reduce on-site water use	Education/ training	Low
	Provide subsidies to households to replace high water demand appliances with more efficient models	Direct investment	Low
	Incentivize/require IDAs/water utilities/ROCs to establish subsidy programs to replace high water demand consumer appliances with more efficient models	Policy oversight	Medium
	Incentivize/require IDAs/water utilities/ROCs to install meters at the dwelling/user level, improving the ability to charge consumers based on their actual level of water demand.	Policy oversight	Medium
Wastewater Systems	Require IDAs/ROCs/water utilities to eliminate 'combined sewer overflow' designs wherever system expansion is being pursued, reducing the overall amount of material that must be processed on a regular basis, cutting energy demand.	Policy oversight	Medium

Section 6: Conclusion

154. Approaching climate change from an urban perspective places boundaries around the topic that are different than the national or sectoral orientation traditionally applied to the topic. The use of urban boundaries changes the conversation in meaningful ways, because the impacts on a specific economy, piece of infrastructure, or neighborhood become much more tangible.

155. In the 2014-2020 Operating Program period, the Romanian Government has an excellent opportunity to target the mitigation and adaptation needs of cities across the country. Some of these funds would necessarily represent a continuation of initiatives from the prior programming period, targeting district energy system upgrades, building efficiency improvements, the expansion of public transport systems, improvements to water distribution and wastewater treatment systems, and the development of improved solid waste disposal facilities.

156. Efforts should necessarily prioritize the energy and transport sectors, however. These are the two largest contributors to Romania's overall GHG emissions picture, and they face greater vulnerabilities as a result of climate change. The solid waste and water also require attention, however, to ensure that Romania achieves the environmental gains and other accession commitments it made when joining the European Union several years ago. Efforts targeting these sectors can still be positioned as climate-related investments, helping satisfy Romania's obligation to spend no less than 20% of its operating program funds on climate-focused activities.

157. This report has also highlighted significant data and planning gaps that must be addressed. Little is known about the GHG emission profile of most Romanian cities, or the specific climate risks these cities will face in the coming decades. Using EU Operating Program funds to support such analyses would provide the foundation for comprehensive planning activities essential to the future of Romania's cities. To the maximum extent possible, these climate plans should be woven into any long term economic and spatial development strategies that central and regional government officials are already pursuing. Doing so is critical to ensure that Romania does not lock its cities into a high carbon pathway, or that policies and investments made today will not place future economic activity or lives at risk once the impacts of climate change become more manifest.