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Using biodegrable waste in Georgia with support of public expenditure

Designing and costing a green public investment programme

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Designing and costing a green public investment programme

Foreword

Together with national governance or regulatory mechanisms, public investments are an essential part of creating an enabling environment framework for the transition to a greener and more sustainable development path. Since 2012, the OECD has provided capacity development support to several countries in Eastern Europe, Caucasus and Central Asia (EECCA). This aims to increase knowledge and practical skills of local public authorities responsible for environmental and climate change policies to better manage green public expenditure.

The project “Designing Green Public Investment Programme and Conducting Training in Georgia” was implemented under the “European Union for Environment” (EU4Environment) Action from March 2021 to April 2022 in close co-operation with the Ministry of Environmental Protection and Agriculture of Georgia (MEPA). During the project launch meeting on 11 March 2021, the ministry and other stakeholders discussed the focus and scope of the proposed programme. They agreed it would use agricultural residues from farms, as well as green waste and bio-waste from both households and food and beverage producers.

The preparation of the programme comprised four main stages: i) initial scoping and data collection; ii) adjustment of the programming and costing methodology; iii) development of an investment programme in line with good international practices; and iv) preparation of an analytical report. The programme relies on publicly available data collected through desk research, as well as information received in bilateral meetings with public and private sector experts in Georgia. Wherever possible, it used the most recent data (February 2022).

The implemented activities were both analytical and practical. They included both programme design (main elements, methodology, costing model), as well as training on medium-term environmental and climate-related investment planning and management (selection procedures, project cycle management). Also, the project outlined the necessary associated actions required for the programme implementation phase (setting the timeframe, allocating necessary human resources, adopting administrative procedures, etc.). It also reviewed the existing and potential domestic financing mechanisms (including public-private partnerships) in light of facilitating green investments.

The OECD implemented the project in a participatory approach with MEPA, its main counterpart in the EU4nvironment’s Activity Area 3.3 in Georgia. As a major player in environmental and climate change policy in the country, the ministry had a substantive role in setting the direction (focus) of the programme, as well as co-ordinating on a national level. Activity Area 3.3 of the EU4Environment, and its Work Plan for Georgia, envisage providing technical assistance and capacity development to help increase the capacity of government authorities to better manage public environmental spending.

In this line, technical assistance sought primarily to equip government officials and experts in Georgia with know-how and practical skills in designing a public environmental expenditure programme. Such programmes help obtain adequate resources from the public budget and leverage international co-financing for its implementation. The programme has been designed in line with international good practices and can serve as a model for preparing other low-carbon public investment programmes within national medium-term expenditure frameworks.

During the two stakeholders' meetings and a number of bilateral meetings (held both virtually and in person as the pandemic allowed), other local and international institutions and experts also helped shape the final programme design. The strengthened communication channels between various levels of public administration, citizens and other stakeholders (depending on the type of the programme) will ultimately contribute to sustainability of the planned investment.

Not least, the project also aimed to facilitate and contribute to the knowledge transfer and experience-sharing between the European Union and its Eastern Partnership (EaP) countries concerning best practices and lessons learnt in the preparation and implementation of large (nationwide) public support programmes. Therefore, the project also supported complementary activities and requirements needed to successfully implement the programme.

In December 2021, on the margins of this project, the OECD organised a webinar with experts from the agricultural and bioenergy sectors in the EU countries. The objective was to support Georgia and other EaP countries in leveraging private (or any non-state) investments into equipment and technologies that divert environmental and climate-related problems connected with the treatment of agricultural residues, green waste and bio-waste. The webinar targeted national public authorities in the region dealing with environment, agriculture and energy issues, as well as representatives of beneficiaries of the proposed public support (e.g. farmers' associations).

The OECD has been supported in this work by the EU4Environment National Action Co-ordinator in Georgia. In addition, a team of international and national consultants (contractors and sub-contractors) provided relevant experience and practical expertise in the preparation, costing and management of multi-year public environmental investment programmes.

The study was prepared with the financial support of the European Union within the EU4Environment Programme and Germany's Federal Ministry for the Environment, Nature Conservation and Nuclear Safety through its International Climate Initiative.

The views expressed herein are those of the authors only and can in no way be taken to reflect the official opinion of the European Union, its members, the governments of the EaP countries or the EU4Environment implementing partners (OECD, United Nations Economic Commission for Europe, United Nations Environment Programme, United Nations Industrial Development Organization and the World Bank).

The study was prepared within the framework of the GREEN Action Task Force hosted by the OECD Environment Directorate.

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Abbreviations and acronyms

a	Annum
AA	Association Agreement (of the European Union)
AR	Autonomous republic
ABP	Animal by-product
AP	Action plan
BAU	Business as usual
CDM	Clean Development Mechanism
CIS	Commonwealth of Independent States
CoM	Covenant of Mayors
COP	Conference of the Parties (to the UNFCCC)
CPT	Clean Public Transport (OECD Programme)
CSAP	Climate Strategy and Action Plan
DB	Doing business (score)
DCFTA	Deep and Comprehensive Free Trade Area
EaP	Eastern Partnership (of the European Union)
EIB	European Investment Bank
EBRD	European Bank for Reconstruction and Development
ECS	Energy Community Secretariat
EEC	Energy Efficiency Centre Georgia
EECCA	Eastern Europe, Caucasus and Central Asia
EPR	Extended producer responsibility
EUR	Euro (Eurozone currency)
FDI	Foreign direct investment
GCAP	Green City Action Plan
GCF	Green Climate Fund
GDP	Gross domestic product

GEF	Global Environment Facility
GEL	Georgian lari
GHG	Greenhouse gas (emissions)
GIZ	German Development Cooperation (*Deutsche Gesellschaft für International Zusammenarbeit)*
GoG	Government of Georgia
IEA	International Energy Agency
IFI	International financial institution
INDC	Intended Nationally Determined Contribution
IRENA	International Renewable Energy Agency
IRR	Internal rate of return
IU	Implementation unit
KfW	KfW Development Bank (*Kreditanstalt für Wiederaufbau*)
KPC	Kommunalkredit Public Consulting
LEDS	Low Emission Development Strategy
LLC	Limited liability company
Ltd.	Limited (liability company)
LT-LEDS	Long-Term Low Emission Development Strategy
LULUCF	Land use, land-use change and forestry
MDF	Municipal Development Fund of Georgia
MENRP	(former) Ministry of Environment and Natural Resources Protection of Georgia
MEPA	Ministry of Environmental Protection and Agriculture of Georgia
MEUR	Million EUR
MoESD	Ministry of Economy and Sustainable Development of Georgia
MRV	Measurement, reporting and verification
MTEF	Medium-term expenditure framework
MWMP	Municipal Waste Management Plan
NAMA	Nationally Appropriate Mitigation Action
NBWS	National Biodegradable Waste Strategy
NWMS	National Waste Management Strategy
NWMAP	National Waste Management Action Plan
NBG	National Bank of Georgia
NDC	Nationally Determined Contribution

NECP	National Energy and Climate Plan
NEEAP	National Energy Efficiency Action Plan
NEFCO	Nordic Environment Finance Corporation
NGO	Non-governmental organisation
NPV	Net present value
NREAP	National Renewable Energy Action Plan
NSEAP	National Sustainable Energy Action Plan
OECD	Organisation for Economic Co-operation and Development
OPTIC	Optimising Public Transport Investment Costs (OECD Model)
PE	Programming entity
PCM	Project cycle management
PoG	Parliament of Georgia
PPP	Public-private partnership
RE	Renewable energy
REC	Regional Environmental Centre
SEA	Strategic environmental assessment
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
SFM	Sustainable forest management
SME	Small and medium-sized enterprise
SWM	Solid waste management
SWMCG	Solid Waste Management Company of Georgia
TPES	Total primary energy supply
TSG	Tbilservice Group
TSU	Technical support unit
UCO	Used cooking oil
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VAT	Value added tax
WEG	World Experience for Georgia

WMC	Waste Management Code

Units and compounds

CH_4	Methane
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
Gg CO_2eq	Gigagram of carbon dioxide equivalent
GJ	Gigajoule
GWh	Gigawatt-hour
ha	Hectare
kg	Kilogramme
kJ	Kilojoule
km	Kilometre
km^2	Square kilometre
kW	Kilowatt
kWh	Kilowatt-hour
MJ	Megajoule
mm	Millimetre
MW	Megawatt
Mt CO_2e	Megatonne of carbon dioxide equivalent
m^2	Square metre
m^3	Cubic metre
NO_x	Nitrogen oxides
N_2O	Nitrous oxide
PJ	Petajoule
SO_2	Sulphur dioxide
t	Tonne
t CO_2	Tonne of carbon dioxide
TJ	Terajoule

Executive summary

About a half of more than 1 million tonnes of municipal waste generated annually in Georgia is of a biological origin. In the non-municipal sectors, agriculture and forestry activities generate the major streams of biodegradable waste. When all municipal (kitchen waste, green waste, etc.) and non-municipal (agriculture, forestry, etc.) waste streams are considered, biodegradable waste accounts for over 60% of the total volume of waste generated in the country.

The environmental objective of the designed green public investment programme in Georgia is to reduce the amount of biodegradable waste disposed at landfills, illegally burnt or dumped (dumpsites, rivers). These practices cause a negative environmental impact on the quality of air, water and soil. The programme is also designed to contribute to Georgia's climate change mitigation efforts, renewable energy targets and its transition to a green economic model of development (Chapter 1).

To limit its scope, the programme focused on non-municipal waste generated by agriculture, households, and food and beverage producers. The study conducted an economic analysis, which identified six groups of projects ("pipelines") in two areas with potential to reduce illegally dumped or burnt biodegradable waste (Chapter 4). In practice, the environmental objectives of the programme will be accomplished by supporting investment in using the biodegradable waste for energy production (biomass and biogas) or producing compost.

The project estimated the cost basis for the green public investment programme based on unit cost estimates for various infrastructure components. These include composting containers, bailers for biomass residue and boilers, etc. Using Optimising Public Transport Investment Costs (OPTIC), an OECD Excel-based model, the project calculated programme costs and benefits (reduction of emissions of greenhouse gases) for the first (pilot) phase and the second (scaling-up) phase (Chapter 3).

The key (financing) input and (environmental) output parameters of the programme's implementation are summarised below.

- Phase 1 will be launched on a small scale. The total cost of the programme is estimated to be **EUR 2.95 million**, of which **EUR 1.74 million** will be co-financed from the programme and **EUR 1.21 million** is expected to come from investment by private or public investors (households, farmers, municipalities). The pilot phase could allow achieving a reduction of **13 873 tonnes of carbon dioxide per year (t CO_2/a)**. This CO_2 reduction is relatively low due to the small scale of the pilot phase.
- Phase 2 will extend the pilot phase. The investment cost of Phase 1 and Phase 2 is estimated at **EUR 130.55 million**, of which about **EUR 99.92 million** in public support will be needed; **EUR 30.63 million** is expected from investment by private or public investors. The estimated CO_2 reduction after implementation of the two phases is **222 393 t CO_2/a**.
- A Phase 3 that scaled up to the full potential described by the economic analysis could be implemented after 2030.

With respect to financial commitment, the economic analysis demonstrates that public support must be relatively high under current conditions – between 50-80% – to ensure the interest of potential beneficiaries (Chapter 4). The proposed financing instruments are public subsidies in the form of grants. Experience shows this tool has been the main driver in many countries in motivating private and public beneficiaries to allocate their own financial resources to purchase new – and more environment- and climate-friendly – equipment or installations. These generally require a higher initial investment (in terms of purchase cost) but bring several benefits in the future (in this case, cheap biomass fuel).

Co-financing from the state budget is typical of state environmental programmes. However, considering the budget constraints in Georgia and the substantial total costs of the programme, it will be challenging for the public financier to cover all these costs alone. If the state covers only a part of programme costs, the national contribution will be important to demonstrate real commitment to international partners (i.e. potential co-financiers of the programme).

Besides the financial commitment, the study has also looked into two other important areas where the contribution of the national government is essential – policy and regulatory reform, and institutional set-up. The programme needs to be integrated into national policy, strategic documents and respective action plans, so that the inputs from the programme (i.e. programme costs) can feed into the budgeting process. If the programme is not integrated, the budget can still be finalised, albeit without contributions from the programme.

Various economic and regulatory barriers may complicate implementation of even a well-designed investment programme. Low energy prices combined with low enforcement of proper disposal of biodegradable waste constitute major obstacles for programme implementation in Georgia. The national government should therefore review the relevant regulatory basis and eliminate barriers to the extent possible (Chapter 2). Combining such regulatory improvements with financial support from the state is more likely to lead to reduction of the disposed or burnt biodegradable waste and result in significant environmental and climate-related improvements.

Not least, an optimal institutional set-up for the programme's implementation should be selected and mandated (Chapter 5). As this is the last step in programme preparation, at this stage, all elements of the programme will have been clarified and a consensus on its priorities reached. Regardless of the type of institutional set-up, programme management should involve an institutional structure and procedures that promote environmental effectiveness, embody fiscal prudence, and use financial and human resources efficiently. Subsequently, the government needs to ensure that resources, qualified staff and instruments are sufficient to implement the programme.

1 Introduction

This chapter presents a brief overview of guiding national strategies of Georgia and the country's international commitments in the climate change arena. Specifically, the chapter focuses on Georgia's main climate change policies, energy sector policies and green economy policies. The overview includes strategies and action plans covering both mitigation and adaptation, with a focus on energy sector targets (energy efficiency, renewable energy). The introduction also touches upon investment needs in this sector, as well as means through which the OECD can help Georgia address prevailing challenges under this EU4Environment project. The chapter concludes with a brief summary of the OECD experience with the proposed methodology, as well as an outline of main steps in the programme preparation.

Georgia's environmental and climate-related efforts

Since leaving the Soviet Union and gaining independence in 1991,[1] Georgia has notably progressed in economic development and in increasing the well-being of its citizens. As a relatively small country, classified by the United Nations (UN) as an economy in transition, Georgia's contribution to global greenhouse gas (GHG) emissions amounts to 0.03% (2018).[2]

As a non-Annex I country, Georgia has been a Party to the United Nations Framework Convention on Climate Change (UNFCCC) since 1994 and gained access to Kyoto Protocol's Clean Development Mechanism (CDM) in 1999.[3] Georgia acceded to the 2009 Copenhagen Accord – prepared at the 15th Conference of the Parties (COP15) – in 2010 and submitted its Nationally Appropriate Mitigation Actions (NAMAs) to the UNFCCC. In 2015, the country presented its Intended Nationally Determined Contribution (INDC) to the UNFCCC secretariat, and in 2017, it ratified the Paris Agreement.[4] With this, Georgia joined 191 Parties and committed to contribute towards the goals of the Paris Agreement. Among other goals, the Paris Agreement aims to hold the global average temperature increase well below 2°C and pursue efforts to limit to 1.5°C compared to the pre-industrial level.

Georgia's first INDC defined commitments up to 2030: the unconditional target to reduce its GHG emissions is set at 15% below the business-as-usual (BAU) scenario by 2030 (in absolute terms, 32% below 1990 level). The conditional target – subject to access to low-cost financial resources, technology transfer, etc. – is to reduce GHG emissions by 25% below BAU level (or 40% below 1990 level) by 2030 (GoG, 2015[1]).[5] The INDC's BAU scenario does not include the positive effect of land use, land-use change and forestry (LULUCF) as a net carbon sink. Georgia's INDC describes Georgia's national targets on climate change mitigation and adaptation. However, it does not indicate the size of finance needed to achieve its GHG emission reduction targets or include information on detailed actions needed to achieve the targets.[6] Instead, the NDC refers to other official policy documents on climate mitigation actions, namely the Low Emission Development Strategy (LEDS) and the National Energy Efficiency Action Plan (NEEAP) (OECD, 2018[2]).

However, after the ratification of the Paris Agreement, the country announced it would present a more ambitious NDC by 2021. Through the updated NDC, submitted to the UNFCCC in 2021,[7] Georgia commits to reduce its GHG emissions growth by 35% unconditionally below 1990 levels and 50-57% conditionally (2°C or 1.5°C scenarios), depending on international financial resources (excluding emissions from LULUCF) (GoG, 2021[3]). This would imply that total national emissions, excluding LULUCF, should be limited to 29.25 megatonnes of carbon dioxide equivalent (Mt CO_2e) in 2030. NDC also has sectoral targets in seven economic sectors: transport, buildings, energy generation and transmission, agriculture, industry, waste and forestry.

Georgia's 2030 Climate Change Strategy and **2021-2023 Action Plan** (Climate Strategy and Action Plan – CSAP) follow and support targets set in the NDC. Therefore, they provide measures for each of the seven priority sectors of the economy relevant to climate change mitigation. The strategy provides a long-term vision but also outlines sectoral targets for GHG emissions reduction: 15% for energy generation and transmission, 15% for transport and 5% for industry compared to BAU (reference scenario). At the same time, the CO_2 absorption capacity of forests should be increased by 10% from the 2015 level (GoG, 2021[4]).[8]

In 2020, Georgia launched the elaboration of the multi-sectoral **Long-Term Low Emission Development Strategy (LT-LEDS)** until 2030.[9] The strategy, drafted in 2021, was considered by government agencies in 2022 but has not yet been approved (at the same time, other countries defined climate objectives until 2050).

Table 1.1 presents a brief overview of the country's national climate change mitigation and adaptation strategies and action plans.

Table 1.1. Georgia's main climate change policies

Title	Scope	Status	Note
Georgia's Climate Change Action Plan 2021-2023	National	Approved in 2021	Includes measures such as reducing emissions from the transport sector or transforming the energy sector, as well as increasing the share of renewable energy.
Georgia's 2030 Climate Change Strategy[10]	National	Approved in 2021	Identifies mitigation measures for national GHG emissions in seven priority sectors set out by Georgia's Updated NDC.
Georgia's Country Programme with the Green Climate Fund (GCF)	National	Finalised, updated version under procedural approval process at MEPA	Analyses key national climate change strategies and actions and serves as an instrument to synthesise fundable project ideas on climate change.
Georgia's First Nationally Determined Contribution (NDC)	National	Submitted to UNFCCC in 2015	Communicates Georgia's climate-related targets internationally under its commitment to the Paris Agreement. The Climate Action Plan is a short-term action plan to achieve the 2030 target.
Georgia's Long-Term Low Emission Development Strategy (LT-LEDS) until 2030	National	Drafted in 2021 and under inter-ministerial consultations	Develops different emissions reduction scenarios based on the updated NDC. National and sectoral mitigation targets (both unconditional and conditional ones) will be identified for 2020-30, 2030-40 and 2040-50.
Georgia's Low Emission Development Strategy (LEDS)	National	Draft finished in 2017	Identifies sectoral strategies and goals to achieve low-carbon development pathways (served as a basis for development of CSAP).
Georgia's Updated Nationally Determined Contribution (NDC2)	National	Submitted to UNFCCC in 2021	Supports the low-carbon development of the transport, buildings, energy generation and transmission, agriculture, industry, waste and forest sectors. It also sets the 2030 Climate Change Strategy and Action Plan for determination of mitigation measures.
National Adaptation Plan	National	Under development	The first draft will focus on the agriculture sector.
Nationally Appropriate Mitigation Actions (NAMAs)	National	Ended	Developed NAMAs on biomass energy, buildings, sustainable forest management, transport and hydropower.

Note: CASP = Climate Strategy and Action Plan. MEPA = Ministry of Environmental Protection and Agriculture.
Source: Authors' compilation. See also (OECD, 2018[2]); (OECD, 2019[5]).

According to baseline information in CSAP Georgia, GHG emissions through BAU will amount to 30.8 Mt CO_2e by 2030. Meanwhile, measures identified in CSAP will ensure emission levels are decreased to 27.5 Mt CO_2e (a reduction of approximately 11%). The 35% reduction target would imply that total national emissions, excluding LULUCF, should be limited to no more than 29.25 Mt CO_2e in 2030. In addition to the specific activities set out in the Action Plan, CSAP provides a means of demonstrating to international partners and investors that Georgia is committed to implementation of its Updated NDC (GoG, 2021[4]).

The approach of Georgia's climate change policy – co-ordinated by the Ministry of Environmental Protection and Agriculture (MEPA) – is either through introduction of new technologies or more efficient management and targeted policy making. Georgia has not (yet) adopted strategies on the national level for several strategic sectors – such as energy, transport or industry – that would articulate specific and time-bound sustainable development targets.

Box 1.1. Georgia's climate adaptation challenges

Agriculture is one of the most vulnerable sectors to climate change in any country's economy (mostly affected by land or wind erosion, landslides, mudflows, floods, etc.). Average annual temperature in West Georgia increased by 0.3°C, and in East Georgia the increase has reached 0.4-0.5°C since 1990. Georgia's mild climate and abundant water resources mean that increase of average temperature will not necessarily result in negative effects for agriculture or tourism (where adaptation can be achieved through changing locations/altitudes or products). However, climate change effects have negative impact on the functioning of cardiovascular and respiratory systems (due to higher air temperature, intensification of heat waves or increased humidity).

The overreliance on hydropower – with its 80-90% share of current and planned generation capacity – combined with a lack of national energy strategies and respective policies means that energy security is still a concern. Most of Georgia's water resources are exposed to climate change effects (melting glaciers, frequent droughts) and might not be able to meet future demands for more domestic energy consumption. The outlined investments in low emission or sustainable development strategies are supposed to bring about technological advancement of the country through adoption of innovative approaches. This will contribute not only to a creation of (greener) jobs but also to a more rational use of natural resources (preventing its depletion multiplied by climate change effects).

Source: (GoG, 2015[6]).

Georgia joined the EU Energy Charter in 2016 and became a full member of the Energy Community in 2017 with an obligation to elaborate the NEEAP and the National Renewable Energy Action Plan (NREAP). These action plans aim to help Georgia comply with the EU's directives (in particular, the Energy Efficiency Directive 2012/27/EU11 and the Renewable Energy Directive 2009/28/EC12). They also reflect EU directives and regulations in the energy field in domestic legislation set out in Annex XXV to the Association Agreement. The overall legal and policy energy framework in Georgia does not yet fully comply with requirements set out by the EU-Georgia Association Agreement and the Energy Community Treaty. However, a Contracting Party should be a strong driver for, among others, renewable energy and energy efficiency investments in Georgia (OECD, 2018[2]).

The **Law on Energy Efficiency**, pending adoption for several years, was eventually adopted in 2020. It aims to increase energy savings, energy supply security and energy independence, as well as eliminate barriers that hinder the efficiency of energy supply and consumption and achievement of the national energy saving target set by the NEEAP. According to the law, the Ministry of Energy of Georgia should also promote and implement programmes for use of alternative energy sources, including the introduction of energy-efficient stoves and solar-powered water heaters (PoG, 2020[7]).

The first NEEAP, initially drafted for 2017 to 2020, identified national energy efficiency targets for 2020, 2025 and 2030 targets and outlined financing schemes for sector-specific energy efficiency measures. The NEEAP 2019-2020 has been substantially revised from the 2017 version, including the targets. If the policies are implemented and investments (costed at EUR 1.37 billion) undertaken, these will bring about energy savings of 14% in primary energy sources and 11% in final energy consumption by 2030, compared to the BAU scenario. The NDC13 includes additional focus sectors from both (horizontal) public and private spheres, as well as industry, transport, energy and buildings (residential) sectors (GoG, n.d.[8]).

Besides a recent revision of the NEEAP, the Ministry of Economy and Sustainable Development of Georgia (MoESD) is working on the **National Energy and Climate Plan (NECP)** as recommended in the Energy Community Treaty. Georgia's draft NECP was supposed to be finalised by the end of 2022 with adoption in 2023, covering the period until 2030 and setting new targets in the field of energy and climate. The integrated NECP will be fully aligned with Georgia's updated NDC and CSAP, comprising five dimensions: energy efficiency, energy security, internal energy market, research and innovation, and decarbonisation of the economy. CSAP is supposed to contribute to the decarbonisation component of the NECP.

The MoESD has also prepared the **National Sustainable Energy Action Plan (NSEAP).** This plan, prepared with support of the United Nations Economic Commission for Europe (UNECE), will focus on the cross-cutting nature of sustainable energy transition. The plan will integrate measures and activities specified in sub-sectoral strategies and action plans in the field of energy, such as the NEEAP or NREAP. The NSEAP also outlines specific measures and total costs in the field of energy efficiency and renewable energy, as well as access to energy to meet the 30% target of energy consumed from renewable energy for 2020 (GoG, n.d.[9]).

Similar to the NEEAP, the NSEAP focuses on buildings, public bodies, industry, transport and the energy sector. Apart from larger-scale measures like hydropower, solar and wind energy, the plan also envisages support of micro-generation – less than 100 kilowatts (kW) – from renewable sources, improved management of solid biomass resources (forests) or efficient wood-burning stoves for rural households.

In 2008, the European Union launched the Covenant of Mayors (CoM) initiative – now part of EU4Energy programme for Eastern Partnership (EaP) countries (CoM East) – to help local authorities implement sustainable energy policies (CoM, 2017[10]). As of 2022, 24 signatories from Georgia have committed to reduce CO_2 emissions either by 20% by 2020 (7 municipalities), or by 30% with climate change adaptation measures implemented by 2030 (15 municipalities). In addition, 11 municipalities have made commitments to develop voluntary Sustainable Energy Action Plans (SEAPs) in 5+1 sectors – energy efficiency in buildings, transport, local renewable energy generation, lighting and landscaping, as well as to raise public awareness.[14]

Table 1.2. Georgia's climate-related energy development documents

Title	Scope	Status	Note
Law on Energy Efficiency	National	Adopted in 2020	Provides legal foundation for promoting and implementing energy efficiency and establishes a procedure for developing national energy efficiency targets.
National Energy and Climate Plan (NECP) 2021-2030	National/ sectoral	Draft to be finalised end of 2022 and adopted in 2023 (together with the State Energy Policy 2030)	Accords with the recommendation from the Ministerial Council of the Energy Community and aligns with NDC and CSAP.
National Energy Efficiency Action Plan (NEEAP) 2019-2020	National	Adopted in 2019	Identifies national energy efficiency targets for 2020, 2025 and 2030, as well as policy measures (roadmap) and financial needs to achieve the targets, contributing to Georgia's NDC and aligning with the EU's Energy Efficiency Directive 2012/27/EU.
National Renewable Energy Action Plan (NREAP)	National/ sectoral	Adopted in 2019	Develops national policy framework and targets (by 2030) for renewable energy sources, which is also compatible with Renewable Energy Directive 2009/28/EC.
National Sustainable Energy Action Plan (NSEAP) 2018-2030	National/ sectoral	Draft prepared	Identifies best practices, measures and procedures for a sustainable energy transition, with a focus on the cross-cutting nature of energy efficiency, renewable energy and energy access.
Sustainable Energy Action Plans (SEAPs) under the Covenant of Mayors	Municipal/ sectoral	11 SEAPs have been approved and submitted as of 2018	Shows the individual signatory municipalities' commitments (targets and actions) to voluntarily reducing GHG emissions and energy demand or increasing energy efficiency. SEAPs cover the period until 2020, the Sustainable Energy and Climate Action Plans (SECAPs) until 2030.

Source: Authors' compilation. See also (OECD, 2018[2]); (OECD, 2019[5]).

In 2017, municipal authorities in Tbilisi approved a **Green City Action Plan (GCAP)** (Table 1.3). This was developed with support of the European Bank for Reconstruction and Development (that adopted the Green Cities Programme in 2016) and financially supported by the Czech Republic. The action plan targets, among others, areas such as water and wastewater services, municipal waste management, energy (energy efficiency and renewable energy), business development, land use and biodiversity, as well as resilience of urban infrastructure. In the energy and buildings sector, the Tbilisi's GCAP is aligned with NEEAP, and for transport, buildings and municipal Infrastructure, the GCAP reflects the city's SEAP completed in 2011 under the auspices of the CoM (TCH and EBRD, 2017[11]).

Investment environment and investment needs in Georgia

With the expected economic growth in the 2020s, GHG emissions will continue to rise unless investments are redirected into low-carbon technologies and infrastructure. CO_2 emissions from Georgia's energy sector due to fuel combustion will increase by 72.3% amounting to 11.2 megatonnes (Mt) by 2030 (GoG, 2015[6]). In the energy sector, where the electricity infrastructure is of higher quality, efficiency can be improved in production, distribution and consumption. However, energy efficiency gains can also be achieved in more outdated non-energy sectors such as transport, wastewater and solid waste (where the amount of waste is expected to increase).

Georgia has worked on preparing a green growth and socio-economic development strategy at the national level to mainstream environmental considerations in a wider policy context. In 2009, Georgia joined the OECD's Declaration on Green Growth,[15] thereby making a commitment towards the country's green growth orientation and support of green investments (with regard to human, natural or financial capital).

The envisaged **Green Economy Strategy** will encompass economy, environmental protection, energy, agriculture, infrastructure and education sectors. The strategy aims to embrace sustainable development primarily through technological advancement of the country. As of this writing, the strategy – led by the Ministry of Economy and Sustainable Development[16] – has not been adopted. However, the concept presented in 2018 highlights the importance of improving environmental management in the country.

In 2014, the government of Georgia adopted a five-year **Social-Economic Development Strategy.** Known as **"Georgia 2020",** the strategy relies more on the private sector to boost the economy rather than the state in the areas of governance, energy (including energy efficiency and renewable energy), transport, water and industry. According to the strategy, the state should stimulate the private sector, facilitate investments and create a fair and protected business environment. Therefore, state interventions in economic activities should be limited to sectors where the private sector remains weak and inefficient (GoG, 2014[12]).The strategy recognises the importance of infrastructure development, especially energy and transport. However, technological advancement of the country, especially in processing agricultural products and natural resources, is equally important.

The **Agriculture and Rural Development Strategy for 2021-2027** recognises the need to maximise the agricultural potential of Georgia for the benefit of the national economy. Among its three strategic areas are environmental protection and sustainable usage of natural resources in rural areas (Goal 2). Sustainable use of forest resources and support for implementation of energy-efficient and renewable energy technologies and practices are mentioned as key environmental objectives within this area (GoG, 2014[12]). The strategy focuses mostly on climate change adaptation (such as implementation of climate-smart agriculture practices). However, some components are relevant to climate change mitigation targets.

Table 1.3 lists the approved strategies and action plans, or ones being developed, concerning the socio-economic or green development path.

Table 1.3. Georgia's main development and green economy policies

Title	Scope	Status	Note
Agriculture and Rural Development Strategy of Georgia 2021-2027	National/ sectoral	Approved in 2019	Addresses challenges to social-economic development in rural areas and recognises the need to maximise country's agricultural potential for the benefit of the national economy
Green Economy Strategy	National	Under development	Develops green economy interventions in various sectors, which can also lead to higher income and employment
Social-Economic Development Strategy – "Georgia 2020"	National	Adopted in 2014	Identifies priorities and approaches to achieve long-term, sustainable and inclusive economic growth, including rational use of natural resources
Tbilisi Green City Action Plan (GCAP) 2017-2030	Municipal	Developed in 2017	Presents benchmarking and priorities for tasks and defines the long-term Green City vision – within a timeframe of 10-15 years – supported by EBRD and its Green Cities Programme
Tbilisi Sustainable Urban Transport Strategy 2015-2030	Municipal/ sectoral	Finalised in 2016	Defines policy directions and priorities on sustainable transport to be implemented between 2015 and 2030

Note: EBRD = European Bank for Reconstruction and Development.
Source: Authors' compilation. See also (OECD, 2018[2]); (OECD, 2019[5]).

In the last decade, private sector investments have been the main driver of economic growth in the country (UNEP, 2018[13]). The Georgian government has tried to use this momentum to include the private sector in infrastructure development by improving the regulatory framework for public-private partnerships (PPPs). However, public authority capacities to prepare and implement PPP projects need to be strengthened.

The national strategies have both identified areas for public support and also outlined the necessary financial resources. The green economy model – as calculated by the EaP GREEN's "Supporting the Development of a Green Growth Economic Strategy in Georgia" – will require interventions of GEL 24.7 billion between 2018 and 2040. These would mainly target three key (to a large extent intertwined) sectors of Georgia's economy: agriculture, building and tourism. The annual contributions will correspond to 4.9% of gross domestic product (GDP) between 2018 and 2030 and 2.4% of GDP between 2018 and 2040. More than 80% will be targeted to buildings and tourism for energy efficiency measures (UNEP, 2018[13]).

The planned investments, adoption of innovative approaches and policy changes aim to bring about technological advancement in the country. Numerous benefits are expected compared to the BAU scenario. This will take the form of avoided costs (e.g. lower energy and power demand), as well as added economic development (higher GDP, higher government revenues and disposable household income, lower unemployment, etc.). More efficient use of natural resources will help protect them from depletion and the multiple effects of climate change. Georgia's water resources are largely exposed to climate change effects (melting glaciers, frequent droughts) and might not be able to meet the increased domestic energy consumption demands in future.[17]

Georgia is not an industrial economy. Total GDP growth was 4.7% in 2018; the industrial sector represented only 0.2 percentage points (the service sector had the remaining 4.5%) (NBG, 2019[14]). Consequently, Georgia is not capable, for the moment, of producing modern (and energy-efficient) materials and technologies. On the one hand, imports are a feasible way to improve standards; on the other, they are usually more expensive than local production. By creating demand, new (green) jobs can emerge and reduce the unemployment rate of 12.7%. However, these need to be supported with tailored vocational trainings to decrease structural unemployment (Namchavadze, 2019[15]).

Georgia has already created favourable conditions for foreign investors. It attracts foreign direct investment (FDI) in many sectors, including finance, manufacturing, tourist infrastructure, construction and energy. In

2020, Georgia ranked seventh among 190 economies in the World Bank's Ease of Doing Business Indicators with a DB score of 83.7%. This topped all post-Soviet countries and all but one EU countries, and was a marked improvement from being out of the top 100 in 2005-06.[18] Since 2004, Georgia has eliminated many bureaucratic barriers and reduced the overall tax burden with its liberalisation reforms. However, ensuring free market competition and enforcing bankruptcy regulation still remains a challenge (GoG, 2014[12]).

Georgia's economy – both its industrial and service sectors – needs the right incentives (subsidies in the form of tax reductions, grants, discounted loans or free technical assistance) to replace outdated materials and equipment, increase value added of products and, as a result, expand the country's export potential. However, the government expects to significantly increase education spending while keeping debt relatively stable (around 46% of GDP in coming years). Consequently, infrastructure investments – together with wage growth in public sector – will probably receive much less attention than before (Moody's, 2019[16]).

Georgia's Association Agreement (AA) with the European Union – which includes a **Deep and Comprehensive Free Trade Area (DCFTA)** – entered fully into force in July 2016 and opens new opportunities for Georgia to attract investments. The DCFTA will gradually eliminate barriers (tariffs) and open the EU market for Georgian goods, services and capital. This, in turn, will make it more appealing for EU investors to invest in Georgia. As part of the AA, Georgia has committed to removing obstacles in importing environment- and climate-friendly goods and services (such as tariff barriers) as well as investing in sustainable renewable energy and energy-efficient products and practices (Article 321, par. b and c). The GEF-funded project "Climate Change and Technology Needs Assessment", implemented in Georgia in 2011-12, laid the foundation for this direction.[19]

How the OECD can help address some of these challenges

Technical assistance through the EU4Environment project "Designing Green Public Investment Programme and Conducting Training in Georgia" aimed to enhance the investment planning and management capacities of government officials and associated experts in Georgia in public environmental spending. In particular, the EU4Environment project aimed to help equip government officials and experts with know-how and practical skills on designing a public environmental spending programme.

This project will increase the chances of obtaining adequate resources from the public budget and leveraging international co-financing for implementation. Economically sound and credible multi-year investment programmes are better positioned to successfully compete for public support – both from national and international sources – and leverage the funds to embark upon a path of greener and more sustainable development. The programmes are designed in line with international good practices. As such, they can be a model for other low-carbon public investment programmes within national medium-term expenditure frameworks (MTEFs).

The technical assistance (and specifically its costing model) helped national public authorities to calculate the public funds needed to bring about (or contribute to) the achievement of the country's environmental and climate-related targets (that are mostly defined at the national level). Ultimately, successful implementation of the green public investment programme will help accelerate socio-economic development (e.g. through creation of green jobs, adoption of innovative technologies).

Box 1.2. How green public investment programmes are prepared

The methodology applies a programmatic approach to low-carbon public expenditure by creating pipelines of priority environmental projects that will be supported by public sector funds, mainly through subsidies in the form of grants. This will mobilise private investors by providing them not only with direct financial support – especially before the new technologies reach market maturity – but also giving them guidance about investments that can bring the desired environmental and socially beneficial outcomes.

OECD technical assistance projects apply four main pillars of the programmatic approach towards green public spending:

- Pillar one: Preparing economic analysis that investigates the supply and demand side of potential technologies and equipment within the agreed target sector that could be included in the project pipelines.
- Pillar two: Developing costing methodology and the associated costing model that calculates the amount of finances – both on the supporters' and beneficiaries' side – required to achieve the desired environmental (or other) outcomes.
- Pillar three: Proposing an institutional set-up that also includes operating regulations (best practices of project cycle management) needed to be put in place, and policy and regulatory barriers that, conversely, need to be eliminated (if any).
- Pillar four: Providing capacity development that will enable the future implementer of the programme (national public authorities) to launch it, given that budgetary and personnel allocations have been made.

Besides the main pillars, further areas of support in the designing and costing phase of the project also include an overview of possible financing sources (both national and international public sources) as well as an overview of the overall policy and regulatory framework of the target sector (and the associated recommendations).

This project built on previous OECD work in public environmental spending management, integrating the environmental sector into medium-term budgetary processes and on climate change economics. The OECD has developed several policy tools that aim to support efforts of governments to design and implement green public investment programmes – either at national or local level – in a cost-effective way and in line with good international practices.[20]

The OECD applies a programme costing methodology focused on environmental and climate-related investment programmes. An Excel-based model helps assess implementation costs – both "hard" investments and administration/management spending – of a particular investment programme against foreseen/aspired environmental impacts. In this way, it enables implementers to optimise targets given a specified programme budget, or vice versa – to adjust the programme budget to achieve set targets (see Annex D for details).

Essentially, the model is an analytical tool that can help the decision-making process become better informed and more transparent. The accompanying analytical report puts these calculations into a practical frame. To that end, it outlines additional conditions and actions needed for a public investment programme (foreseen timeframe, human resources, adoption of administrative procedures, etc.).

Since 2016, the OECD has designed green public investment programmes for public transport sectors in three partner countries from Eastern Europe, Caucasus and Central Asia (EECCA). The associated model – called Optimising Public Transport Investments Costs (OPTIC) – was developed for Kazakhstan (2016) and subsequently also applied in Kyrgyzstan and Moldova (2019). Although previously adapted for the public transport sector, the tool can be modified for use in any environmental sector (in a broader sense) where the government aims to spur private investments with public support means (e.g. through subsidies in form of grants) (Box 1.3).[21]

Box 1.3. Selected examples of green public investment programmes

Since 2012, the OECD has provided technical assistance and capacity building to public authorities from Eastern Europe, the Caucasus and Central Asia (EECCA) in designing and costing green public investment programmes, as well as in supporting complementary activities and requirements needed for implementation. The green public investment programmes were prepared for energy efficiency of the housing sector (Kazakhstan[22]), as well as clean urban public transport (Kazakhstan,[23] Kyrgyzstan[24] and Moldova[25]).

During the current phase, EU4Environment supports strengthening public spending management in two EU Eastern Partnership (EaP) countries and two new environmental sub-sectors: water supply (Azerbaijan[26]) and biodegradable waste stream (Georgia[27]). All these programmes have been designed in line with international good practices and can be a model for other low-carbon public investment programmes within national medium-term expenditure frameworks (MTEFs). Beyond primary technical assistance, capacity development activities for programme implementation are also being conducted under the EU4Environment Action (Moldova[28]).

In 2021-22, the OECD prepared a series of webinars to help partner governments implement green public investment programmes. The first webinar presented the experience from managing public spending in Poland and the Czech Republic using national environmental funds as implementing bodies.[29] The second webinar introduced another way to manage public finances for environmental investments from Austria, Switzerland and the Netherlands through outsourcing part of the administration to non-governmental organisations or the private sector.[30]

The next two webinars focused on the substantial part of the programmes, i.e. the focus sectors. Experts from Denmark, Italy and the international bioenergy sector showed ways of using biodegradable residues for energy purposes.[31] Meanwhile, specialists from Austria, Romania and Slovakia conveyed best practices on increasing water supply and wastewater treatment in rural and remote areas in their countries.[32]

In a similar vein, the government of Georgia has requested the OECD to help increase its staff capacity to prepare and implement green public investment programmes. The project was financially supported by the EU for Environment (EU4Environment) Action – and was also implemented within its framework. The basic elements of this co-operation were agreed upon during the inaugural EU4Environment Regional Assembly meeting in June 2019 in Brussels.[33]

The EU4Environment Action supports countries in the EaP region, including Georgia, to improve national governance and regulatory mechanisms that support transition to a greener and more sustainable development path (Box 1.4). Public expenditure forms an essential part in efforts to create a level playing field for environmental and climate-related objectives. The work area on greening public spending (Activity 3.3.1) focuses on helping partner governments use public resources – both budgetary and personnel – effectively and efficiently to reach countries' national environmental and climate-related objectives, as well to increase the overall well-being of its citizens.

Box 1.4. About EU4Environment

The "European Union for Environment" (EU4Environment – Green Economy) Action helps the Eastern Partnership countries preserve their natural capital and increase people's environmental well-being. To that end, it supports environment-related action, demonstrates and unlocks opportunities for greener growth, and sets up mechanisms to better manage environmental risks and impacts.

It is funded by the European Union and implemented by five Partner organisations – Organisation for Economic Co-operation and Development (OECD), United Nations Economic Commission for Europe (UNECE), United Nations Environment Programme (UNEP), United Nations Industrial Development Organization (UNIDO) and the World Bank - over 2019-2024, with a budget of EUR 20 million.[34]

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Notes

[1] Although Georgia left the Commonwealth of Independent States (CIS) in 2009, due to geographic proximity and historical experience, its performance is usually compared with other post-Soviet countries in the region.

[2] See, for instance, EC's Emissions Database for Global Atmospheric Research – EDGAR: https://edgar.jrc.ec.europa.eu/overview.php?v=booklet2019 (accessed on 29 March 2022).

[3] As of 2022, there are seven projects registered in the country. Another two have been rejected.

[4] Georgia is not a Party to the 1991 UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) nor its Protocol on Strategic Environmental Assessment. The Georgian government signed the Kiev Protocol on SEA in 2003 but has not ratified it.

[5] The unconditional target would require a reduction of carbon intensity of Georgia's economy by 34% and the conditional target by 43% since 2013.

[6] For an analysis and overview of Georgia's climate-related financing needs and options, see, for instance, OECD's Mobilising Finance for Climate Action in Georgia (OECD, 2018[2]).

[7] For the updated submission, see also the UNFCCC's website at: https://unfccc.int/documents/497505 (accessed on 12 July 2022).

[8] For the 2021-2023 Action Plan of Georgia's 2030 Climate Strategy, see: https://mepa.gov.ge/En/Files/ViewFile/50122.

[9] For the inception report, see: https://eu4climate.eu/download/long-term-low-emissions-development-strategy-of-georgia.

[10] Sometimes referred to as Georgia's 2030 Climate Change Strategy and 2021-2023 Action Plan (Climate Strategy and Action Plan – CSAP). CSAP serves as an underlying strategy and short-term action plan for implementing the updated NDC.

[11] See the Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02012L0027-20210101 (accessed on 29 July 2022).

[12] See the Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32009L0028 (accessed on 5 August 2022).

[13] For comparison, the (First) NDC foresees a reduction in emission intensity per unit of gross domestic product by approximately 34% from 2013 to 2030 for the unconditional 15% target (BAU), and 43% for the conditional 25% target (GoG, 2015[1]).

[14] See the European Covenant of Mayors for climate and energy for the Eastern Partnership countries (Georgia) at: www.com-east.eu/en/about-us/covenant-of-mayors-east/georgia (accessed on 23 June 2022).

[15] See text of the Declaration at: www.oecd.org/env/44077822.pdf.

[16] The elaboration of the Green Economic Growth Strategy was supported by GIZ, UN Environment and the OECD through the "Greening Economies in the Eastern Neighbourhood" (EaP GREEN) programme launched in 2013.

[17] The overreliance on hydropower – with an 80-90% share of the current and planned generation capacity – combined with a lack of national energy strategies and respective policies contribute to preserving energy security concerns.

[18] In 2020, the closest (Kazakhstan) ranked 25th with a DB score of 79.6%. See the *Ease of Doing Business Ranking 2020 at:* www.doingbusiness.org/content/dam/doingBusiness/pdf/db2020/Doing-Business-2020_rankings.pdf.

[19] For the final report and action plan, see: www.tech-action.unepdtu.org/country/Georgia. Georgia, together with GCF, is developing a new Technology Needs Assessment document, which will include an updated list on prioritised technologies in the sectors. See www.greenclimate.fund/sites/default/files/document/georgia-unep-ctcn.pdf.

[20] Some of these tools include: Good Practices for Public Environmental Expenditure Management (www.oecd.org/env/outreach/38787377.pdf) and the Handbook for Appraisal of Environmental Projects Financed from Public Funds (www.oecd.org/env/outreach/38787377.pdf).

[21] The so-called Clean Public Transport (CPT) Programmes are specific green public investment programmes. However, a green public investment programme can leverage private investments in low-carbon infrastructure in any environmental sector (energy efficiency, renewable energy, solid waste management, water supply and sanitation, etc.). Many activities conducted by sectoral programmes will

also contribute to increasing capacities of authorities to implement green public investment programmes in general (such as funding application drafting, project selection procedures and others).

[22] For the final report, see: www.oecd.org/environment/outreach/KAZ%20report_programme%20design_ENG_web%20version.pdf.

[23] For the final report and policy highlights, see: www.oecd.org/env/promoting-clean-urban-public-transportation-and-green-investment-in-kazakhstan-9789264279643-en.htm (accessed on 30 September 2022).

[24] For the final report and policy highlights, see: www.oecd.org/environment/promoting-clean-urban-public-transportation-and-green-investment-in-kyrgyzstan-b6b91b9a-en.htm (accessed on 30 September 2022).

[25] For the final report and policy highlights, see: www.oecd.org/environment/promoting-clean-urban-public-transportation-and-green-investment-in-moldova-31925aae-en.htm (accessed on 30 September 2022).

[26] For the project's final event, see: www.eu4environment.org/events/training-workshop-on-designing-and-implementing-green-public-investment-programmes (accessed on 30 September 2022).

[27] For the project's final event, see: www.eu4environment.org/events/training-on-designing-and-implementing-green-public-investment-programmes-on-bio-waste-in-georgia (accessed on 30 September 2022).

[28] For the project's final event, see: www.eu4environment.org/events/training-on-the-implementation-of-the-designed-clean-public-transport-in-moldova (accessed on 30 September 2022).

[29] For more information, see: www.eu4environment.org/events/designing-and-implementing-green-public-investment-programmes-experience-from-poland-and-the-czech-republic (accessed on 30 September 2022).

[30] For more information, see: www.eu4environment.org/events/alternative-schemes-for-implementing-green-public-investment-programmes-experience-from-austria-switzerland-and-the-netherlands (accessed on 30 September 2022).

[31] For more information, see: www.eu4environment.org/events/utilising-agricultural-residues-experience-from-european-countries (accessed on 30 September 2022).

[32] For more information, see: www.eu4environment.org/events/designing-and-implementing-green-public-investment-programmes-experience-on-water-supply-and-wastewater-treatment-in-rural-and-remote-areas (accessed on 30 September 2022).

[33] For more information, see: www.oecd.org/fr/environnement/ouverture/inaugural-eu4environment-regional-assembly.htm (accessed on 30 September 2022).

[34] For more information please see: https://www.eu4environment.org/.

2 Setting the scene for a green public investment programme

This chapter introduces Georgia's attempts to improve its waste management sector, including several reforms that align its policy and regulatory framework more closely with the EU acquis. However, it also outlines the main challenges in the country's municipal solid waste management, with a focus on the non-treated biodegradable component. It then presents Georgia's main targets in renewable energy generation, especially from controllable renewable sources (biomass, biofuels). In this context, the chapter also outlines the main policy and legislative acts that aim to help the country achieve energy independence, security of supply and diversification of resources. Beyond the energy sector, the chapter also touches upon environmental damages caused by inadequate treatment of biodegradable – and especially organic – waste.

Policy and regulatory framework for the waste sector in Georgia

In recent years, Georgia has taken many positive steps in the field of waste management. This includes national commitments within the framework of an Association Agreement (AA) with the European Union (EU) to develop a waste management system in full compliance with EU requirements. Accordingly, Georgia has begun implementing a great variety of reforms to ensure the gradual harmonisation and approximation of its legislation to EU directives. Despite the achievements, important issues related to proper waste management standards at national and local levels remain unaddressed. A recent study, for example, revealed significant gaps and challenges in Georgia's municipal solid waste management (World Bank, 2021[1]).

The country's economic development is one factor causing an increasing amount of (solid) waste. At the same time, the increasing amount of waste is also responsible for the country's increasing greenhouse gas (GHG) emissions. Over the years, the waste management sector in Georgia has experienced slow but steady growth, and this is expected to continue. The waste management sector accounted for approximately 8% of total national GHG emissions in 2015 (1.39 megatonnes of carbon dioxide equivalent [Mt CO_2e]).[1] Emissions are expected to increase by approximately 33% to up to 1.85 Mt CO_2e in 2030, under a reference scenario (GoG, 2021[2]).[2]

Problems with waste management in Georgia include disposal of household and hazardous waste without proper regulations. A significant part of the country's municipal waste is disposed at dumpsites and improperly arranged landfills that were built in the past century. Such sites do not use up-to-date technologies such as geomembranes to ensure waste containment or have gas collection systems. As such, they do not meet modern quality standards (GoG, 2021[2]).

Georgia's long-term vision for the waste sector strongly focuses on waste reduction, as well as separate collection and recycling. National legislation introduces a five-step hierarchy system: i) waste prevention; ii) preparation for re-use; iii) recycling; iv) other recovery; and v) disposal (GoG, 2021[2]).

To achieve the country's climate-related and environmental targets, Georgia's government needs to raise public awareness on these five steps among citizens and companies. It also needs to consolidate different strategies and communicate clear dates for entering legislation into force. Waste producers, consumers and local authorities should be encouraged to collaborate better on setting and implementing the schemes, such as extended producer responsibility (EPR), especially for packaging wastes.

Waste management

Adoption of the **Waste Management Code (WMC)** in 2014 (2994-RS/2014) was the main consequence of the EU AA with Georgia regarding waste management and environmental protection. It was also the first step in establishing a modern legal framework for implementing sustainable solid waste management (SWM) policies, such as waste prevention, re-use, and environmentally safe treatment and disposal. The WMC defines the waste management hierarchy as prevention, re-use, recycling, recovery (including energy recovery) and disposal. It also designates the roles and responsibilities of competent authorities and defines waste management as a process of collection, temporary storage, pre-treatment, transportation, recovery and disposal.

Furthermore, the WMC sets requirements for waste management planning frameworks at the national, municipal and individual levels. The WMC has provided a great impetus for noteworthy legal-regulatory, policy and institutional changes in the field during the six years. This includes adoption of an overarching, 15-year **National Waste Management Strategy (NWMS) 2016-2030** and associated five-year **National Waste Management Action Plan (NWMAP) 2016-2020** (World Bank, 2021[1]). At the local level, the WMC obliges municipalities to develop five-year **Municipal Waste Management Plans (MWMPs)** – in line with

National Strategy and Action Plans and their submission to the Ministry of Environmental Protection and Agriculture of Georgia (MEPA) for review and later approvals by the local municipal councils.

MEPA and other competent authorities have developed the national sectoral strategy and an action plan for SWM, which have been approved by the Georgian government. The NWMS is a major policy document that sets objectives, indicators and key targets in the SWM sector. As its main objective, it strives to make Georgia a country that prioritises waste prevention and recycling. For instance, according to the NWMS and the NWMAP, all dumpsites in the country should be closed by the end of 2020. The waste collection rate should be at 90% by 2020 and at 100% by 2025, with all municipal waste being collected, part of it recycled and part of it disposed at non-hazardous waste landfills.

The NWMAP 2016-2020 lays down the targets and specific actions concerning the management of biodegradable waste (Table 2.1).

Table 2.1. NWMAP targets and actions concerning the reduction of biodegradable waste going to landfills and their achievement status

Target / action	Description	Implementation period	Responsible institution(s)	Implementation status
T 4.4	Minimise disposal of municipal biodegradable waste at landfills			P/I
A 4.4.1	Develop strategy on biodegradable waste	2018-19	MEPA	P/I
A 4.4.2	Conduct campaign promoting home composting of household biodegradable waste and consider pilot project in remote areas	2018-20	MEPA	P/I
A 4.4.3	Implement pilot project for wine producers biodegradable waste	2018-20	MEPA	P/I
A 4.4.4	Implement pilot project on composting biodegradable agricultural waste	2017-19	MEPA	P/I
A 4.4.5	Implement pilot project on composting garden waste	2018-20	Municipalities and MEPA	P/I

Note: implemented (I); partially implemented (P/I) and not implemented (N/I).
Source: Technical Resume Assessment of National Waste Management Strategy 2016-2030 and National Waste Management Action Plan 2016-2020". EU4Environment /UNEP / REC, 2021.

Based on the Action Plan, MEPA is developing a new NWMAP 2021-2025. To that end, it is receiving financial assistance from the European Union and technical/financial assistance from a Georgian non-governmental organisation (NGO) – the Regional Environmental Centre for the Caucasus (REC Caucasus).[3] Several implementing regulations and guidelines have also been adopted to support the Waste Management Code (2994-RS/2014) and their gradual implementation has already begun.

In the framework of EU4Environment, the United Nations Environment Programme (UNEP) supported implementation of the project on the review of the National Waste Action Plan 2016-2020 and development of a draft National Waste Management Action Plan 2021-2025 for implementation of a NWMS in Georgia.[4] The deadline for implementing the NWAP was 2020. Implementation of the 2016-2020 Action Plan was evaluated to analyse achievements, gaps and opportunities, as well as the needs for the Action Plan for 2021-2025. The measures were given three different statuses based on their progress – implemented, partially implemented and not implemented.

The WMC also requires development and adoption of a **National Biodegradable Waste Strategy (NBWS)** to reduce organic waste at sanitary landfills (World Bank, 2021[1]). Such a strategy is required by the AA and the Deep and Comprehensive Free Trade Area (AA/DCFTA) signed by Georgia with the European Union. Article 302 of the AA mentions waste management and strategic environmental planning, among others, as co-operation areas. Moreover, Georgia commits to approximate its legislation to the EU acts and international instruments referred to in the Annex XXVI to the AA (Decision 2014/494/EU).[5] This also relates to Article 5 of the Landfill Directive 1999/31/EC on the not acceptable treatment of waste in landfills.[6] The article requires Georgia to set up a national strategy to reduce biodegradable waste sent to landfills.

The Waste Management Code (2994-RS/2014) also foresees development of a strategy for municipal biodegradable waste management until the end of 2019 (PoG, 2014[3]). A draft of the **Biodegradable Municipal Waste Strategy** was developed (under the EU-funded project "Technical Assistance for the Improvement of Waste Management Systems in Georgia", 2017-2018)". The strategy does not yet have official status and was not available for review.

Table 2.2. Georgia's waste and bio-waste management documents

Title	Scope	Status	Note
Biodegradable Municipal Waste Strategy	Municipal/ sectoral	Draft developed	Contains targets and measures to reduce the quantity of biodegradable waste disposed of in landfills
National Biodegradable Waste Strategy (NBWS)	National/ sectoral	Developed in 2018, approval pending	Defines activities (by 2025, 2030 and 2040) to reduce the quantity of biodegradable waste disposed of in landfills (as detailed in five-year APs)
National Waste Management Action Plan (NWMAP) 2016-2020 2022-2026	National/ sectoral	Approval of AP 2022-2026 pending	Lays down targets and actions concerning management of solid waste as defined by NWMS
National Waste Management Strategy (NWMS) 2016-2030	National/ sectoral	Approved in 2016, updated in 2022	Sets objectives, indicators and key targets to align country's waste policy with the European Union, particularly in waste prevention and recycling
Municipal Waste Management Plans (MWMPs)	Municipal /sectoral	WMC set a deadline for adoption by end of 2017	Cover all aspects of municipal solid waste management (generation, collection, treatment, etc.) and should also conform to NWMS and NWMAP quantitative and qualitative targets, objectives and planned actions
Waste Management Code (WMC)	National/ sectoral	Adopted in 2014	Establishes legal framework in the field of waste management and defines goals and objectives for waste prevention, re-use, and collection, transportation and environmentally safe treatment or disposal of waste

Source: Authors' compilation.

Renewable energy and sources

In addition to the climate-related documents mentioned in the previous chapter (Table 1.1) – Nationally Determined Contribution (NDC), Low Emission Development Strategy (LEDS) and National Energy Efficiency Action Plan (NEEAP), the government has developed and adopted various legal frameworks for renewable energy, especially hydropower. The share of renewables in the electricity mix is one of the highest in the world, accounting 3 839 megawatts (MW), or 77% of capacity in 2020, and almost entirely produced by hydro. Still, Georgia is a net importer of energy. The negative energy balance accounted for 158 500 terajoules (TJ) in 2018. The renewable total primary energy supply (TPES) accounts for 46 500 TJ (23%) out of the total of 199.7 TJ.[7]

Despite the long-term and legitimate focus on the country's water resources, interest in other sources of renewable energy has also grown. It might increase the share of renewable energy in total final energy consumption, which has been around 27% (mainly attributable to hydropower generation and wood fuel).[8]

For more systematic promotion and regulation of renewable energy sources, Georgia has adopted or aims to prepare several legislative and policy acts in this field.[9] The existing legal framework in Georgia should satisfy the requirements of the Renewable Energy Directive (2009/28/EC)[10] and the EU's acquis in general. Moreover, it should also reduce energy dependence, increase energy security, contribute to environmental protection, stimulate development of ageing and outdated facilities, create premises for sustainable development and growth and create new jobs (ECS, 2017[4]).

Provisions regulating various features of renewable energy are set out both in primary and secondary legislation. The use of potential renewable energy sources became one of the major factors of Georgia's energy sector development in the **Main Directions of the State Policy in the Energy Sector,** first adopted in 2006 and updated in 2015. The document emphasises, among other things, the importance of developing a transparent legal framework, functioning energy markets, and the necessary infrastructure – all with a particular focus on clean energy and regional perspective (PoG, 2006[5]); (PoG, 2015[6]).

The **Energy Strategy 2020-2030** was developed by the Ministry of Economy and Sustainable Development of Georgia (MoESD) in 2019. It will be approved in accordance with Resolution No. 629[11] and replace the first version for 2016-2025.[12] The strategy should reflect all steps and implementation measures to meet EU requirements undertaken by the AA and Association Protocol signed by Georgia. Its ultimate goal is to set key priorities for achieving sustainable development in the energy sector, including energy independence, security and reliability, diversification of energy sources and creation of energy reserves (USAID, 2019[7]).

The **State Energy Policy 2021-2030** is being discussed publicly and undergoing strategic environmental assessment (SEA). It defines the vision (up to 2050), priorities, strategic directions and actions for sector development until 2030. It also provides the basis for short, medium- and long-term development strategies and programmes of the sector and other energy-related fields.[13] The State Energy Policy is expected to be finalised by the MoESD and approved by the Georgian Parliament in 2023, together with the National Energy and Climate Plan (NECP), to gain official status.

The **State Programme "Renewable Energy 2008"**, adopted in 2008 and amended in 2013, was the first leading document to define rules and procedures for initiating and implementing renewable energy projects in Georgia. The programme provides incentives for investors in terms of fixed prices (for hydropower and other renewable energy) and guaranteed power purchase agreements. However, the resolution does not contain renewable energy targets or a national action plan in the sector (GoG, 2008[8]).

The **Law on Electricity and Natural Gas**, adopted in 1999, aims to support predominant use of local hydropower and promote expansion of other energy resources. It gives priority to use alternative renewables and measures related to increase of generation efficiency. Among the non-fossil and sustainable energy sources is bio- and hydropower, geothermal, solar, wind and marine (including tidal, wave and thermal) energies.[14] Although not primarily focused on renewable energy sources, the law excludes micro producers of energy with installed capacity up to 100 kilowatts (kW) and located at the place of consumption from the obligation to obtain construction permits or a production licence. They are also excluded from entrepreneur tax obligations. In addition, the law provides a net-metering policy framework (GoG, 2019[9]).

The **Law on Promoting the Generation and Consumption of Energy from Renewable Sources**, adopted in 2019, establishes the legal basis for the promotion, encouragement and use of energy from renewable sources. Importantly, it also sets a binding national target for renewable energy share in total final energy consumption.[15] Until 2019, Georgia was the only country in the Eastern Europe, Caucasus and Central Asia region, except Turkmenistan, not to have adopted any quantitative targets for renewable energy (or energy efficiency) in legislation (OECD, 2019[10]).

The law mandates that at least 35% of all energy consumed for electricity generation, heating, and cooling and transport by 2030 come from renewable sources. Furthermore, at least 10% of all energy used by all types of transport come from renewable sources by 2030. The law also stipulates adoption of the national action plan for renewable energy and development of national support or certification schemes, as well as provision of trainings and guidelines on renewable energy technologies, among other things.

In 2019, the Ministry of Economy and Sustainable Development of Georgia adopted the **National Renewable Energy Action Plan (NREAP),** which had been developed with support of the United Nations Development Programme (UNDP). The document contains measures to promote renewable energy and increase its share of renewables in final energy consumption. The proposed measures include policy changes and sustainable practices, as well as investments in renewable energy generation (wind, solar, biogas) and their integration into the existing grid, or enhanced support of use and exploitation of biofuels (GoG, 2019[9]).

However, for 2020, the NREAP set no quantified targets apart from contributing to the general target of 30% of energy consumed from renewable energy. As its overall objective, the NREAP sought to outline the legislative and institutional framework of Georgia in light of compliance with the Renewable Energy Directive 2009/28/EC.[16] This included national policies to develop existing biomass resources and mobilise new ones for different uses, including forest and agriculture residues or green waste.

The NREAP also mentions development of the **New Forest Code**, with support of the World Bank, which should be a key part of forestry reform and sustainable forest management. The new code should also become a foundation for restoration of forestry in the country, providing sectoral sustainability and rational use of forest resources in accordance with ecological, social and economic values. The fuel wood that constitutes about 35% of domestic primary energy in Georgia does not fall under responsibility of the Ministry of Economy and Sustainable Development of Georgia and is not considered in the energy policy (GoG, 2019[9]).

The new code should prevent unsustainable practices and put a ceiling on the unlimited access to and exploitation of the forests by citizens, mainly caused by lacking options for alternative energy resources. Besides illegal logging, draught and forest fires (accelerated by the impacts of climate change) increase forest degradation, reflected in the decrease of their quality and volume, which ultimately leads to reduced emission removal potential of Georgian forests. At the same time, energy-efficient technologies and energy-efficient fuel (briquettes and pellets) have a quite high potential in terms of saving firewood in Georgia (GoG, 2021[2]). At the same time, the measures outlined in the Forest Code from 2020 and the National Forest Concept for Georgia adopted in 2013 will also be relevant for increasing the carbon capture capacity of forests and climate change mitigation.[17]

Nationally Appropriate Mitigation Actions (NAMAs) will facilitate implementation of the NEEAP and NREAP strategies. With regard to renewable energy, biomass for rural development mitigates about 36 000 tonnes of CO_2 per year with the possibility of scaling up to 188 000 t annually. Georgia has one project in progress (forestry) and three others under development (buildings, renewables) under NAMAs for GHG emissions reduction.[18]

The draft **State Strategy for the Development of Solid Biofuels** is under government review with approval expected soon (GoG, 2019[9]). However, no timelines have been agreed for adoption. The strategy's main goal is to facilitate use of solid biomass residues in Georgia by encouraging production and acceptance of modern solid biofuels. To that end, it prioritises sustainable supply, processing and overall management of solid biomass residues from forest, agriculture, industry and other sources. It also supports development of new technologies and business processes to produce the solid biofuels (GoG, 2019[9]).

Table 2.3 lists the main policy documents concerning the energy sector, including both fossil fuels and renewables.

Table 2.3. Georgia's guiding energy sector regulation

Title	Scope	Status	Note
Energy Strategy of Georgia 2020-2030	National/ sectoral	Developed by MoESD in 2019	Specifies the country's target indicators and priorities for protection of the environment and ensuring sustainability of the energy sector, as well as security, regional and technological development issues
Law on Electricity and Natural Gas	National/ sectoral	Adopted in 1999, amended in 2013	Supports priority use of local hydro, other (alternative) renewable and natural gas resources
Law on Promoting the Generation and Consumption of Energy from Renewable Sources	National/ sectoral	Adopted in 2019	Establishes the legal basis for the promotion, encouragement and use of energy from renewable sources and sets respective mandatory national targets In line with the Renewable Energy Directive 2009/28/EC
Main Directions of the State Policy in the Energy Sector	National/ sectoral	Adopted in 2006, amended in 2015	Develops a long-term comprehensive state vision, which will later become the basis for the development of short-, medium- and long-term strategies for 2030, with a special emphasis on use of Georgia's renewable energy resources
National Forest Concept for Georgia	National/ sectoral	Approved in 2013	Serves as a basis for sustainable development of the forest management and related policy frameworks
New Forest Code of Georgia	National/ sectoral	Adopted in 2020	Creates a foundation for restoration of forestry in the country, providing sectoral sustainability and rational use of forest resources in accordance with ecological, social and economic values
State Energy Policy 2021-2030	National/ sectoral	Adoption pending (together with NECP 2021-2030)	Amends the Main Directions of the State Policy in Energy Sector and develops a long-term comprehensive state vision (up to 2050) for the energy sector with a focus on sustainable energy supply, energy efficiency or renewable energy sources
State Programme "Renewable Energy 2008"	National/ sectoral	Adopted in 2008, amended in 2013	Specifies rules and procedures for development of new renewable energy sources and provides incentives for investors in terms of fixed price and guaranteed power purchase agreements
State Strategy for the Development of Solid Biofuels	National/ sectoral	Draft prepared in 2017, under review	Sustainable management and provision of supply of solid biomass residues, as well as advancement of respective new technologies

Source: Authors' compilation. See also (OECD, 2018[11]); (OECD, 2019[10]).

LEDS (Table 1.1) is also a key strategic document (draft version, 2017[19]). Prepared with assistance from the US Agency for International Development, LEDS outlines several activities to reduce net GHG emissions in the energy sector, including efficient biomass heaters and solar hot water heaters. Among the non-energy sub-sectors, solid waste has considerable potential for reducing GHG emissions. For instance, the collection and incineration of emitted gas from solid waste landfills could save 292 000 tonnes of methane in CO_2-equivalent by 2030 (if Sustainable Energy Action Plans are implemented in Tbilisi, Batumi, Kutaisi and Zugdidi) (GoG, 2015[12]).

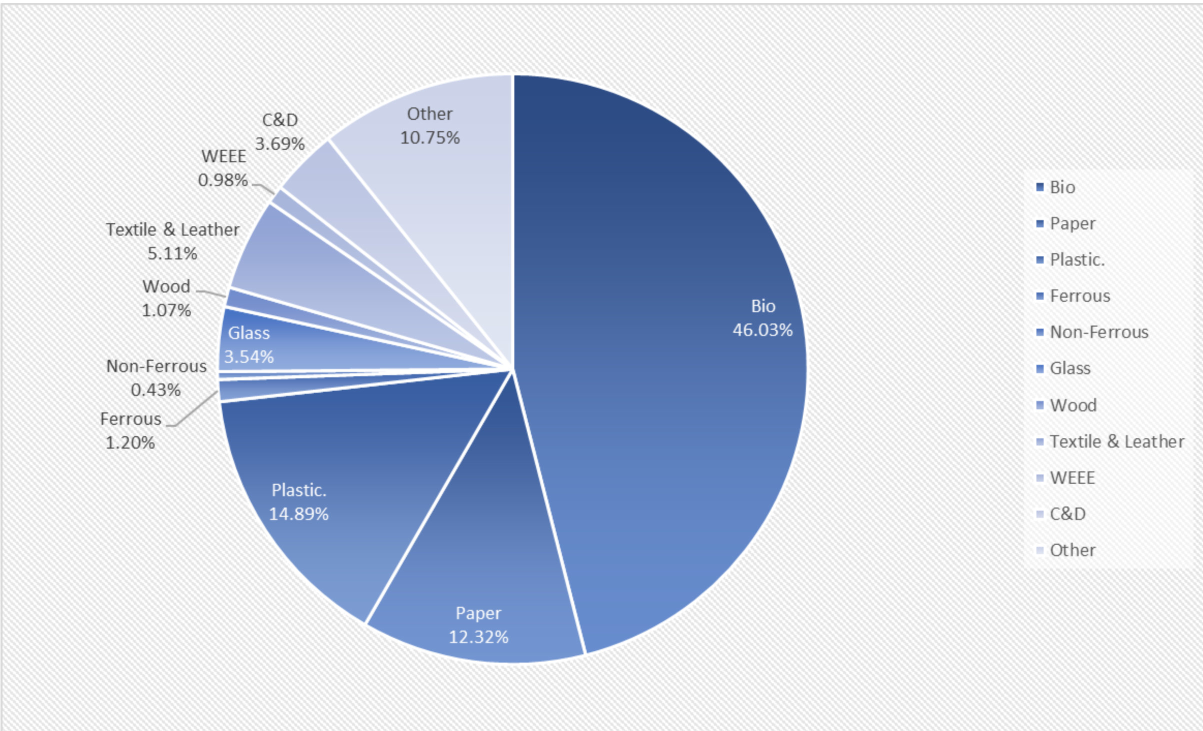
Main features and challenges with regard to bio-waste in Georgia

Despite the government's progress towards integrated waste management systems, Georgia still faces many challenges. These include, for example, reducing disposal of biodegradable waste at landfills, preventing illegal dumping, achieving full cost recovery of waste systems and shifting to the circular economy to turn waste into resources and products. Each of these challenges needs to be addressed in the short, medium and long term. The sector can further benefit from better infrastructure and sustainable practices – including know-how, financing mechanisms and improved capacity, especially at the municipal level.

Biomass has the potential to play a major role in Georgia's energy supply (other than wood logging). Its energy sector is largely based on hydropower and fuelwood, in addition to fossil fuel imports.[20] At the same time, informal and poorly controlled exploitation, like illegal logging for energy, is rapidly degrading Georgia's forests and resulting in significant environmental and economic damage. This is further reducing accessibility of fuel wood and may lead to more forest degradation and energy shortages in the near future. Alternative local energy resources for heating are needed to replace fuel wood. Residual biomass waste of forestry and agriculture is a viable substitute that many countries are already using effectively.

The country generates more than 1.1 million t of municipal waste annually. Of this amount, most (about 508 000 t) is biodegradable waste deposited into old landfills without further processing (World Bank, 2021[1]). Biodegradable waste accounts for over 60% of total waste quantity when all its streams are included (food, green waste, paper, wood and other biodegradable fractions) – the largest component of waste in the country (Figure 2.1). Of this waste, 46% on average is organic waste, with some regions (Rustavi and Gardabani) exceeding 50%. Food waste is the most common component of organic waste.

Figure 2.1. Average waste composition of Georgia



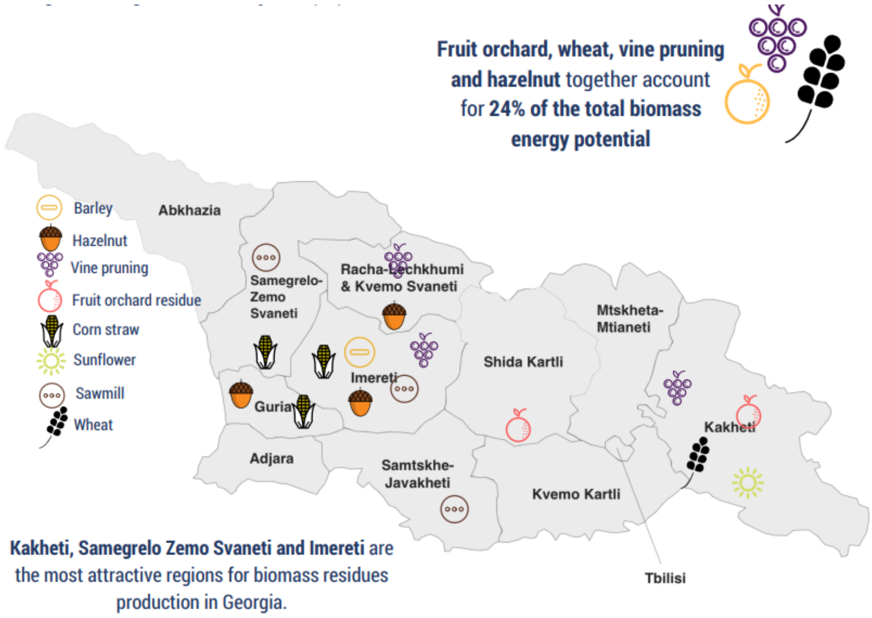
Note: C&D = Construction & Demolition; WEEE = Waste from Electrical and Electronic Equipment.
Source: World Bank, Georgia Solid Waste Sector Assessment Report, May 2021.

In non-municipal sectors, agriculture and forestry activities generate the major streams of biodegradable waste. Agriculture bio-waste comprises crop residues and animal by-products (ABPs). The Waste Management Code (2994-RS/2014) does not regulate crop residues, treating them as part of biomass. According to the Code, crop residues also cover manure, straw and natural materials used in farming, forestry or energy generation (PoG, 2014[3]).

The Forest Code (5949-SS/2020), in turn, governs management of forest and wood waste, including disposal (PoG, 2020[13]). It defines wood and forest waste as "bark, oil, sawdust, unusable firewood branches, and uprooted trees left over from the implementation of forest care measures and timber production, which are no longer valued as wood due to the influence of natural or other factors" (World Bank, 2021[1]).

Traditionally, Georgians engage in gardening and raising crops, as well as using wood for heating or cooking. Forests cover 40% of Georgia's total area (69 700 km²). Approximately 2.6 million hectares (ha) is agricultural land, including 468 000 ha of arable land, 115 000 ha of land with perennial crops and 1 940 000 ha of permanent meadows and pastures.[21]

Figure 2.2. Main areas of biomass residues



Source: Biomass Energy Country Profile Georgia, GEF/UNDP/MENRP, 2016.

According to a field study prepared for UNDP by World Experience for Georgia,[22] crop residues are generally divided into two categories: field (biological materials after harvest, such as stems and husks) and process (biological materials after processing, such as pulp and bagasse) residues (UNDP, 2014[14]).

Environmental aspects associated with biodegradable waste management

Georgian waste management legislation and policy – unlike EU legislation – set no quantitative targets for either biodegradable diversion (re-use, recycling, composting, etc.) or landfilling. Thus, they ignore opportunities for prompt treatment such as aerobic or anaerobic decomposition of this stream. Nor are there end-of-waste quality criteria for recyclable fractions of waste and bio-waste to encourage proper treatment of these waste streams.

Furthermore, laws, regulations and policies do not foster food waste prevention through food donations to charitable organisations or re-use, high food safety and hygiene levels. Nor do they encourage "use by" or "best before" dates instead of expiration dates.[23] On the contrary, such transactions are subject to value added tax (VAT) and profit tax under current regulations. This policy dissuades retail and hospitality services from donating food to charitable organisations or vulnerable populations (PoG, 2012[15]). The main environmental problems associated with rapid growth in biodegradable waste generation – especially those connected to landfilling and illegal disposal – include:

- **Landfill gas production**. By volume, landfill gas typically contains 45-60% methane, with the rest consisting of mainly CO_2. In addition to its odour, fugitive landfill gas emissions can contribute significantly to global warming.
- **Leachate production**. Leachate can contaminate groundwater. In addition to its odour, leachate often contains high concentrations of pollutants.
- **Slow rate of waste degradation**. Landfills containing biodegradable waste continue to generate leachate and landfill gas many years after closure. This demands continuous landfill gas and leachate management over the long term. Moreover, decomposing biodegradable waste after closure results in site settling due to volume reduction. This process likewise requires long-term maintenance and monitoring.

Dumping and landfilling waste mainly affects water or soil quality. However, burning of residues causes negative effects on air quality and increases GHG emissions:

- **Field burning of residual biomass from perennial and annual crops**. This includes burning the large amounts of orchard and vineyard cuttings, fine bay branches, and wheat and barley stems and roots. In most cases, this is illegal.[24] Burning also causes GHG emissions without any accompanying energy benefit.

In terms of quantity, according to the Fourth National Communication of Georgia to the UN Framework Convention on Climate Change, the following data on emissions from these sectors for 2017 are noteworthy (Table 2.4).

Table 2.4. Emissions from the selected sectors in 2017

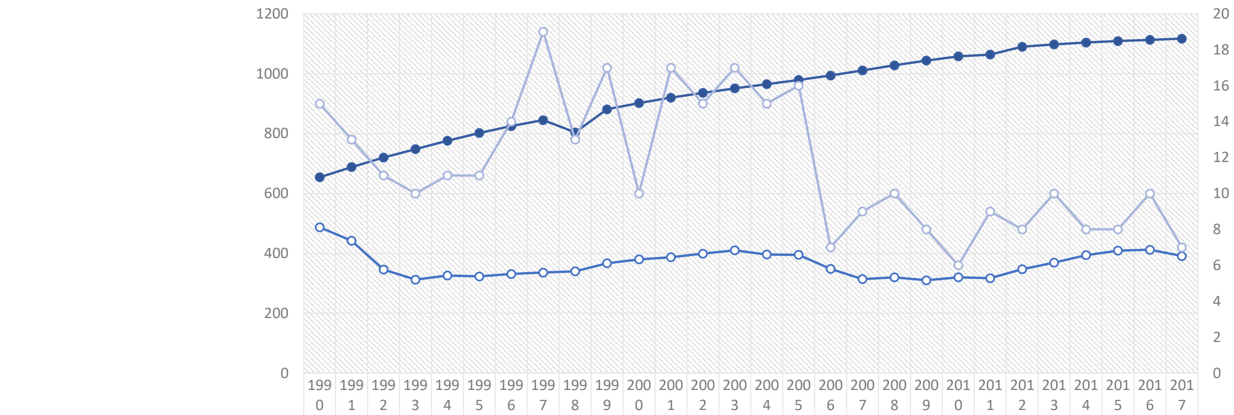
Source	GHG	Gg CO_2eq.
Solid waste disposal on land	CH_4	1 117.0
Manure management	CH_4	51.0
	N_2O	340.0
Solid waste disposal on land	CH_4	5.0
	N_2O	2.0

Source: World Bank, Georgia Solid Waste Sector Assessment Report, May 2021.

Table 2.2 mainly covers landfill waste. Given waste management service coverage of 64%, emissions from the waste management sector are likely to be higher than indicated from these calculations.

Figure 2.3. Emissions from the agriculture and waste sectors in 1990-2017

(Gg CO_2eq)



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Solid Waste Disposal and Land	654	688	720	748	776	802	825	845	804	881	902	920	936	951
Manure Management	487	442	346	312	326	323	331	336	340	367	380	387	399	410
Field Burning of Agricultural Residues	15	13	11	10	11	11	14	19	13	17	10	17	15	17

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Solid Waste Disposal and Land	965	979	994	1011	1028	1044	1058	1064	1090	1098	1104	1109	1113	1117
Manure Management	396	395	348	314	320	310	320	317	347	369	394	409	412	391
Field Burning of Agricultural Residues	15	16	7	9	10	8	6	9	8	10	8	8	10	7

Source: World Bank, Georgia Solid Waste Sector Assessment Report, May 2021.

The high share of hydro/marine renewables in the electricity generation mix is also the main reason why the electricity and heating sector produces the lowest energy-related CO_2 emissions in Georgia. Within this sector, natural gas makes up 96% of all emissions, while non-renewable electricity generation accounted for 24% (2 840 GWh) in 2019.[25]

Defining the focus of the green public investment programme

On 11 March 2021, EU4Environment organised a “Discussion on prioritisation of the types of projects, including their geographical focus, to be potentially supported through the future programme” in Georgia. The meeting brought together officials from MEPA and their invited experts, representatives of other ministries (finance, economy, and sustainable development), municipal governments and municipal companies, and non-governmental organisations involved in the sector.

The discussion concluded that municipal waste management will be difficult as it depends on many issues, including the need for separation at source and updated municipal waste management plans. These issues also make it difficult to work with households. Thus, participants determined it would be better to focus on non-municipal biodegradable waste produced in larger quantities, i.e. by farmers and food producers that generate a lot of biodegradable waste (wine producers, food processing).

Box 2.1. Definitions of biodegradable waste

There are two terms in EU legal instruments concerning biodegradable waste.

"Biodegradable waste" is "any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard" (Article 2 of the Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste as amended by Regulation (EC) No. 1882/2003).

"Biodegradable municipal waste" includes "biodegradable waste" and "municipal waste" (Articles 2 and 5 of the Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste).

Combining the two definitions, "biodegradable municipal waste" means biodegradable waste from households, as well as other waste that, because of its nature or composition, is similar to waste from households.

Based on the discussion, the programme will focus on reducing biodegradable waste from farmers and food producers sent to landfill. It proposes the following streams of biodegradable waste:

- biodegradable waste from farmers (use of biomass from agriculture production to generate heat energy – local in the same farm or to produce biomass fuel, small-scale composting facilities for farmers)
- biodegradable waste and bio-waste from households (green waste and kitchen waste for aerobic composting)
- bio-waste waste from food and beverage producers (food/beverage production waste for anaerobic digestion facilities).

The environmental objective of the proposed programme is to reduce the amount of biodegradable waste disposed in landfills, illegally burnt or dumped into the countryside or rivers. These practices harm both air and water quality. The programme focuses on the non-municipal waste generated by agriculture. It is also designed to contribute to Georgia's climate change mitigation efforts (see Chapter 1 for Georgia's unconditional commitment to reduce national GHG emissions).

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[3] For more information, see https://rec-caucasus.org/project/national-waste-action-plan-2021-2025-of-georgia (accessed on 30 May 2022).

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[7] Although the generation capacity of hydro/marine increased by 4.8% in 2019-20, meaning additional 175 MW of net capacity, the capacity use of hydro/marine remains quite low – only 28% in 2019 (implying 8 932 GWh). See IRENA's Energy Profile of Georgia at: https://www.irena.org/ (accessed on 26 April 2022).

[8] By source, the electricity and bioenergy share in the renewable energy consumption is 72% and 28%, respectively. By sector, households consumed twice as much renewable energy in TJ than the industry sector and more than 40% in total (2018). See IRENA's Energy Profile of Georgia at:

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[9] The government has authority to adopt national strategies and the associated action plans, while Parliament is responsible for adopting laws and other legislative acts.

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[19] See Draft Georgia's Low Emission Development Strategy (LEDS) (EN).pdf (asiapacificenergy.org): https://policy.asiapacificenergy.org/sites/default/files/Draft%20Georgia%27s%20Low%20Emission%20Development%20Strategy%20%28LEDS%29%20%28EN%29.pdf.

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[21] National Statistics Office of Georgia, www.geostat.ge (accessed on 26 May 2022).

[22] Prepared for UNDP under Micro-Capital Grant Agreement for Non-Credit Related Activities of 26 April 2014.

[23] While Georgia allows all three options, producers consider “use by” and “best before” to be a bad marketing strategy ("best before" makes it sound like the product goes “bad” after the date, but that is not the case).

[24] As specified by Article 35 of Georgia's Waste Management Code (2994-RS/2014) and Law on Soil Protection (490/1994), burning of waste other than in permitted incinerators is prohibited. See Waste Management Code of Georgia, Law No. 2994-RS of 26 December 2014, published in Legislative Herald of Georgia on 12 January 2015. Available at https://matsne.gov.ge/en/document/view/2676416?publication=10; and the Law No. 490 of 12 May 1994 on Soil Protection, published on 12 May 1994 in Departments of the Parliament of Georgia, 18. Available at https://matsne.gov.ge/ka/document/view/93874?publication=9 (accessed on 18 May 2022).

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3 Main elements of the green public investment programme

This chapter presents the focus areas and the associated investment pipelines for the designed green public investment programme in the biodegradable waste sector. The programme also outlines the main implementation phases and calculates the required financial resources using a specific costing model. The costing model estimates environmental benefits of the programme, focusing on reduction of emissions of carbon dioxide, i.e. reduction of non-treated biodegradable (organic) waste. The chapter also outlines a proposed level of co-financing from the national budget or international financing sources (minimum subsidy level), the projected timeframe for implementation and the ideal implementation set-up.

What will the programme involve?

Significant volumes of bio-waste are deposited in landfills and dumpsites without any attempt at further processing, alongside burnt or unused solid biomass residues. For example, a low estimate of biodegradable waste generated the agricultural sector starts around 304 000 t annually (Annex A).

In practice, the programme will achieve its environmental objectives by supporting investment in use of biodegradable waste for energy or compost production. The development of public environmental spending programme aimed to define various project pipelines.[1] These include investments to generate heat energy (locally in the same farm or to produce biomass fuel); small-scale aerobic composting facilities for farmers and households in rural areas (green waste and bio-waste); and anaerobic digestion facilities for food and beverage producers (bio-waste).

As part of preparation for the green public investment programme, a market analysis (see Chapter 4) identified six groups of projects (i.e. pipelines) for investment to reduce illegally dumped or burnt biodegradable waste:

Waste to energy:

- supply chain for vine pruning or similar residues for biomass boilers, mainly in public buildings
- briquettes or pellet production facilities that use residues (hazelnut shells, fruit orchard pruning sunflowers, wheat straw, bay leaf, etc.)
- biomass boilers and equipment for local incineration of biomass (wheat, corn straw, sunflower).

Aerobic composting and anaerobic digestion:

- farmers/household composting bins (aerobic composting of garden and kitchen residues)
- food industry composting containers (aerobic composting)
- food industry composting bioreactors (anaerobic digestion).

The proposed investment pipelines should be accompanied by other measures, especially laws against illegal burning, dumping, collecting or landfilling of biodegradable waste.

The programme has two (three) phases:

- **The first (pilot) phase** will be launched on a small scale, establishing five supply chains for vine pruning or similar residues for biomass boilers and one producer of non-wood briquettes or pellets. In addition, it will help 20 farmers establish local incineration of biomass (wheat straw or similar). The pilot phase will also promote local composting in rural areas by supporting the supply of composting bins. In the case of food producers outside of urban centres, the pilot phase will test establishment of local composting facilities: one composting container installation (aerobic composting) and one bioreactor (anaerobic digestion).
- **The second (scaling-up) phase** will extend the pilot phase. By 2030, it aims to use 35-40% of potential biomass for energy and cover 20% of the rural population with household composting. Before extending composting containers and bioreactors, the programme would wait for results of the pilot and development of the municipal collection of bio-waste and municipal composting.
- **A possible third phase,** which will scale up to the full potential of the market analysis (Chapter 4), can be implemented after 2030.

Phase 1 (pilot phase)

Public support in the pilot phase would focus on supply chains for vine pruning or similar residues used for biomass boilers, mainly for public buildings. Testing in Telavi and the feasibility study by the Efficiency Centre (EEC) Georgia show the potential of replicating a similar model (EEC, 2019[1]).[2] Also, an

International Energy Agency report presents the potential use of vine pruning, fruit orchard pruning, hazelnut shells, walnut shells and bay leaf residues (IEA, 2020[2]). Data from 2014 indicate these residues have a theoretical energy content of 28 petajoules (PJ), and achievable energy content of roughly 7.7 PJ (UNDP, 2014[3]). The vine pruning only has a potential of 2 PJ of achievable energy. The pilot phase will test five more supply chains for use of residues.

The pilot phase will also test public support for production of non-wood pellets or briquettes. Wood briquettes are already produced in Georgia but on a limited scale. The pellets/briquettes will ensure use of large amounts of residues (vine pruning; fruit orchard pruning; hazelnut shells; walnut shells; and bay leaf residues). In locations with no local heat demand, pellet/briquettes can be transported to locations with larger heat demand.

Wheat straw or similar residues can be used for local incineration in biomass boilers. Typically, 4.5-5 hectares (ha) of wheat straw generates enough energy to heat a 250 square metres (m^2) household.[3] The farmer must attach a straw bailer to the tractor, storage space and boiler suitable to use straw bails. The pilot phase will help 20 farmers establish local incineration of biomass.

Further, the pilot phase will support reduction of biodegradable waste in rural areas by composting or anaerobic digestion. Local provision of composting bins is an inexpensive solution. Experience shows that bins can compost about 150 kilogrammes (kg) of biodegradable waste (kitchen waste and garden residues) annually, turning it into high-quality compost.[4] It is a low-cost solution that can be applied widely although it would require an awareness campaign. The pilot phase will support the purchase of 2 000 such bins.

Given the programme does not want to interfere with municipal waste management and composting of biodegradable waste, and that separate collection is at an early stage, the pilot phase will also help establish one composting container installation (for aerobic composting) and one bioreactor (for anaerobic digestion). These will be installed next to food producers outside of urban centres who produce sufficient amounts of biodegradable waste. The minimum capacity for installation is 3 000 t per year for composting containers and 1 500 t per year for bioreactors. However, higher capacities are more economically efficient.

Table 3.1 provides the key (financing) input and (environmental) output parameters of the pilot. Total cost is estimated at EUR 2.95 million, of which EUR 1.74 million will be co-financed from the programme. Private or public investors (households, farmers, municipalities) are expected to provide the remaining EUR 1.21 million.

Table 3.1. Key input and output parameters of the programme`s pilot phase

	Unit	Phase 1
Total number of new supply chains for vine pruning or similar residues for biomass boilers	No.	5
Total number of non-wood briquettes or pellets installations	No.	1
Local incineration in biomass boilers	No.	20
Composting bins	No.	2 000
Composting containers	No.	1
Bioreactors	No.	1
Total costs of installations	**MEUR**	**2.95**
Of which co-financed by the programme	MEUR	1.74
Of which co-financed by private/public beneficiaries	MEUR	1.21
Total CO_2 reduction	**t CO_2 /year**	**13 873**

Source: OECD calculations, OPTIC model.

As shown in Table 3.1, the pilot phase could allow a reduction of 13 873 tonnes of carbon dioxide per year (t CO_2/a). This CO_2 reduction is relatively low due to the small scale of the pilot phase (for details on CO_2 emission factors, see Annex D).

Phase 2 (scaling-up phase)

Considering the significant potential for environmental improvements from using biodegradable waste, Phase 2 (which would last up to five years; see timeline in Chapter 4 was costed using the adjusted Optimising Public Transport Investment Costs model. Overall, Phase 2 aims to achieve a utilisation rate of about 40% of the biomass produced in Georgia that is suitable for energy production.

Regarding the supply chain for vine pruning or similar residues, the total potential is 2 PJ/a[5] or 556 gigawatt-hours per year (GWh/a). According to the Telavi feasibility study, the energy used for two public gardens is 205 086 kilowatt-hours per year (kWh/a). This means, given the area of vineyards, 2 711 such supply chains can be established if all the potential is used (EEC, 2019[1]). The second phase could store another 1 000 supply chains in Georgia by 2030 that will use 37% of the total potential. This will be supplemented by another five installations of pellets/briquettes. The production of pellets/briquettes can use any biodegradable waste that has calorific value. However, dry materials are easier to process (require less drying) and produce better biomass.

Fruit orchard pruning, hazelnut shells, walnut shells, and bay leaf or vine pruning residues provide another 2 PJ of potential energy. The typical installation has a capacity of 10 000 t per year with a calorific value (at the low end) of at least 130 terajoules (TJ). Thus, the total potential is about 15 such installations. It is proposed that the second phase will store another four installations in Georgia by 2030 that will use 33% of the total potential.

Using wheat straw for local incineration in biomass boilers offers the potential of another 1 PJ. Assuming average winter temperatures, straw boilers are loaded with fuel two or three times a day. A house with an area of about 250 m^2, working without an accumulation tank, needs straw from 4.5-5 ha annually. Given an average production of about 5 t/ha, each house would consume 25 t of straw annually. Caloric value 15 megajoules per kilogramme (MJ)/kg (=15 GJ/t) so one installation uses 375 gigajoules (GJ) (25 t $\times$ 15 GJ/t). Thus, the total potential of such installations is 2 667 GJ. The second phase could store another 1 000 installations by farmers in Georgia by 2030 that will use 38% of the total potential.

About 500 000 households are living in rural areas, most of them may install small composting bins and use kitchen waste or residues from gardens. The second phase could help buy 100 000 such bins that will allow 20% of the rural population to home compost by 2030.

Use of aerobic composting and anaerobic digestion by food producers is more complicated because the cost of such installations depends on scale. In other words, collection and processing of biodegradable waste is more economically feasible through bigger (municipal) installations. Thus, the programme proposes to support these installations while it builds more public support for them. Most food producers will wait for the regulation (that will forbid dumping of such biodegradable waste or illegal delivery to the landfill) and separate collection of biodegradable waste by municipalities. Only then will food producers choose the cheaper option, i.e. delivering biodegradable waste to the municipal installation.

In total, the programme will result in 1 005 supply chains for vine pruning, 5 non-wood briquette or pellet production installations and 1 020 local incinerations of biomass. The programme will also result in 102 000 units of small composting bins. Finally, it will have one composting installation base on containers and one bioreactor.

Table 3.2. Key input and output parameters of the assessed programme

	Unit	Phase 1 & Phase 2
Total number of new supply chains for vine pruning or similar residues for biomass boilers	No.	1 005
Total number of non-wood briquettes or pellet installations	No.	5
Local incineration in biomass boilers	No.	1 020
Composting bins	No.	102 000
Composting containers	No.	1
Bioreactors	No.	1
Total cost of installations	**MEUR**	**130.55**
Of which co-financed by the programme	MEUR	99.92
Of which co-financed by private/public beneficiaries	MEUR	30.63
Total CO_2 reduction	**t CO_2 /year**	**222 393**

Source: OECD calculations, OPTIC model.

What are the costs and benefits?

Using the OPTIC model to estimate costs and benefits

The costs and benefits of the programme were estimated using the Optimising Public Transport Investment Costs (OPTIC) model. The OECD developed this tool to help public authorities prepare and estimate, as precisely as possible, the costs and environmental benefits of green public investment programmes (Box 3.1). The model was first designed and tested in Kazakhstan.[6] The assumptions surrounding cost calculation and emission reduction factors are described in Annex D in the section “Programme costing for Phase 1 (pilot phase) and Phase 2 (scaling-up phase)”.

Box 3.1. The OPTIC model

The spreadsheet-based Optimising Public Transport Investment Costs (OPTIC) model is a simple, easy-to-use decision support tool. It was developed to calculate and optimise total programme costs, as well as potential reductions of emissions of CO_2 and other pollutants from urban public transport (carbon monoxide, nitrogen oxides, particulate matter, sulphur dioxide), from the proposed project pipelines. The model also enables potential beneficiaries to calculate the optimal level of subsidy available to them.

Optimisation of costs and benefits implies achieving given targets at the lowest possible cost for the public financier. Both targets and subsidy levels can be re-calculated (or optimised) and adjusted accordingly if underlying economic conditions change over the programme period. For example, tariffs could be increased, interest rates on commercial loans lowered or available public financing reduced or augmented.

The model consists of seven modules: i) assumptions; ii) emission factors; iii) transport sector overview with information on bus fleet and age; iv) determination of the subsidy level; v) cost calculation; vi) calculation of emission reductions; and vii) programme costing and environmental effects.

Although the model was designed for public transport, it was adjusted for use of the green public investment programme (i.e. biodegradable waste).

Emission reductions

The OPTIC model uses a set of pollution factors to estimate environmental outcomes. A detailed discussion of emissions factors is provided in Annex D.

Using the OPTIC model, the programme costs and benefits (reduction of GHG emissions) were calculated for the pilot phase and the second phase. While no sensitivity analysis for the scenarios was performed, changes in the programme's cost effectiveness might occur if the prices used for the costing change.

CO_2 emissions are estimated to decline by 13 873 t CO_2/a (Table 3.3) in Phase 1, and by 222 393 t CO_2/a under Phase 1 & 2 (Table 3.4).

Table 3.3. Key parameters of the assessed programme – Phase 1

Type	Investment costs	Subsidy	Emission reductions per year
	MEUR	MEUR	t CO_2
Vine pruning or similar residues for biomass boilers	0.47	0.38	709
Non-wood briquettes or pellets	1.0	0.50	7 150
Local incineration in biomass boilers	0.48	0.36	413
Composting bins	0.1	0.05	350
Composting containers	0.6	0.30	3 501
Bioreactors	0.3	0.15	1 751
Total:	**2.95**	**1.74**	**13 873**

Source: OECD calculations, OPTIC model.

Table 3.4. Key parameters of the assessed programme – Phase 1 & 2

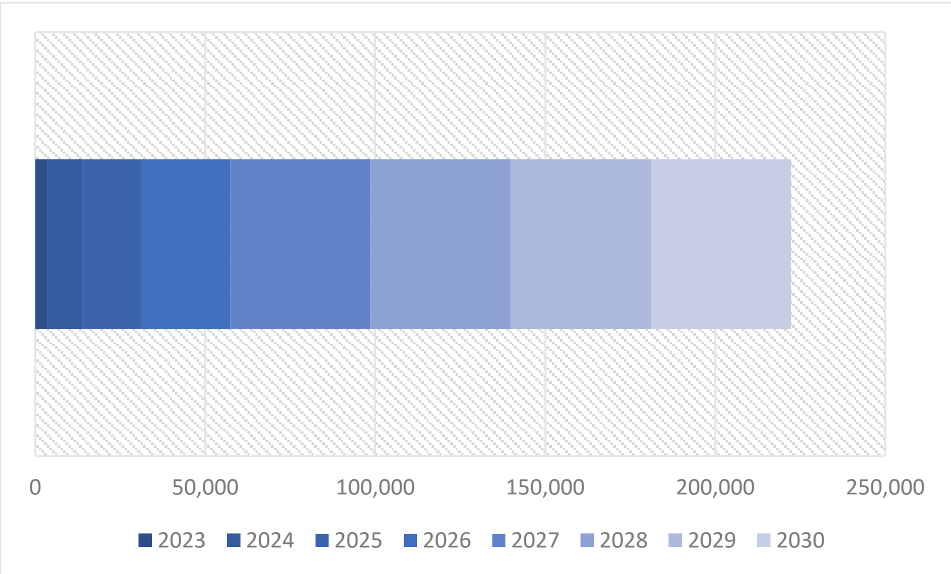
Type	Investment costs	Subsidy	Emission reductions per year
	MEUR	MEUR	t CO_2
Vine pruning or similar residues for biomass boilers	95.07	76.06	142 499
Non-wood briquettes or pellets	5.0	2.50	35 750
Local incineration in biomass boilers	24.48	18.36	21 038
Composting bins	5.1	2.55	17 855
Composting containers	0.6	0.30	3 501
Bioreactors	0.3	0.15	1 751
Total:	**130.55**	**99.92**	**222 393**

Source: OECD calculations, OPTIC model.

Figure 3.1 presents possible GHG reductions under both phases in Georgia.

Figure 3.1. Aggregated annual emissions reductions resulting from programme, 2023-2030

(t CO_2)



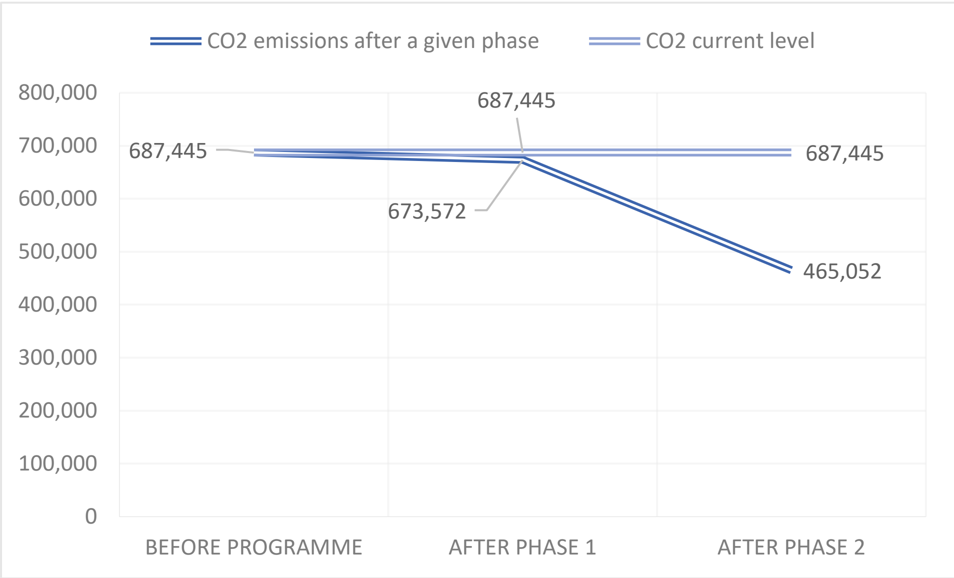
Source: OECD calculations, OPTIC model.

Figure 3.2 compares possible GHG reductions from the programme's phases with current levels of emissions from biodegradable waste from rural areas.

Significant emission reductions start accumulating in Phase 2. By the end of Phase 2, CO_2 emissions are estimated to begin decreasing by about 222 393 t/a (i.e. a reduction of 30% compared to the baseline).

Figure 3.2. Potential carbon dioxide reductions resulting from the programme

(t CO_2)



Note: The values reflect emissions of the potential biodegradable waste from rural areas.
Source: OECD calculations, OPTIC model.

Investment costs and financing options

Analysis suggests that total costs of the programme will be substantial. The pilot phase will amount to about EUR 2.95 million. The investment cost of Phase 1 and 2 is estimated at EUR 130.55 million (Table 3.5), of which some EUR 99.92 million in public support will be needed.

It will be challenging for the public financier (national and local governments) to cover all these costs by itself. To address this challenge, additional financial support will be needed from international donors.

The programme proposes public support in the form of a subsidy (grant). This needs to motivate private and public beneficiaries to allocate their own financial resources to purchase new equipment or installations. Such an approach generally requires higher initial investment (in terms of purchase cost) but brings some future benefits (low cost of biomass fuel).

Figure 3.3. Financing from own sources and public grant

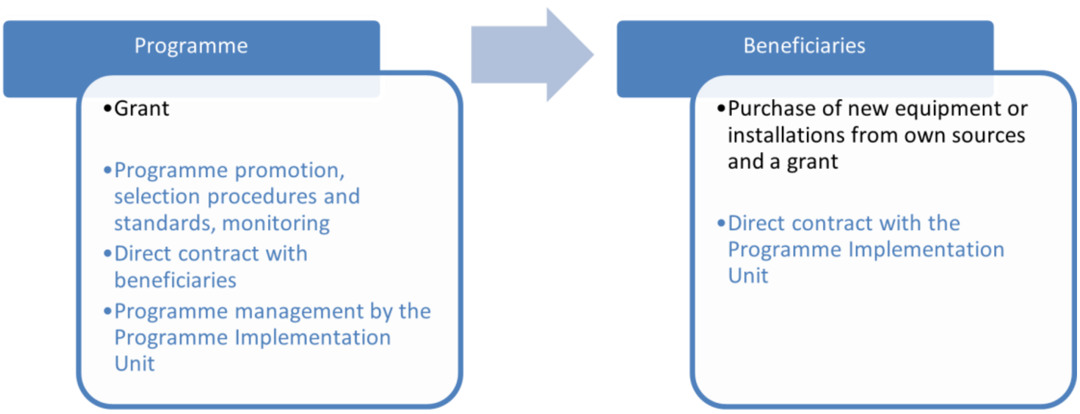
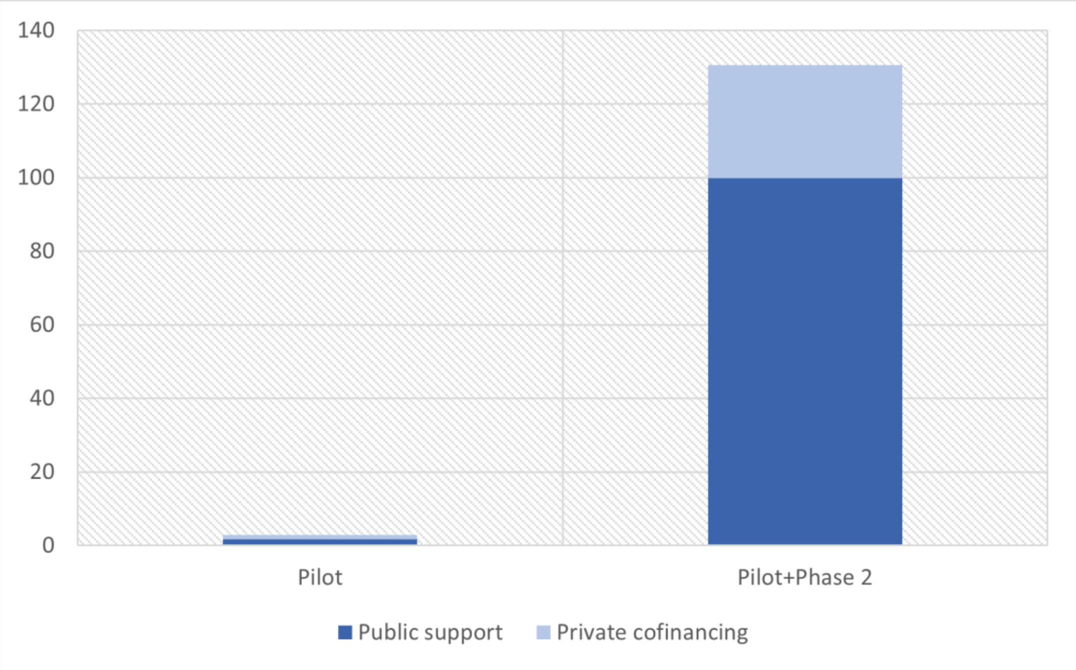


Figure 3.4 presents the overall programme costs for investors (i.e. private and municipalities) and public sector financiers (both national and international) in the pilot phase and the scaling-up phase.

Figure 3.4. Overview of programme's total investment costs

(EUR million)



Source: OECD calculations, OPTIC model.

In terms of total investments (Phases 1 and 2), almost EUR 16 million will be disbursed annually from both public and private sources – calculated as EUR 130.55 million divided by eight years (two years for the pilot phase and six years for the second phase). Table 3.5 summarises the size, results and associated costs of the programme over the eight years.

Table 3.5. Summary of programme costs, Phases 1 and 2

(EUR)

	Overall costs	Public co-financing								
		Total	Year							
			1	2	3	4	5	6	7	8
		EUR million								
Preparation costs (including fundraising)	0.2	0.2	0.1	0.1						
Pilot phase	2.95	1.7	0.9	0.9						
Implementation unit (operating costs)	0.6	0.6			0.1	0.1	0.1	0.1	0.1	0.1
Second phase	130.55	99.9			8.3	12.5	19.8	19.8	19.8	19.8
Total	**131.35**	**102.5**	1.0	1.0	8.4	12.6	19.9	19.9	19.9	19.9

Source: OECD calculations, OPTIC model.

What is the optimal co-financing level?

Calculating the optimal level of public co-financing to buy new equipment or installations is an important element of the analysis. Estimates suggest the level of public funds should not exceed the rates in Table 3.6. These rates, which represent the optimal subsidy level per project pipeline, were calculated using the OPTIC model based on the net present value of selected types of investment.

The rate of financial assistance (subsidy rate) should be set to ensure it leverages rather than replaces beneficiaries' spending. The subsidy should encourage potential beneficiaries to participate in the programme without providing incentive to profit from the subsidy. Therefore, the subsidy should be kept at the absolute minimum level, especially given the scarcity of public resources. This optimal minimum can be defined as the rate of assistance that makes environmentally and economically important projects financially viable (Annex D).

The calculation considers the current prices of natural gas as an alternative fuel.

Table 3.6. Summary of public support for the programme

Programme pipeline	Investment	Estimated public co-financing
Waste to energy	Vine pruning or similar residues for biomass boilers	80%
	Non-wood briquettes or pellets	50%
	Local incineration in biomass boilers	75%
Aerobic composting and anaerobic digestion	Composting bins	50%
	Composting containers	50%
	Bioreactors	50%
	Side investments	from municipalities

Note: Percentage values denote the level of public support in the purchase costs.
Source: OECD calculations, OPTIC model.

Two issues need to be noted regarding the calculation of this optimal subsidy level. First, current prices of natural gas have until recently been relatively low. As a result, many beneficiaries use stoves fuelled using wood residues that can be obtained nearly for free. Second, as for composting, the current price for disposal of biodegradable waste is the same as regular waste (i.e. no incentive to produce compost).

It is essential to monitor market developments regularly (and how they interact with the programme design) (Chapter 4). This could involve changes in equipment and fuel prices, development of the market for new technologies and availability of other financing sources. The programme needs to reflect such market changes, and the state subsidy level adjusted accordingly. The section on "Programme costing for Phase 1 (pilot phase) and Phase 2 (scaling-up phase)" in Annex D provides an indicative calculation of the optimal subsidy level based on current (2021) prices. These, however, are offered more as an illustration of how the subsidy level needs to be calculated rather than as absolute values. The model provides an opportunity to adjust and optimise programme assumptions and their effects by changing the basic data as appropriate.

What will the timeframe look like?

Given the programme will be co-financed with public funds, a preparation period will be needed before the first phase. This will allow time to include the programme provisions in the state budget process, as well as to identify and apply for funding from additional financing sources (including donors).

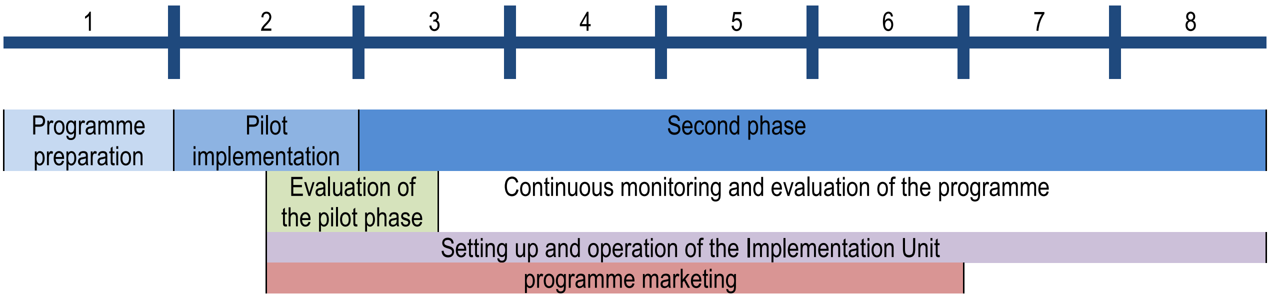
Once project financing is agreed upon, the rollout of the programme will be relatively rapid. The pilot phase could thus take up to two years. The second phase will take about five years (Figure 3.5).

In addition, Georgia should evaluate the programme annually. After assessing whether the selected and implemented projects are helping to meet government objectives, the government should revise the programme, if necessary. Since the programme is designed to be co-financed through the state budget, any update should be co-ordinated with the multi-year budget and its requirements. On this basis, the government should prepare annual financial plans for financing through the regular annual budget.

The experience of other countries with similar publicly supported investments suggests that programmes are best implemented over the medium to long term (namely, five to ten years) and linked to government targets. The results of the first phase will be evaluated to decide whether to continue with the second phase. If it goes ahead, the second phase will be carried out over six years and then reviewed in detail. A decision can then be made to extend or end it, informed by possible new policy objectives and government goals or market developments.

Figure 3.5. Proposed timeline

(in years)



What is the proposed implementation set-up?

The programme implementation will require institutional arrangements that ensure entail transparent and cost-effective decision making. The report analyses several institutional options. The institutional set-up proposed in this study includes three levels: i) a programming entity; ii) an implementation unit; and iii) a technical support unit. Their roles and responsibilities are presented in detail in the report.

The analysis suggests the Ministry of Environmental Protection and Agriculture (MEPA) perform the role of programming entity (supervisory body). Programme implementation should be a separate and distinct function from the programming role. An institution with a co-operation agreement with MEPA could implement the programme, for example. Regardless of the choice, the implementing entity should have a degree of independence. This would ensure decisions respect rules and criteria aligned with programme objectives and are not subject to undue political influence.

Inter-ministerial co-operation is vital for successful implementation. Such a programme can help increase the profile of the environment and climate on the energy policy agenda.

Conclusions

As the OPTIC model calculations have shown, the total cost of implementing the programme will be substantial. New technologies are more expensive before they reach market maturity. Therefore, public financial support will be necessary to help private and public beneficiaries buy modern and environment-friendly equipment and installations.

The investment programme foresees public grants as the most targeted support option. The financing sources are available and can be provided by several actors – national public authorities (grants), national commercial banks (commercial loans) or international/development financial institutions (preferential loans and grants).

When calculating the optimal level of public support (subsidies in the form of grants), the programme analysis considers contributory factors such as lower running costs (as biomass fuel is less expensive).

For these reasons, the programme does not need to be completely grant-financed. It is designed to increase investments without making investments too profitable (or support purchases that would/could take place without public support).

In any case, it should apply a robust methodology to estimate investment costs, set the optimal level of subsidy and forecast the expected environmental benefits. This can make the programme more credible for both national and international public financiers.

References

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DEA (2018), *Biomass Statistics*, Danish Energy Agency, Copenhagen, https://ens.dk/sites/ens.dk/files/Statistik/metode_halm.pdf. [5]

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UNDP (2014), *Assessment of Wood and Agricultural Residue Biomass Energy Potential in Georgia*, United Nations Development Programme, New York, http://weg.ge/sites/default/files/final_report-weg_0.pdf. [3]

Notes

[1] Pipelines are usually characterised by the technology applied. However, the programme will likely need to apply other criteria such as geography (e.g. specific cities or regions), service life (e.g. replacement of equipment used X years and more) or another indicator to limit its scope.

[2] The feasibility study was prepared within the scope of the EU Commission funded project “Biomass chain establishment in the framework of the project Biomass Energy and Energy Efficient Technologies as a Sustainable Energy Solutions for Georgian CoM signatories” (ENI/2017/392-880).

[3] For example, potential wheat straw yield is 4.3-4.5 t/ha (Bioenergy, 2016[4]), so 5 ha may give 22.5 t of straw of calorific value of 14.5 MJ/t (DEA, 2018[5]), which yields 326.25 MJ annually.

[4] "Using a model household garden for garden waste quantification and treatment through home composting", a handbook for small-scale composting facility management.

[5] The biomass potential is estimated using the values provided by WEG (UNDP, 2014[3]) and IEA (IEA, 2020[2]) reports.

[6] OECD (2017), *Promoting Clean Urban Public Transportation and Green Investment in Kazakhstan*, Green Finance and Investment, OECD Publishing, Paris, https://doi.org/10.1787/9789264279643-en.

4 Economic analysis of the programme

This chapter describes in detail the supply chains of the proposed investment pipelines and the feasibility of re-directing the (biodegradable and organic) material flow to generate value-added products. Based on a market study, the chapter analyses the availability and costs of relevant technologies and their possible introduction or wider use in Georgia. Beyond the machinery or equipment (hard investments), the study also considers other related costs, such as labour, energy, and other production and distribution costs. Finally, the chapter lays out the main co-financing sources and their instruments (grants, preferential loans, commercial loans), as well as the complementarity or additionality of the designed programme with the activities of other donors in Georgia.

The initial scoping and analytical stage involved a market analysis to determine the most viable project pipelines (project types) that could be financed under the green public investment programme, together with their cost estimates and potential impacts. The market analysis began with an overview of the main features of the solid waste management sector with respect to biodegradable waste. To that end, it examines the various generators of biodegradable waste in Georgia, estimating future waste flows and the fractions that might be used to produce energy and generate useable compost. In particular, it found that vineyard cuttings and hazelnut shells (which are already used privately for heating purposes) provide the best potential source of biomass for energy generation.

Use of biodegradable waste to produce energy

Biodegradable waste has a significant calorific value and, after processing, can be used to produce energy. Wood waste is most often used for energy. However, given the focus of the programme on agriculture waste, this chapter also considers biodegradable waste from farming.

Using biodegradable waste, however, has the following drawbacks:

- low energy density, i.e. large volumes of biodegradable waste must be collected to be useful as energy
- the need for storage since biodegradable waste is not always available when heat energy is needed
- a calorific value that depends on the humidity of the harvested material and thus requires drying before use
- boilers adapted for biodegradable waste fuel to reduce air pollution.

Given large volumes of biodegradable waste in Georgia, the proposed programme will focus on biodegradable waste that is most suitable to produce energy, i.e. relatively dry.

The supply chain for vine pruning

Residues from vine pruning or similar residues can be used to heat public buildings or for small heating systems. The supply chain model was tested in Telavi; the feasibility study identifies conditions under which the model can be replicated (EEC, 2019[1]).

The feasibility study budgeted EUR 94 600 for equipment comprising two tractors, a baler, bale chipper, trailers and truck. The storage place was not priced and assumed the existing one would be adopted. The costs do not include the cost of the boiler, which is similar to the alternative solution (heating using natural gas).

According to the feasibility study, the total price of the required fuel using the vine pruning residues is GEL 15 500 annually. Meanwhile, use of natural gas costs GEL 24 037 annually. The difference of EUR 2 305 annually is not enough to pay back the increased investment costs of EUR 94 600. An estimated EUR 76 801 of public financial support will be required to make the case more attractive to potential beneficiaries (net present value, or NPV) using 5% discount rate is EUR 0).

Briquettes or pellet production facilities

The programme may produce a large supply of the vine pruning residues but also hazelnut shells, fruit orchard pruning residues, sunflowers and bay leaf residues – so much that it could surpass heat demand. In this case, producing the pellet (or briquettes) would be a better option than using the biomass locally. The pellet or briquettes could be sold on the market and used elsewhere in Georgia and in Caucasus. In this case, farmers should be compensated for transport costs and receive some additional small incentive.

The pellet from residues will likely have a slightly lower calorific value than the typical wood pellet. Thus, the selling price for the pellet is assumed to be GEL 550 net per tonne (at the ExWorks price – the price for the buyer to pick up the pellets at the production plant). In comparison, the wood briquettes are sold for GEL 800 gross per tonne.

Since the facility is expensive, the programme needs public financial support to attract the private sector. The estimated investment costs are EUR 1 million. The investment and operating cost may vary depending on the quality of residues. As described above, the coarse shredding may be skipped. Further, the drying process will be less needed if the residues are dry.

The estimated operating costs are relatively high 5 244 020 GEL/a, and include:

- Labour of 20 people with average salaries of 12 201 GEL/a
- Collection of biomass: 200 GEL/t
- Energy and other operations: 250 GEL/t
- Distribution of the final product: 50 GEL/t.

Considering the selling price of 550 GEL/t, the NPV of such a project is negative. The 50% public support of such a project will make NPV positive and will increase the internal rate of return (IRR) to 10%. This is a fair value considering the high risk of installation.

Biomass boilers and equipment for local incineration

Farmers can use residues like wheat or corn straw, sunflowers and the like to heat their farms. The technology requires baling, storage and a boiler suitable to use these kinds of residues.

The solution is widely used in Europe. An estimated 4-5 hectares (ha) of wheat produce enough wheat straw to heat 250 square metres (m^2) of a house with relatively low energy efficiency. The assumed investment costs include a boiler of 30 kilowatt-hours (kWh) and round baler for straw. It is assumed the farmer will arrange for storage and has a tractor. The operating costs include maintenance and a small amount for fuel: 200 EUR/a. The alternative solution is heating by natural gas that will require 250 $m^2 \times$ 140 kWh/m^2 / 10.29 kWh/m^3 of natural gas $\times$ 0.57 GEL/m^3 for a total of 496 EUR/a. Thus, it will require a great deal of public financial support; to make it attractive will require EUR 18 715 per installation.

Use of biodegradable waste to produce compost

Another solution to using biodegradable waste from farming and food production is aerobic composting and anaerobic digestion. Composting can be organised at the level of households, farmers and food producers. It can be also organised as part of municipal solid waste management but that is not part of this programme. Thus, the technology focuses on home composting in rural areas, composting at food producers and anaerobic digestion in bioreactors at food producers.

Home composting using composting bins

Home composting with bins is the cheapest and the simplest way to compost. The cost of the bin varies from EUR 50-100.

The potential benefit is produced compost with a value estimated at EUR 4 annually. With the investment cost of EUR 50, the programme will need public support to cover half (EUR 25). This can change if disposal of biodegradable waste is charged (or the programme introduces an incentive for backyard composting through a reduced fee for waste disposal).

Composting containers

The installation capacity starts from hundreds of tonnes per year (t/a) but better efficiency is achieved for capacities about 3 000 t/a. The investment costs of the installation vary. For 3 000 t/a capacity, the costs can be assumed to be EUR 600 000 (200 EUR/t of the capacity). The operating costs comprise maintenance, electricity and labour. However, the benefit of non-disposal of the waste and possible use of compost are meant to compensate for operating costs.

The level of public financial support depends on factors related to legislation and tariff policy. It depends whether waste generators pay for disposal of this waste and if so what the tariff is for disposal of biodegradable waste. The programme assumes that 50% of the investment costs are co-financed through public support.

Bioreactors

Bioreactors are used for anaerobic digestion. They work well with many types of biodegradable waste; fruit and vegetable waste fit the requirements.

The investment costs of the installation vary; for a 1 500 t/a capacity, costs can be assumed as EUR 300 000. The operating costs comprise maintenance, electricity, water and labour. However, the benefit of having the waste and possible use of biogas are understood to compensate for operating costs.

As for the bioreactors, the level of public financial support depends on many circumstances that depend, in turn, on legislation and tariff policy. Do waste generators pay for disposal of biodegradable waste? Or do they pay at the same rate as for municipal waste? Or do they pay a special tariff rate for disposal of biodegradable waste? The programme assumes that 50% of the investment costs are co-financed through public support.

What co-financing is available for investment projects?

Large-scale investment programmes in Georgia have been financed by international financial institutions (IFIs), donors, public money and private investment. This section reviews some of the potential financing sources for the programme.

State budget

Co-financing from the state budget is a typical source of financing for state environmental programmes. Given the budget constraints of Georgia, the state can only co-finance part of the programme costs. On the other hand, this part will be important to show commitment to potential donors or IFIs to obtain international co-financing. Regardless of the share of co-financing from the state budget, it has to be carefully planned in the budget process and included in the mid-term expenditure framework and basic data and directions documentation.

Municipal Development Fund of Georgia

The Municipal Development Fund of Georgia (MDF), established in 1997, co-operates with all large investment banks and financial institutions operating in Georgia. The government of Georgia and the Ministry of Regional Development and Infrastructure of Georgia approve the Fund's Supervisory Board, which provides overall co-ordination. Classified as a legal entity under public law, the Fund boosts the institutional and financial capacities of local self-government bodies by co-financing investments in local infrastructure and services aimed at improving the economic and social conditions of local populations.[1]

The MDF implements infrastructure projects, including urban revitalisation, tourist and cultural heritage monuments, and construction and rehabilitation of schools and kindergartens. It also improves natural disaster prevention infrastructure, creates a sustainable economic base for internally displaced persons, and rehabilitates water supply and wastewater treatment systems.

In 2019, the Fund initiated 250 projects, completing 70 with an overall budget of about EUR 100 million. Under the educational infrastructure programme, construction/rehabilitation projects for 161 schools were initiated throughout the country.[2] MDF is the main implementer of an infrastructure project at the municipality level and also implementing programmes with the support of KfW Development Bank, World Bank, European Bank for Reconstruction and Development (EBRD), the Nordic Environment Finance Corporation (NEFCO), etc.

Given the high demand for MDF financing from other sectors, it prefers not to be a source of co-financing of the programme. However, it can co-finance supplementary actions, like energy efficiency renovation and boilers in public buildings.

Donors and international financial institutions

Donors are already active in providing support to the use of bio-waste to energy.

Increasing energy efficiency has been an EU priority for years. This has ranged from supporting legislative reforms, providing access to financing for energy-efficient renovation and supporting innovative new practices. EU support has been used to renovate ten public schools, seven kindergartens and four other public buildings. In addition, the European Union has helped businesses to introduce energy efficiency measures, thus lowering operating costs, as well as enabling businesses to invest those savings.[3]

The EU-funded project “Biomass Energy and Energy Efficient Technologies as Sustainable Energy Solutions for Covenant of Mayors Signatories” has helped the Ikalto Kindergarten in Telavi Municipality to switch to more energy-efficient biomass heating (mainly vine pruning residues from the municipality).[4] As part of the Covenant of Mayors for Climate and Energy (CoM) initiative, the thermo-rehabilitation of Ikalto Kindergarten resulted in fully heating the facility in winter. It used biomass energy technology instead of firewood that could heat up only 40% of the building in winter. At the same time, biomass saved 60% of costs,[5] as well as substantial amounts of greenhouse gas (GHG) emissions and air pollution.[6]

With its support in the area of biodiversity, energy and natural resources, KfW Development Bank is the largest donor in the southern Caucasus. KfW is helping Georgia implement a project “Biodiversity and Sustainable Local Development – Georgia” with a grant of up to EUR 24 million (with EUR 16.25 million allocated to the Agency of Protected Areas).[7] The project aims to strengthen the protected area network in Georgia and support socio-economic development in the support zone around protected areas. It focuses on conservation and sustainable use of biodiversity, including developing ecotourism and other sources of income for the local population.[8]

The European Union and the KfW implement the “Integrated Solid Waste Management System in Kutaisi” project. With its budget of EUR 26 million for 2015-19, it aims to support and improve the capacities of the Solid Waste Management Company of Georgia. It also aims to provide strong support to municipalities in the Imereti, Racha-Lechkhumi and Kvemo Svaneti regions to start waste separate collection, improve composting culture and improve overall waste management system planning.

The KfW also supported the “Integrated Solid Waste Management System for Kakheti and Samegrelo-Zemo Svaneti regions” project. The total budget of EUR 38 million for 2016-20 funds pilot composting and recycling in the chosen regions. It also aims to improve waste collection and transporting systems.[9]

The CoM was joined by 24 towns and municipalities of Georgia to voluntarily reduce GHG emissions 20% by 2020 and 30% by 2030. As stated in Chapter 1, 11 municipalities already submitted Sustainability Energy Action Plans (SEAPs) (until 2018). This suggests emissions reduction mainly from transport, public and domestic sectors. Under this initiative, participating municipalities estimated their GHG emissions baseline and developed SEAPs, as well as measurement, reporting and verification (MRV) methodologies to capture the effects of the proposed mitigation actions. The experience from the CoM was considered while updating the design of the MRV system of Georgia.

Georgia as a Non-Annex I country to the United Nations Framework Convention on Climate Change is eligible to participate in only one of the three mechanisms defined by the Kyoto Protocol, such as the Clean Development Mechanism (CDM). In Georgia, seven CDM projects are registered and the forecasted reduction rate is 1.84 Mt CO_2e annually. Project “Enabling Implementation of Forest Sector Reform in Georgia to Reduce GHG Emissions from Forest Degradation” – prepared by German Development Cooperation through GIZ – was submitted and approved by the Green Climate Fund (GCF).[10]

The GIZ-GCF project aims to help Georgia establish a nationwide sustainable forest management (SFM) system, as well as promote market development for energy-efficient and alternative fuels in line with EU acquis, which the government of Georgia has committed to implement. In the first component, the project will develop an appropriate institutional structure and a business model for SFM in the three target regions of Kakheti, Mtskheta-Mtianeti and Guria. This will then be replicated to cover all forest areas in the country. In the second component, the project will address the main driver of Georgia’s forest degradation – unsustainable fuelwood consumption by the rural population – by awareness raising, provision of financial incentives and consumer financing products in partnership with financial institutions. The third component will build up capacities of local authorities and citizens to participate in the sustainable management of forests.[11]

The EBRD is active in Georgia, implementing 266 projects in the country to date valued at EUR 4 528 million of cumulative EBRD investment. Almost half (49%) of the EBRD portfolio is directed to the private sector.[12] The EBRD finances different sectors, including solid waste management. For example, in 2021 it approved a sovereign loan of up to EUR 9.6 million to buy vehicles, machinery and equipment, as well as to support digital route optimisation and truck pool management systems. Ultimately, these purchases supported municipal services (solid waste management, street lighting, street cleaning and drainage) in Tbilisi.[13]

Given the significant reduction of GHG emissions expected through the programme, climate donors and IFIs could co-finance it as well. During the preparatory phase, programme promoters will approach the GCF and IFIs with climate-related facilities.

Local banks

Local banks could also provide financing through loans. There are 14 commercial banks operating in Georgia down from as many as 37 in 2005. All but one of these banks have foreign capital. Total assets of the commercial banking sector have increased by just over 100% from GEL 34.5 billion in 2017 up to GEL 67.1 billion in 2022. At the end of 2022, total income was expected to be about GEL 708 million, of which 71% (GEL 504 million) from interest income. Interest income mainly comes from loans (GEL 430 million or 85% of the total), followed by securities (GEL 56.6 million or 11%) and other (GEL 17.2 million or 4%). Of loan interest income, most is from loans to individuals (GEL 310 million or 72% of the total), followed by loans to legal entities (GEL 115 million or 27%) and interbank loans (GEL 5 million or 1.2%). At the end of 2022, estimated profits were expected to be GEL 243 million.[14]

Thus, the commercial banking sector has comparatively less experience with loans to non-individuals. Loans to municipalities are not evident in the official data.

The EBRD has provided credit lines to support sustainable energy and provide access for small and medium-sized enterprises (SMEs) through three commercial banks: Bank of Georgia, ProCredit Bank Georgia and TBC Bank.

Given the high need for public financial support, co-financing from local banks can cover the remainder only, i.e. they can provide loans to finance their part of the beneficiaries' contribution.

Conclusions

If the reviewed domestic financing sources are accepted, the state budget shall be the main source of co-financing and ensure commitment of the country to implement the programme. The MDF cannot be used directly to provide purchase subsidies (grants) for new equipment under the programme. However, it could perhaps finance necessary accompanying measures (e.g. energy efficiency measures and boilers).

Reference

EEC (2019), *On Establishment of Biomass Chain for Telavi Municipality*, Energy Efficiency Centre, Tbilisi. [1]

Notes

[1] See http://mdf.org.ge/?site-lang=en&site-path=fund/about (accessed on 30 June 2022).

[2] See http://mdf.org.ge/?site-lang=en&site-path=news/&id=3678 (accessed on 22 June 2022).

[3] See https://eu4georgia.eu/energy (accessed on 23 June 2022),

[4] The main advantage of vineyard-pruning residue biomass is its combustion temperature, which is 1.5-2 times higher than that of firewood. A tonne of biomass can replace approximately 3.6 m³ of firewood, or 550 m³ of natural gas. The European Union gave the municipality two tractors for collecting and processing vineyard-pruning residues to be used for biomass-operated heaters, thus helping create a renewable energy supply chain. See https://georgiatoday.ge/doing-more-with-less-georgias-energy-efficiency-dreams-start-to-be-made-real (accessed on 15 June 2022).

[5] With a budget of over GEL 800 000, the rehabilitation works also included thermal insulation of the building, instalment of a solar water-heating system, a grid-connected solar micro power plant, energy efficient windows and replacement of existing lighting with LED lights. See, for instance: www.eeas.europa.eu/delegations/georgia/eu-ambassador-opens-energy-efficient-kindergarten-ikalto-kakheti_en (accessed on 27 April 2022).

[6] For more information, see also: https://eu4georgia.eu/an-energy-efficient-kindergarten-opens-in-kakheti-with-eu-support (accessed on 29 April 2022).

[7] See, for instance: https://mepa.gov.ge/En/News/Details/20878 (accessed on 18 April 2022).

[8] See www.developmentaid.org/tenders/view/782535/consulting-services-natural-resource-management-biodiversity-and-local-development (accessed on 09 May 2022).

[9] For international projects with SWMCG, see: https://waste.gov.ge/ka/?page_id=349&lang=en (accessed on 12 May 2022).

[10] For more information, see: www.greenclimate.fund/document/enabling-implementation-forest-sector-reform-georgia-reduce-ghg-emissions-forest; or www.greenclimate.fund/project/fp132 (accessed on 24 May 2022).

[11] See the project's Funding Proposal (FP132) from 21 August 2020 at: www.greenclimate.fund/sites/default/files/document/fp132-giz-georgia_0.pdf.

[12] See overview of EBRD's projects in Georgia at: www.ebrd.com/georgia-data.html (accessed on 16 June 2022).

[13] The beneficiary is the Tbilservice Group Ltd. See www.ebrd.com/work-with-us/projects/psd/52577.html (accessed 30 November 2022).

[14] See the National Bank of Georgia at: https://nbg.gov.ge/en/statistics/statistics-data (accessed on 15 July 2022).

5 Institutional arrangements and implementation barriers

This chapter lays out the basic forms of institutional set-up that similar national-level subsidy programmes require in developed countries. Hence, the proposals are based on best practices and consider different budgetary and administrative capacities. The chapter also highlights the need for implementation autonomy, as well as checks and balances (accountability). It outlines the main roles, responsibilities and procedures of the programming and implementing entities, and also suggests possible institutions that would be suitable and qualified to fulfil the respective roles. The chapter concludes with the main policy distortions and lack of awareness that need to be addressed to support implementation and achievement of targets.

Good practice institutional arrangements for managing public investment programmes

There are several different good practices for managing public environmental spending. Simple spending programmes (e.g. financing research or education, buying simple equipment or standard services) can be managed directly by assigning additional responsibilities to existing government institutions at a variety of levels, using regular staff and routine budget processes. For larger-scale, targeted programmes – in particular, programmes that involve financing capital investments, such as this programme – special institutional arrangements are recommended. These special arrangements may take many forms and involve various types of implementing units (OECD, 2007[1]).

Deciding which form is most appropriate will generally depend on a variety of factors related to sources of finance, types of disbursements envisaged, and the legal and political culture of governance in a given country. Regardless of the institutional form, public environmental spending management should involve institutional structures and procedures that promote environmental effectiveness, embody fiscal prudence, and use financial and human resources efficiently.

Experience shows these arrangements can take four basic forms:

1. government implementation units (IUs)
2. environmental funds or a similar public finance institution
3. directed credit or a line of credit to financial intermediaries (such as banks)
4. outsourcing.

Government IUs are the most common arrangements, and include the following institutional forms:

- government departments that procure goods and services or finance specific projects within the state budget
- project IUs in a government department to implement projects within a specific government spending programme included in the budget
- autonomous/decentralised government units financed by the budget but created to decouple delivery of services or administrative tasks from policy formulation.

Government IUs mainly manage government budget resources, although project IUs may also manage multilateral or bilateral grant resources. Regardless of the type of government IU chosen, carrying a programme to completion requires capacity for project selection, implementation and monitoring. This means hiring skilled, trained personnel dedicated to the programme. Environmental programmes of EUR 50 million annually and about 200 contracts per year implemented in Central and Eastern Europe generally need a staff of more than 20 people.

For the programme discussed in this study, given the relatively small number of contracts (except composting bins) and homogenous types of investments required, only five people will be needed (see Table 3.3 and Table 3.4 for implementation costs). The co-financing of composting bins can be organised as a limited administrative burden. On the other hand, a lot of effort will be required for the awareness building and promotion component. This effort, however, can be outsourced (e.g. to non-governmental organisations, or NGOs) to stay within budget.

In most instances, the institutional arrangement for large-scale (investment) programmes includes both a management (implementation) unit and a supervisory body. The IU's unit's management and staff are responsible for day-to-day project cycle activities (identification, selection, appraisal and monitoring of projects), development of the annual spending plan and budget, and monitoring and preparation of reports. The supervisory body usually focuses on strategic decisions and approving internal operating procedures and rules (including eligibility and appraisal criteria to guide project selection). This division of responsibilities provides a system of checks and balances and improves accountability. The supervisory body retains final authority to approve financing of individual projects recommended by the IU's technical staff after the appraisal process. In the case of the programme, the programming entity (PE) would assume the supervisory function.

Outsourcing or contracting out is another option if the government department does not have the capacity to fulfil its duties as an IU. This allows the department to contract with an outside supplier for provision of goods and services typically provided internally. If this option is chosen, good practice requires that outsourcing be conducted through competitive tendering.

Proposed institutional set-up for the programme

In preparing any public investment programme, the public financier must ensure that essential individual elements are carefully designed and in place before launch. This section summarises these elements for the green public investment programme in Georgia proposed as part of this study. It explains how and why the project team arrived at these solutions.

Effective programme implementation requires the following elements:

- stable and predictable sources of finance
- institutional arrangements to manage spending, with sufficient resources, qualified staff and instruments to meet objectives
- well-documented principles, rules and operating procedures for project cycle management (PCM)
- clearly defined and robust criteria for appraisal, selection and financing of investment projects
- clearly defined procurement rules.

To facilitate implementation of this investment programme, this chapter and the annex provide detailed information on the following arrangements:

- a proposal for institutional arrangements comprising three levels: i) PE; ii) IU; and iii) a technical support unit (TSU)
- a proposal for PCM procedures, including eligibility criteria, project appraisal criteria, project-ranking procedures and financing rules (Annex C).

The institutional set-up needs to ensure that sufficient resources to meet the programme's objectives, and that qualified staff and instruments to implement the programme are made available. In general, programming and project appraisal should be strictly separated. Programming is the responsibility of the PE in the government agency appointed to manage the investment programme. Project appraisal is a technical process by competent technical staff recruited on a competitive merit basis and held responsible for their decisions. The IU should be operationally and technically independent, and shielded from political pressures by rules and procedures developed by the programme's technical staff.

The role of the programming entity

The Ministry of Environmental Protection and Agriculture (MEPA) is best suited to act as the PE. It could use its available staff and resources to undertake its programming duties, while consulting with other relevant government agencies, professional associations, local municipalities and NGOs, as appropriate. In addition, representatives of these bodies may be invited to sit on the programme's supervisory board and play an advisory role.

The PE designs the programme, including:

- Defining priority environmental objectives for the investment programme that are specific, measurable, realistic and time-bound.
- Developing an investment programme that responds to the overall environmental and climate-related objectives, including specific targets, cost estimates, descriptions of eligible project types and beneficiaries, terms of financing, procedures, principles and criteria of project appraisal and selection, procurement rules, programme timeframe and indicators of performance.
- Determining sources of funds and the size of the financial envelope of the investment programme.
- Selecting the best institutional arrangements for managing the investment programme – in particular, deciding whether the programme can be managed directly by existing government institutions at different levels, or whether special institutional arrangements are required.
- Selecting, contracting and monitoring the IU to manage the investment programme.
- selecting and monitoring the TSUs required to implement the programme (Adapted from (OECD, 2007[1])).

Deciding on an implementation unit

The IU may also undertake the drafting the programme's operating regulations, if MEPA so delegates. It needs to consult with the TSU(s) in drafting and using its operating regulations. Since programming is a political process, the responsibilities for programming and PCM should be separate and distinct, with the IU managing the project cycle. The IU conducts marketing activities for the programme, identifies beneficiaries and appraises beneficiaries' project proposals for eligibility. It would also provide MEPA with information on the planned number of beneficiaries and programme financial needs. The IU would report to MEPA on programme spending so that MEPA can monitor budget implementation for a given year (or programming cycle) and project type (project "baskets").

The role of IU could be fulfilled by:

- the Rural Development Agency, which implements a variety of programmes/projects initiated by MEPA
- National Environmental Agency
- an NGO (like Energy Efficiency Centre Georgia)
- a local bank or banks selected through public tender, and which would sign a co-operation agreement with MEPA.

Institutional setting in the field of waste management

In the Georgian waste management sector, several ministries under the supervision and guidance of MEPA play major roles in developing national legislation and policies, budgeting, co-ordinating a variety of policy implementation, law enforcement, waste accounting, reporting and database management, etc.

Appointing a technical support unit

The TSU would give specialised assistance, advice and expertise in the areas of production of energy from biodegradable waste and use of biodegradable waste for composting and anaerobic digestion. As this task is quite wide, no one entity can play this role. Other TSUs may be defined as deemed necessary and prudent.

Fundamental operating regulations

The effective implementation of the programme requires the IU to define and publicise its operational rules and regulations. At a minimum, the core elements of such rules should include:

- definitions
- general provisions
- definition of eligible projects
- rules for awarding grants
- rules for modifying or terminating a grant contract
- procedures for programme review.

The grant agreement with the beneficiary should include the following terms and conditions:

- amount of grant award (as an absolute value or as a share of total project investment cost)
- start and end dates of the project to be financed, as well as planned environmental effects
- date on which the grant, or its instalments, will be transferred to the recipient
- rights of the IU to control the awarded grant, as well as the method of recovering the grant if the project fails to meet its stated objectives
- grantees' specific obligations arising under the contract with the programme IU
- conditions under which the contract loses its force
- consequences of contract dissolution
- project durability period and consequences of violating it.

The grant for a project should not cover 100% of the funds earmarked for that type of project in the IU's annual financial plan. This is to leverage resources from other sources and ensure the commitment of recipients to implementing the project using their own resources.

Given the nature of investments to be financed, the programme should be financed by the state budget within the medium-term expenditure framework (MTEF) process. Financial support should be provided in the form of grants.

There are other procedural rules that need to be considered. For example:

- The grant may be transferred to the applicant all at once or in instalments (tranches).
- A portion of the grant may be transferred in advance (up to 20% of the total value of the project) if project start-up is impossible without advance funding.
- The recipient of a grant advance should be required to return to the IU any interest resulting from holding the grant in its bank account (or the amount may be deducted from future tranches).
- The dates for transferring grants are determined by the IU based on funds at its disposal and upon consideration of an applicant's proposal, as presented in the application.
- Financial resources from the grant are transferred exclusively to meet payments required by the grantee. The recipient should allow the IU full access to original invoices prepared by contractors or suppliers.

The OECD Handbook for Appraisal of Environmental Projects Financed from Public Funds includes details of all the rules that need to be considered in defining procedures for the programme IU. It could be useful in further defining procedural rules for the programme – see (OECD, 2007[1]).

The programme implementation shall strictly apply project sustainability criteria, i.e. when public support is provided, it must use assets for at least five years. This can be imposed on public bodies (municipalities) but a guarantee might also be required from the private entity that will be realised after five years.

Promoting the programme and awareness building

Promotion, which is essential for success, is the responsibility of the IU. The promotion package might include the following elements:

- building awareness among local farmers
- sending programme information to local administrations and potential beneficiaries
- distributing programme rules to local administrations and potential beneficiaries
- maintaining the IU's website with information on rules for awarding grants and application forms
- issuing press releases.

The costs of programme promotion should be included in the programme costs envelope.

Eliminating policy distortions

Various regulatory barriers may complicate implementation of even a well-designed investment programme. Therefore, before a programme is developed and financed, the government of Georgia should review the relevant regulations and eliminate any barriers to the extent possible. Combining such regulatory improvements with financial support from the state is more likely to lead to reduction of the disposed or burnt biodegradable waste and result in significant reductions in GHG emissions.

The economic analysis shows that, in current conditions, the level of public support has to be high (between 50-80%) to ensure the interest of potential beneficiaries.

One of the biggest obstacles for an investment programme in the biodegradable waste sector in Georgia is competition from low energy prices and low level of enforcement of the proper disposal of biodegradable waste.

For the same reasons, the programme implementation may face several barriers in the second (scale-up) phase:

- Competition for wood-based biomass is high. At the same time, the production costs of wood-based biomass are lower than other types of biomass, such as agricultural residues. This situation has a negative impact on sustainability of forests but will continue without regulatory changes. Possible measures include reduction of illegal unsustainable consumption and "social cutting". Concurrently, the certification of biomass can be introduced, giving preference to agriculture biomass. Such a certification may be used to stimulate the public sector, as well as energy and cement industries, to use agriculture biomass.
- Competition from cheap and low-efficient wood stoves that use mostly woodchips. More efficient stoves or automatic boilers will use briquettes and pellets that can be produced from wood waste but also agriculture biomass.
- Competition from natural gas. Although international natural gas prices are rising and consumer prices are following, investment costs for the agriculture biomass supply chain are high.
- Agricultural residues are not covered under waste management legislation. Consequently, producers are not obliged to collect and use them sustainably. Thus, their alternative costs are low.
- Alternative costs of biodegradable waste disposal are low due to uncontrolled and illegal disposal. If properly implemented, the costs of biodegradable waste disposal (e.g. composted by municipal facilities) will make investments more attractive.
- Farmer behaviour when demand for agriculture biomass increases. Suppliers will increase prices once they realise there is a market for previously unused residues.

- Taxation. Sale of agricultural biomass may raise the problem of income tax that will reduce the interest of suppliers. Also, the universal value added tax of 18% is applied to all fuels, with no distinction between fossil and renewable.
- The fragmentation of agricultural producers complicates implementation of the supply chain. It should start in areas with a high concentration of agriculture biomass and bigger producers.
- Low awareness. Neither the use of bio-waste for energy nor for composting is widely promoted and known to society. This might be a significant barrier to implementing the programme.

Conclusions

There are several possible institutional set-ups for managing the programme. The optimal institutional set-up should be selected only after all elements of the programme are clarified and consensus reached on its priorities.

Regardless of the type of institutional set-up, the programme management should involve an institutional structure and procedures that promote environmental effectiveness, embody fiscal prudence, and use financial and human resources efficiently. Subsequently, the government needs to ensure that resources, qualified staff and instruments are sufficient to implement the programme.

It is advisable for larger (investment) programmes – such as this one – to also appoint a supervisory body. This body would adopt strategic documents and undertake strategic decisions, as well as oversee management in terms of project selection, implementation and monitoring (PCM).

Importantly, both the management and the supervisory body should be protected from political pressures through operating rules and procedures. The government of Georgia should also aim to eliminate the policy and regulatory barriers that could hamper implementation of the programme. A reflection on other countries' experiences could provide an indicative checklist of measures and approaches to tackle these problems.

Reference

OECD (2007), *Handbook for Appraisal of Environmental Projects Financed from Public Funds*, EAP Task Force, OECD Publishing, Paris, http://www.oecd.org/env/outreach/38786197.pdf. [1]

Annex A. Generation and processing of biodegradable waste in Georgia

Generation of biodegradable waste

Forestry residues

As pointed out by World Bank (2021[1]), wood waste biomass from forestry activities comes from two main sources:

- timber harvesting and logging – treetops, branches and foliage, stumps (excluding roots), and sawdust
- primary timber processing at sawmills – slabs, edgings and off-cuts, sawdust and fines, bark and various production losses.

Citing UNDP (2014[2]), a field study prepared by World Experience for Georgia, the World Bank study points out that extraction of timber and firewood leaves 38% of wood waste biomass (e.g. treetop, branches and foliage, stumps and sawdust) in the forest every year after harvesting. Annually, this figure is approximately 280 000 cubic metres (m^3).

About 34% of wood waste accumulates in sawmills. This waste is handled in various ways, including open burning (onsite or nearby), disposal nearby or offsite, transfer to the local population (free of charge or for sale, presumably for fuel use), internal company use for heating and the drying of their wood products, and further processing to produce briquettes (UNDP, 2014[2]).

Table A A.1. Estimated wood waste residues (biomass), by origin, annual potential

(m^3)

Source of wood waste residue	Annual potential
Timber harvesting (licence holders, local population, illegal cutting)	2 886 000
Primary wood processing (sawmills, early and mid-term tending and thinning, measures to support natural regeneration)	1 161 000
Total	4 047 000

Source: World Bank, Georgia Solid Waste Sector Assessment Report, May 2021.

Biomass residues

The significant part of biomass residues is unused and therefore may present an opportunity for businesses to produce pellets, briquettes or other types of modern biofuels. The Georgian market remains essentially untapped in this regard.

From agriculture, the following crops have high potential according to UNDP (2014[2]):

- **Vineyard and orchard pruning residues** – the amount of vine cutting residues amounts to 3.2–3.5 tonnes per hectare (t/ha), of which 90% is burnt soon after cutting in the early spring.
- **Winery residues** – several big wineries have annual accumulation of several hundred tonnes of pressed pomace and have difficulty with its disposal.
- **Bay fine branches** remaining from bay leaf harvesting, with high concentration in Khobi municipality.
- To a lesser extent, **wheat** (mostly in Dedoplistskaro municipality in the Kakheti region) and potentially the **sunflower**.
- The residues of **other crops** have alternative uses and are less likely to be available for energy.

Only some farmers pay for removal of residues from their orchards and wineries, which presents an opportunity for an alternative solution for waste disposal.

The World Bank study points to a range of estimates on the total amount of biodegradable waste generated from the agricultural sector from 304 000 tonnes (t) to over 1.5 million t. At the same time, the UNDP study estimates the agriculture and forestry sectors generate 78% and 22%, respectively, of the bio-waste nationally.

Cuttings from vineyards may be the most abundant residual biomass that does not have widespread alternative use. The amount of pruning is difficult to assess with high confidence, since different farmers report waste amounts in different measures, including number of bunches, number of cars per hectare or weight per hectare. For the UNDP study, 40 farmers were interviewed with the total farming territory of 195 hectares (ha) and 643 t of waste. Replies regarding the mass of vine pruning available from 1 ha ranged from 3.2-3.5 t. Farmers pointed out that if the vineyard is intensive and planted with new species, it needs much less cutting. Conversely, if it is old, waste will be added to pruning residues. All interviewees confirmed they burn about 90% of vine cuttings immediately after removal from the vineyards.

Vine and fruit pruning is crucial to avoiding spread of disease. Because about 85% of orchards are vulnerable to disease, cuttings are removed and burnt. Nearly all (95%) pruning is removed from the fields by 15 March each year. From the UNDP survey of 25 farmers with 104.4 ha of fruit orchards, an estimated 3.5 t of pruning residues are left from a 1-ha fruit orchard. While farmers usually burn cuttings or consume them for private use, they expressed willingness to give the residues to third parties.

Hazelnut businesses were also interviewed. According to respondents, approximately 50 000-60 000 t of hazelnuts are produced in Georgia every year, mainly in Guria, Aphkazeti and Samegrelo. Ten large and 50 small businesses operate in Zugdidi, which produces 80% of the country's hazelnut crop. Residue makes 40-50% of total hazelnut, which in the past has been used for heating and cooking. UNDP survey respondents, however, indicated that use of hazelnut residue is gradually decreasing because of the gasification process. This decrease is occurring despite the fact that gas heating cost three to four times more at the time of the survey (GEL 120 worth of shells were sufficient for the previous heating season).

Favourable hazelnut prices have led to increased production. According to survey respondents, however, the hazelnut shells are stored in the open air and are often wet. The population prefers to use the wet shells for heating since they burn longer. The price for the hazelnut residues varies by season. At the time of the survey, in the beginning of the season, the wet residues cost 5-7 tetri per kg while in high season the price was 10-15 tetri.

Food waste

The UNEP Food Waste Index Report (2021), as cited in World Bank (2021[1]), is the main source of food waste assessment for this study together with information obtained from the Solid Waste Management Company (SWMCG) and the Tbilservice Group (TSG).

The UNEP study assesses food waste generation across three sectors: household, food service and retail.

Total estimates of food waste generation are provided in Table A A.2.

Table A A.2. Total estimated quantity of food waste, by source

	kg/capita/year	t/year
Household estimate	101	403 573
Food Service estimates	28	110 504
Retail estimates	16	62 511
Total		576 588

Source: World Bank, Georgia Solid Waste Sector Assessment Report, May 2021.

According to the SWMCG and TSG data, some food waste is disposed of in landfills. In 2019 and 2020, for example, 4 095.54 t and 2 651.03 t of food waste were deposited in landfills, respectively.

Food waste generated in the household sector is completely disposed of in landfills. For their part, foodservice and retail sectors have contracts with the waste management company. Usually, their waste is disposed of under that contract – which means the food waste from these sources should be calculated.

According to UNEP (2021[3]), the non-household (i.e. business sector) generates an estimated 173 015 t of food waste. This corresponds to the sum of the estimates for food service and retail in Table A A.2. Accordingly, based on data from the waste management company, only a small amount (1.5-2.5%) of food waste generated in the business sector is dumped legally in landfills.

Energy use of agriculture residue

Perennial crop production generates an estimated 304 kilotonnes (kt) of agricultural residue, with 5.6 petajoules (PJ) (1 565 GWh) of annual energy resource potential. Seven crops are the main source of pruning residue: grape, apple, peach, pear, hazelnut and bay leaf. At the same time, the Samegrelo-Zemo Svaneti region is the main biomass resource provider in Georgia: 80 kt of agricultural residue, with 1.4 PJ of energy production resource potential.

Vineyards contribute the largest part of agricultural residue (about 108 kt annually, with 2.0 PJ of total energy production potential). There is a clear tendency to increase the area devoted to viticulture and the amount of resulting biomass can also be expected to increase.

Fruit orchards contribute the next highest among biomass residue, with a total of 81 kt and a total energy production potential of 1.5 PJ. Hazelnuts constitute the third largest generator of agricultural residue: total residue 68 kt, with 1.3 PJ total potential energy production. Fruit orchards are the main agricultural residue providers in Abkhazia (AR reported part) and the second agricultural residue provider for the Samegrelo-Zemo Svaneti region. A total residue of 81.4 t, with 1 465.2 gigajoules (GJ) total energy resource is available in Abkhazia from fruit orchards and a residue of 25 715.8 t, with 0.5 PJ total energy resource in Samegrelo.

Table A A.3. Top agriculture residues with their total energy resource indications

Agriculture residues	Total residue (kt/year)	Total energy resource (PJ/year)
Vineyard	108	2.0
Fruit orchards	81	1.5
Hazelnut	68	1.3

Source: UNDP (2014), Assessment of Wood and Agricultural Residue Biomass Energy Potential in Georgia, Field Study.

Hazelnuts are the main source of agriculture residue in the hazelnut producing regions – Adjara, Guria and Samegrelo-Zemo Svaneti. They are generally used as an alternative heating source in those regions. The total residue estimates are as follows:

- Ajara: 1 196.25 t, with 0.02 PJ of total energy production potential
- Guria: 14 524.65 t, with 0.3 PJ of total energy production potential
- Samegrelo-Zemo Svaneti: 43 995.9 t of total residue, with 0.8 PJ of total energy production potential.

Due to the high export demand for local hazelnuts, the surface area devoted to hazelnut production can be expected to increase; accordingly, new and expanded orchards will increase the available biomass.

Table A A.4. Main hazelnut producer regions

Region	Total residue from shells (kg)	Region total energy production potential (GJ/year)
Samegrelo-Zemo Svaneti	15 676 700	293 154
Guria	5 175 450	96 781
Imereti	2 022 750	37 825

Source: UNDP (2014), Assessment of Wood and Agricultural Residue Biomass Energy Potential in Georgia, Field Study.

In the Imereti, Kakheti, Racha-Lechkhumi and Kvemo Svaneti and Kvemo Kartli regions, vineyards provide the main potential for agricultural residue. Total residue and energy production potential from vineyards by region are:

- Imereti: 24 893.6 t, with 0.5 PJ of total energy production potential
- Kakheti: 64 458.3 t and 1.2 PJ of total energy production potential
- Racha-Lechkhumi and Kvemo Svaneti: 3 909.2 t, with a 0.047 PJ total energy production potential
- Kvemo Kartli: 5 095.3 t, with 0.1 PJ of total energy production potential.

Vine pruning residue is not a significant alternative heating source. Most residues are left in the field or burnt. According to farmers quoted in the UNDP field study, the transportation and storage costs are much higher than the value of its alternative use for heating generation (UNDP, 2014[2]).

The Samegrelo-Zemo Svaneti region is the main producer and exporter of bay leaves. It generates total residue of 7 500 t, with 0.1 PJ of total energy production potential from current bay leaf plantations. Local farmers, however, do not use bay leaf residue as an alternative heating source. It is difficult to use bay leaf residue without cutting the stems because the bay leaf is an ether-bearing plant and its stems contain a high quantity of ether-bearing oil. Farmers with access to cutting machinery use the bay leaf residue in the same boiler used for hazelnut shells.

Apple, and fruit orchards overall, are the main source of biomass for Shida Kartli, Mtskheta-Mtianeti and Samtskhe-Javakheti regions. The following total residue and total energy production potential can be estimated from apple orchards in the three regions as follows:

- Shida Kartli: 21 kt and 0.4 PJ
- Mtskheta-Mtianeti: 446.4 t and 0.08 PJ
- Samtskhe-Javakheti: 1 732.8 t and 0.03 PJ.

In the main, agricultural residue is not used as an alternative energy resource in Georgia because of the high cost of biomass collection, transportation and storage. Local populations mostly burn pruning residues directly in the field to prevent spread of disease. The ash from burnt stems is used as biological fertiliser in orchards and vineyards.

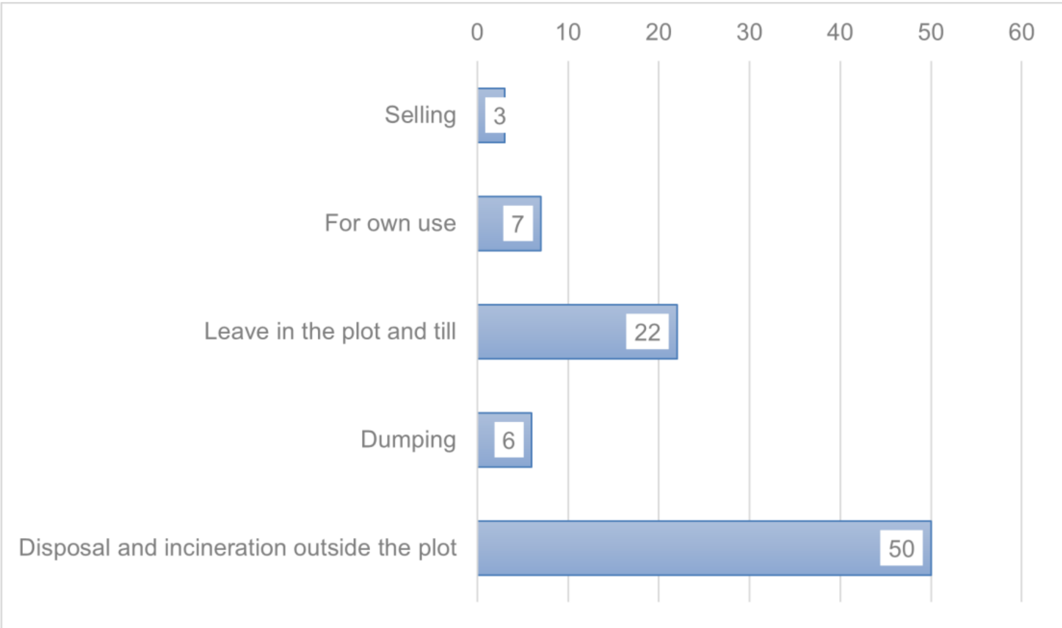
Waste disposal and use

The typical cost of removal per hectare of orchard or vineyard is about GEL 40-50. It costs GEL 25 in the East Georgia region to hire a daily worker. The cost of cleaning up the average vineyard of 10-15 ha is GEL 400-600 while for orchards in Kartli the cost is GEL 300-400. On the other hand, the National Wine Agency reports that a worker's daily labour costs GEL 50. If a tractor is required, the total daily cost per hectare rises to GEL 150, including the worker.[1]

According to the UNDP field study, most of the waste is collected and burnt on the field by farmers. A relatively small part of the waste is left on the fields and used for other purposes (see Figure A A.1) (UNDP, 2014[2]).

Figure A A.1. Methods of dealing with residues here

(number of farmers)



Source: UNDP (2014), Assessment of Wood and Agricultural Residue Biomass Energy Potential in Georgia, Field Study.

Farmers mostly leave straw on the ground or use it for cattle feed. Only three farmers interviewed as part of the UNDP field study sold the residue and had been paid 0.40 tetri for a bunch. In all, 30-40% of straw is left on the ground. The rest of the residue is used for animal feeding. Concerning expenditures for collection and disposal, most farmers say they hire someone for various field work (five to ten people). Small farms spend about GEL 400-600 annually on waste disposal; for bigger farms, this amount increases up to GEL 1 000. Expenditure on waste disposal varies across residue types (UNDP, 2014[2]).

Table A A.5. Waste disposal

Type of residue	Expenditure on resume disposal per hectare
Vineyard residue	40 GEL/ha
Fruit trees residue	62 GEL/ha
Straw	11 GEL/ha

Source: UNDP (2014), Assessment of Wood and Agricultural Residue Biomass Energy Potential in Georgia, Field Study.

Waste flow projection

The following estimates are for total waste flows, by type.

Table A A.6. Waste flow forecast

(t/year)

	2018			2020			2025		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Total SW	611 233	175 927	787 160	617 334	174 482	791 816	634 033	171 134	805 167
Organic	292 780	66 501	359 281	295 703	65 954	361 657	303 702	64 689	368 391
Green waste	41 564	29 732	71 296	41 979	29 487	71 466	43 114	28 922	72 036
Paper/cardboard	64 791	18 648	83 439	65 437	18 495	83 932	67 208	18 140	85 348
Total biodegradable	399 135	114 881	514 016	403 119	113 936	517 055	414 024	111 751	525 775
Average annual GR	-	-	-	0.50%	-0.41%	0.30%	0.54%	-0.39%	0.34%

	2030			2040		
	Urban	Rural	Total	Urban	Rural	Total
Total SW	805 167	652 847	1 458 014	697 091	163 244	860 335
Organic	312 714	63 562	376 276	333 906	61 706	395 612
Green waste	44 394	28 418	72 812	47 402	27 588	74 990
Paper/cardboard	69 202	17 824	87 026	73 892	17 304	91 196
Total biodegradable	426 310	109 804	536 114	455 200	106 598	561 798
Average annual GR	0.59%	-0.35%	0.39%	0.66%	-0.30%	0.47%

Source: National Biodegradable Waste Strategy (proposed).

Biomass residue

The following table summarises the energy production potential from biomass residue.

Table A A.7. Estimate of biomass residue to use in energy production potential

Source of residue	Residue (t/ha)	Under cultivation (ha)	Total estimate (t/year)	Total energy potential (PJ/year)	Current use
Vine pruning	1.7-2.9*	48 000**	81 300 – 139 200	2.0	90% is being burnt soon after cutting in the early spring
Orchard pruning residues	3.2-3.5***	23 142	81 000	1.5	
Hazelnut			68 000	1.3	Burnt after cultivation
Other			15 500	0.8	Burnt after cultivation
Total			304 000	5.6	

Source: * Telavi project. ** www.vades.wine/pages/wine-in-georgia; *** UNEP Food Waste Index Report 2021.

Composting

According to UNEP Food Waste Index Report 2021, the non-household (i.e. business) sector generates 173 015 t of food waste. Projections were adjusted for per capita generation rates cited in the World Bank report. Thus, the projection in Table 6.8 can be considered a low estimate, whereas UNEP (2021[3]) provides a high estimate.

Table A A.8. Estimate of compost generation

(t/year)

Food waste source	2018	2020	2025	2030
Total food waste, food service and retail (non-households)	164 104	163 544	167 886	171 744
Total food waste, households	376 693	375 407	378 676	380 823
Total food waste	540 797	538 951	546 562	552 566

Note: “households” may include small farmers.
Source: Updated projection based on UNEP Food Waste Index Report 2021.

Local producers

Biodiesel Georgia LLC

In 2018, for the first time in Georgia and the whole region of the South Caucasus, a Georgian start-up (Biodiesel Georgia LLC) used modern technology to launch a biodiesel plant and start production of alternative, clean, renewable, environmentally friendly fuel. Since then, the plant has been operating successfully, constantly increasing its production. Biodiesel is a clean-burning alternative fuel, made from biolipids – natural vegetable oils, and/or animal fats, i.e. renewable bio resources. Biodiesel is meant to be used in standard diesel engines and no engine modification is required. Biodiesel, unlike conventional, petroleum-based diesel fuel, does not pollute the environment; it is a renewable, eco-friendly and carbon-neutral fuel.

The best raw material for biodiesel production is secondary, used cooking oil (UCO). Biodiesel Georgia LLC has developed an effective and efficient network to collect UCO collection countrywide; the oil suppliers are fast-food and other restaurants, hotels and many other companies. Each month, the company collects 60 t from more than 1 000 oil suppliers throughout Georgia. Since 2018, the company has already collected and processed more than 980 t of UCO in Georgia and produced more than 750 t of biodiesel.

Thus, Biodiesel Georgia LLC has saved around 1 250 t of CO_2 from being released into the atmosphere. Production of biodiesel from secondary UCO brings double environmental benefits. On the one hand, UCO, which is liquid waste, will no longer be disposed of in waste landfill sites. On the other, it will not be used in the food chain again to threaten human health. Instead, it will be collected and turned into the most environmentally friendly fuel possible.

While processing UCO, Biodiesel Georgia LLC produces bio-glycerine as a by-product. This is considered another valuable product, which is in demand by the medicine and pharmaceutical industry. Therefore, no residues and/or waste are left; Biodiesel Georgia LLC uses a “no-waste-left” technology.

Today, biodiesel can be purchased at several gas stations in Tbilisi. Biodiesel is also sold as a blend with conventional diesel fuel.

Marneuli composting facility

Marneuli municipality composting plant produces 40-57 t of pure compost from green bio-waste collected at local agrarian markets and a canned food factory. The plant – which contains a mechanical mixer, a shredder and a grading sieve – is located on 2 ha, 10-15 km from Marneuli City; 1 ha is used for composting. The designed capacity of the plant is approximately 5 000 t/a of waste recycling (i.e. compost production). Aerobic decomposition is used, involving organic matter, moisture, oxygen and aerobic bacteria. Maturation of the compost takes two to three months.

The plant produces five types of products, including pure compost and its derivatives (e.g. pot plant soil, outdoor plant soil, etc.). Products are packed for market in 5-, 10-, 20- and 30-l bags. The product is primarily sold in "Gorgia" supermarket. Similar supermarkets such as Domino, Agrohub and Goodwill are potential retailers for Marneuli compost and its derivatives. MEPA's central laboratory certifies all products of the Marneuli factory. Marneuli compost sells for 0.9 GEL/l, peat compost for 0.7 GEL/l and composted soil costs for 0.4 GEL/l.

Kutaisi composting centre

In 2018, Kutaisi composting centre was created within the project "Waste Free Rivers for a Clean Black Sea", which is funded by the European Union. The composting centre is designed for composting green waste generated in the city (tree branches, grass, leaves). The centre can produce 2 024 t of prepared compost per year, as well as least 10 000 m^3 of green waste. The Ministry of Environmental Protection and Agriculture of Georgia provided Kutaisi City with a permit for processing (composting) biodegradable waste. The composting centre started operating in May 2021; the first stream of compost mass has already been taken for composting.

Production of the clean technology equipment

None of the proposed clean technology equipment is widely produced in Georgia because the market basically does not exist. Thus, at the beginning of the programme implementation, the equipment will be imported or assembled locally.

If the market allows local production, the easiest way to create green jobs will be production of the following:

- composting bins, if the proposed scale and technology are appropriate for Georgia
- straw boilers that can be manufactured and do not require sophisticated technology.

As for other equipment, the programme will not generate a market to open full production, although local assembly can be considered.

References

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UNEP (2021), *UNEP Food Waste Index Report 2021*, United Nations Enviromnent Programme, Nairobi, https://wedocs.unep.org/bitstream/handle/20.500.11822/35280/FoodWaste.pdf. [3]

World Bank (2021), *Georgia Solid Waste Sector Assessment Report*, World Bank, Washington, DC, https://openknowledge.worldbank.org/handle/10986/35704. [1]

Note

[1] Source: Personal communication with a representative of the National Wine Agency, 15 July 2021.

Annex B. Overview of clean technologies in the biodegradable waste sector

This annex provides an overview of the six cleaner options for using biodegradable waste available in Georgia. These six options can be grouped into two uses of biodegradable waste: producing energy and compost.

For a detailed description of each type and its main features, comparative advantages and drawbacks of each technology, and its market penetration (Annex A).

Use of biodegradable waste to produce energy

Biodegradable waste has a huge calorific value and, after processing, can be used to produce energy. Most often, the wood waste is used for that purpose. However, given the programme's focus on agriculture waste, biodegradable waste from farming is also considered.

The available technologies have the following drawbacks:

- Biodegradable waste has relatively low energy density (i.e. large volumes are needed to produce energy).
- Biodegradable waste is not always produced at the moment when heat energy is needed and thus requires storage.
- The calorific value of the biodegradable waste depends on the humidity of the harvested material and thus requires drying before use.
- Boilers adapted for biodegradable waste fuel are needed to reduce air pollution.

The proposed programme will focus on biodegradable waste that is most suitable to produce energy, i.e. relatively dry.

The supply chain for vine pruning

Residues from vine pruning or similar residues can be used to heat public buildings or small heating systems. Public buildings (or larger private buildings) are proposed because they require more power generation to maintain good combustion parameters and reduce air pollution. Such combustion parameters can be achieved in larger boilers of about 200 kilowatts (kW). They are difficult to achieve in small, household-size boilers of typically 20-30 kW.

The supply chain model was tested in Telavi and the feasibility study proved the model can be replicated. The supply chain comprises several local wine producers that already have a problem with residues from vine pruning in their vineyards (usually burnt near the vineyards). The supply chain consists of the following equipment:

- baler (the vine pruning has to be collected by vine baler attached to the tractor)
- truck to transport bales to the storage place (tractor and trailer)
- storage place

- chipping or pelleting bales equipment (bale chipper).

The feasibility study identified costs of EUR 94 600 for the equipment, which comprises two tractors, baler, bale chipper, trailers and truck. The storage place was not valued (estimated) and it is assumed that an existing one will be adopted.

The feasibility study estimates CO_2 emissions reduction by 141.79 tonnes per year (t/a) from the installation (EEC, 2019[1]).

Briquettes or pellet production facilities

A large supply of vine pruning residues and also hazelnut shells, fruit orchard pruning residues, sunflowers, bay leaf residues, and small heat demand may be available. In this case, rather than use biomass locally, it would be better to produce the pellet (or briquettes) for sale on the market and use elsewhere in Georgia. In this case, it is assumed farmers will be compensated for transport costs and receive some additional small incentive.

The production facility that can produce 10 000 t of the pellet annually contains the following stages:

Coarse and rough grinding

In the case of chips, for the coarse shredding, usually trunks, the powerful chippers (with a typical power of up to 150-200 kW) are used. For many agriculture residues, shredding can be skipped.

Pre-grinding prepares the raw material for thermal treatment in a dryer, the highest efficiency of which is achieved for the 10-20 mm fraction. Initial shredding takes place in shaft chippers or hammer chippers equipped with screens of an appropriate size adapted to the final parameters of the granules.

Drying

This process requires prior grinding of the raw material into sawdust/needles with dimensions up to 10-20 mm. This creates the highest drying efficiency because the drying agent penetrates the raw material particles through and reduces the water level to the desired 10-12%.

Drum dryers and belt dryers can be used.

Dryers are installed together with a cyclone station, fans, raw material tank and a furnace with a feeder. The equipment varies depending on the type of dryer. Moisture meters should be used to monitor humidity on an ongoing basis and thus regulate the flow of raw material.

Grinding

Particles need to be the same size before granulation both to produce high-quality granules and to reduce the amount of dust.

The rotating hammers of the hammer mill, in addition to reducing the waste volume, crush the chips, and open the pores and fibre structures. This facilitates the entry of water or water vapour, which results in better compaction of the raw material in the die holes and higher factory efficiency. In addition, appropriate fragmentation softens the lignin fibres.

Conditioning and granulating

The pre-prepared raw material is compacted in the granulator through grinding. Before the raw material reaches the pelletising chamber, it is soaked with water or steam in a conditioner. This is a necessary step for pellet production.

The key element is the matrix and rollers. The matrix parameters are adjusted to the specific raw material.

Cooling

Counterflow coolers have four tasks to fulfil: reducing humidity, increasing mechanical strength, increasing energy value and lowering the temperature of the granules.

After leaving the cooler, the granules are ready for cleaning in a vibrating screen because they are already sufficiently hard and will not be mechanically damaged. Moreover, they become a full-value fuel with high calorific value.

Granule cleaning

After cooling, the granulate can be subjected to final cleaning in a vibrating screen.

A screen separates unwanted crumbs, dust and small pellets and directs them to a pneumatic conveying system that returns them to production, i.e. nothing is wasted.

Clean granules are stored in the granule tank where they are sent to packaging or shipment.

Storage and packaging of granules

Pure granules (pellets) can be stored in a flat warehouse (e.g. straw granulate), expedition silos or in granulate tanks. The choice depends on whether the granules are shipped in bulk or packed.

Pellets are packed in 5-10-15-25 kg bags in automatic or semi-automatic weighing and packing machines or in big bags with a capacity of 0.5-1 t.

The estimated investment costs are around EUR 1 million. The investment and operating cost may vary depending on the quality of residues. As described above, the coarse shredding may be skipped. Further, the drying process will be less needed if the residues are dry.

The estimated CO_2 emissions reduction is 7 150 t/a from the installation. This considers emissions from the alternative fuel (natural gas) that equals 55 kg of carbon dioxide/megajoule (CO_2/MJ) and the respective calorific value of the biomass of 13 000 kilojoule/kilogramme (kJ/kg).

Biomass boilers and equipment for local incineration

Farmers may use residues like wheat or corn straw, sunflowers and the like to heat their farms. The technology requires baling, storage and a boiler suitable to use this kind of residue.

The solution is widely used in Europe. An estimated 4-5 ha of wheat produce enough wheat straw to heat a 250 square metres (m^2) of house of relatively low energy efficiency. The assumed investment costs include a boiler of 30 kWh and a round baler for straw. It is assumed the potential beneficiary will arrange/adopt a storage place, and that the farmer has a tractor.

The estimated CO_2 emissions reduction is 20 625 t/a from the installation based on emissions from the alternative fuel (natural gas) of 55 kg of CO_2/MJ and a calorific value of the biomass needed to heat the house of 375 MJ.

Use of biodegradable waste to produce compost

Another solution to use biodegradable waste from farming and food production is aerobic composting and anaerobic digestion. Composting can be organised at the household level and also by food producers. (It can be also organised as part of a municipal solid waste management, but that is not part of this programme). Thus, the description of technology focuses on home composting in rural areas, composting by food producers and anaerobic digestion in bioreactors of food producers.

Home composting using composting bins

Home composting using bins is the cheapest and simplest way of composting. It requires an organised bin (plastic bin or wooden or cement constructed bin) and time. Home composting requires three basic ingredients:

- Browns – dead leaves, branches, twigs, etc.
- Greens – grass clippings, vegetable waste, fruit scraps and coffee grounds (i.e. garden and kitchen residues).
- Water – the right amount of water, greens and browns is important for compost development.

The composting process produces good quality compost and reduces the amount of waste disposed. In this way, it reduces methane emissions from landfills and lowers the carbon footprint. The compost can be used in gardens, which reduces the need for chemical fertilisers. Thus, composting has also some economic value for households.

Experience shows that a typical backyard composting bin can process about 150 kg of compost annually. The cost of the bin varies from EUR 50-100. It could be cheaper if the beneficiary built the bin, but this would require an awareness campaign. Considering that it is easier to dispose of biodegradable waste, public financial support for the purchase of composting bins will be more effective until such awareness can be built.

The estimated CO_2 emissions reduction is 175.1 kg/a. This reflects the difference between emissions from dumpsites and open burning of 1 193 kg of CO_2eq/t,[1] of waste and emissions from aerobic organic waste composting 26 kg of CO_2/t and annual digestion of 150 kg of bio-waste.

Composting containers

There are several technologies to organise aerobic composting. An installation based on composting containers applies aerobic biological treatment (composting), performed by controlled aeration of waste in containers. The system is mobile and modular, which allows expansion and flexibility according to quantity of waste available in different seasons. System installation is easy, fast and simple, as only a concrete base is required. It is constructed from two or more containers of which one is for equipment (mainly ventilators and automatic control) and the others for composting itself.

The aeration of the waste mass is controlled through a pipe network, which is embedded in the containers. The processed air, which passes through the material, is sent to the biofilter to be deodorised and purified before being released to the atmosphere. Each container has a blower system, a leachate collection system and an automatic adjustment and control system of the treatment. Biological treatment reduces the waste mass, treats it and destroys pathogenic microorganisms. This process produces a stabilised and odourless material, which can be used as fertiliser. As the main advantage of this system, both oxidation/stabilisation and maturation take place in the container. This means that no additional space is required for maturation of the waste piles.

The installation capacity starts from hundreds of tonnes per year but better efficiency is achieved for capacities about 3 000 t/a. The investment costs of the installation vary; a 3 000 t/a capacity would cost about EUR 600 000. The operating costs consist of maintenance, electricity and labour. However, these costs will be compensated by the benefit of non-disposal of the waste and possible use of compost.

The installation can be set up next to the food producer that generates a suitable amount of organic waste for composting.

The estimated reduction of CO_2 emissions is 3 501 t/a. This reflects the difference between emissions from dumpsites and open burning of 1 193 kg of CO_2/t of waste; emissions from aerobic organic waste composting 26 kg of CO_2/t; and annual digestion of 3 000 t of bio-waste.

Bioreactors

Bioreactors are used for anaerobic digestion. They work well with many types of biodegradable waste; fruit and vegetable wastes fit the requirements.

The installation will be set up next to food producers in urban centres that produce enough biodegradable waste. The installation has a minimum 1 500 t/a capacity, although higher capacities are more economically effective. The bioreactor can work almost continuously if supplied with waste. The advantage of the installation is that the produced biogas can be used locally or mixed with natural gas and used in food processing.

The investment costs of the installation vary; a capacity of 1 500 t/a would cost EUR 300 000. The operating costs comprise maintenance, electricity, water and labour. However, the benefit of non-disposal of the waste and possible use of biogas would offset operating costs.

The estimated CO_2 emissions reduction is 1 750.5 t/a. This reflects the difference between emissions from dumpsites and open burning of 1 193 kg of CO_2/t of waste; emissions from organic waste processing of 26 kg of CO_2/t; and annual digestion of 1 500 t of bio-waste.

Reference

EEC (2019), *On Establishment of Biomass Chain for Telavi Municipality*, Energy Efficiency Centre, Tbilsi. [1]

Note

[1] Adjusted value from JASPERS "Calculation of GHG Emissions in Waste and Waste to Energy Projects Dorothee Teichmann & Christian Schempp November 2013 (revised version)", https://jaspers.eib.org/LibraryNP/JASPERS%20Working%20Papers/Calculation%20of%20GHG%20Emissions%20in%20Waste%20and%20Waste-to-Energy%20Projects.pdf.

Annex C. PCM procedures, including criteria, project appraisal criteria, project-ranking procedures and financing rules

Simplified approach

For two project pipelines – local incineration of the biomass boilers and composting bins – there is a limited number of technology providers. Thus, the simplified approach for pre-selected suppliers would be best. This is represented by the EBRD Green Technology Selector.[1]

In short, the implementing agency asks technology providers to submit technical information. After reviewing it, especially the performance of the technology, it issues a certificate for the particular equipment. The baseline may be adjusted periodically to reflect new technology development, maturity of market supply, market penetration rates and technology costs. In addition, the supplier list will be regularly updated to include the latest technologies, materials and new suppliers.

Beneficiaries can use this certificate of pre-approved technologies to apply for public support, i.e. they do not need to fill out an application, only a simplified form for the payment.

The project cycle management (PCM) applied during the second phase of the programme will be complex. To keep administrative and transaction costs for beneficiaries low, in addition to providing loans, the banks will undertake the bulk of the administrative and document preparation work.

It will comprise several distinct stages, including: i) programme preparations; ii) project identification; iii) project development; iv) project eligibility assessment; v) selection of projects for financing; vi) financing of projects; and vii) project implementation. Each stage is detailed in the sections below.

Programme preparations

Programme preparations will comprise preparation of internal procedures, forms and instructions for beneficiaries.

Identification of projects

The first step in PCM is to identify eligible projects that respond to the strategic and specific objectives of the national environmental/climate and energy policy, as well as programme objectives. As discussed earlier, eligible projects are selected from the project pipelines. Only investment projects (i.e. those involving capital outlays) are eligible for financing under this programme. The list of eligible projects will be reviewed on an annual basis by the implementation unit (IU) to ensure the list remains responsive to national environmental/climate and energy policy objectives.

Development of projects

The second step defines the manner in which projects are developed. The IU will promote the project, which will involve publication of leaflets for potential beneficiaries that define eligibility related to projects, beneficiaries and criteria, as well as the type of financing.

Eligibility assessment of projects

The eligibility assessment involves screening projects for compliance with eligibility criteria. If a project is eligible (i.e. if it receives a “no” response to any question in the eligibility assessment), it is rejected and a written explanation is sent to the applicant. The project may be re-evaluated upon modification and re-submission.

If a project is deemed compliant with eligibility criteria, but the prospective beneficiary has not submitted all necessary documentation, the IU requests clarifications.

Selection of projects

Having passed through the previous stage (eligibility screening), the projects are selected for financing and implementation. The process of selecting projects for financing and implementation ends when the budget allocated to the type of projects or the programme as a whole (whichever comes first) for the given period is exhausted.

The IU writes applicants whose projects pass the cut-off level for financing to inform them their project has been selected for financing.

Financing of projects

Once the priority projects have been selected based on available funds, the IU designs the proposed financing scheme for the project. This involves determining the amount of the grant required for the project to be viable.

When the proposed financing schedule has been defined, the IU invites the applicant to negotiations and signature of the contract. The contract shall detail the rights and responsibilities of each party to the agreement, measures to be taken in the event of the beneficiary’s non-compliance with the terms and conditions of the contract, and a disbursement schedule for the approved funds.

Implementation of projects

If the supplier has not already been selected, the beneficiary initiates a tender procedure (in accordance with the public procurement law if the purchases of this beneficiary fall under this law). Once implementation has started, the IU, as per the contract, maintains the right to monitor and inspect the project in a scope not limited to:

- comparing actual to planned results in physical terms (e.g. number and type of equipment)
- monitoring implementation of any accompanying investments.

Management of the programme

Settling payment of the grant

The IU pays beneficiaries in one of two ways:

- Public funds, according to the agreed disbursement schedule, are transferred to the beneficiary, who organises a tender to select a contractor; the beneficiary pays the contractor upon delivery of service and submission of invoice.
- Public funds, according to the agreed disbursement schedule, are transferred to the beneficiary, who organises a tender to select a contractor; the bank pays the contractor upon delivery of service and submission of invoice.

Control and monitoring of project effects

In contrast to the control and monitoring procedures during project implementation, post implementation control and monitoring (*ex post* evaluation) involves determining whether the project has met its stated objectives. Control and monitoring of project effects is primarily the responsibility of the manager of the green public investment programme.

Direct and immediate measurement of project outcomes in terms of CO_2 reduction is difficult. Therefore, it is proposed to monitor only the physical outcomes of the project, namely: the number of new technologies and their capacity installed.

If objectives have not been met, the beneficiary may have to return some or all of the financial support provided under the programme. The contract must clearly regulate such an eventuality.

Maintenance of a database of project and programme effects

A key element of PCM is creating and maintaining a database of project and programme effects. The IU should determine the best format for the database, such as an Excel-based system or a database software. The following parameters need to be reflected and maintained in the database:

- Programme:
  - expenditures by year for each type of project
  - actual expenditures compared to those budgeted
  - calculated CO_2 emission reductions by year.
- Projects:
  - number of projects by type, by year
  - physical outcomes by year: number of new installations by type and capacity
  - calculated emission reductions by year (estimated)
  - project cost effectiveness: cost per unit of emission reduction.

The database should be used to inform future beneficiaries about adjustments and appraisal criteria as needed and to ensure relevancy.

Note

[1] For the Green Technology Selector, see: https://techselector.com/georgia-en/ (accessed on 02 May 2022).

Annex D. Explanatory guide for using the adjusted OPTIC model

The spreadsheet-based Optimising Public Transport Investment Costs (OPTIC) model helps the government of Georgia in the preparation and estimation of the costs and environmental benefits of the programme, in particular in costing the following project pipelines:

- Waste to energy:
  - investment in the supply chain for vine pruning or similar residues for biomass boilers, mainly in public buildings
  - investment in briquettes or pellet production facilities that use residues (hazelnut shells, fruit orchard pruning sunflowers, wheat straw, bay leaf, etc.)
  - investment in biomass boilers and equipment for local incineration of biomass (wheat, corn straw, sunflower).
- Aerobic and anaerobic composting:
  - investment in farmers/household composting bins (aerobic composting)
  - investment in food industry composting containers (aerobic composting)
  - investment in food industry composting bioreactors (anaerobic digestion).

Other types of similar models on the market focus on estimating greenhouse gas (GHG) emission reductions for a country or for groups of countries. These models mainly focus on GHG emissions from industry and consider different scenarios for the country's economic development. These types of models, however, are not suitable for this investment programme, which focuses on reducing emissions only from particular pipelines.

Overall structure of the OPTIC model

The OPTIC model consists of seven modules: i) assumptions; ii) emission factors; iii) determination of subsidy level; iv) cost calculation; v) emission reductions calculation; vi) programme costing and environmental effects.

The model has been prepared in Excel and uses macros. Therefore, when starting the model, the macros in Excel should be enabled. This requires adjusting security settings to "medium". For earlier versions of Excel, security settings can be changed using the following commands: Tools>Macros>Security. For Excel 2010 and 2013, the macro security settings can be set in the "Developer" tab. If the Developer tab is not visible, it can be accessed by going to: File>Options>Customize Ribbon and then selecting Developer from the options in the right-hand window.

Preparations to start using the OPTIC model

The user fills cells that are highlighted in yellow in the Excel sheets.

First, users need to complete the information on assumptions and emission factors. Assumptions can be found under the “Assumptions” tab. The following information is essential for the model: the average price of a new technologies for each project pipeline.

After providing information on basic assumptions, the user next inputs information on emissions from new technologies. This can be found under the “Emission factors” tab. The emissions will be identified in tonnes of the emitted pollutant per year. The information on emissions is key for the calculation of emission reductions (Table A D.1).

Table A D.1. Assumed emissions factors

Investment type	CO_2 (t/year)
Vine pruning or similar residues that will be used for biomass boilers	142
Non-wood briquettes or pellets	7 150
Local incineration in biomass boilers	21
Composting bins	0.1751
Composting containers	3 501
Bioreactors	1 751

Source: OECD, OPTIC model.

Determining the subsidy level

The module on determining the subsidy level considers both investment costs and savings that beneficiaries may achieve by implementing new technologies. For example, the use of the fuel from biodegradable waste will generate operating costs but will also reduce use of other fuels for heating, like natural gas.

The module assumes that investments should generate at least a minimum return for beneficiaries; thus, the social discount rate is used to determine the net present value (NPV) of the project. The subsidy is then determined at the level at which NPV is equal to zero. This subsidy aims to encourage potential beneficiaries to participate in the programme without encouraging them to make a profit based on the subsidy. The calculation of the subsidy level for the local incineration of the biomass is presented in Table A D.2 and Table A D.3.

The cost of equipment (EUR 24 000) was compared with the average cost of a traditional gas boiler (EUR 3 000) that the beneficiary would have purchased without public support.

Table A D.2. Assumptions for calculating the level of public support for local incineration of the biomass

	Investment costs (EUR)	Operating costs (EUR/year)
Local incineration of biomass	24 000	200
Natural gas boiler	3 000	496

Source: OECD, OPTIC model.

Next, the savings on operating costs were considered due to the lower price of the biomass. The parameters used to calculate savings are presented in Table A D.3.

Table A D.3. Calculation of the level of public support for local incineration of the biomass (EUR thousand)

Year	0	1	2	3	4	5	6	7	9
Investment costs for a new local incineration of the biomass	24 000								
Difference in price compared to a standard natural gas boiler	21 000								
Required public support	18 715								
Annual operating cost savings	296	296	296	296	296	296	296	296	296
NPV	0								

Source: OECD, OPTIC model.

Similar calculations are made for other pipelines:

Table A D.4. Assumptions for calculating the level of public support

Type	Investment costs	Alternative investment costs	Operating costs	Reference operating costs	Required public subsidy	Calculated subsidy
	EUR	EUR	EUR	EUR	EUR	%
Vine pruning or similar residues for biomass boilers	94 600	0	4 185	6 490	76 801	81%
Non-wood briquettes or pellets	1 000 000	0	1 415 885	0	500 000	50%
Local incineration in biomass boilers	24 000	3 000	200	496	18 715	78%
Composting bins	50	0	0	4	22	43%
Composting containers	600 000	0			300 000	50%
Bioreactors	300 000	0			150 000	50%

Source: OECD, OPTIC model.

Box A D.1. Determining the optimal subsidy level

The level of the subsidy should be sufficient to attract potential investors/beneficiaries to apply for support from the programme without making the implemented projects profitable. To evaluate a given project, the net present value (NPV) is calculated by totalling the expected net cash flows (cash inflows, or receipts, minus cash outflows, or expenses) over the project operating period. Net cash flows are discounted using the rate that reflects the costs of a loan of equivalent risk on the capital market. An investment will yield a profit if the NPV is positive. All measures that yield a positive NPV using a discount rate that corresponds to the applied rate of return can be deemed beneficial.

The NPV is calculated as in the following formula:

$$\mathrm{NPV} = \sum_{i=1}^{n} \left(NCF_i \times \frac{1}{(1+r)^i} \right)$$

where:

– NCF_i is the net cash flow in the i-th year

– r is the discount rate.

Using discounting considers the investor's expectations with respect to the measure. The NPV need only be greater than zero during the operating period. For the funder, it can be a threshold criterion for support. For the investor, a positive NPV shows the project is worth the investment. Finally, using NPV enables the funder to find the optimal level of support for the programme or an individual project

The calculation of the subsidy level should be based on economic principles: if the project is not profitable for the beneficiary but is socially significant, the subsidy should make it just profitable. In simple terms, the financial NPV including the subsidy should be about zero euros. This would mean the project yields an acceptable rate of return for the investor/project promoter.

The "determination of the subsidy level" module uses this principle by making a simple financial analysis of the cash inflows and outflows in each year of the analysis. Cash inflows (receipts) generated by the project include savings expressed in terms of the money saved by beneficiaries. In terms of cash outflows (expenses), the simple financial analysis totals the difference in investment costs of clean and traditional technologies calculated in the other modules. In the subsidy module, the subsidy is included on the cash outflow side as a negative value.

It was assumed that the investments will be made during the first year of the project and the savings averaged over the nine years of operation. Together, the period of analysis is ten years, a typical lifetime for this type of project. The subsidy is calculated so that the result of the NPV calculation is equal to zero euros.

This approach to calculating the subsidy will enable the government to avoid over-investing, while providing an investment incentive for potential beneficiaries without making it too profitable for investors. Essentially, the subsidy level should provide just the necessary leverage for individual potential beneficiaries to undertake clean investments.

Cost calculation

The cost calculation module under the "Costs" tab shows the estimated investment costs and the required subsidy by the green public investment programme. This information is provided in a table format (as shown in Table A D.5) that contains data on the number of new installations, total investment costs, level of subsidy and net costs to beneficiaries. In this module, users simply input factual information without making any decisions on the programme.

Table A D.5. Investment costs, subsidies and net costs for beneficiaries

Type	Number of investments	Investment costs	Subsidy	Net costs for beneficiary
Vine pruning or similar residues for biomass boilers	1 005	95 073 000	76 058 400	19 014 600
Non-wood briquettes or pellets	5	5 000 000	2 500 000	2 500 000
Local incineration in biomass boilers	1 020	24 480 000	18 360 000	6 120 000
Composting bins	102 000	5 100 000	2 550 000	2 550 000
Composting containers	1	600 000	300 000	300 000
Bioreactors	1	300 000	150 000	150 000
TOTAL		**130 553 000**	**99 918 400**	**30 634 600**

Source: OECD, OPTIC model.

Emission reductions calculation

The emission reductions calculation module, under the “Emissions” tab, shows the estimated annual emission reduction of CO_2. This information is provided in an Excel table (Table A D.6) that contains data on number of new installations, the unit emissions reduction and total emissions reduction from the pipeline. In this module, users simply input the factual information without making decisions on the programme.

Table A D.6. Emissions reduction based on the purchase of new installations

Type	New installations	Emissions reduction	Total emissions
		t CO_2	t CO_2
Vine pruning or similar residues for biomass boilers	1 005	142 499	384 393
Non-wood briquettes or pellets	5	35 750	107 250
Local incineration in biomass boilers	1 020	21 038	55 007
Composting bins	102 000	17 855	88 280
Composting containers	1	3 501	35 010
Bioreactors	1	1 751	17 505
TOTAL		**222 393**	**687 445**

Source: OECD, OPTIC model.

Programme costing and environmental effects

The programme costing and environmental effects module is under the “Decision” tab (Figure A D.1). This is the main module to support decision making. It can be used for automatic calculation of the programme costs and for manual adjustments.

The upper part of the screen contains the information on the programme target. Users may define one of the following programme targets:

- investment costs
- subsidy budget (amount of funding available for subsidies)
- CO_2 emission reduction.

By clicking on the “Go” button to the right of the respective target, the model calculates the programme financial envelope necessary to achieve the target, for that target only, excluding the other targets.

Figure A D.1. Adjusting programme costs and environmental effects

Programme target	Costs			Emissions		
	Investment costs	100	Go	CO2 (t/a)	45 000	Go
	Subsidy budget	50	Go			

Source: OECD, OPTIC model.

The results are presented in an Excel table (Table A D.7) that contains basic information on the number of new technologies, investment costs, subsidies and emission reductions per year. If users want to see details, the “Emissions” or “Costs” tabs should be used (described earlier).

Table A D.7. Relationship between programme costs and environmental effects

Type	Number of installations /equipment	Investment costs	Subsidy	Emissions reduction per year			
		MEUR	MEUR	t CO_2	NO_x*	SO_2*	PM*
Vine pruning or similar residues for biomass boilers	1 005	95.07	76.06	142 499	n/a	n/a	n/a
Non-wood briquettes or pellets	5	5.00	2.50	35 750	n/a	n/a	n/a
Local incineration in biomass boilers	1 020	24.48	18.36	21 038	n/a	n/a	n/a
Composting bins	102 000	5.10	2.55	17 855	n/a	n/a	n/a
Composting containers	1	0.60	0.30	3 501	n/a	n/a	n/a
Bioreactors	1	0.30	0.15	1 751	n/a	n/a	n/a
TOTAL		**130.55**	**99.92**	**222 393**	n/a	n/a	n/a

Note: * More relevant for other sectors than biodegradable waste.
Source: OECD, OPTIC model.

Users may change the project pipelines by providing their own information on the number of new technologies. The calculations are updated accordingly.

Programme costing for Phase 1 (pilot phase) and Phase 2 (scaling-up phase)

In the spreadsheet titled “Programme targets” (Figure A D.2), users may define whether the calculation is for the pilot phase (Phase 1), which covers only two cities, or for Phase 1 and 2.

Figure A D.2. Adjusting programme targets

Phase	1 & 2	Go

Source: OECD, OPTIC model.

By clicking on the “Go” button to the right of the defined scenario, the model calculates the programme costs and emission reductions. The targets are thus ignored.

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Green Economy in Eastern Partner Countries

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Using biodegrable waste in Georgia with support of public expenditure

The green public investment programme for Georgia aims to utilise non-municipal organic waste generated by agriculture, households, food and beverage production. Within EU4Environment, the OECD applied a programmatic approach to create pipelines of priority investment projects that will help the Government of Georgia achieve its environmental and climate-related targets. The programme will support the partner country to process biodegradable waste that is currently disposed in landfills, illegally burned, or dumped in nature. Using the OECD costing model, the programme calculates the level of funding needed for subsidies to convert waste into energy (biomass, biogas) or compost. This will result in a substantial reduction of greenhouse gas emissions, prevent water and soil pollution and will also encourage private investment in environment and climate-friendly technologies. Notably, government officials and experts in Georgia will be equipped with the know-how and practical skills to design similar public environmental expenditure programmes. Such programmes are better positioned to successfully compete for both national and international public support, and to leverage the funds necessary to embark upon a greener and sustainable development path.

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