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An Assessment of Investment Needs for Climate Action in Armenia up to 2030

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An Assessment of Investment Needs for Climate Action in Armenia up to 2030

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Foreword

Estimates of how much money countries need to invest to reach their climate targets over the coming years can support their budget planning and their capital raising strategies. They can also provide visibility to investors on the pipeline of forthcoming investable projects. At the same time, comprehensive assessments of investment needs for climate action up to 2030 and beyond are missing across countries in the South Caucasus as well as in most OECD member countries.

This assessment, conducted by the OECD, shows that Armenia will need to invest at least USD 5.7 billion (AMD 2.7 trillion) in gross fixed assets to reach its climate action targets by 2030; or USD 8.3 billion (AMD 4 trillion) if investments in nuclear energy will go ahead as planned. The assessment underlines the urgency to source the financial means required and allocate them accordingly to reach Armenia's targets.

The current assessment also shows that Armenia should continue to develop more concrete targets, policies and programs up to 2030 and beyond. With the development and elaboration of new and existing government plans and strategies, such as Armenia's energy strategy, the National Adaptation Plan or commitments under the Paris Agreement, financial needs might become clearer in the course of 2021 and beyond and will provide opportunity to refine the present assessment.

Close cooperation and communication with stakeholders spanning the Ministry of Finance, the Ministry of Environment, the private and civil society sphere as well as the international community allow concerted action to develop national capital raising and spending plans. Clear carbon reduction pathways up to at least 2030, including sector-specific targets and policies, will help Armenia implement its commitments under the Paris Agreement and reach carbon neutrality by 2050.

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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 Eastern Partnership Countries or the implementing partners.

This report and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

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Abbreviations and acronyms

ADB	Asian Development Bank
AMD	Armenian Dram
CCGT	combined-cycle gas turbine
EBRD	European Bank for Reconstruction and Development
EE	energy efficiency
EIB	European Investment Bank
EPIU	Environmental Project Implementation Unit
EU	European Union
EUR	Euro
FAO	Food and Agriculture Organization
GCF	Green Climate Fund
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
INDC	Intended Nationally Determined Contribution
IRENA	International Renewable Energy Agency
CAEP	Climate Action Enhancement Package
KFW	KfW Development Bank
MSW	municipal solid waste
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
RE	renewable energy
SFM	sustainable forest management
TAP	Armenia's Technology Action Plan
TNA	Armenia's Mitigation Technology Needs Assessment
UNDP	United Nations Development Programme

UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USD	US Dollar
WWF	World Wide Fund for Nature

1 Context and background of the study

This document, prepared by the OECD Secretariat, develops estimates of the investment needs for climate action in the Republic of Armenia (Armenia). The Ministry of Environment of the Republic of Armenia (Ministry of Environment) and the OECD jointly launched the work in January 2019.

The project aimed to provide an evidence base for policy reform discussion among Armenia's stakeholders and for mobilising finance for climate objectives in line with the country's national targets, for example under the Intended Nationally Determined Contribution (INDC) communicated to the United Nations Framework Convention on Climate Change (UNFCCC). Such stakeholders include Armenian ministries, public and private sector entities (business and the financial sector), development partners and civil society organisations.

There exists a lack in comprehensive data on estimated investment needs for climate action as well as actual and planned climate finance spending. This is common not only across countries in the South Caucasus, but widespread amongst most OECD member countries. Although the landscape of climate finance is slowly improving, an assessment for the members of the European Union, for example, has shown that most countries lack quantified investment needs to achieve their climate action targets (Eichler et al., 2017[1]).

Having even crude estimates of investment needs to reach Armenia's climate targets not only helps fill gaps in knowledge. It can support Armenia in planning investments more strategically, in developing capital raising plans and in providing visibility to investors on the pipeline of forthcoming investable projects (Eichler et al., 2017[1]; OECD, 2018[2]).

Given that Armenia is highly vulnerable to the negative impacts of a changing climate, dependent on energy imports (75% of its total energy supply) and has low industrial and buildings energy efficiency it will need to undertake significant investments in mitigation and adaptation infrastructure. Compounded by a lack of available domestic financial resources, it is important that Armenia uses existing resources efficiently and is able to plan for future funding needs. The current analysis aims to support Armenia with these objectives.

Scope, information sources and methodological background

Based on inputs from Armenian institutions and their development co-operation partners, as well as through its own research, the OECD Secretariat has listed about 50 climate-related actions with indicative investment costs. It estimates indicative needs for investment in gross fixed assets, based on the information obtained from different sources.

As of June 2020, the assessment by the OECD Secretariat captures gross investment costs in the following thematic areas to different extents:

- Forestry

- Agriculture (including land-use)
- Water supply and sanitation
- Energy supply (renewable energy and energy efficiency on the supply side)
- Transport
- Disaster risk reduction
- Waste management
- Industry-sector energy efficiency
- Residential building energy efficiency
- Public building energy efficiency.

While the abovementioned thematic areas are by no means comprehensive to cover the nation-wide investment needs for climate action in Armenia, they are largely aligned with the priority sectors for climate change mitigation and adaptation identified under Armenia's INDC submitted to the UNFCCC in 2015, which is under the process of revision as of 2021. The timeframe applied for the assessment of investment costs is from 2020 to 2030 and aligned with the interim timeframe under Armenia's INDC.

The data gathered comprises both estimates of the amount of investments required and funding that has been pledged. Little of this money has been allocated already. However, with the development and elaboration of new and existing government plans and strategies, such as Armenia's energy strategy or the NDC Partnership Plan, financial needs might become clearer in the course of 2021 and beyond and will provide opportunity to refine the present assessment. The investment needs assessment does not distinguish between the sources of where the funding will come from (private or public entities) because for most sectors this information was not available. If available, however, the accompanying table with project-level data in Annex A shows the sources of finance.

Although the timeframe for the analysis is from 2020 to 2030, some of the targets for sectors and projects have timelines before 2030. This implies that the final numbers might be underestimates, for instance if projects are extended or scaled up before 2030 or plausible upscaling potentials within the period 2020-2030 are not properly captured due to a lack of data.

To obtain information, the OECD Secretariat undertook multiple stakeholder consultations with the following Armenian institutions and their partners, to which the OECD Secretariat is grateful for their valuable input.

Apart from the information from stakeholders, particularly useful documents for the assessment include Armenia's Mitigation Technology Needs Assessment Report (Republic of Armenia Ministry of Nature Protection, 2017[3]) and country programmes or reports from international financial institutions:

- Ministry of Environment (including the Environmental Project Implementation Unit)
- Ministry of Economy (including those in charge of the agriculture sector)
- Ministry of Finance
- Ministry of Territorial Administration and Infrastructure, including the Water Committee and those in charge of the energy sector
- Ministry of Emergency Situations
- Ministry of Transport
- Ministry of Health
- The Central Bank of Armenia
- Armenia Renewable Resources and Energy Efficiency Fund, and
- Development co-operation partners, including ADB, EBRD, EIB, FAO, GIZ, KFW, LDK Consulting, the NDC Partnership Support Unit in Armenia, UNDP, UNIDO, World Bank and WWF.

Challenges and ways forward

It should be noted that the investment cost assessment exercise has faced multiple challenges and would greatly benefit from discussion among relevant government agencies and stakeholders, further methodological development and additional data. The list below outlines main challenges as well as possible ways forward to improve the robustness of investment needs assessment in Armenia in the future. Despite these challenges, the assessment makes an important contribution to fill a gap in knowledge because even a rough comprehensive estimate of the investments needed across sectors did not exist. The main issues identified by the analysis include, but are not limited to, the following:

- **Lack of official targets on sector-specific climate action**: Except for a few renewable energy types, there has been limited information about concrete and officially adopted targets of introduction of particular climate actions towards 2030, while recognising ongoing development of several important strategic documents within the government. The current lack of targets has led to considerable challenges in identifying (i) activities the government officially plans to promote for the next ten years, (ii) robust assumptions on uptake of these activities or technologies, and to a lesser extent (iii) their baselines (i.e. the current levels of their introduction in Armenia).

  It is encouraging that there is a range of ongoing initiatives in Armenia in developing concrete targets and action plans in various policy areas (e.g. a National Adaptation Plan, energy efficiency measures in the industry sector, introduction of sustainable forest management, construction of additional reservoirs, etc.). Such targets and action plans, once they are developed and adopted, would provide important reference points against which investment needs could be assessed.
- **Definitions of climate action and incremental costs**: As in many other countries across the world, Armenia currently does not have a set of clearly defined criteria on what constitutes climate change adaptation or mitigation in the country. For instance, while it is relatively straightforward to consider solar energy projects to be a climate mitigation action, it is less clear whether construction of additional reservoirs is primarily motivated by climate concerns despite its likely benefit for climate risk management (e.g. floods and droughts).

  Therefore, the current figures on investment needs for climate action should be interpreted as investment cost of both (i) activities that primarily target climate mitigation or adaptation (or both) and (ii) activities for which climate objectives are relevant but not the fundamental driver or motivation.[1]

  On the second type, a climate-related project, either mitigation or adaptation or multi-focal, is often embedded within a broader, more general development programme. For instance, while a water-efficient irrigation project would target climate change adaptation to make the agriculture sector more resilient to decreasing water availability due to climate change, it could primarily focus on enhancing agriculture productivity and water security. In which case, a large part of the project could have been implemented without climate-related objectives. Due to limited time and data availability, the current estimation was unable to delineate the incremental costs (i.e. additional costs for climate action) from the total project costs.

  As of June 2020, there is no agreed set of detailed criteria to classify investments with respect to climate objectives. Armenia could, however, benefit from the ongoing EU initiative in developing an EU taxonomy for sustainable activities, aimed at establishing criteria for economic activities with a substantial contribution to a set of environmental objectives, including climate change mitigation and adaptation. The final report on the EU criteria came out in March 2020 and includes screening

[1] For further discussion, see also https://www.oecd.org/dac/environment-development/Annex%2018.%20Rio%20markers.pdf

criteria for 70 climate change mitigation and 68 climate change adaptation activities, including criteria to avoid significant harm to other environmental objectives.[2]

- **Replication and upscaling potentials**: A number of climate-related initiatives will be implemented during the period 2020-2030. Some have already started while others will be implemented after 2020. A number of those initiatives are pilot projects and may have good potentials for upscaling and replication, once they prove effective. In theory the investment needs assessment could take into account such replication or scaling-up potential of certain initiatives regardless of whether they have secured funding. The current assessment, however, has only been able to capture such potential to a very limited extent thus far due to insufficient available information on replicability or scalability of the initiatives.

  Quantified indication of replication or scaling-up potentials of pilot initiatives, as part of their next steps or exit strategies, could provide public- and private-sector actors with a clearer prospect of how some of those piloted projects, technologies and techniques could be further disseminated in Armenia. While understanding it may not be always straightforward, considerations for replicability and scalability form already part of certain funding criteria (e.g. by the Global Environment Facility and the Green Climate Fund).
- **Information on costs for specific activities and technologies**: For many activities and technologies, the project team has not been able to identify information on unit costs of introducing particular technologies in Armenia. The OECD Secretariat used some information from secondary sources such as publicly available studies and academic journals as well as expert judgements through the stakeholder consultation. Cost information available in another country (e.g. the Russian Federation) was also used as a proxy in some cases.
- **Operational costs**: As mentioned earlier, this assessment only looks at investments in (tangible) fixed assets in the selected sectors. The investment needs therefore do not take into account operational and/or maintenance costs of the activities studied. In some sectors, the water supply and sanitation sector for example, operation and maintenance can add significant amounts to the capital costs of infrastructure investments.
- **Net benefits:** The costs specified here as investment needs do not reflect the benefits (e.g. cost saving) that would occur because of the investments. It can be assumed that some of the benefits of the investments listed will be high and might even outweigh their costs in the end. A report by the World Bank found, for example, that building climate resilient infrastructure results in USD 4 in benefit for each USD 1 invested (Hallegatte, Rentschler and Rozenberg, 2019[4]).

  While the agreed scope of this study was only on investment costs, it could be a way forward to investigate sector-specific cost-benefit analysis in selected areas of climate actions.

[2] The final report on the EU taxonomy can be found here: https://ec.europa.eu/info/files/200309-sustainable-finance-teg-final-report-taxonomy_en

Overview of Armenia's climate mitigation and adaptation targets

Armenia sets out to become ecosystem GHG emissions neutral by 2050 (2.07 tons/per capita per year) in its INDC. Armenia has developed and adopted various government decrees as well as plans relating to all aspects of mitigation and adaptation activities, such as sustainable development, energy security, energy efficiency, sustainable agriculture, rehabilitating forests and promoting sustainable forest management, protecting land, soil and water resources as well as waste management. Most of these decrees include targets up to 2020, as mentioned above. As regards renewable energy generation and improving energy efficiency, however, some targets go beyond 2020 and set concrete goals.

The government set a target to increase the share of renewables (excluding large hydropower plants) in the power generation mix from around 10% to 26% by 2025. Two large hydropower plants (more than 30 MW installed capacity) are planned for construction[3] and 30 low performing small hydropower plants are planned to be upgraded (target for 2024). Cities which have joined the Covenant of Mayors aim to achieve 30% GHG emissions reduction by 2030, compared to baseline emissions. Armenia also wants to retrofit almost 20 000 residential and more than 6 000 public buildings to improve their energy efficiency. According to Armenia's Green Climate Fund Country Program, the country wants to have 10 000 electric vehicles in circulation by 2024. Armenia also wants to modernise and upgrade the energy distribution network including energy storage. It wants to improve energy efficiency of small and medium sized enterprises.

Armenia is currently working on refining and updating its National Adaptation Plan (NAP) to advance medium and long-term adaptation planning. Planned adaptation measures include the introduction and cultivation of climate resilient crops, anti-flood and land degradation protection. Armenia wants to introduce agricultural insurance schemes. Plans also involve the rehabilitation of irrigation water networks, construction of new water reservoirs and expansion of modern irrigation systems, including but not limited to drip irrigation, for at least 500 hectares. The protection of Lake Sevan's water and biodiversity forms another goal. Increasing resilience to climate related natural disasters, including the establishment of monitoring and early warning systems, are of particular strategic importance in Armenia's adaptation planning.

Armenia also has ambitious goals to reduce deforestation and increase reforestation and afforestation activities. The country wants to almost double the existing forested area by 2050 compared to 2015 which will require afforestation/reforestation of about 265 000 ha of land. It plans to plant ten million trees by the end of 2021 alone, for reforestation and urban greening. As part of its pledge under the Bonn Challenge, a global effort to restore deforested and degraded land, Armenia is planning to afforest/reforest 50 000 ha of land by 2030.

Some of Armenia's climate mitigation and adaptation targets up to 2030 are more quantitative and measurable than others, as already mentioned. In light of ongoing initiatives, such as the development of Armenia's energy strategy, the NAP, the Green Climate Fund Country Program and the INDC Partnership, as well as policy discussions, the investment needs assessment presented here is limited to the information that was available as of June 2020. Several assumptions have been made as indicated above and are revealed in the detailed list of projects. As Armenia continues to develop concrete targets and action plans in various policy areas and adopts them, the investment needs can be further updated and refined. The investment need assessment presented here can serve as a base on which more detailed and further analyses can build.

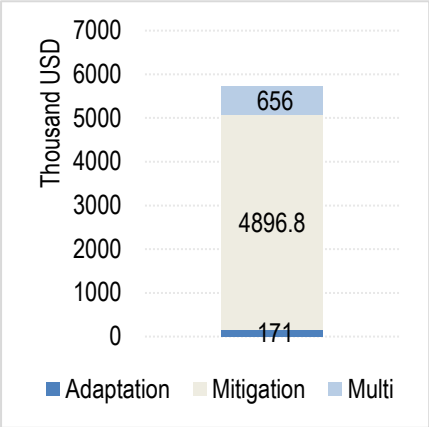
[3] Armenia is currently developing its energy strategy so this information may change.

2 Preliminary results

Based on available data, the preliminary results of the investment needs assessment show that gross investment costs for climate mitigation and adaptation in Armenia for the period 2020 to 2030 would amount to around USD 5.7 billion[4] (AMD 2.7 trillion[5]) if one excludes investment in planned nuclear power.[6] If one were to include nuclear power plant investments, the estimated investment cost would be around USD 8.3 billion (AMD 4 trillion).

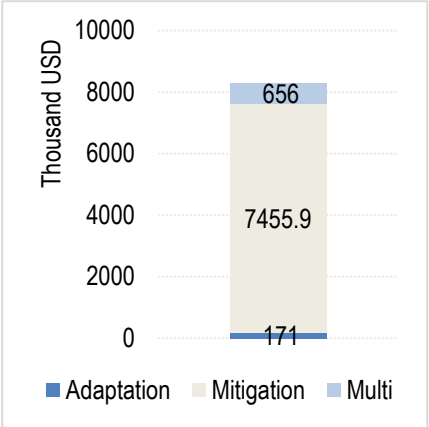
Among the total gross investment needs (without nuclear investment) for 2020 to 2030, the large majority of estimated investment needs (more than 80%) is for climate mitigation, amounting to around USD 4.9 billion (AMD 2.3 trillion) (86% of total). The shares of adaptation investment are over USD 170 million (AMD 82 billion) (3%) and of multi-focal activities (mitigation and adaptation) are over USD 656 million (AMD 315 billion) (11%). Forestry, water and sanitation are classified here as multi-focal activities (as explained further in the sectoral overviews below) and agricultural activities as well as disaster risk reduction are defined as adaptation measures. Energy, transport and waste management are categorised as mitigation activities.

Figure 1. Gross investment needs for adaptation, mitigation and multi-focal activities without nuclear (2020-2030)



Note: In inflation adjusted USD 2019 values.
Source: Author's estimations

Figure 2. Gross investment needs for adaptation, mitigation and multi-focal activities with nuclear (2020-2030)



Note: In inflation adjusted USD 2019 values.
Source: Author's estimations

[4] This is based on USD values in 2017, inflation adjusted for 2019 (with an inflation rate of around 5% roughly). In 2021, 1 USD = 0.83 EUR.

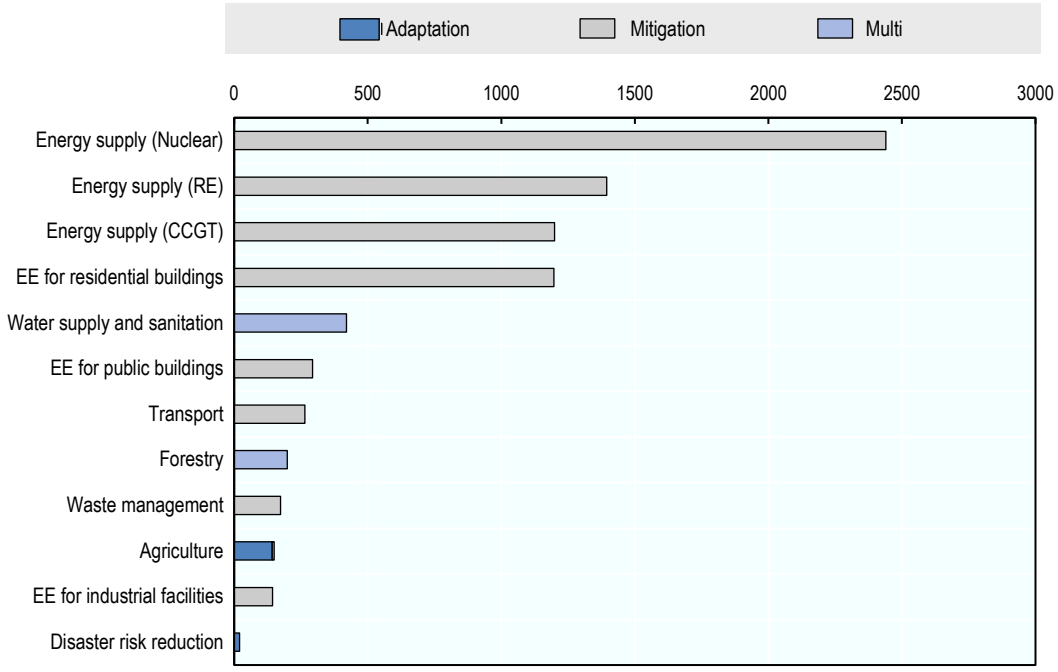
[5] Using January 2020 values of USD 1 = AMD 479.260 from XE Currency Exchange, 12 January 2020.

[6] As of 2021, Armenia is developing its energy strategy and the plans for the development of new nuclear power capacity may change.

Results by sector

The investment needs assessment finds that energy supply is by far the biggest sector that needs investment for climate action (Figure 3). The following section describes each of the sectors in more detail.[7]

Figure 3. Gross investment needs assessment by sector (USD million)



Note: RE= renewable energy; CCGT= combined-cycle gas turbine; EE= energy efficiency.
Source: Author's estimations

Energy supply sector

The energy supply sector would require the largest amount of gross investment in fixed assets for climate action– nuclear energy (USD 2.44 billion) (AMD 1.17 trillion), renewable energy (USD 1.4 billion) (AMD 668 billion) and energy from combined-cycle gas turbine plants (USD 1.20 billion) (AMD 575 billion). These estimates draw on information provided by the Ministry of Energy, the Armenian Country Program for the Green Climate Fund and updated information that was prepared by the UNDP Armenia Office for the country's National Communication to UNFCCC.[8] Breakdown of renewable investment needs would be: USD 800 million (AMD 383 billion) for hydropower (of which USD 240 million (AMD 115 billion) for large hydropower plants, i.e. with installed capacity of more than 30 MW, USD 500 million (AMD 234 billion) for

[7] The following sector-specific dollar values are not inflation adjusted for 2019 because of the different assumptions made for their estimates and differently dated sources. Given that the numbers displayed here should not be taken as precise estimates we ask the reader to understand them as the rough range of the potential size. Some of the numbers are rounded.

[8] This information is currently under development. The information used in this assessment is based on the draft version from 07 May 2020.

medium-sized hydropower and USD 60 million (AMD 29 billion) for small hydropower plants, USD 300 million (AMD 144 billion) for wind energy and USD 295 million (AMD 141 billion) for solar energy. There may be further potential for untapped geothermal resources. This assessment, however, has not been able to obtain concrete plans for the development of these renewable energy sources.

Energy efficiency for residential buildings

Large investments are also needed to improve energy efficiency in the building sector – residential buildings (USD 1.2 billion; around AMD 570 billion) and public buildings (USD 294 million; around AMD 140 billion). The data is based on a study conducted by the LDK Group with support of the European Investment Bank under "EU High Level Initiative on Energy Efficiency in Armenia" and is supplemented with information from the Armenian Country Program for the Green Climate Fund and information from the UNDP Armenia Office for the country's National Communication to UNFCCC.

Industrial energy efficiency

The current estimate for the investment needs for energy efficiency in the industry sector is USD 144 million (AMD 69 billion), based on much less granular information sources and assumptions. Due to imited sector-specific targets it was difficult to find information on different types of energy efficiency technologies, which could have been applied to different kinds of firms and enterprises in the industry sector. As a compromise, this assessment takes 20% improvement of energy efficiency by 2030 as an indicative target. While the 20% resulted out of informal discussion with the Ministry of Energy in light of the EU Association Agreement, this level might lead to considerable underestimation of investment needs. The Ministry of Energy considers that an official target on industry-sector energy efficiency could be determined in 2021, which would serves as a basis for future adjustment to the investment needs assessment.

Water supply and sanitation

Water supply and sanitation could incur significant costs amounting to USD 420 million (more than AMD 200 billion) between 2020 and 2030. This assessment lists water supply and sanitation as multi-focal activities because they can have both mitigation (e.g. energy) and adaptation (e.g. agriculture) impacts, even if the primary motivation for investments in water and sanitation infrastructure would not be climate or energy related (and might have health improvement as their objectives, e.g.).

Especially, the sanitation part of water infrastructure will require significant investments. Because wastewater treatment is costly, not just in terms of investment but even more in terms of operation and maintenance, a review of Armenia's experience with public-private-partnerships in the water sector suggests that large scale implementation of wastewater treatment could be deferred until a later stage when the economic case for it is stronger (World Bank, 2017[5]). It is important to set realistic goals for this sector. According to analysis from the OECD (2017[6]), financing sources are currently not up to par to cover the significant costs. Funding from the central and local governments is very limited, private funding almost non-existent and international funding is going mainly towards water supply (OECD, 2017, p. 54[6]). Tariffs are still too low to cover costs, do not depend on the amount of wastewater produced, do not distinguish between industrial and domestic users and some users are not charged at all (OECD, 2017[6]). Therefore, tariffs would need to be restructured in order to generate additional revenues. The OECD (2017[6]) study proposes some options on what form this could take.

Transport

The possible investment needs for a low-carbon transport system in Armenia could amount to USD 265 million (AMD 127 billion). This number currently covers only an initiative to introduce cleaner public buses, leasing arrangements and financial incentives to support uptake of electric vehicles. The data gathering

exercise found mentions of the goal to increase public transport options, but failed to find concrete projects or quantitative targets. Alongside industrial energy efficiency, this sector again lacks clear government targets which made a more realistic assessment of needed investments difficult. There may be other transport projects planned or underway, but they are not included in this assessment.

Forestry

Forests constitute carbon sinks and therefore can be defined as a mitigation measure. At the same time funding is allocated for sustainable forest management to make Armenia's forests more resilient to a changing climate and prevent wildfires, amongst others. This analysis therefore defines forestry as serving both mitigation and adaptation targets and classifies forestry as multi-focal.

Both preservation of forests and reforestation form important objectives in Armenia's strategy. As mentioned above, Armenia wants to almost double the existing forested area from 11% to 20% by 2050 which will require afforestation/reforestation of about 265 000 ha of land. As part of its pledge under the Bonn Challenge Armenia is planning to afforest/reforest 50 000 ha of land by 2030.

This analysis finds that around USD 200 million (AMD 95 billion) will be needed for mitigation and adaptation in Armenia's forestry sector up to 2030. Given limited available data and a lack of clear and agreed plans for adaptation (and to a lesser extent, mitigation) actions, these figures may be significant underestimates. Due to deforestation through the mining sector, illegal logging and collection of fuel wood by households (around 70% of rural households heat their homes and cook with wood (Food and Agriculture Organisation of the United Nations [FAO], 2018[7])[9]), the scope for more sustainable forest management in Armenia remains large.

Agriculture

The assessment finds that agriculture (USD 150 million; AMD 72 billion) and disaster risk reduction are considered to be the sectors that would require the largest amounts of adaptation finance.

According to KfW Development Bank (2019[8]), 35% of all workers in Armenia make their living in agriculture and most of them are small subsistence and family farms, almost none of which have savings; therefore even small crop failures often cause economic distress. With temperatures in Armenia forecast to rise by between 1.3 to 1.7^{0}C in 2040 and by between 2.6 to 3.2^{0}C in 2070 (Republic of Armenia Ministry of Nature Protection, 2015[9]), rainfall will become more volatile, dry periods and droughts more frequent (KfW Development Bank, 2019[8]; Republic of Armenia Ministry of Nature Protection, 2015[9]). At the same time, hail and frost already often destroy entire harvests of regions causing damage worth millions (KfW Development Bank, 2019[8]).

One adaptation measure includes agricultural insurance. The government of Armenia decided to develop agricultural insurance a few years ago to bring more stable earnings for small farmers and improve their credit standing (KfW Development Bank, 2019[8]). This in turn can enable small farmers to invest in their farms through loans and modernise Armenian agriculture as a whole (KfW Development Bank, 2019[8]). The introduction of insurance schemes has started in 2019. A mix of domestic sources (from the Ministry of Agriculture), bilateral and international funding (KfW and the Climate Investment Fund) will subsidise insurance payments up to 50-60%, for now covering fruit orchards and vineyards against hail, fire and spring frost (Agroinsurance, 2019[10]). Funding for at least 2023 seems to be allocated already for agricultural insurance.

There seem to be plans involving the restoration or augmentation of dams to improve irrigation in the region. However, more detailed information about costs and timelines for this could not be found. If

[9] This information might update in the future due to a methodology revision.

additional investments will be undertaken on dams these should be included in this assessment once available.

Waste Management

Investments to improve waste management in Armenia could amount to around USD 174 million (AMD 83 billion) up to 2030. These costs stem mostly from a number of projects capturing methane or biogas for electricity and heat generation. However, they also include closing landfills and dumpsites in Kotayk and Gegharkunik as well as closing and rehabilitating the Nubarashen landfill site in Yerevan, processing mining waste and protecting surface water from pollution amongst others.

Disaster Risk Reduction

Measures to reduce disaster risk in Armenia could require around USD 20 million (around AMD 10 billion) of investments. This includes an Adaptation Fund supported project to increase the resilience of land and ecosystems, amongst others, to floods. It also includes a project to modernise Armenia's weather, climate and hydrological services.

3 Conclusions

The assessment conducted by the OECD shows that Armenia will need to undertake significant investments between now and 2030 to reach its climate and energy targets. Armenia will need to invest at least USD 5.7 billion (AMD 2.7 trillion) to reach its climate action targets by 2030, USD 8.3 billion (AMD 4 trillion) if investments in nuclear energy will go ahead as planned. Armenia's gross domestic product (GDP) is expected to reach almost USD 13 billion in 2021 and USD 19 billion in 2025 (International Monetary Fund, 2020[11]). Based on these GDP growth projections and assuming the USD 5.7 billion will be spent between 2020 and 2027, over the course of the next seven years Armenia would have to undertake annual investments in the range of 4-6% of its GDP.

The assessment therefore underlines the urgency to source the financial means required and allocate them accordingly to reach Armenia's targets. Close cooperation and communication with stakeholders spanning the Ministry of Finance, the Ministry of Environment, the private and civil society sphere as well as the international community would allow concerted action to develop national capital raising and spending plans.

At the same time, the assessment has shown that Armenia can do more to close existing climate action policy gaps. Armenia can develop and align its policies with the targets it has set up to 2030 and the goal to reach carbon neutrality by 2050. The assessment has shown that concrete targets, policies and programs are missing. Clear carbon pathways including sector-specific targets will help Armenia implement its INDC. One way forward here could be to set out five-year carbon reduction plans. Armenia can then develop policies to reach these targets in the relevant sectors.

The focus of the assessment lay on fixed assets. However, institutional capacity including administrative capacity on climate and energy will need to be built as well and maintained over the coming years. Administrative capacity is crucial to ensure that the investment projects listed in this assessment are well conceptualised, their benefits and costs realistically assessed, that they are well planned, implemented, monitored, finalised and evaluated. Armenia has recognised this and has already dedicated some resources towards capacity building. Additional costs will very likely arise not only for capacity building but also for additional monitoring, reporting and evaluation of the climate actions listed in this assessment and beyond.

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Annex A. Investment needs assessment- project-level information

Sector	Activities	Action type	Start	End	Target to be implemented from 2020-30	Unit	(Gross) Investment cost per unit (USD 1000/ unit)	Operational cost from 2020-30 (USD 1000)	Total (gross) cost from 2020-30 (USD 1000)	Note	Source(s)
Agriculture	Soil erosion prevention through ecological restoration measures	Adaptation		2030	3 500	ha			11 085.00	Soil erosion prevention through ecological restoration measures. (Identified in a GEF-support project as component 2) Perhaps, further up-scale potential exists, since landslides prone areas have been identified with a total surface of 1 221 km^2 (='122.1 ha),' especially affecting Vajots Dzor, Tavush, Lori, Gegharkunik, and Syunik marzes Soil erosion prevention could be done for additional 3 500 to 5 000 ha for the next 10 years (inputs from Ministry of Environment).	GEF Inputs from Ministry of Environment
Agriculture	Windbreaks as climate change adaptation tool	Adaptation	2020	2030	4 000	ha			12 281.48	TNA: The potential area of windbreaks all over the country is around 2 160 ha (the number of potential beneficiaries is 230 000). Planting of 2 160 ha of windbreaks and the maintenance of these during the first year will cost AMD 3 240 million (= USD 6.632 million). Additional comments from Ministry of	Armenia's Technology Action Plan (TAP) Armenia's Mitigation Technology Needs Assessment (TNA) Ministry of Agriculture

										Agriculture: At least 4 000 ha of new forests together with recultivation of existing ones will be reasonable number until 2030.	
Agriculture	Hail nets for newly planted orchards	Adaptation	2020	2030		ha	25		9 542.34		Based on discussion with Ministry of Economy (Agriculture Department); costs from NDC Partnership Action Plan May 2020
Agriculture	Installation of additional irrigation	Adaptation	2020	2030	25 000	ha	2.25		56 250.00	The Water Committee indicated additional 50 000 ha of new irrigation would be possible for the next 10 years. To be conservative and minimise the risk of double counting, the estimate here assumes 50% of them will be implemented.	Based on discussion with Ministry of Economy (Agriculture Department)
Agriculture	Improved irrigation system in Ararat and Armavir marzes	Adaptation		2025	2 000	ha			10 000.00	Grant amount USD 10 million (8.5 million Ministry of Environment; 1.5 million Water Committee. 4 years, 20 cooperatives to be supported, 2000 ha upgraded irrigation, 10 transactions on land consolidation expected.	NDC Partnership Plan May 2020
Agriculture	Climate smart agriculture (Khosrov Forest State Reserve and Dilijan National Park)	Adaptation	2019	2021					2 506.00	Adaptation Fund supported project.	https://www.adaptation-fund.org/wp-content/uploads/2019/01/Armenia_for-web.pdf
Agriculture	Improvements in seed and planting material certification system	Adaptation		2022					84.94		NDC Partnership Action Plan May 2020
Agriculture	Agriculture value chain review	Adaptation		2022					53.22		NDC Partnership Action Plan May 2020
Agriculture	Introduction of more climate resilient crops	Adaptation	2020	2025	5 000	ha	2 625		13 125.00	Diversification of agricultural production in low-lying communities of Meghri region of Syunikmarz and Noyemberyan region of	From EPIU also referred to in TNA

										Tavushmarz.	
Agriculture	Introduction of agriculture insurance	Adaptation	2020	2023		Beneficiary			12 200.00	EUR 5.3 million for the implementation of the pilot program of the agricultural insurance system in Armenia. The main grant amount of EUR 4.8 million was supposed to be directed exclusively to subsidizing the purchase of insurance policies by farmers. The remaining amount of EUR 515 000 went to cover the costs associated with consulting. The Ministry of Agriculture will co-finance the program in the amount of EUR 5 million. The Climate Investment Funds will provide EUR 2 million, of which EUR 200 000 will be used to subsidize the purchase of insurance policies, and EUR 1.8 million – for consulting services. Consulting will be handled by a consortium of three companies. EUR 1.9 million were allocated for the creation of AINA, the retraining of personnel and the formation of the institution of an appraiser, the development of by-laws and the services of a consulting company.	https://agroinsurance.com/en/armenia-govt-approved-the-procedure-for-subsidizing-insurance-payments-under-the-pilot-ag-insurance-program/
Agriculture	Pasture management	Adaptation	2020	2023	720 000	ha	0.008		5 760.00	Removing of lumps, seeding of areas with low level of vegetation, reconstruction of roads and watering system, which will require USD 5.76 million or AMD 2.8 billion (on average, USD 8 000 per 1 000 ha). Targeted size is 720 000 ha in 5 regions.	TNA
Agriculture	Livestock management systems	Adaptation	2020	2023					10 000.00	Identifying and strengthening local breeds and improving local genetics through cross-breeding; comments from Ministry of Agriculture (September 2019): Efficient and affordable adaptation practices need to be developed for the rural poor who are unable to afford expensive adaptation technologies. For instance, reduction of lower number of livestock to more efficient ones.	GCF Country Program Ministry of Agriculture
Agriculture	Sustainable land use	Multi	2020	2030					7 058.82	WWF: EUR 1.5 million for 10 communities which account for 25% of total potential	WWF might be able to provide more detailed

										areas.	information in future
Forestry	Reforestation and afforestation investments on public forest lands	Multi	2025	2030		ha			180 000.00	Information from Ministry of Environment in the light of the national commitment to reforestation.	Derive estimated cost from FAO proposal to GCF To be updated when the project proposal is available.
Forestry	Prevention of wildfires	Multi							3 500.00		Data obtained from UNDP (this measure is also mentioned in NC3, p47)
Forestry	Mitigating deforestation drivers	Multi		2026	9 000	households	0.388888889		3 500.00	Via tailored rural energy efficiency (EE) investments at the household level (appliances and practices) to reduce energy needs and optimization of livestock sector. By 2026, at least 9 000 households from forest adjacent communities in target areas adopt EE practices/ appliances and reduce pressure on forest resources deriving from livelihood activities.	Derive estimated cost from FAO proposal to GCF To be updated when the project proposal is available.
Forestry	Replanting of 10 million trees	Multi	2019	2021	10 000 000	trees			10 000.00	Government funded replanting of 10 000 000 trees by end 2020 (due to COVID-19 by end of 2021).	NDC Partnership Plan May 2020
Forestry	Sustainable forest management	Multi	2020	2027	1 000	ha	1.5		1 500.00	SFM implies complex implementation of technologies and measures: an inventory of tree species should be carried out in the forestry, a nursery farm should be organized, walnut, hazel and cornel trees resistant to global climate change should be recovered, activities should be carried out for the creation of buffer zones of protected areas, forest conservation, protection and ecotourism development.	From EPIU also referred to in TNA
Forestry	Assessment of forest landscape restoration opportunities in Armenia	Multi	2020	2022					250.00		

Disaster risk reduction	Full modernisation of Armenia's Service for Hydrometeorology for weather, climate and hydrological information and services	Adaptation	2020	2025					19 000.00	Red from Hydromet and World Bank report.	P70 of WB/GFDRR (2018) Modernizing Weather, Climate and Hydrological Services: A Road Map for Armenia
Disaster risk reduction	Artik city closed stonepit wastes and flood management pilot project	Adaptation	2019	2023					1 435.00	Adaptation Fund supported project - To improve and to promote self-recovery of more than 300 ha of arable land 190 ha of pastures, 15 ha of hay meadows, 640 ha of artificial forests, 80 ha of water reservoir and other natural landscapes. - To reduce hazards caused by floods and to contribute to adaptation of natural and agricultural landscapes and ecosystems in the impact zone of floods. - To raise awareness and knowledge level.	https://www.adaptation-fund.org/project/artik-city-closed-stone-pit-waste-flood-management/
Water supply and sanitation	Water and wastewater systems	Multi	2015	2032					420 000.00	Total investment costs for water and wastewater systems for 2017-2032 are estimated at AMD 300 billion (about USD 628 million, or about USD 42 million per year). Of this amount, AMD 262.5 billion (87.5%) should be from state investment and AMD 37.5 billion (12.5%) from investments made directly by the lessee for the whole contract duration). ("Water Supply and Sanitation Strategy and Finance Program" approved by the RA Government in August, 2015 cited in source next column); Note: Excludes O&M. OECD study estimates for sanitation alone USD 900 000 required between 2017 and 2027 plus around USD 470 000 for O&M (cited "EUR 52 million additional O&M costs per year").	https://ppiaf.org/documents/5694/download?otp=b3RwIzE1NzIxMTkz OECD, 2017. Reforming Sanitation in Armenia: Towards a National Strategy

Energy supply (RE)	Small hydro power	Mitigation		2025	0	MW	3 525			Data obtained from Min of Energy Cost data from IEA (Russia).	Ministry of Energy IEA
Energy supply (RE)	Medium-size hydro power	Mitigation		2022	176	MW	2 840		499 840.00		IRENA (2017) Ministry of Energy
Energy supply (RE)	Large hydro power	Mitigation			44.7	MW			240 000.00	Reconstruction and rehabilitation of Sevan – Hrazdan Irrigation System.	GCF Country Program
Energy supply (RE)	Solar (large)	Mitigation		2022	215	MW	815		175 225.00		Ministry of Energy
Energy supply (RE)	Solar (small)	Mitigation		2020	106	MW	940		99 640.00		Ministry of Energy
Energy supply (RE)	Installation of solar panels and engagement of farmers from vulnerable communities under the franchising scheme	Mitigation		2024					10 000.00		GCF Country Program
Energy supply (RE)	Wind	Mitigation		2025	300	MW	1 000		300 000.00		Ministry of Energy
Energy supply (RE)	Geothermal	Mitigation		No target	0	MW	4 800				
Energy supply (Nuclear)	Nuclear	Mitigation		2027	600	MW	4 066		2 439 600.00	Data obtained from Ministry of Energy Cost data from IEA.	Ministry of Energy IEA
Energy supply (CCGT)	New Combined cycle gas turbine power plants 1	Mitigation	2021	2021	234	MW	1 282		299 988.00	UNDP estimation under LEAP Cost information from ADB	UNDP ADB (https://www.adb.org/sites/default/files/project-documents/51090/51090-001-rrp-en.pdf) Ministry of Energy
Energy supply (CCGT)	New Combined cycle gas turbine power plants 2	Mitigation	2021	2021	300	MW	3 000		900 000.00	UNDP estimation under LEAP.	Ministry of Energy

Energy supply (RE)	Renewable energy financing tool" – credit line to the 1) autonomous producers, 2) Utility scale solar projects, and 3) existing small hydropower plants	Mitigation							20 000.00		GCF Country Program
Energy supply (RE)	Technical upgrades of low performing small hydropower plants	Mitigation							50 000.00		GCF Country Program
EE for residential buildings	Construction and mortgage lending facility for implementation of high class energy efficiency projects in residential buildings	Mitigation	2020	2030					50 000.00	Construction and mortgage lending facility" for implementation of high class energy efficiency projects in residential construction field to be followed by converting initial loans to the mortgage loans to private individuals.	GCF Country Program
EE for residential buildings	EE retrofit in residential buildings	Mitigation	2020	2030	7 700				1 096 594.43	19 000 residential buildings (100 million m^2).Through discussion with Ms Astghine Pasoyan, it is assumed that 7 700 buildings will be rehabilitated over 11 years from 2020 to 2030.	High Level Initiative on Energy Efficiency in Armenia: GAP ANALYSIS FOR BUILDINGS ENERGY EFFICIENCY
EE for residential buildings	Construction of energy efficient and renewable energy	Mitigation		2024					50 000.00		GCF Country Program

	powered residential district for vulnerable families										
EE for public buildings	EE retrofit in public buildings	Mitigation	2020	2030	1320				277 395.60	6 550 public buildings Based on input from Ms Astghine Pasoyan, the OECD assumes that 1 320 buildings will be rehabilitated over 11 years from 2020 to 2030.	High Level Initiative on Energy Efficiency in Armenia: GAP ANALYSIS FOR BUILDINGS ENERGY EFFICIENCY
EE for public buildings	Energy efficient street lighting in Gyumri Municipality	Mitigation	2020	2023	863				8 705.88	EBRD funded; grant agreement signed 3 March 2020.	NDC Partnership Plan May 2020; More info in EBRD progress report
EE for public buildings	Energy efficient street lighting in Yerevan	Mitigation	2020	2021	892				7 764.71	CO_2 savings 892 t p/a Electricity savings 2 084 MWh p/a	NDC Partnership Plan May 2020; More info in EBRD progress report: http://armenia-ndcpp.s3-website.eu-central-1.amazonaws.com/pp/10.2-armenia-ebrd-progress-report.pdf
EE for industrial facilities	Industrial sector energy efficiency	Mitigation	2020	2030	20	%			133 977.60	20-30% improvement of all economy Indicative target by Ministry of Energy, based on NEEAP and the EU Association Agreement. The final goal will be defined in the program to be developed in 2021	Ministry of Energy
EE for industrial facilities	SME Financing tool – credit line for energy efficiency upgrades of SMEs	Mitigation		2024					10 000.00		GCF Country Program
Transport	Leasing electric vehicles	Mitigation		2024	10 000				20 000.00	GCF: 10 USD million. Acba Leasing: USD 10 million	GCF Country Program
Transport	Financial	Mitigation						20 000	20 000.00	The proposed project is aimed at designing	GCF Country Program

	instrument to increase private uptake of Evs							000		of financial instruments that will address low-emission transport issues through providing concessional loans and subsidies to those citizens of Armenia willing to procure Electric Vehicles (or replace ordinary ones with EVs).	
Transport	Replacing buses	Mitigation	2020	2030	1 500	buses	150		225 000.00		Ministry of Transport (expert judgement)
Waste management	Utilization of methane form Yerevan city landfill for electricity and heat production	Mitigation	2015	2029	140 000	Gg CO_2-eq			33 411.76	EIB funded. Also involves construction of a new sanitary landfill and closure and rehabilitation of the existing Nubarashen.	TNA 2 EBRD projects; NDC Partnership Plan May 2020
Waste management	Complex processing of Artik mining waste	Mitigation			0.8	Gg CO_2-eq			20.50	Investment cost is calculated based on the information available in TNA. This information was developed under the TNA.	TNA
Waste management	Surface water resource protection from pollution (Compact)	Mitigation			2.2	Gg CO_2-eq			22.40	Investment cost is calculated based on the information available in TNA. This information was developed under the TNA.	TNA
Waste management	Surface water protection from pollution (Natural)	Mitigation			2	Gg CO_2-eq			18.00	Investment cost is calculated based on the information available in TNA. This information was developed under the TNA.	TNA
Waste management	Utilization of biogas originated from chicken manure and heat (electric) energy cogeneration system (CHP) in "Aras Poultry Factory" CJSC	Mitigation		2024	12.4	Gg CO_2-eq			120 000.00	Investment cost updated from GCF Country Program. Target and unit to be updated since this information was developed under the TNA.	GCF Country Program TNA
Waste management	Existing Lusakert	Mitigation			25	Gg CO_2-eq			50.00	Investment cost is calculated based on the information available in TNA. This	TNA

	biogas plant operation and reissuance organizational technology									information was developed under the TNA.	
Waste management	Chicken manure recycling and processing of granular organic fertilizer	Mitigation			3	Gg CO_2-eq			20.00	Investment cost is calculated based on the information available in TNA. This information was developed under the TNA.	TNA
Waste management	Establishment of waste treatment facilities (2) in remote and low populated rural communities via introducing pyrolysis technology	Mitigation	2020	2030	100 000	tCO_2/year			300.00	It is intended to install pyrolysis facilities (installation of mobile facilities is also considered) in the rural and low populated areas where provision of the waste collection services is limited and costly.	From Ministry of Territorial Administration
Waste management	Pilot project on introduction of waste segregation culture in one of average-size (with population of 20 000) communities in Armenia	Mitigation	2020	2030	600	tCO_2/year			100.00	In the result of the implementation of the project bins for segregated waste collection will be installed in the community and 600 tonnes of MSW will be derived from landfills annually. Emissions reductions into the atmosphere by 600 tonnes CO_2-eq per year. The pilot project aims at introduction of waste segregation culture among population.	From Ministry of Territorial Administration
Waste management	Closure of dumpsites and landfills in Kotayk and Gegharkunik regions	Mitigation	2020	2030	7 300	tCO_2/year			20 000.00	A sanitary landfill is to be constructed in Kotayk and Gegharkunik regions and all the MSW generated in those regions are to be taken to that landfill. All the existing dumpsites and landfills in those regions should be closed.	From Ministry of Territorial Administration

Administrative capacity	Synergies in mitigating climate change, adapting to its consequences and conserving Armenia's unique ecosystems, including biodiversity, land and waterborne habitats	Multi	2020	2020					190.00	Project pipeline and portfolio management capability.	NDC Partnership Plan May 2020
Administrative capacity	Establishment of a climate change department in the Ministry of Environment	Multi							247.00	EUR 220 000; could be some overlap with project below.	From CAEP and information from Ministry of Environment
Administrative capacity	Smart local climate action monitoring, including improved monitoring and oversight of local governments' actions in energy efficiency, climate change mitigation and adaptation	Multi							298.80	Not started, looking for funding. Point 2 in the NDC Partnership Plan aims to establish a system of climate monitoring and reporting in Armenia; there are various actions listed which are not costed. Costs for this activity are listed and therefore included here. Overall needs for monitoring and evaluation likely to be much higher and costs will need to be estimated.	NDC Partnership Plan June 2020

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Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

An Assessment of Investment Needs for Climate Action in Armenia up to 2030

Comprehensive assessments of investment needs for climate action up to 2030 and beyond are scarce across countries in the South Caucasus as well as in most OECD member countries. Estimates of how much Armenia will need to invest to reach its climate targets over the coming years can support Armenia in its budget plans, in its capital raising strategy and in providing visibility to investors on forthcoming investable projects.Through information provided by Armenian institutions and their development co-operation partners, as well as through its own research, the OECD Secretariat has estimated investment costs in gross fixed assets for around 50 climate-related actions in Armenia.

The assessment shows that Armenia will need to invest at least USD 5.7 billion (AMD 2.7 trillion) in gross fixed assets to reach its climate action targets by 2030; USD 8.3 billion (AMD 4 trillion) if investments in nuclear energy goes ahead as planned. The assessment has faced a number of obstacles, mostly related to limited data availability. The intention is to have this document as a starting point for discussion amongst relevant stakeholders and to suggest ways in which the present assessment can be improved in the future.

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