Annex 10

Economic Analysis

to the GCF Funding Proposal (Simplified Approval Process)

ALBAdapt – Climate Services for a Resilient Albania

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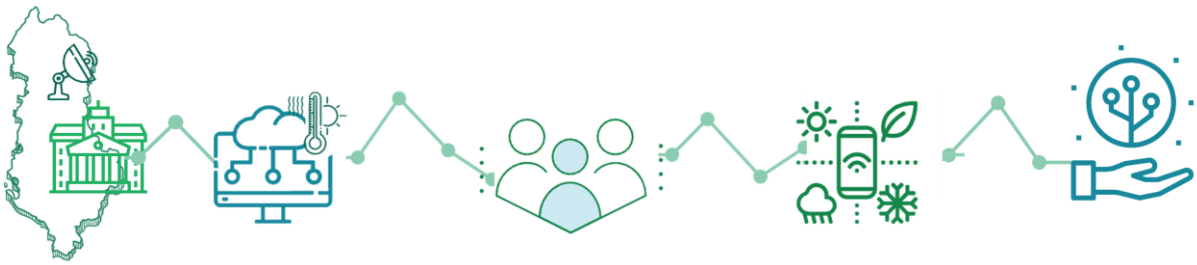

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Abbreviations and Acronyms

BCR	Benefit-Cost Ratio
BEP	Break-Even Period
CIEWS	Climate Information and Early Warning System
EU	European Union
ENPV	Economic Net Present Value
EIRR	Economic Internal Rate of Return
EWS	Early Warning System
GDP	Gross Domestic Product
IGEO	Institute of Geosciences
IMF	International Monetary Fund
IRR	Internal Rate of Return
MHEWS	Multi-Hazard Early Warning System
NAP	National Adaptation Plan
NC	National Communication
NCPA	National Civil Protection Agency
NDC	Nationally Determined Contribution
NMHS	National Meteorological and Hydrological Service
NPV	Net Present Value
RCP	Representative Concentration Pathway
SDR	Social Discount Rate

1. Cost-Benefit Analysis of the Albanian CIEWS

1.1 CIEWS Costs and Benefits

The benefits arising from the restructuring or establishment of the National Meteorological and Hydrological Service (NMHS) and National Framework for Climate Services (NFCS) in conjunction with a Multi-Hazard Early Warning System (MHEWS) – hereafter referred to as a Climate Information and Early Warning System (CIEWS) to connote the combination of the systems – stem partly from avoiding the costs associated with climate hazards. Additionally, the enhanced accuracy and timeliness of climate information provided to end-users can support productivity gains as climate-sensitive sectors integrate such information into their everyday operations.[1]

The International Monetary Fund (IMF) estimates that natural disaster losses in Albania averaged ~Euro 18.8 million per year in nominal terms (~Euro 15.0 million in real terms) in the period 1980-2021.[2] The World Bank estimates natural disaster losses of ~Euro 21.9 million in nominal terms (~Euro 17.5 million in real terms) per year.[3] The NAP provides an annual nominal estimate of ~Euro 36.3 million (~Euro 29.1 million in real terms).[4] Other sources provide considerably higher estimates.[5] The economic analysis uses a consensus (average) estimate of Euro 25.7 million nominal (Euro 20.5 million real) as the annual damage stemming from climate-induced hazards. This is considered to be a conservative damage rate, as it disregards the fact that the frequency and severity of climate hazards are expected to increase in the future.[6]

The World Bank estimates that a functional CIEWS in South-Eastern Europe can be expected to avoid approximately 10-50% of damage costs arising from climate hazards.[7] This damage avoidance capability is derived empirically and incorporates various effects, including forecast accuracy, warning lead times, public trust in warnings, dissemination-related factors and non-linearities/threshold effects. The World Bank notes that its estimate of avoided damage capability is conservative because it does not incorporate indirect losses: i.e. the loss in output that results from the loss in assets.

The economic analysis provides a central scenario that incorporates 20% damage cost avoidance (i.e. Euro 5.1 million per year in nominal terms; Euro 4.1 million per year in real terms), as well as a more conservative scenario (10% avoided damage costs – Euro 2.1 million per year in real terms) and a more optimistic scenario (50% avoided damage costs – Euro 10.3 million per year in real terms).

Further, the World Bank estimates that the productivity gains in climate-sensitive sectors arising from a functional CIEWS range from 0.1-1% of gross domestic product (GDP).[8] Such impacts are widely acknowledged in the literature.[9] For reasons of conservativeness, the economic analysis considers productivity increases for only three sectors: agriculture (19% of GDP), tourism and travel (10% of

[1] Hallegate, S. (2012), 'A cost-effective solution to reduce disaster losses in developing countries: hydro-meteorological services, early warning and evacuation', *World Bank Policy Research Working Paper*, No. 6058: https://openknowledge.worldbank.org/server/api/core/bitstreams/f9fc0526-63bf-5ac0-b690-2b818ebab967/content
[2] IMF (2022), *Albania: Selected Issues*: https://www.elibrary.imf.org/downloadpdf/journals/002/2022/363/002.2022.issue-363-en.pdf
[3] World Bank (2008), *Strengthening the Hydrometeorological Services in South Eastern Europe*: https://www.preventionweb.net/files/7650_StrengtheningHydrometeorologicalSEE1.pdf
[4] Republic of Albania (2021), *National Adaptation Plan for Climate Change in Albania*: https://unfccc.int/sites/default/files/resource/National_Adaptation_Plan_Albania.pdf
[5] For example: World Bank (2019), *Climate-Resilient Road Assets in Albania*: https://openknowledge.worldbank.org/bitstream/handle/10986/31616/Climate-Resilient-Road-Assets-in-Albania.pdf?sequence=1&isAllowed=y; Cinaj, V. and Ribaj, R. (2021), 'Macroeconomic impact of natural disasters in Albania', *Ovidius Economic Sciences Series*, 21: https://stec.univ-ovidius.ro/html/anale/RO/2021/Section%201%20and%202/8.pdf
[6] Republic of Albania (2022), *Fourth National Communication of the Republic of Albania under the UNFCCC*: https://unfccc.int/sites/default/files/resource/Fourth%20National%20Communication%20of%20Albania%20to%20the%20UNFCCC_EN.pdf?download
[7] Hallegate, S. (2012), 'A cost-effective solution to reduce disaster losses in developing countries: hydro-meteorological services, early warning and evacuation', *World Bank Policy Research Working Paper*, No. 6058: https://openknowledge.worldbank.org/server/api/core/bitstreams/f9fc0526-63bf-5ac0-b690-2b818ebab967/content
[8] Hallegate, S. (2012), 'A cost-effective solution to reduce disaster losses in developing countries: hydro-meteorological services, early warning and evacuation', *World Bank Policy Research Working Paper*, No. 6058: https://openknowledge.worldbank.org/server/api/core/bitstreams/f9fc0526-63bf-5ac0-b690-2b818ebab967/content
[9] ODI (2020), *The 'Triple Dividend' of Early Warning Systems*: https://cdn.odi.org/media/documents/202006_odi_triple_dividend_wp_final.pdf

GDP), and energy (12% of GDP). These are considered by the IMF (2022)[10] to be the most climate-sensitive sectors of the Albanian economy.

The existence of a functional CIEWS in Albania is expected to boost the productivity of these sectors in the following ways:

- In the agriculture sector, accurate weather forecasts are vital for planning purposes (e.g. planting dates and fertilizer application). Timely and accurate forecasts, combined with an effective early warning system, are particularly important in the Albanian context, where the agricultural sector is dominated by unsophisticated, information-poor farmers: 86% of farms are family-owned and smaller than 2 hectares in size.[11]
- In the tourism and travel sector, weather is a predictor of future activities (e.g. hotel bookings, site visits, etc.)[12] and weather forecasts can be used to predict road traffic, plan road salting and other preventive actions, etc.[13]
- In the energy sector, weather forecasts are used to manage production. The Albanian energy sector is unusually sensitive to weather/climate: 99% of electricity is generated by hydro-power, and additional wind (220 megawatts, MW) and solar PV (240 MW) capacity is coming online.[14] Weather forecasts can also be used to manage demand, notably relating to space cooling.[15]

Together, the agriculture, tourism and travel, and energy sectors account for ~41% of Albania's GDP, or approximately Euro 6.6 billion in real terms. A productivity gain of 0.1% applied to these sectors equates to approximately Euro 6.6 million in real terms; a gain of 1% equates to Euro 65.6 million in real terms.

Avoided damage costs and productivity gains are converted from nominal to real values by stripping out direct taxes.[16] In 2018, direct taxes were approximately 26% of GDP[17]; in 2021, they were approximately 19%.[18] An intermediate value of 20% has been used in the economic model.

The real investment cost of establishing / improving the CIEWS is approximately Euro 34.83 million in real terms. Based on consultations with the Institute of Geosciences (IGEO) (the NMHS) and the National Civil Protection Agency (NCPA) (early warnings), annual real operating costs of the CIEWS put in place by the project are estimated to be approximately Euro 1 million in real terms. The ramp-up of operating costs reflects the project's installation schedule for hardware and software.

1.2 Model Scenarios

The benefit-cost calculation consists of:

- Benefits: avoided climate damage costs; productivity gains in climate-sensitive sectors.
- Costs: investment costs; annual operating costs.

Benefits and costs are calculated annually over a 20-year period: seven years of project implementation[19] plus 13 subsequent years of CIEWS operation. For the purpose of calculating the

[10] IMF (2022), *Albania: Selected Issues*: https://www.elibrary.imf.org/downloadpdf/journals/002/2022/363/002.2022.issue-363-en.pdf
[11] Zhllima, E. et al (2022), 'Awareness of climate change impact and adaptation in agriculture – the case of Albania, *European Countryside*, 14: https://media.proquest.com/media/hms/PFT/1/m36VQ?_s=w6n8uHg8ny9pMY1kQt4qS3KyDNk%3D
[12] Vrana, V. (2023), 'Sustainable tourism development and innovation: recent advances and challenges', *Sustainability*, 15: https://mdpi-res.com/d_attachment/sustainability/sustainability-15-07224/article_deploy/sustainability-15-07224-v2.pdf?version=1682558379
[13] World Bank (2019), *Climate-Resilient Road Assets in Albania*: https://documents1.worldbank.org/curated/en/696431556877729366/pdf/Climate-Resilient-Road-Assets-in-Albania.pdf
[14] Gebremedhin, A. and Zhuri, M. (2020), 'Power system analysis: the case of Albania', *International Journal of Innovative Technology and Interdisciplinary Sciences*, 3: https://ntnuopen.ntnu.no/ntnu-xmlui/bitstream/handle/11250/2994149/Gebremedhin.pdf?sequence=1&isAllowed=y
[15] ERE (2020), *The Situation of the Power Sector and ERE Activity During 2019*: https://ere.gov.al/doc/ERE_annual_report_2019_26102020.pdf
[16] Indirect taxes such as VAT are already excluded from GDP statistics.
[17] IMF (2022), *Albania: Technical Assistance Report: Tax Policy Reform Options for the MTRS*: https://www.elibrary.imf.org/downloadpdf/view/journals/002/2022/052/article-A001-en.pdf
[18] Stermugu, A. and Ballkoçi, V. (2022), 'The impact of direct tax and indirect tax on economic growth in Albania', *American International Journal of Business Management*, 9: https://www.aijbm.com/wp-content/uploads/2022/09/I598287.pdf
[19] The implementation period of the ALBAdapt project is six years (72 months). This is expected to span seven calendar years.

economic net present value (ENPV) and to provide a sensitivity analysis, three social discount rates (SDRs) have been taken into account, namely 0%, 5% and 10%.

The Nationally Determined Contribution (NDC), the National Adaptation Plan (NAP) and the National Communication (NC) do not provide any guidance on what SDR should be used in Albania. However, the values of 0%, 5% and 10% are informed by the discount rates used by EU Member States and they are commonly used rates in the literature and other GCF project proposals. For example, a World Bank climate adaptation study in Albania uses an SDR of 4.5%.[20]

In the context of sensitivity analysis, the GCF EFA Guidance suggests using an SDR equal to twice the country's per capita growth rate. According to the World Bank[21], the per capita GDP growth rate for Albania over the period 1998-2022 was 5.2%; thus, use of the 10% discount rate is consistent with the GCF guidance.

The economic model produces valuation results – the economic net present value (ENPV), the economic internal rate of return (EIRR), the benefit-cost ratio (BCR) and the break-even period (PEB) – for three scenarios and three social discount rates (0%, 5%, 10%):

- **Conservative scenario**: 10% avoided damage costs; 0.1% sectoral productivity gains.
- **Central scenario**: 20% avoided damage costs, 0.1% sectoral productivity gains.
- **Optimistic scenario**: 50% avoided damage costs, 1% sectoral productivity gains.

Table 1: Real Benefits From The Fully-Functional CIEWS (Euro millions)

Scenario	Annual Avoided Damage	Annual Increased Productivity	Total Annual Benefits
Conservative	2.053	6.560	8.614
Central	4.107	6.560	10.668
Optimistic	10.269	65.600	75.869

Table 2: Annual CIEWS Real Benefits (Euro millions)

Year	Conservative Scenario	Central Scenario	Optimistic Scenario
1	-	-	-
2	-	-	-
3	1.723	2.134	15.174
4	3.446	4.267	30.348
5	5.168	6.401	45.521
6	6.891	8.534	60.695
7	8.614	10.668	75.869
8 – 20	8.614	10.668	75.869

Table 3: Annual CIEWS Real Investment and Operational Costs (Euro millions)

Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Years 8-20
CIEWS Investment Costs	2.067	5.749	5.749	5.749	5.749	5.749	4.009	-

[20] World Bank ESMAP (2009), *An Assessment of Climate Change Vulnerability, Risk and Adaptation in Albania's Energy Sector*: https://www.esmap.org/sites/default/files/esmap-files/BN002-09_Albania_An%20Assessment%20of%20Climate%20Change%20Vulnerability,%20Risk,%20and%20Adaptation%20in%20Albania%27s%20Energy%20Sector%20(ENG).pdf

[21] https://api.worldbank.org/v2/en/indicator/NY.GDP.PCAP.KD.ZG?downloadformat=excel

CIEWS Operational Costs	-	-	-	0.1	0.2	0.4	0.8	1.0
CIEWS Total Costs	2.067	5.749	5.749	5.849	5.849	6.149	4.808	1.0

Table 4: Annual CIEWS Real Net Benefits (Euro millions)

Net Benefits (Benefits-Costs)			
Year	**Conservative**	**Central**	**Optimistic**
1	(-2.066)	(-2.066)	(-2.066)
2	(-5.749)	(-5.749)	(-5.749)
3	(-4.026)	(-3.616)	9.424
4	(-2.404)	(-1.582)	24.497
5	(-0.781)	0.450	39.571
6	0.741	2.384	54.545
7	3.804	5.858	71.059
8-20	7.614	9.668	74.869

2. CIEWS Economic Performance

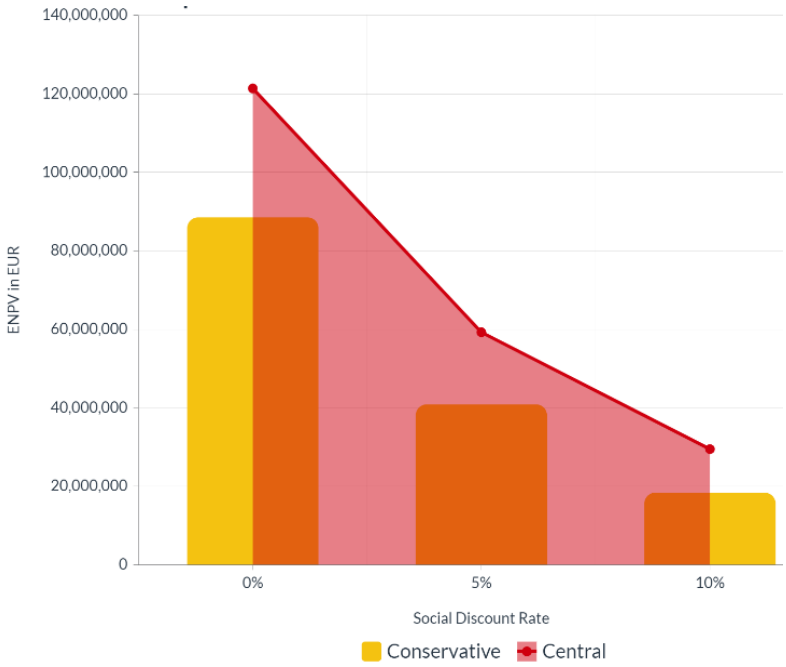
2.1 Economic Net Present Value (ENPV)

ENPV values are positive for all three scenarios across the three social discount rates used. The ENPV under the central scenario with a 5% SDR is Euro 59.2 million. Even under the conservative scenario with a 10% SDR, the ENPV is clearly positive (Euro 18.3 million).

Table 5: ENPV Results (Euro millions)

Scenario	ENPV (0% SDR)	ENPV (5% SDR)	ENPV (10% SDR)
Conservative	88.497	40.834	18.341
Central	121.358	59.227	29.444
Optimistic	1,164.58	643.135	381.916

Figure 1: ENPV Under the Conservative and Central Scenarios



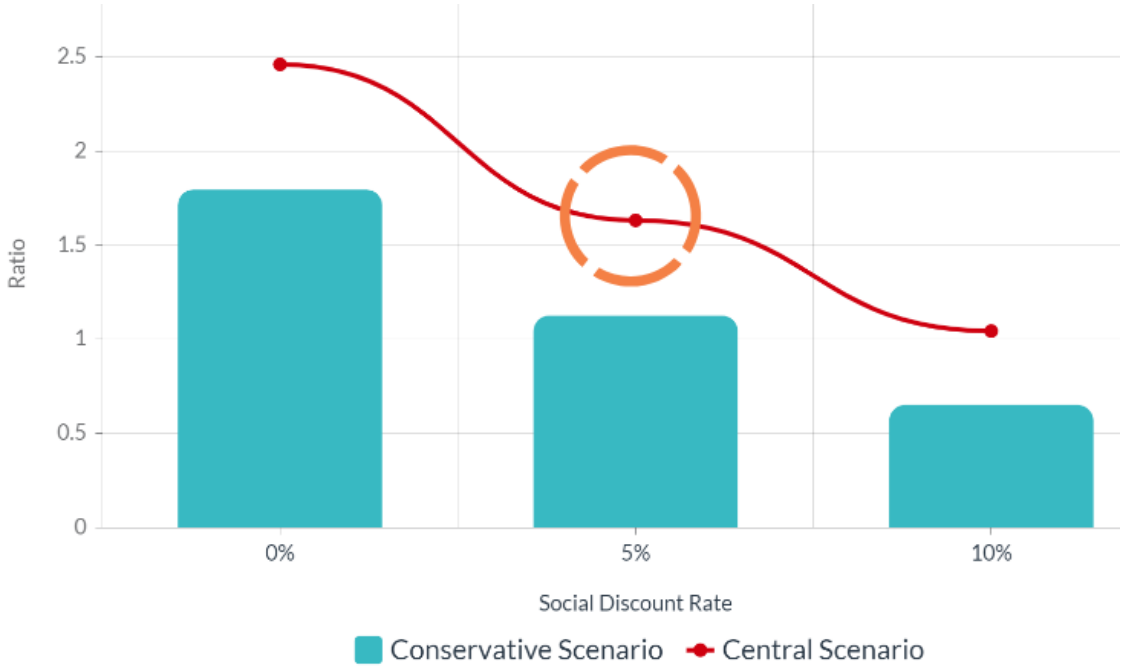
2.2 Benefit-Cost Ratio (BCR)

BCR ratios are greater than 1 for all scenarios except for the conservative scenario with a 10% SDR. Given the extreme conservativeness of the conservative scenario and the use of what is considered to be an artificially high SDR, the less-than-unity value of the BCR in this extreme case is understandable. The central case BCR under a 5% SDR – 1.63 – is considered to be more realistic, albeit itself still a rather conservative estimate of the project's economic value.

Table 6: BCR Results

Scenario	BCR (0% SDR)	BCR (5% SDR)	BCR (10% SDR)
Conservative	1.79	1.12	0.65
Central	2.46	1.63	1.04
Optimistic	23.61	17.71	13.53

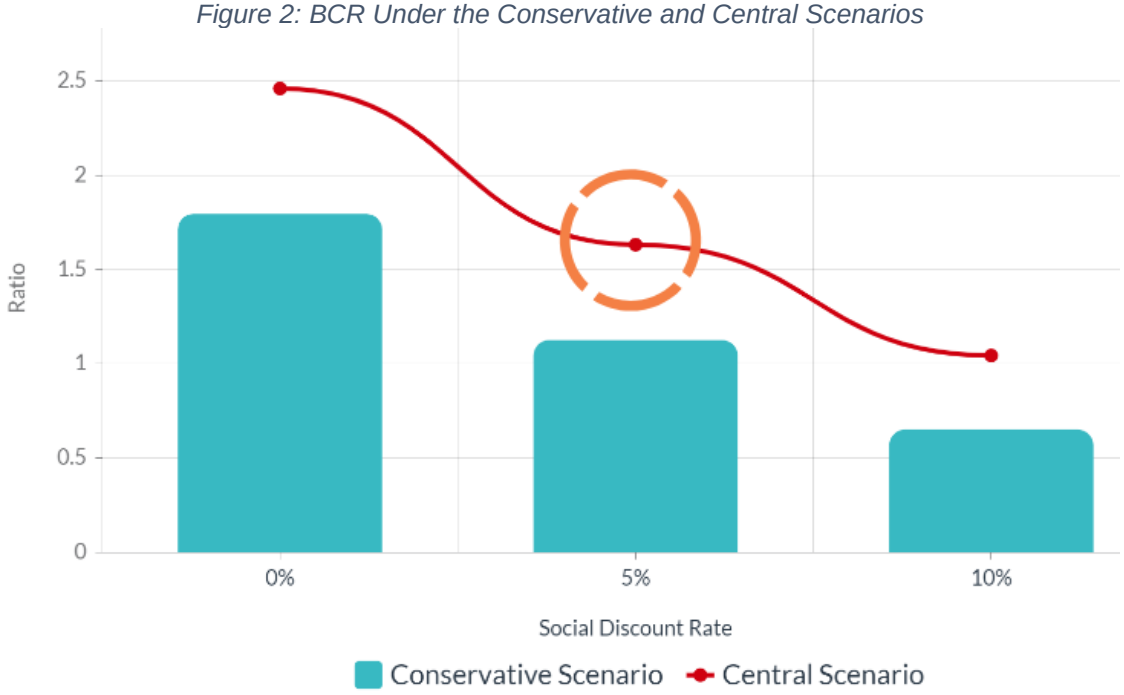
Additionally, the graphical representation (Figure 2



2.3 Break-Even Period (BEP)

Under the central scenario, the BEP begins in (calendar) Year 8. In the conservative scenario, it begins in Year 9 and in the optimistic scenario it begins in Year 3.
), provides a clearer overview of the Central scenario, and the respective ratio, including the ways that the SDR affects the Conservative scenario when compared to the Central one.

Figure 2: BCR Under the Conservative and Central Scenarios



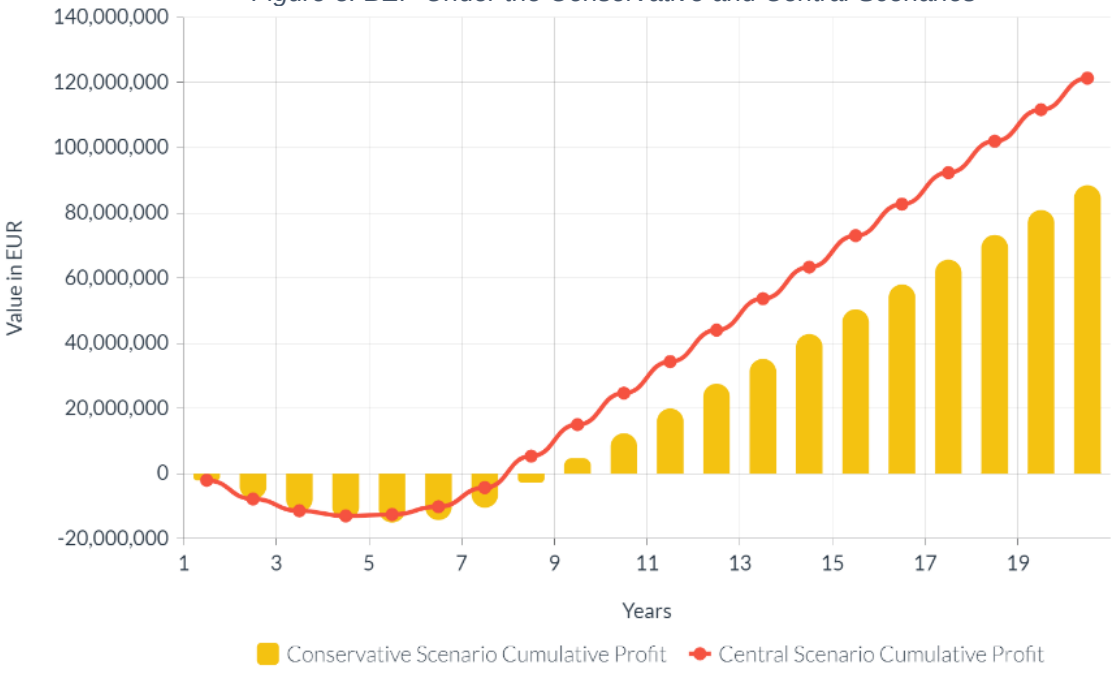
2.4 Break-Even Period (BEP)

Under the central scenario, the BEP begins in (calendar) Year 8. In the conservative scenario, it begins in Year 9 and in the optimistic scenario it begins in Year 3.

Table 7: Cumulative CIEWS Real Net Benefits (Euro millions)

Calendar Year	Conservative	Central	Optimistic
1	(-2.067)	(-2.067)	(-2.067)
2	(-7.817)	(-7.817)	(-7,817)
3	(-11.844)	(-11.433)	1.608
4	(-14.248)	(-13.016)	26.106
5	(-15.029)	(-12.565)	65.678
6	(-14.288)	(-10.180)	120.223
7	(-10.483)	(-4.322)	191.283
8	(-2.869)	5.347	266.152
9	4.745	15.014	341.021
10	12.359	24.682	415.890
11	19.973	34.350	490.759
12	27.587	44.017	565.628
13	35.201	53.685	640.497
14	42.814	63.352	715.366
15	50.428	73.020	790.235
16	58.042	82.688	865.104
17	65.656	92.355	939.973
18	73.270	102.023	1,014.84
19	80.823	111.690	1,089.72
20	88.497	121.358	1,164.580

Figure 3: BEP Under the Conservative and Central Scenarios



2.5 Economic Internal Rate of Return (EIRR)

The EIRR under the central scenario is 28%, which is far higher than any of the social discount rates (0%, 5%, 10%) considered. Similarly, the EIRRs under the conservative and optimistic scenarios are positive and exceed the SDRs.

Table 8: EIRR Results

	Conservative	Central	Optimistic
EIRR	22%	28%	165%

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