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# ASSESSMENT OF CARBON MARKET POTENTIAL FOR AZERBAIJAN`S NATIONALLY DETERMINED CONTRIBUTIONS

***23 November 2023***

## Glossary

| | |
|---|---|
| **AFOLU** | Agriculture, Forestry and Other Land Use |
| **Art6.4ER** | Art 6.4 Emissions Reduction (unit) |
| **BAU** | Business-as-usual |
| **CA** | Corresponding Adjustment |
| **CARP** | Centralised Accounting and Recording Platform |
| **CDM** | Clean Development Mechanism |
| **CER** | Certified Emission Reduction |
| **$CO_{2e}$** | Carbon dioxide equivalent |
| **CORSIA** | Carbon Offsetting and Reduction Scheme for International Aviation |
| **COP** | Conference of the Parties to the UNFCCC |
| **CCPs** | Core Carbon Principles (Standards) |
| **CDR** | Carbon Dioxide Removal |
| **CPIs** | Carbon Pricing Instruments |
| **ESG** | Environmental, Social and Governance (Standards and Safeguards) |
| **ETS** | Emissions Trading System |
| **EU ETS** | European Emissions Trading System |
| **ESCR** | Environmental and Social Corporate Responsibility |
| **FOLU** | Forestry and Other Land Use |
| **GHG** | Greenhouse Gas |
| **GS** | Gold Standard |
| **IPPU** | Industrial Processes and Product Use |
| **ITMO** | Internationally Transferred Mitigation Outcome |
| **JCM** | Joint Crediting Mechanism |
| **LDCs** | Least Developed Countries |
| **LEAP** | Low Emissions Analysis Platform (a software tool) |
| **LT-LEDS** | Long-Term Low Emissions Development Strategy |
| **LULUCF** | Land Use, Land Use Change, and Forestry |
| **MAC** | Marginal Abatement Cost |
| **MACC** | Marginal Abatement Cost Curve |
| **MRV** | Monitoring, Reporting, Verification |
| **NAMA** | Nationally Appropriate Mitigation Action |
| **NBS** | Nature Based Solutions |
| **NDC** | Nationally Determined Contribution |
| **NGO** | Non-Governmental Organisation |
| **NPV** | Net Present Value |
| **PA** | Paris Agreement |
| **PMI** | Partnership for Market Implementation |

| | |
|---|---|
| **SDGs** | Sustainable Development Goals |
| **SOP** | Share of Proceeds |
| **TSVCM** | Taskforce for Voluntary Carbon Markets |
| **VCM** | Voluntary Carbon Market |
| **VCS** | Voluntary Carbon Standard |

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# 1. Introduction

The objective of this report was to critically examine the overall abatement potential of emissions through climate change mitigation initiatives, as strategized by the Azerbaijani government within the framework of its Nationally Determined Contributions (NDC), current and planned, with a view to examining carbon market options in order to co-finance their implementation. The official NDC of Azerbaijan was submitted to the UNFCCC in October 2015. Its target is to achieve a 35% reduction in greenhouse gas emissions (GHG) by 2030 compared to the 1990 baseline emissions. The government of Azerbaijan has not yet submitted a revised 2030 NDC, nor has the Long-term Low Emissions Development Strategy been communicated at the time of the finalization of this report. Therefore, the analysis has been focused on the scope of the current official NDC of Azerbaijan, and the report examines the carbon market opportunities as identified in the current NDC on the basis of the available information as well as the gaps in the information that will have to be addressed to expand the assessment to all the sectors of the economy.

In particular, this report focuses on the identification of prospective abatement strategies, starting with the analysis of abatement costs in energy generation. Firstly, the energy sector is by far the greatest source of GHG emissions in Azerbaijan. Secondly, due to the forecasted sustained growth of the population, the energy demand in the country will continue to grow exponentially. All NDC actions and sectors can potentially benefit from carbon markets but information on the marginal abatement costs could be one of the indicators used by the government of Azerbaijan to prioritize actions in need of financial support and focus on these, while the less costly options could be implemented by the companies and individuals, incentivized by taxation or regulatory measures. Carbon markets could provide much-needed impulse, improving the uptake of some technologies. Therefore these outcomes are anticipated to guide the Azerbaijani government in formulating a robust approach towards participating in carbon markets. The report provides estimates of the cumulative carbon reductions that may be achieved, with the intent to calculate the volume of cumulative reductions that may be potentially put on the carbon markets, thereby contributing to lowering the costs of the necessary investments.

The assessments of the abatement costs are recognized as a key tool driving the decarbonisation of economies, reducing costs of the proposed measures. The abatement cost is a cost of reducing or, in some cases, not emitting GHG emissions. Total additional costs (including the costs of investment and the additional operation costs) divided by the reduced emissions provide information on the abatement costs which can be positive or, in some cases, negative. Negative costs of abatement reflect options of reducing emissions with a net economic gain. This means that investors implementing measures generating negative costs of abatement will earn money while reducing GHGs. GHG reductions generated from such measures cannot be put on the carbon market because they are not additional, meaning these actions, as profitable, would have occurred notwithstanding the financial support that can be provided through the carbon markets and represent investment opportunities that can be addressed by domestic policies and measures. Additionality is one of key indicators of the stringency and efficacy of carbon markets as a universally recognized method of allocating resources to carbon mitigation. As such, with the environmental stringency that carbon markets are trying to achieve, energy efficiency measures, paying for themselves without the income from carbon markets, are not considered in this study and instead are recommended as domestic investment opportunities in Azerbaijan.

The focus of this study is on the abatement costs in the domain of renewable energy, as per the long-term perspective of decarbonisation of the Azerbaijani economy, in line with the objectives of the Paris Agreement. The analytical results of this appraisal will provide insights into renewable energy investments capacity to generate economic returns from carbon markets, with the intent to partially finance climate mitigation efforts in Azerbaijan through support to dissemination of a number of renewable energy technologies, to upscale the low-carbon investments beyond the already planned capacity. At the same time, wide dissemination of renewable energy generation will support the nation's sustainable developmental objectives.

This report is focusing on decarbonisation of the energy sector for a number of reasons. Firstly, the energy sector is by far the greatest source of GHG emissions in the country. Secondly, due to the forecasted sustained growth of the population, the energy demand in Azerbaijan will continue to grow exponentially. Meanwhile, the government policy is to reduce GHG emissions, while supporting sustainable economic development of the country. Therefore addressing the growing energy demand while simultaneously tackling the associated emissions will be a priority for the government in the foreseeable future. Thirdly, a significant portion of the required statistical information pertaining to the energy sector in Azerbaijan is accessible and can be analysed within the timeframe of this study. While not deep-diving into other sectors, the project will provide a blueprint for the analysis of accessible technologies and the assessment of their carbon market potential.

Azerbaijan is one of the countries that have abundant fossil fuel resources. Oil and gas provide around 90% of export revenues and finance around 60% of the state budget, while at the same time supplying 98% of the primary energy and over 90% of the country's electricity.[1] However, in the long term, global trends towards decarbonisation indicate the need to diversify both, Azerbaijan's exports and the country's energy supply to maintain the economic growth, cushion the economy against global volatility of prices and ensure sustainable development. Importantly, as a Party to the Paris Agreement, Azerbaijan has committed itself to decarbonisation in line with the IPCC recommendations approved by the UNFCCC, to limit the growth of the global average temperature until the end of this century to below 2 degree Celsius, striving to achieve the limit of 1.5 degree Celsius, compared to the pre-industrial levels.

While energy efficiency policies are needed to reduce the growth of the expected demand for energy, the deployment of renewable energy will help Azerbaijan to achieve its planned 2030 NDC targets, opening up options for its increased ambition in the next NDC cycle and supporting the planning for the use of carbon market proceeds to increase the speed of decarbonisation and to achieve carbon reductions that the country ought to contribute under the Paris Agreement.

The report looks closer at the carbon market opportunities that may be explored to speed up the transformation of the energy sector in Azerbaijan and ensure a growing green energy supply. Notwithstanding the existing voluntary markets, Article 6 of the Paris Agreement opens new opportunities for upscaling carbon market mechanisms. The majority of NDCs contain a provision confirming countries' readiness to engage in Article 6 market mechanisms to support the implementation of the NDC activities.[2] However, the rules adopted under Article 6 impose strict accounting that creates risks of not achieving their NDCs for countries authorising excessive transfers of carbon credits, regardless of whether these credits were generated in sectors included in the NDC or in sectors that are not included in the NDC if the NDC is not covering all sectors of the economy of a country. Article 6.2 regulates the trade of emission reductions between two or more countries based on bilateral or multilateral agreements. The traded units are called international mitigation outcomes (ITMOs).

Transfers of ITMOs result in corresponding adjustments of NDCs. The host country NDC will have to deduct a number of ITMOs transferred to the buyer country, increasing emissions of the host country

[1] International Energy Agency, Azerbaijan 2021 Energy Policy Review, p. 11

[2] UNFCCC 2022 NDC Synthesis Report, 26 October 2022.

and the buyer country will add the purchased ITMOs to its NDC, increasing its reductions. Transfers of credits created under Article 6.4 (Article 6.4 Emission Reductions, A6.4ERs) will also have to be adjusted between the NDCs of a host country and those of the buyer countries. This rule does not yet apply to voluntary markets. However, the convergence of the rules applied to international markets[3] and voluntary markets is increasingly likely with the growing carbon reduction ambitions of countries that need to bridge the gap between collective mitigation outcomes and the long-term collective goal of the Paris Agreement and the growing numbers of non-state stakeholders undertaking voluntary net-zero pledges, and the buyer countries' recognition of such voluntary efforts as inputs to their NDCs. As a result, procedures applied to voluntary offsets are expected to evolve towards Article 6 market mechanisms[4], seeking obligatory host country authorisations.

As signalled in the Inception Report, Article 6 imposes compliance risks for the NDCs of countries authorising excessive transfers of carbon credits. These risks can be mitigated by setting up reliable monitoring, reporting and verification (MRV) systems at the country level and maintaining an up-to-date inventory of GHG emissions, combined with a national registry. For the national government, it is necessary to obtain reliable upfront knowledge of the mitigation potential of the country in each of the sectors of the national economy and to calculate the costs and benefits of actions that may be undertaken, to decide on the priorities in the NDC implementation plan.

With the approaching end of the first global stocktake under the Paris Agreement during the next COP.28 in Dubai in December 2023, and the next round of the NDCs submissions to be informed by its outcome, the government of Azerbaijan may wish to decide how to approach the existing options to raise the ambition of its NDC in line with the Paris Agreement. Co-financing from carbon markets may be one of the financial sources that will help to achieve the new, more ambitious targets.

## 2. Analysis of the GHG emission reductions

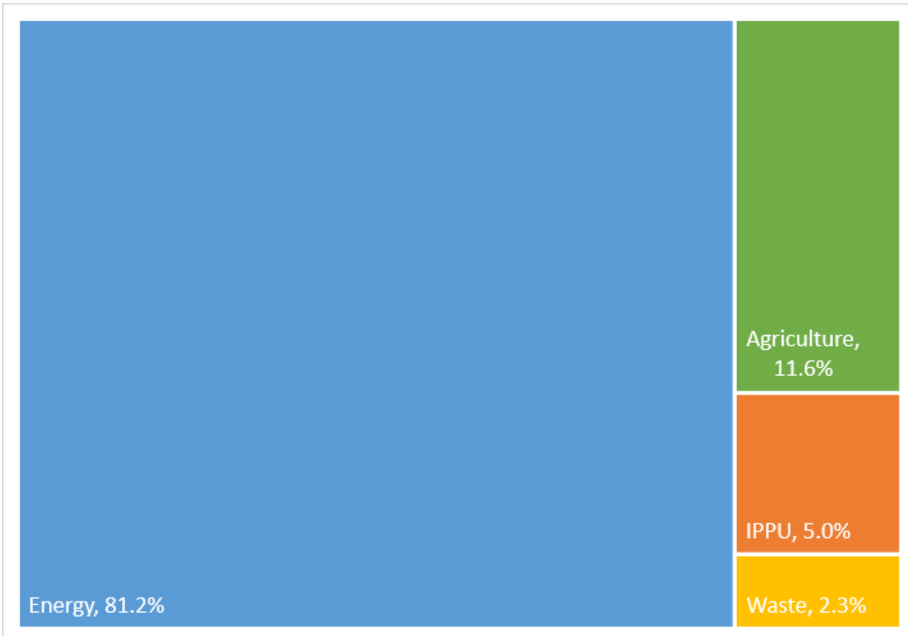
Principal reference documents and data sources reviewed within the current research include Azerbaijan's first NDC, Fourth National Communication to the UN Frameworks Convention on Climate Change (UNFCC), Azerbaijan 2030: National Priorities for Socio-Economic Development, Strategy of socio-economic development of the Republic of Azerbaijan in 2022-2026, State Program of socio-economic development of the regions of the Republic of Azerbaijan in 2019-2023 and draft Long-term Low Emission Development Strategy for Azerbaijan.

[3] Article 6.2 and 6.4 of the Paris Agreement.

[4] This report does not discuss Article 6.8 of the Paris Agreement (non-market approaches).

According to *Climatewatch*[5], Azerbaijan is the world's 87th largest emitter, with a total share of 0.11% in global anthropogenic GHG emissions.

**Figure 1: GHG emissions of Azerbaijan by sectors included in the Nationally Determined Contribution, 2021**




Source: Azerbaijan State Statistical Committee

*Figure 1* above demonstrates why it is essential for the country to focus primarily on reducing GHG emissions from its **energy sector**. Obviously, in 2021, more than 81% (53.4 Mt CO2e) of Azerbaijan`s GHG emissions are energy-related. In order to achieve progress on its decarbonisation pathway that Azerbaijan has committed to by signing up for the Paris Agreement, the country has to address its energy supply and demand in a holistic way. As indicated by the IEA 2021 Azerbaijan Energy Policy Review[6], the increase of the share of renewable energy in the energy mix from 16% in 2018 to 30% in 2030, planned by the government, is a step in the right direction. Further increase in the deployment of renewable energy would enable Azerbaijan to speed up its progress on the pathway towards decarbonisation in the long term, in line with the IPCC recommendations. If combined with consistent implementation of the energy efficiency policy tapping low-hanging fruits of reducing energy waste and demand-side measures, the renewable energy transition will help in the transformation and

[5] WRI CAIT Climate Data Explorer

[6] IEA, Azerbaijan 2021 Energy Policy Review, p. 14. It should be noted that renewable energy term encompasses all types of energy derived from renewable sources. This includes not only electricity but also heat and transportation fuels. For example, solar thermal energy (heat) for water heating, biofuels like ethanol for transportation, and geothermal energy for direct heating are all considered renewable energy sources.

diversification of Azerbaijan's economy. IEA 2021 Azerbaijan Energy Policy Review quotes key barriers to energy efficiency in the country, identified by the Energy Charter Secretariat in its 2020 in-Depth Review of the Energy Efficiency Policy of the Republic of Azerbaijan. The latter was assessed as inadequate, lacking an official national target and measures. Azerbaijan, as stressed by the IEA's most recent review, has yet to adopt and implement specific strategies, action plans with targets and measures leading to necessary improvements in energy efficiency.[7] There is significant scope to reduce the use of energy across sectors such as transport, buildings as well as industry. A consideration of the resulting carbon reductions as potential inputs to the future NDCs should be subject to further research which remains outside the scope of this analysis.

**Agriculture** is the second biggest source of emissions, at 11,6% (7.6 Mt CO2e) of total GHG emissions in 2021. According to the Fourth National Communication (NC4), almost no preventive measures were taken to reduce GHGs from the livestock subsector.[8] It may be assumed therefore that this subsector has a considerable potential for abatement measures. The NC4 proposes some actions (measures) that would result in lowering GHG emissions from the livestock, such as:

1) Setting up live weight limits on the livestock, especially for cattle, once the domestic demand is met;
2) Implementing measurement, reporting and verification (MRV) system on GHG emissions from the livestock;
3) Monitoring the improvement of the effective manure management system in livestock farms;
4) Impose carbon taxes;
5) Encouraging the use of bio-methane for energy production.[9]

However, no quantified GHG emission reduction potential has been established for emission mitigation measures in the livestock subsector of agriculture and the technical potential for measures such as biomethane to energy conversion is not known so it cannot be used to support the quantification of the carbon market potential of this measure. The NC4 provides information on historical levels of emissions from the livestock sector between 1990 and 2016. Total annual CH4 emissions from livestock increased from 260,33 ktCO2e in 1990 to 266,72 ktCO2e in 2016. It is to be expected that the growth continued in the period after 2016 and is set to continue in the future under unchanged BAU circumstances. Globally, around 32% of methane emissions linked to human activity are coming from livestock, mainly from manure management (or the lack of it) and enteric fermentation.

Another source of growing GHG emissions from agriculture is reported as the increase in rice cultivation. Rice is the crop identified as one of the leading global agricultural emission sources and is responsible for 11% of total anthropogenic methane emissions. From 2015, government-sponsored

[7] IEA, Azerbaijan 2021 Energy Policy Review, p. 118
[8] Azerbaijan NC4, p.91
[9] Azerbaijan NC4, p.91

rice-cultivation programmes increased the rice cultivation area and the emissions reported from this crop starting with 2011 increased from 65,62 ktCO2e to 94,41 ktCO2e in 2016. To see the expected impact of potential abatement in the rice cultivation activity, it would be necessary to calculate BAU emissions from rice cultivation and look at the abatement potential, as is the case of other agricultural activities in Azerbaijan. However, methane is not the only greenhouse gas emitted from this sector. N2O emissions also increased correspondingly, so the future carbon market strategy in this sector should investigate several abatement scenarios and identify carbon marketable options based on the MAC assessment and market demand trends.

The **industrial processes and product use** (IPPU) sector, contributing a 5% (3.3 Mt CO2e) share, stands as the third-largest source of GHG emissions in Azerbaijan in the year 2021. This sector encompasses a range of activities, including chemical and petrochemical production, mineral product manufacturing, metal production, and the use of various synthetic products that release emissions during their lifecycle. While energy production and agriculture might lead in terms of emission volumes, the IPPU sector still plays a notable role in the country's overall emission profile. Its impact comes not only from the volume of emissions but also from the particular types of gases released, some of which have a significantly higher global warming potential than carbon dioxide.

The **waste sector** is the fourth source of GHG emissions in Azerbaijan and growing in response to the rapid population growth and the increase of industrial production. This sector contributed to 2.3% (1.5 Mt CO2e) of GHG emissions in 2021. Apart from moving towards a circular economy, Azerbaijan can potentially reduce its methane emissions from landfills by capturing these emissions and using them to produce energy as well as building incineration (waste-to-energy) plants to reduce waste sent to landfills. Overall emissions of methane from open landfills increased in Azerbaijan from 748.6 ktCO2 in 1990 to 1272.7 ktCO2e in 2018.

As regards **emissions and removals from land use**, the data for the 1990-2021 period do not include information from the 20% of land, which was under occupation till 2020 and thus government of Azerbaijan was not able to collect data from that area. The numbers will have therefore be adjusted and recalculated to enable any projections until 2030 based on historical trends, and the abatement potential from change in agricultural practices or reforestation/afforestation. The historical data reported with regard to 80% of the Azerbaijani current territory showed significant uncertainties. However, in 1990-1995 deforestation negatively affected removals, while in 1997-1998 the tendency was lowered and the removals started to increase. In the whole 1990-2021 period reported in the Azerbaijan State Statistical Committee, the removals increased from -3.7 Mt CO2e in 1990 to -7.7 Mt CO2e in 2021. However, given the doubling of removals, the measures responsible for these results go beyond the avoided deforestation. There are no data available on other potential abatement measures in the forestry sector, such as afforestation, reforestation and improved forest management. The future detailed carbon market strategy for this sector should, again, investigate possible scenarios of increasing forest coverage through responsible reforestation and afforestation programmes, some of which could be financed by carbon markets.

## 2.1. The ambition of Azerbaijan's 2030 NDC

As a proactive contribution to global climate change mitigation strategies, Azerbaijan is looking at an objective to reduce its greenhouse gas (GHG) emissions by 35% by the year 2030, using 1990 as the reference year.[10] As reported in 2021 to the UNFCCC by Azerbaijan in its Fourth National Communication (NC4), total GHG emissions of Azerbaijan in 1990 amounted to 82.7 MtCO2e[11] without taking into account the removals.[12] Net 1990 emissions[13], according to the NC4 again, were estimated to have been in the range of 79.0 Mt CO2e[14]. In line with this assumption, the planned 2030 reduction would amount to 28.9 MtCO2e[15] of net GHG emissions compared to 1990 levels by 2030. It is necessary to point out that the 2030 NDC target is a single-year target and cumulative emission reductions in the period included in the NDC need to calculated in order to assess its carbon market potential in line with the rules applicable to international carbon markets (as discussed in Chapter 2 of this report)

This commitment underscores Azerbaijan's efforts to limit growth in its emissions and represents a step in the right direction of its progression towards a more sustainable, low-carbon future. Azerbaijan's GHG emissions, after the significant reduction in the years 1996-1998, have been on the rise, slightly decreasing in 2009-2011, to resume growth from 2012 until they stabilised between 2015 and 2016.[16] According to the State Statistical Comittee of Azerbaijan, in 2021, net GHG emissions were 58.1 Mt CO2e. This represents an increase compared to the 2016 data (54 Mt CO2e)[17], the increase is largely due to the expansion of the energy sector. However, in line with the NDC, 2030 net GHG emissions of Azerbaijan should not exceed 51.36 Mt CO2e. The initial NDC of the country comprises energy (oil and gas sector, renewable energy sector, transport sector), agriculture, waste and LULUCF (land use, land-use change and forestry) sectors.

In contrast to many nations, Azerbaijan's inaugural NDC does not specify an annual GHG emissions reduction target leading up to 2030, nor does it define reduction targets at the sectoral level. In light of this absence, pertinent supplemental documents and several assumptions have been utilized to

[10] https://unfccc.int/sites/default/files/NDC/2022-06/INDC%20Azerbaijan.pdf; https://unfccc.int/sites/default/files/resource/Azerbaijan%20INC.pdf
[11] 82675 Gg CO2e
[12] Azerbaijan NC4 (2021), p.64
[13] With removals.
[14] 78985 Gg CO2e
[15] 28919 Gg CO2e
[16] Azerbaijan NC4, p.64; WRI Climatewatch data.
[17] As reported in the NC4, see above.

enable the computation of the current NDC's sectoral level targets, looking at their progress throughout the years ahead. Specifically, employing the available measures and technologies within each sector, an assessment of the potential GHG contributions has been conducted. This evaluation aims to understand the extent to which each sector can contribute towards the realization of the overarching national objectives on GHG emission reduction and provide input on the decarbonisation pathway. Based on the well-known LEAP model and the authors' own adjustments, sectoral contributions have been estimated for two alternatives: a business-as-usual scenario (BAU) as well as a scenario with adopted climate change policy measures (further referred to as the "with policy measures" scenario, WPM).[18] In light of the government's delineation of objectives for the year 2030 , it is prudent to meticulously contemplate both these temporal frameworks for the purpose of comprehensive analysis.

Tables 1 and 2 present the estimated values for both, the BAU scenario and the scenario with the policy measures (WPM) until 2030 and 2050, respectively. Specifically, the results of the BAU scenario are presented in percentage share and absolute terms in the second and third columns. Columns 4 and 5, on the other hand, illustrate the percentage share and absolute values under the WPM scenario. Columns 6, 7 and 8 provide a detailed analysis of the difference between the BAU and WPM scenarios. In particular, column 5 displays the absolute total reduction in Mt CO2e achieved by implementing the WPM scenario compared to the BAU scenario. In contrast, column 6 showcases the contribution of each sector to the total reduction, presented as a percentage. The final column shows the percentage reduction achieved in each sector when comparing the BAU and WPM scenarios.

**Table 1. GHG emission reduction potential in Azerbaijan, 2030**

| Sectors | BAU scenario | | With policy measures scenario (WPM) | | Difference between BAU and WPM scenarios | | |
|---|---|---|---|---|---|---|---|
| | *% share* | *Mt CO2e* | *% share* | *Mt CO2e* | *Mt CO2e* | *% share* | *% reduction* |
| **Energy** | 81.9 | 66.3 | 81 | 43.3 | -<br>23.0 | 83.5 | 34.8 |
| **Agriculture** | 9.8 | 7.9 | 10.4 | 5.6 | -2.3 | 8.5 | 29.7 |
| **Waste** | 2.2 | 1.8 | 2.8 | 1.5 | -0.3 | 1.1 | 16.9 |
| **IPPU*** | 6.2 | 5 | 5.8 | 3.1 | -1.9 | 6.9 | 38.1 |
| **Total** | **100** | **81** | **100** | **53.4** | **27.6** | **100** | **34.1** |

** Industrial Processes and Product Use*

*Source: Climate Watch data, estimates from the LEAP model, authors elaboration.*

[18] LEAP, the Low Emissions Analysis Platform, is a widely-used software tool for energy policy analysis and climate change mitigation assessment developed at the Stockholm Environment Institute.

It is obvious that, under the BAU scenario, a projection of GHG emissions demonstrates escalating magnitudes, with estimates reaching 81 Mt CO2e (net emission - 71.7 Mt CO2e[19]) and 131.1 Mt CO2e (net emission - 116.8 MtCO2e) in 2030 and 2050, respectively. This scenario is constructed under the assumption that no substantive mitigation policies and/or strategies will be implemented and that there will be no major shifts in technological advancements, economic conditions or climate change-related policies, while population growth and urbanisation will continue as expected. Thus, the BAU scenario envisages a continuity of present conditions without significant alterations.

Conversely, "with policy measures" scenario postulates that the country will implement a diverse set of climate change-related legislative actions intended to attenuate GHG emissions. Thus, it is unequivocally clear that, in the context of the "with policy measures" scenario, there could be a significant reduction in GHG emissions. In particular, it is estimated that in 2030 and 2050, emissions will stand at 53.4 Mt CO2e (net emission - 44.1 Mt CO2e[20]) and 29 Mt CO2e (net emission - 15.1 Mt CO2e), respectively.

As indicated above, the energy sector is the largest source of GHG emissions in Azerbaijan and has the greatest mitigation potential. Under the current NDC, it is expected to provide almost 81.8% of the planned emissions abatement by 2030. This sector has also the greatest potential, by volume, to contribute to substantial GHG reductions of Azerbaijan's emissions by 2050 (see Table 2)

**Table 2. GHG emission reduction potential in Azerbaijan, 2050**

| Sectors | BAU scenario | | With policy measures scenario (WPM) | | Difference between BAU and WPM scenarios | | |
|---|---|---|---|---|---|---|---|
| | *% share* | *Mt CO2e* | *% share* | *Mt CO2e* | *Mt CO2e* | *% share* | *% reduction* |
| **Energy** | 81.8 | 107.2 | 81.4 | 23.6 | 83.6 | 81.9 | 78 |
| **Agriculture** | 9.5 | 12.4 | 15 | 4.4 | 8.1 | 7.9 | 64.9 |
| **Waste** | 2.1 | 2.7 | 2.9 | 0.8 | 1.9 | 1.8 | 68.9 |
| **IPPU** | 6.7 | 8.8 | 0.7 | 0.2 | 8.6 | 8.4 | 97.7 |
| **Total** | **100** | **131.1** | **100** | **29** | **102.1** | **100** | **77.9** |

*Source: Climate Watch data, estimates from the LEAP model with authors' elaboration (compound growth rate has been calculated for the past years and applied till 2050).*

This indicates that agriculture ranks as the second-largest contributor to GHG emissions in Azerbaijan by volume. However, when considering the sector's proportion of the country's total GHG emissions,

[19] While calculating the net emission, land use, land use change and forestry sectors has been taken into account.
[20] Land use, land use change and forestry sectors are also included here.

it presents a relatively modest opportunity for reduction. Specifically, the potential for emissions abatement in agriculture is projected at 8.5% by 2030 according to the WPM scenario, with a slight decline to 7.9% by 2050 within the same scenario, in terms of its contribution to the total additional abatement achievable. IPPU sector comes a distant third, with a 6.9% share of the additional abatement potential until 2030, increasing to an 8.4% share by 2050. Finally, the waste sector, which is the last mentioned in the NDC, is estimated to offer an additional reduction potential of 1.1% compared to the business-as-usual scenario by 2030. However, its contribution to further reduction possibilities is expected to increase slightly to 1.8% by the year 2050.

A comparison of the potential abatement opportunities in the sectors included in the current NDC of Azerbaijan by both, their volumes and percentage share, confirms that focusing on the abatement measures in the energy sector should be the first step in the analysis leading to the identification of additional abatement potential, enabling Azerbaijan to fulfil the ambition of its current NDC and increase its next NDC ambition, subsequently progressing towards the long-term decarbonisation, in line with the IPCC recommendations. Moreover, part of the surplus could be directed by the government to carbon markets, international or voluntary, or provide a basis for a domestic offset scheme, thereby remaining part of the NDC efforts.

It needs to be stressed again that energy efficiency measures which are the most economically efficient among energy-related GHG abatement measures are not examined in the context of this assessment as these measures are not suitable for carbon market finance. Consequently, it may be assumed that the resulting abatement could either contribute to the increased ambition or increase the pool of carbon reductions that could potentially go to carbon markets. The next step in this analysis is looking at the number of renewable energy technologies that could be deployed by 2050, driving GHG emissions reductions and providing a pool of carbon credits that could be transacted through international and voluntary markets.

## 2.2. The costs of implementing reduction measures in the energy sector within the initial NDC of Azerbaijan

The principal focus of this section is dedicated to the investigation and discourse of renewable energy resources, specifically investigating their projected influence on the reduction of emissions, as well as the associated economic implications. Regrettably, NDC does not provide an estimation of the comprehensive implementation costs at either an overall or sector-specific level. Consequently, there appears to be an absence of formally established NDC investment plans at the national level to fulfil the objectives delineated within the NDC framework. In the prospective process of resource mobilization, the government can consider a combination of domestic and international financial resources, alongside appropriate utilization of market mechanisms. This strategy is in line with the provisions of Article 6 of the Paris Agreement. However, it is noteworthy that the implementation of

Article 6 projects will be contingent upon the advancement in the implementation of the overall Article 6 framework.

Consequently, numerous underlying assumptions have been employed to facilitate the computation of anticipated investment expenditures, marginal abatement cost (MAC), benefits/costs and emission reductions within the time horizon, specifically until the year 2030.

This section focuses on the estimation of the MACs and all relevant figures as shown in the above table exclusively within the energy sector. Such a decision is grounded in several considerations. First, the energy sector is universally as well as nationally acknowledged as the largest contributor to GHG emissions. Consequently, focusing on this sector offers the most substantial potential for realizing significant, impactful change in terms of national-level emission reduction. Given the universal as well as national imperative to combat climate change, investigating the most cost-effective methods for reducing emissions in this sector is of the utmost relevance and urgency.

Secondly, the technological dynamics and cost structures associated with the energy sector are inherently more homogeneous and easier to model than those in other sectors such as agriculture, IPPU, transportation and waste management. Each of these sectors exhibits diverse, complex and often highly localized characteristics that make estimating MACs and other related figures a substantially more intricate task, requiring additional research and work beyond the scope of this study. In the agriculture sector, for example, the abatement methods can vary widely from improving livestock feed efficiency to reducing synthetic fertilizer use. These methods' costs and effects differ greatly depending on the specific agricultural system in question, the region, and even the specific crop or livestock breed. Likewise, the IPPU sector requires that an in-depth study of different industries, each with unique processes, technologies and associated emissions profiles is carried out to provide inputs necessary for determining MACs specific to Azerbaijan. Similarly, the transportation and waste sectors present their unique complexities and variations, while taking into account the newly recovered territories. By focusing on the energy sector, the study can exploit the relative simplicity and consistency of the cost structures associated with various abatement strategies. This will allow for a more precise, if narrower, analysis. It is an example of the often necessary scientific principle of 'isolating variables' for a more manageable study, which is particularly relevant when dealing with data-intensive calculations such as MACs.

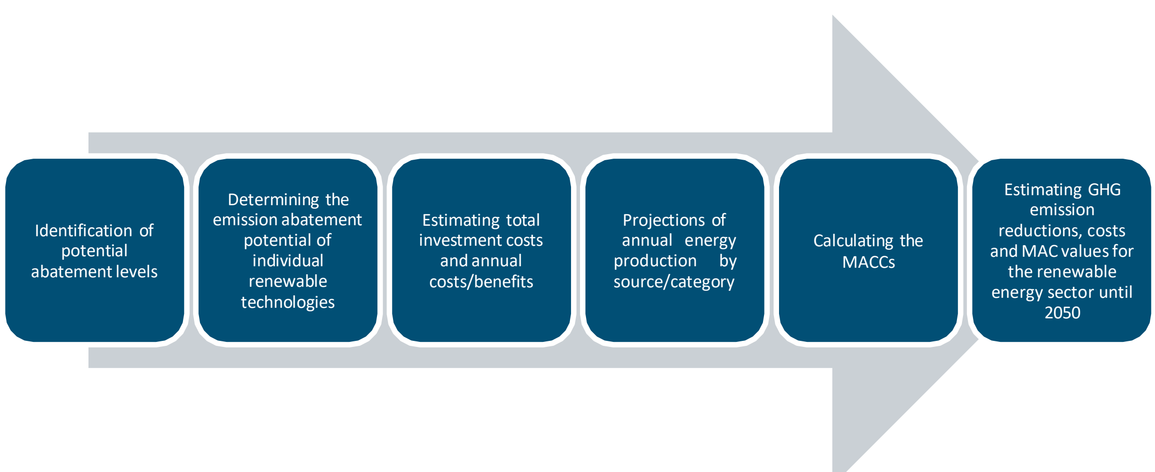
Thirdly, the energy sector has, in many ways, the most developed and available data sets in the country. The accessibility and reliability of energy data, encompassing production, consumption, technology costs, and emissions, are superior to those of the other sectors. This is crucial for deriving accurate MAC estimates as well as estimates of other important values and thus provides another reason for focusing on the energy sector.

Fourthly, due to the inherent constraints of time and resource availability, as well as the absence of readily available data from other sectors, this report has been strategically crafted to concentrate solely on the energy sector and the GHG emission reduction potential of renewable energy technologies applicable to the natural conditions available in Azerbaijan, warranting a comprehensive analysis that would otherwise be impeded by an exhaustive examination of various other sectors. By adopting this focused approach, we endeavour to delve deeply into the intricacies and dynamics of the renewable energy domain, thereby affording a more nuanced and rigorous appraisal of pertinent factors impacting the sector's performance and prospects.

Nonetheless, this does not negate the necessity for MACs and other relevant estimates in other sectors, and future research could aim to expand the scope to include these areas. In particular, it would be necessary to thoroughly research the sectors in Azerbaijan, other than the energy sector, that make substantial contributions to GHG emissions, not only intending to set the price on carbon but also looking at potential abatement trade-offs to lower the cost of the overall decarbonisation of Azerbaijan's economy. The task could start with estimating the emission potential of various scenarios in transportation, agriculture, forestry, mining, industry and waste management sectors. This could in turn allow the policy makers to have a whole picture in terms of the GHG emissions abatement and its cost options. On the other hand, a range of abatement options that require a low level of investments such as implementing numerous energy efficiency measures, adopting a range of various behavioural changes and demand side management programs, supported by taxation and regulation, should also be considered as available domestic policy measures, contributing to the achievement of the NDC targets and beyond, towards mid-century reductions.

## 2.3. Methodology for estimating the MACCs

A customized approach to developing marginal abatement cost curves (MACCs) for renewable electricity production has been developed for the purpose of this report. The methodology was developed by considering emission reduction efforts, reports produced by national and international partners, past projects with similarities, literature review and the consultants` prior experience in the field. The process of the MACC development followed a multi-step approach, as illustrated below:



The following sections methodically unpack each step of the analysis, proceeding in the sequence outlined above.

### 2.3.1. Identification of potential abatement levers

Overall, seven suitable renewable energy transition policy scenarios have been identified to evaluate their cost-effectiveness GHG emission potentials over the following years. Candidates were identified based on prior knowledge of the project experts as well as the information obtained from the Azerbaijan Renewable Energy Agency under the Ministry of Energy of the Republic of Azerbaijan. These seven identified abatement levers are given in Table 3 below.

**Table 3. Potential emission reduction measures for renewable electricity production**

| Measures (policy scenarios) | Description of the measures |
|---|---|
| Electricity generation from solar energy | Electricity generation from solar energy harnesses the power of the sun to produce clean and sustainable electricity. Solar panels, made up of photovoltaic cells, convert sunlight directly into electricity through the photovoltaic effect. This renewable energy source offers numerous benefits, including reduced GHG emissions, lower reliance on fossil fuels and potential cost savings in the long run. As sunlight is abundant and accessible in many regions, solar energy presents a promising solution for a greener and more sustainable future. Azerbaijan possesses favorable conditions for solar power generation due to its ample sunshine and remarkable solar energy potential. According to the Ministry of Energy, the technical capacity for solar power in the country is approximately 23 000 MW. Azerbaijan also boasts an annual average of 2 400 to 3 200 hours of sunshine, which is considered quite favorable on a global scale. The most promising solar resources can be found in the central river valleys as well as the northern and northwestern regions of the country. |
| | The production of electricity through onshore wind power entails capturing the energy of moving air to |

| | |
|---|---|
| Electricity generation from onshore wind power | generate environmentally friendly and renewable energy. Large wind turbines, typically mounted on towers, capture the force of the wind and convert it into electrical power. As the wind blows, it spins the turbine's blades, which are connected to a generator that produces electricity. Onshore wind power is a highly effective and environmentally friendly energy solution, contributing significantly to the renewable energy mix. With continuous advancements in technology and increasing installations, onshore wind power plays a vital role in reducing carbon emissions and promoting a greener energy future. The Azerbaijan Scientific-Research and Design Institute of Power Engineering, in collaboration with the Japanese company Tomen, has identified that the yearly average wind velocity in Absheron peninsula ranges from 7.9 meters per second (m/s) to 8.1 m/s. The confirmation of a 6 m/s average wind speed further strengthens the economic and technical viability of wind power in the region.<br>An estimated technical potential of the onshore wind energy in Azerbaijan is about 3 000 MW according to the Azerbaijan Renewable Energy Agency under the Ministry of Energy of the Republic of Azerbaijan. |
| Electricity generation from offshore wind power | Electricity generation from offshore wind power involves harnessing the power of wind at sea to produce clean and sustainable energy. Massive wind turbines are erected in offshore locations, where the wind is stronger and more consistent. These turbines have large blades that capture the energy from the wind and convert it into electricity through generators. Offshore wind power has significant potential due to the higher wind speeds and expansive offshore areas available for installations. It plays a crucial role in diversifying the renewable energy portfolio and reducing GHG emissions, contributing to a greener and more resilient energy system. |

| | |
|---|---|
| | The Energy Sector Management Assistance Program (ESMAP), initiated by the World Bank Group, has estimated that the technical capacity of offshore wind energy in the Azerbaijani section of the Caspian Sea is approximately 35 GW in shallow waters and 122 GW in deeper waters. This 20 times the country's current installed energy capacity. |
| Electricity generation from hydro energy | Hydropower generation utilizes the energy from the movement or descent of water to produce sustainable friendly electricity. This process involves capturing the kinetic energy of water and converting it into electrical energy using turbines and generators. Water is stored in reservoirs, and its controlled release through dams or channels drives the turbines, which, in turn, spin the generators to produce electricity. Hydro power is a sustainable and reliable energy source that reduces GHG emissions and provides a consistent power supply, contributing to a greener and more resilient energy infrastructure. As can be seen above hydroelectric power is currently the most important renewable energy source in Azerbaijan, yet its full potential remains untapped. The Ministry of Energy states that small-scale hydro has a technical capacity of 520 MW, with the ability to generate approximately 3.2 TWh of electricity on an annual basis. |
| Electricity generation from biomass | Electricity generation from biomass involves utilizing organic materials, such as agricultural residues, wood chips and dedicated energy crops, to produce renewable electricity. These biomass feedstocks are converted into heat or gas through processes like combustion, gasification or anaerobic digestion. The released energy is then harnessed to drive turbines and generate electricity. This sustainable energy source offers several advantages, including reduced GHG emissions and the utilization of organic waste materials. Biomass power plants can be integrated into existing infrastructure. The expansion of industry and |

| | |
|---|---|
| | agriculture sectors in Azerbaijan is opening up new possibilities for generating electricity from biomass sources derived from combustible waste from industries, forestry, food processing agricultural activities and various biological materials. According to the Ministry of Energy, there is an estimated technical capacity of 380 MW for biomass-based electricity generation in the country. This presents a promising opportunity to utilize these diverse biomass resources to meet a growing energy demand in a sustainable and environmentally-friendly manner. |
| Electricity generation from geothermal | Electricity generation from geothermal energy taps into the Earth's natural heat to produce clean and sustainable electricity. By harnessing the thermal energy stored beneath the Earth's surface, geothermal power plants utilize steam or hot water to drive turbines and generate electricity. This renewable energy source offers several advantages, including constant availability, minimal GHG emissions and a small physical footprint. Geothermal energy can be found in regions with active volcanoes, hot springs, or geologically active areas. With the potential for long-term, reliable power generation, geothermal energy is a promising solution for a greener and more sustainable future. According to the Ministry of Energy of the Republic of Azerbaijan, the country has a geothermal energy capacity of approximately 800 MW. Preliminary assessments reveal the presence of 11 geothermal areas within Azerbaijan, containing thermal water ranging from 30°C to 100°C, capable of producing either heat energy or electricity based on the water's thermal characteristics. |
| Electricity generation from wave | Wave energy is generated through the motion of waves formed by wind across the ocean and sea surfaces. Specially designed turbines convert the underwater movement caused by waves into electrical energy. This form of renewable energy is primarily utilized in |

| | |
|---|---|
| | countries with coastal access to seas and oceans. Specialized devices, such as wave energy converters are deployed in coastal areas to capture the motion of the waves and convert it into electrical power. These devices utilize various technologies to extract energy from the waves. Wave power offers immense potential as a consistent and environmentally friendly energy source, contributing to the diversification of the renewable energy mix. Ongoing research and development aim to optimize wave energy capture and make it a commercially viable solution for sustainable electricity generation. Unfortunately, there are no reliable estimates in wave energy potation for Azerbaijan. As per the 2021 Renewable Energy Statistics Report by International Renewable Energy Agency (IRENA), the cumulative installed capacity of this form of energy worldwide amounts to 527 MW. |

### 2.3.2. Determining the emission abatement potential from renewable energy options

The next step is determining the emissions abated from the renewable electricity production alternatives listed above. Renewable energy projects in total shall also lead to GHG being avoided by burning fossil fuels in Azerbaijan. To compute this, mainly the information provided by the UN Intergovernmental Panel on Climate Change (IPCC) was used. In particular, life cycle CO2 equivalent (including albedo effect) emissions (gram CO2 equivalent) per kwh for each renewable electricity production alternative is compared with the same figure observed for the conventional way of producing the electricity (from natural gas). It is assumed that by increasing the share of renewable electricity production, at the same time the country will reduce the use of the natural gas to produce electricity to meet domestic demand. Using natural gas to produce a 1 kwh of electricity causes around 340 gram CO2e of lifecycle emission (Table 4).

**Table 4. Lifecycle emission for selected renewable electricity production alternatives**

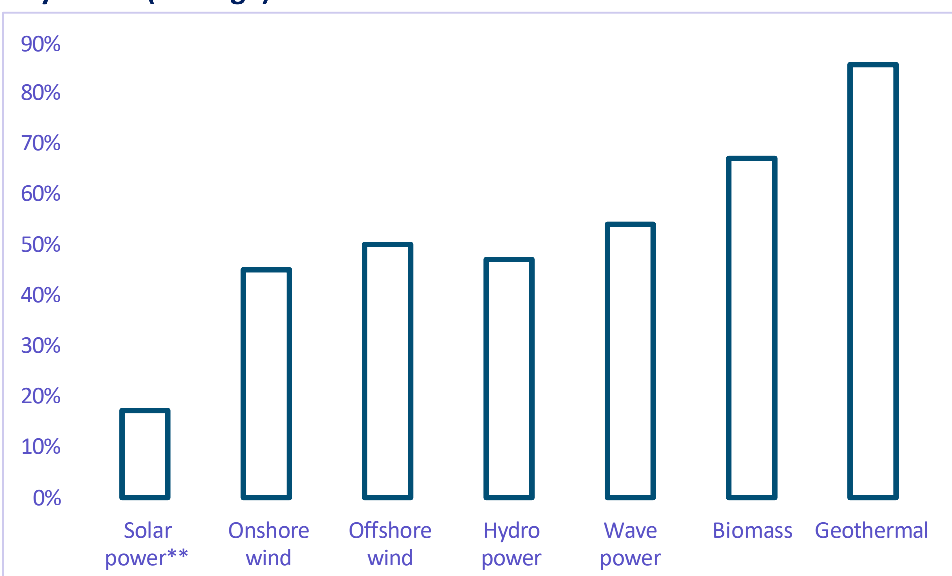
| | Renewable sources | Gram CO2 equivalent per kwh* | NET gram CO2 equivalent saving per kwh |
|---|---|---|---|
| 1 | Solar power** | 41 | 299 |
| 2 | Onshore wind | 11 | 329 |

| | | | |
|---|---|---|---|
| 3 | Offshore wind | 12 | 328 |
| 4 | Hydro power | 24 | 316 |
| 5 | Wave power*** | 22 | 318 |
| 6 | Biomass | 230 | 110 |
| 7 | Geothermal | 38 | 302 |

*Note: *the median figures have been taken for the purposes of this report, *average of solar Photovoltaics (PV) utility and solar PV roof, ***since the information on wave energy is not readily available in the literature, information on this has been taken directly from the impactful ninja newsletter.*
*Source: UN IPCC*

After computing the savings per kwh, it is straightforward to compute the overall GHG abatement while taking into account the capacity of the installed technologies (Figure 2). The information on capacity factors is easily available and can be accessed through, for example, the Renewable Power Generation Cost 2021 report, which is the latest published report publicly accessible on the IRENA website.

**Figure 2. Capacity factor (average) across the renewable sources**

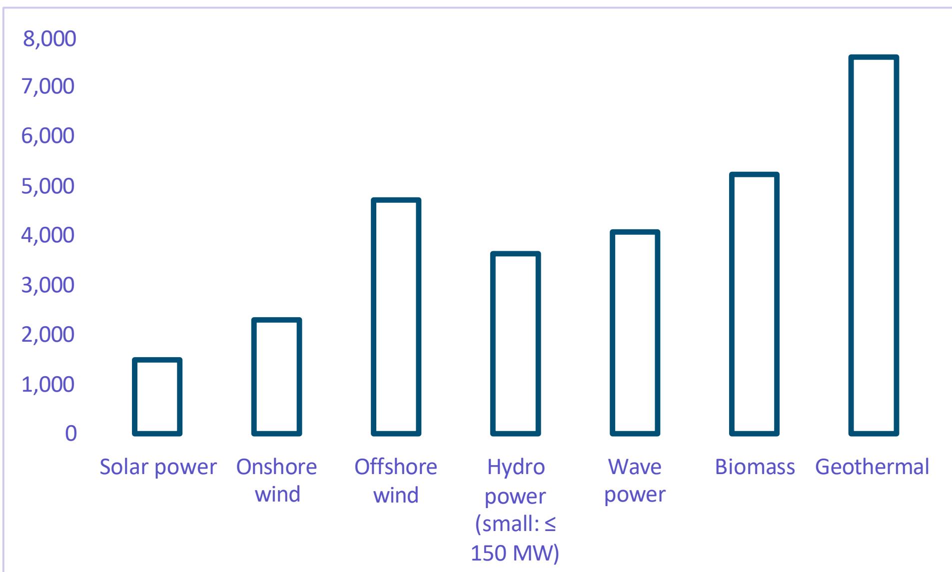



*Source: The Intergovernmental Panel on Climate Change, Information on wave energy taken from Impactful Ninja.*
*Note: **Average of Solar PV utility and Solar PV roof*

### 2.3.3. Estimating total instalment costs and annual costs/benefits

Determining the installation cost per 1 MW electricity power plant requires considering several factors that can influence the overall expenses. While it is challenging to provide an exact cost estimate without specific project details and geographical location, for the purposes of this report average estimates (global weighted) on each project (per 1 MW) has been taken directly from the IRENA Renewable Power Generation Cost 2021 report (Figure 3).

**Figure 3. Total installed cost (global weighted average) per 1MW, in mln AZN**

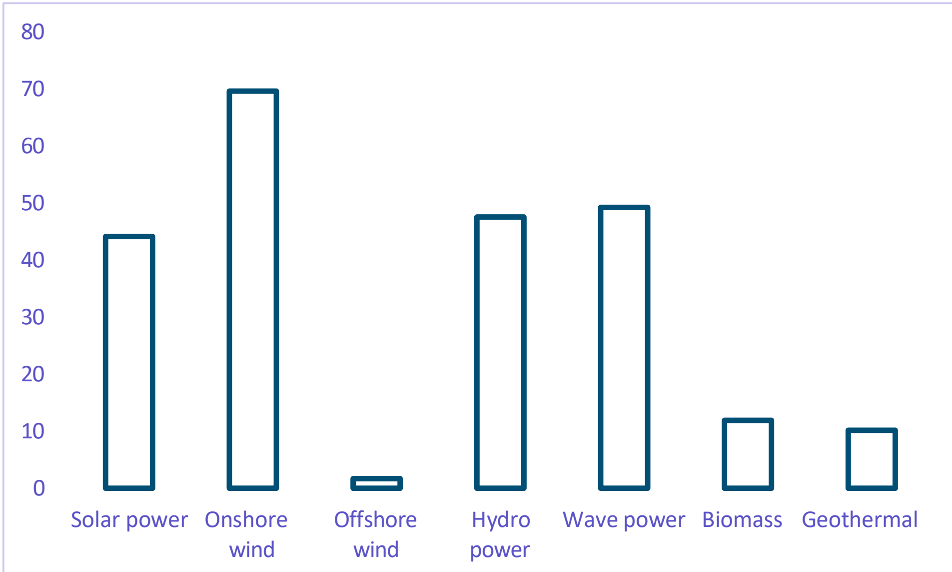



*Source: Renewable Power Generation Cost 2021 report, IRENA*

On the other hand, annual benefits or costs for producing a 1 MWh were also computed based on the information provided by the Renewable Power Generation Cost 2021 report.

In particular, by considering the levelized cost of electricity (LCOE) of the recently commissioned power plant, it was straightforward to determine the cost savings achieved by generating electricity from renewable sources rather than natural gas for each 1 MWh (Figure 4). The overall savings or benefits were estimated by considering the annual production capacity of each alternative energy source mentioned earlier.

**Figure 4. Cost savings of producing electricity from renewable sources, per 1 MWh in AZN**




*Source: Renewable Power Generation Cost 2021 report, IRENA*

### 2.3.4. Projections of renewable energy production by source

In the quest to ascertain the comprehensive financial requirements for the establishment of renewable electricity facilities, it becomes imperative to evaluate the prospective capacity of these envisaged power plants. Given the worldwide transition towards renewable energy sources, the precision in forecasting the supply and demand of electricity from renewable sources has emerged as an indispensable exercise for energy planners and policymakers. Specifically, for Azerbaijan, the growing population is projected to stimulate an upward trend in electricity demand over the forthcoming decades.

Azerbaijan's electricity generation capacity is bifurcated into two primary sources: traditional fuel-based power plants and renewable energy-based power plants. An examination of the statistical data from the past two decades indicates a consistent 7-9% population growth in Azerbaijan every three years. This rate of growth, for the period spanning 2022 to 2030, has been utilized for the present analysis. Consequently, by 2030, a surge of 5.3% in electricity demand (7 900 MW) is anticipated in comparison to the 2022 level (7 500 MW).

Following the estimation of the future electricity demand, it is of paramount importance to project realistic assumptions regarding the proportional contribution of renewable and non-renewable sources to the total electricity generation. It is projected that the share of solar, wind, biomass, hydro, geothermal and wave energy in the total generation capacity will increment in tandem with the growth of Azerbaijan's population. A significant amplification in the contribution of solar and wind energy is foreseen, primarily owing to Azerbaijan's comparatively high potential for these energy sources.

As of present, solar and wind power collectively contribute to a meagre 1% of electricity generation in Azerbaijan, with a significant potential to grow in the coming years.[21] Natural gas is the main source of electricity at present. However, a substantial escalation in the solar and wind power contributions to the total energy supply is anticipated in the future. This projection is substantiated by the agreements signed in 2020 between the Ministry of Energy of the Republic of Azerbaijan and companies "ACWA Power" of Saudi Arabia and "Masdar" of the United Arab Emirates for implementing renewable energy pilot projects. As per these agreements, the construction of 240 MW wind and 230 MW solar power plants is scheduled. For wind energy, the Absheron peninsula and the Caspian coastal strip are the primary areas of focus. Additionally, an upsurge in biomass utilization is also projected, given the necessary development of the agriculture sector aligning with population growth, critical for the conceptualization of biomass-based thermal power plants. There is an anticipated expansion in hydropower-based energy production, as new hydroelectric power stations are expected to leverage the existing hydro resources in the country's liberated territories.

Although geothermal power plants are yet to be established in the country, the potential in the northern part lends the possibility of exploiting this energy source in the future. Wave energy, while limited to the Caspian coastal strip, holds high potential in the northern part of the Absheron peninsula. It is pertinent to highlight the availability of renewable energy sources in the newly liberated Ester-Zangazur and Karabakh economic regions, with governmental plans to create entirely 'green zones' in these territories.

By 2030, it is estimated that conventional energy production will cater to only about 67.5% of domestic demand, with renewable sources accounting for the remaining 32.5%. Of the renewable sources, 23% will be from hydroelectric power plants, 4% will be from solar energy, 4% from wind energy, 1% from biomass, 0.5% from geothermal and 0.5% from the wave energy conversion. This diverse and sustainable mix of energy production is poised to effectively meet the country's domestic electricity demand.

### 2.3.5. Calculating the MACCs: empirical specification

After gathering all the essential data pertaining to each available option for electricity production, it becomes feasible to compute the marginal abatement cost using the provided formula:

$$\boldsymbol{Marginal\ Abatement\ Cost\ (AZN/tonneCO2e)} = \frac{\boldsymbol{Net\ Present\ Value\ (AZN)}}{\boldsymbol{Total\ GHG\ emissions\ abated\ over\ the\ life\ of\ the\ alternatives}}$$

where,

[21] IEA, Azerbaijan 2021 Energy Policy Review, p.70

$$\boldsymbol{Net\ Present\ Value\ (AZN)} = \frac{\boldsymbol{Net\ of\ total\ costs/savings\ (AZN)}}{(\boldsymbol{1 - discount\ rate})^{\boldsymbol{lifetime\ of\ the\ project}}}$$

As evident from the aforementioned equation, in order to determine the marginal abatement cost, it is necessary to estimate the lifespan of the alternative production options and establish a discount rate. For the purposes of this analysis, the lifetime of the alternative production options has been set at 9 years, spanning from 2022 to 2030. This selection aligns with the country's established vision for CO2 abatement, as outlined in the background section of this report.

A discount rate is frequently utilized to account for the diminishing value of money over time. The discount rate is expressed as a percentage and is determined by the governing body responsible for investment decisions. Usually, it can be set at a lower range, like 3-4%, or at a higher range, such as 15%. A higher discount rate is employed to account for the increased risk of the future value of money being reduced. In this report, the discount rate used is derived from the interest rate of the Central Bank of Azerbaijan, which has been set at 10%. This particular interest rate is employed as the discount rate for the analysis conducted in this report.

### 2.3.6. Estimated GHG emission reductions, costs and MAC values for the renewable energy sector until 2050

The estimates of emission reductions, costs and MAC values in the renewable energy sector in Azerbaijan for the period of 2022- 2030 are presented in Table 5 below. More precisely, the second column of the table illustrates the cumulative annual reductions in GHG emissions achieved through the replacement of conventional energy generation with renewable energy alternatives such as solar energy, wind energy (onshore and offshore), wave energy, hydro energy, geothermal and biomass. The third column of the table presents the annual cost savings or benefits of investing in renewables whereas the fourth column illustrates the MAC estimates. The last column shows the overall investment costs for each renewable energy alternative with current prices.

According to estimations, the adoption of renewable energy sources for power generation, in contrast to fossil fuels, could potentially lead to a reduction of total 6.1 Mt CO2e during the timeframe spanning from 2022 to 2030 (cumulative sum across the years and renewable energy sources). Among the renewable energy sectors considered, wind, biomass, geothermal and solar energy production are identified as the primary contributors to this emissions reduction. The transition from fossil fuel-based energy production to renewable sources has the potential to yield substantial average annual net benefits, approximating to a total 924 million AZN.[22] The largest contributor is estimated to be the wind (onshore) and wave power plants with 274.7 and 233.2 million AZN, respectively.

A consideration of cost-effectiveness reveals a distinct hierarchy in the choice of renewable energy sources. From an economic perspective, the production of electricity utilizing onshore wind turbines holds the highest cost-effectiveness (MAC), at an estimated 239.2 AZN per tCO2e. Conversely, the least cost-effective option was found to be electricity production through biomass conversion, with an associated cost of 1 978.3 AZN per tCO2e. Overall, to implement all projects related to the renewable energy transition up to 2030, the country will need to invest more than 3.03 billion AZN (in current prices).

**Table 5. Emission reductions, costs and MAC values in the renewable energy sector for 2022-2030**

| Actions | Total emission savings | Annual net costs/benefits | MAC | Investments costs only (capex) |
|---|---|---|---|---|
| | *thousand tCO2e* | *thousand AZN (discounted)* | *AZN/tCO2e* | *mln AZN (discounted)* |
| **Wind energy (onshore)** | 1 339.7 | 274.8 | 239.2 | 362.3 |
| **Wave** | 383.4 | 233.2 | 369.1 | 160.8 |
| **Hydro energy** | 1 323.2 | 196.0 | 381.9 | 573.5 |
| **Solar energy** | 895.6 | 66.6 | 458.6 | 470.1 |
| **Geothermal** | 564.5 | 76.4 | 465.3 | 300.0 |
| **Wind energy (offshore)** | 1 482.3 | 7.4 | 446.5 | 745.4 |
| **Biomass** | 83.5 | 69.8 | 1 978.3 | 413.2 |
| **.....STOTAL** | **6 072.2** | **924.2** | **-** | **3025.2** |

[22] According to the Central Bank of Azerbaijan as of 25.07.2023, 1 USD = 1.7 AZN

*Source: Authors' calculations*

Based on the assessment of the marginal abatement costs, all renewable energy technologies are not financially self-sufficient in Azerbaijan (their MAC is positive) but some, notably wind and wave energy projects are cheaper to implement and therefore could be promoted as domestic projects by private investors or local communities and/or state-owned companies.

As indicated by the IEA, cost-effectiveness should be the main criterion in selecting the options among selecting the promoted technologies. Since we are talking about electricity, substantial investments will be needed in the transmission grids and battery/storage capacity, and in ensuring reliable electricity supply to industry, services and households. Energy sector reforms and incentives for investment in renewable energy, eg. tax breaks, green certificates, feed-in tariffs and grants or tax deductions to individuals investing in solar panels or heat pumps should be explored as viable fiscal and regulatory instruments enabling the renewable potential of Azerbaijan to be realised.

This means also that all renewable energy projects are additional and can potentially be implemented as Article 6.4 projects or PAMs under Article 6.2, or voluntary projects. Actions generating net benefits (negative MAC values) would not fulfil conditions of eligibility for carbon markets. Although additional barriers or soft costs of implementation may apply, increasing the additionality of otherwise self-financing projects, the very same barriers may be a deterrent to project developers. The calculations of MACCs need to be revisited as the prices of technologies are progressively diminishing, with consequences for the additionality of the projects.

Other than ascertaining the additionality and eligibility for carbon markets, the calculation of the marginal abatement cost could inform the pricing of the GHG reductions generated by the projects. However, the choice between international carbon markets and voluntary markets should be guided by the necessity of the country to first achieve its declared NDC targets. Azerbaijan authorities should be looking at the potential surplus abatement as either the means of increasing Azerbaijan's ambition in the next NDC cycle or as a source of revenue, with the surplus being accounted for as part of the buyer country's NDC under Article 6.2 of the Paris Agreement and potential consequences for slowing Azerbaijan's trajectory to long-term low-emissions target in 2030 and beyond.

# 3. Calculating the carbon market potential of Azerbaijan's NDC and its reduction potential towards 2050

In the period 2022-2030, corresponding with the implementation period of the current NDC and in line with the ambition of the current NDC, Azerbaijan can potentially generate cumulative emission reductions at the level of 10.6 MtCO2e.

The combined reduction potential of the NDC is calculated based on the difference between cumulative emissions in the four NDC sectors (energy, agriculture, waste and IPPU) taking into account cumulative removals under the BAU scenario and the WPM scenario.

This assessment, based on the methodology used in calculating reductions under the current NDC, has been repeated for the 2031-2050 period [extended to 2050, covering 2031-2050 period), resulting in cumulative reductions for 2031-2050 at the level of 24.4 MtCO2e.

To determine the carbon market potential of the abatement surplus until 2050 it is necessary to consider the impact of the corresponding adjustments under Article 6 of the Paris Agreement on the achievement of Azerbaijan's NDC and its decarbonisation pathway until 2050.

## 3.1. The impact of the corresponding adjustments on the carbon market potential

In 2016, Azerbaijan communicated to the UNFCCC an intended nationally determined contribution (INDC) which, after ratification and entry into force of the Paris Agreement became its legally binding NDC, with a single-year target of -35% reduction of GHG emissions compared to 1990 levels by 2030. The ultimate level of admissible GHG emissions under this target depends on the calculation of the 1990 emissions levels. All the countries that are parties to the UNFCCC have to regularly prepare and submit their National Communications and compile GHG inventories. Data provided in these communications can be adjusted in line with the improved methodologies or revised data. The latest Azerbaijan's National Communication, its fourth (NC4) informed the UNFCCC that the 1990 GHG emissions of Azerbaijan were at the level of 79 MtCO2 net (including removals), which is a value revised upwards compared with the previously reported 73.87 MtCO2e, a value used by the WRI CAIT country profile.[23]

Taking into account the -35% against the 1990 levels 2030 target, the current estimate of the maximum level of net GHG emissions of Azerbaijan in 2030, based on the NC4 1990 GHG data assessment, should not exceed 51.36 MtCO2e.

As described in the previous chapter, the WPM scenario assumes that in 2030 Azerbaijan can reduce its emissions up to 44.1 MtCO2e net.

The carbon market potential of Azerbaijan is constrained by the requirement to account for the maximum level of NDC emissions in 2030 or risk the non-achievement of its NDC. This is so because international transfers of mitigation outcomes (ITMOs) under Article 6.2 and 6.4 of the Paris Agreement require that countries participating in such transactions (cooperative approaches) perform relevant corresponding adjustments. Corresponding adjustments (CAs) are used so that parties participating in cooperative approaches do not increase their net emissions within and between their

[23] See chapter 1 of the report, for more details and references.

NDCs implementation periods. Moreover, CAs are to ensure that the mitigation outcomes (MOs) are reconciled for the calendar year in which they are used, ensuring that MOs are used within the same NDC implementation period within which they occurred. Carbon credits issued for reductions in the Host Country (Azerbaijan) and subject to the Host Country Authorisation for Article 6 mechanisms will be deducted from the carbon budget of the country at the first international transfer. Accounting for ITMOs leads to the increase in emissions of the country selling ITMO, equal to the volume of reductions transferred out of the country inventory. The emissions of the buyer, on the other hand, are reduced after transfer of ITMOs to its registry.

Importantly, not only mitigation outcomes transferred under Article 6.2 but also all Article 6.4 transfers are treated as ITMOs. Each transaction under Article 6.2 or 6.4 authorised by the government will therefore increase Azerbaijan's NDC emissions equal to the amount of GHG reductions transferred to the buyer country. The increase in Azerbaijan's emissions will not be equal to the number of credits generated each year (vintage) because Article 6.4 outcomes that are not transferred (they partly stay in the Host Country), do not increase emissions of the Host Country and are accounted as its NDC reductions. It is also true of a pre-agreed number or percentage of MOs achieved through cooperative approaches with other countries that are accruing to the Host Country under each cooperative approach. For example, if under a bilateral agreement with Japan, a certain share of mitigation outcomes is agreed to be transferred out of Azerbaijan's registry, this amount will lower the balance of achieved GHG reductions (regardless of the sector in which they occur) for Azerbaijan and increase the balance of accounted emission reductions for Japan. Moreover, Japan, one of the leaders in building global carbon market is using discounting and set-asides in some methodologies approved its Joint Crediting Mechanism which reduce the number of available credits and so increase the integrity of the system.[24]

In the case of countries participating in cooperative approaches that have a single-year NDC, which is the case of Azerbaijan, the country will have to apply one of the two methods to their CAs, consistently throughout the NDC period:

1. either "providing an indicative multi-year emissions trajectory, trajectories or budget for the NDC implementation period consistent with the implementation and achievement of its NDC, or
2. "calculating the average annual amounts of ITMOs first transferred and used over the NDC implementation period, by taking the cumulative amount of ITMOs and dividing by the number

[24] Joint Crediting Mechanism ｜ Carbon Markets Express (env.go.jp)

of elapsed years in the NDC implementation period and annually applying indicative CAs equal to this average amount for each year in the NDC implementation period and applying CAs equal to this average amount in the NDC year".[25]


In line with the guidance contained in the Annex to decision 2/CMA3 adopted in Glasgow[26], to participate in Article 6.2 countries must first fulfil the participation criteria outlined above.

[25] Decision 2/CMA3, annex: Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement, chapter III. Corresponding adjustments, section B: Application of corresponding adjustments, para.7(a).

[26] Decision 2/CMA3, Annex: *Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement.*

Most countries that are parties to the Paris Agreement provided in their NDCs information about their plans to engage in voluntary cooperation under Article 6 of the Paris Agreement. Almost all of them stated that they plan to or will possibly use at least one type of voluntary cooperation under Article 6. However, some Parties have set qualitative limits on their use of voluntary cooperation for achieving their mitigation targets.

## 3.2. Internationally Transferred Mitigation Outcomes (ITMOs) and NDC accounting

ITMOs are only generated from 2021 onwards, in line with the guidance adopted at COP26 in Glasgow. ITMOs may involve:

1) bilateral country-to-country transfers for the use in NDC compliance

2) transfers for other international purposes (CORSIA) and

3) transfers for other uses (to a private buyer in another country, regardless of the buyer using the units for compliance, ESCR goals or further trade)

Attention should be paid to bilateral agreements. JCM projects will be subject to Corresponding Adjustments as Japan intends to use credits from Joint Crediting Mechanism to support the achievement of its NDC unless otherwise agreed bilaterally. Transfers of ERs vintages issued in the NDC implementation period (2021-2030) will then increase the GHG emissions of the Host Countries.

**Figure 6. Corresponding adjustments of mitigation outcomes between two Parties to the Paris Agreement**

Corresponding Adjustments require that in the event of GHG emissions reaching the level of or being close to the 2030 target, Azerbaijan will have to increase its efforts to match the transferred ITMOs to the level ensuring that the country does not exceed its maximum GHG emissions level in 2030 (51.36 $MtCO_{2e}$). If the GHG emissions of Azerbaijan in 2030 will be lower than the 2030 NDC target, the increase in GHG reductions above the level planned in the NDC may be accounted for as an overachievement of the current NDC. Progress towards such overachievement could also be discounted as the increase of NDC's ambition in the next NDC review and update process (2024-2025).

As stated in the *Article 6.2 guidance*, safeguards are necessary to protect Parties engaged in cooperative approaches from a net increase in their emissions within and between NDC implementation periods, ensuring transparency, accuracy, consistency, completeness, and comparability in tracking progress in implementation and achievement of their NDCs. To minimise the risk of overselling (meaning the increase of 2030 emissions level above the NDC assumption), the total “reserve for cumulative reductions to be used for cooperative approaches under Article 6.2 and projects implemented as Article 6.4 mechanism” should mirror the mitigation outcomes sold as ITMOs. In the event of the government deciding on host authorisations of all mitigation outcomes achieved in the NDC sectors (Article 6.2, Article 6.4, and other uses), the reserve of cumulative GHG reductions to offset transfers until 2030 could be set as equal to half of the projected cumulative reductions in 2021-2030 period, while the other half of the achieved cumulative GHG reductions would provide a pool for transferred mitigation outcomes. This is a precaution to be used especially in those sectors that may face reversal, as in Nature-based Solutions, or to protect the integrity of the outcomes in case of overcrediting. The stringency of principles and rules agreed under Article 6.2 and Article 6.4 does not allow for simple use of methodologies and baselines used under the Clean Development Mechanism (CDM) of the Kyoto Protocol and, in some cases, also in the voluntary market. However, the practitioners agree that in order to launch Article 6 at the scale necessary for it to have impacts hoped for by the Parties to the Paris Agreement and the private sector, it is necessary to transition the existing methodologies increasing their stringency of the methodologies by improving their accuracy and reduce the latent risks that would undermine international carbon market in the way similar to that which affected the CDM in the past. Potential pitfalls of Article 6 are greater than the tribulations of the CDM as under the Paris Agreement the NDCs and Long-Term Strategies of countries participating in Article 6 mechanisms could be affected. Therefore, it is necessary for both, the buyer country and the host country to understand the implications of engaging in carbon markets, and the latter should ensure that its NDC is not jeopardised.

Countries engaging in bilateral or multilateral cooperation based on Article 6.2 have more freedom to decide how to participate in carbon markets as they can agree not only on the share of credits but also on the sectoral and sub-sectoral scope of projects or programmatic approaches, or jurisdictional approaches to achieve their targets jointly and it is up to the partner countries teaming to build their Article 6.2 capability how are they going to proceed. The JCM set up by Japan and involving 28 partner countries, including Azerbaijan, is operated and managed by a Joint Committee consisting of representatives of both, the host country and Japan. JCM credits generated by JCM projects are shared between the involved parties in line with the cooperation agreement. The project cycle is very similar to that of the CDM, with the Joint Committee fulfilling the role of the CDM Executive Board.

Azerbaijan and Japan signed a JCM agreement on 5 September 2022 and, so far, no projects have been initiated. Importantly, JCM supports renewable energy projects in partner countries and is implementing such projects jointly with Chile, Thailand, Indonesia and the Philippines.[27] Having the information on the renewable energy potential in Azerbaijan on the one hand and a general understanding of the JCM cooperation with Japan on the other hand, h as well as a knowledge of the volume of credits that can be transferred out without jeopardising NDC targets, the government may wish to engage first in renewable energy projects, drawing on the information provided in this report. Other types of projects may come later and may be implemented jointly with other countries. To decarbonise its energy sector, Azerbaijan may want to engage in energy transition projects, for example, early decommissioning of some of its power plants. Such projects can generate a new class of carbon assets, that of energy transition credits.

**Energy transition credits** are high-integrity carbon credits that are at present generated from an early retirement of coal plants but in the future, such credits may be granted for early retirement of gas power plants. Overachievement in one sector may provide much sought-after flexibility in deciding how the NDC of a country is ultimately realised.

The differences in technical potential among the NDC sectors do not preclude flexibility between sectoral shares in the overall NDC mitigation outcome in terms of maintaining the maximum level of NDC emissions in 2030. GHG reductions generated in any of the four sectors and/or the increase in the LULUCF removals can compensate for MOs transferred out from other sectors. It is also useful to remember that it is up to countries transferring ITMOs between each other registries (or between countries' accounts in the international registry to be maintained by the UNFCCC Secretariat) to determine what will be the share of reductions between the two. It could range from a majority of credits going to the investor country. In terms of the global effort and the joint achievement of the long-term goal of the Paris Agreement, it is more important for countries to achieve their NDCs than strict adherence to the pathways resulting in successful outcomes. The key principle in setting the ambition of the consecutive NDCs is the "no backsliding" rule but this is the minimum commitment that countries are expected to provide as the achievement of the long-term goal of the Paris Agreement will not be possible without global emissions going down as fast as possible.

Those countries that have communicated to the UNFCCC their long-term low-emissions development strategies (LT-LEDS, LTS) are also responsible for the reconciliation of their consecutive NDCs with their long-term mitigation pathways. In line with this principle, once Azerbaijan communicates its LT-LEDS to the UNFCCC, the consecutive NDCs will need to reflect the emissions trajectory projected in the LT-

[27] Status quo in July 2023.

LEDS. The NDC cycle allows countries to modify and adjust their NDCs to stay on the course towards their long-term targets which affords them flexibility in what types of mitigation projects and in which sectors to implement, depending on the demand for carbon credits. Biennial transparency reports (BTRs) that countries will submit from 2024 onwards pursuant to decision 18/CMA1 will help each country to take stock of the NDC implementation and explain how the progress has been achieved in line with the modalities, procedures and guidelines (MPGs).[28] Countries will also have to submit their *Article 6.2 initial reports*, either at the time of authorization of ITMOs from a cooperative approach or in conjunction with the next BTR. In addition, each country participating in cooperative approaches will provide a report with information on the authorization of ITMOs and of other details enabling the inclusion of ITMOs for recording in the *Article 6 database* for each year before 15 April. Information on the actual status of ITMOs has to be accurate and the initial reports will have to be updated to reflect this principle.

## 3.3. Operationalisation of Article 6 and the use of voluntary carbon markets

The operationalisation of Article 6 creates new norms that are expected to become, in time, a benchmark for the voluntary market. The VCM standards are expected to gravitate towards the international framework and perhaps even go further, to ensure the high integrity of credits used for offsetting emissions voluntarily by corporations. The impulse comes from the buyers who expect high integrity from carbon credits they want to use to support the achievement of their voluntary pledges.

It transpires from the Glasgow outcomes for Article 6 that non-authorised transfers will continue for voluntary markets and Article 6 rules will not impact results-based finance. This compromise agreed upon by negotiators means that there will be no corresponding adjustments for credits from private projects issued under voluntary standards (and REDD+ activities supported through results-based payments) unless there is a demand for corresponding adjustments of VERs subject to agreement of buyers with the host countries.

The Glasgow CMA decisions deliberately left this option as for the time being voluntary corporate actions are not counted towards countries' NDCs. Currently, voluntary market standards, except for the Gold Standard, do not propose that the host country adjust its emissions, but such an option is possible under Article 6 guidance provided in Glasgow. It is up to the Host Country to decide whether to adjust or not to adjust its emissions for voluntary reductions sold. Carbon market experts expect that credits not backed by CAs will not command good prices in the future and there may be not many

[28] Decision 18/CMA.1: Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement. FCCC/PA/CMA/2018/3/Add.2

buyers interested in not adjusted carbon credits. The future low demand may lead to voluntary standards changing their rules towards negotiating corresponding adjustments with the Host Countries.

The rule adopted in Glasgow that CAs will only be mandatory for transfers of reductions from projects/programmes that have been previously authorised by Parties as Article 6 projects/MOs and will not be mandatory for voluntary activities not expressly authorised as Article 6 mechanisms. This could become an obstacle in the expansion of Article 6 modalities unless the majority of the buyer countries, followed by corporations, will subscribe to *San Jose Principles* of only buying credits from projects that have been authorised and are subject to corresponding adjustments.

### 3.4. Application of corresponding adjustments (CAs)

In the case of voluntary markets, the application of CAs between carbon budgets of both, the host and investor countries, would require that investor countries *de facto* recognise voluntary credits for compliance. This could be introduced by, for example, imposing mandatory carbon reduction strategies on companies that are (not yet) covered by compliance measures such as, for example, emissions trading, taxation, or regulations. As long as the use of voluntary carbon credits is not recognised as mandatory by the Investor Country, there is no legal framework in place, and corresponding adjustments of voluntary credits in the investor's country inventory will not occur, even if a voluntary carbon standard offers such an option.

It is to be expected, however, that investors will eventually move towards Article 6.4 to ensure the integrity of the reductions and their mitigation value going beyond offsets though that may mean a convergence of voluntary standards with the international carbon market under the Paris Agreement. It can be expected that the convergence in the Host Country authorisations will eventually occur and that VM transactions will also as a rule entail a host country authorisation. As with VMs reduction outcomes in general, the shift may come with buyers' choice of only purchasing credits from activities that have undergone CAs. Since all ITMOs have to be generated from projects authorised by Host Countries as Article 6 projects, the absence of the Host Country authorisation means that the projects without such authorisation will only be eligible for voluntary markets. Conversely, a Host Country authorisation issued for a project in sector/s not included in the NDC would mean that the transfer of MOs from the Host Country to a buyer country will proportionally increase the GHG emissions of the Host Country.

#### *Reporting on ITMOs*

Accounting rules for a single-year target require that countries agree on either averaging or annual adjustments (the second choice is seen as increasing environmental integrity). A report on the use of

Article 6 will be part of the Biennial Transparency Report (BTR).[29] In 2024, parties to the Paris Agreement will have to communicate to the Secretariat their first BTRs prepared in line with Decision 18/CMA1 guidance.

Paragraph 77 (d) of Decision 18/CMA3 regulates reporting on cooperative approaches involving the use of ITMOs towards an NDC or authorisations of the use of MOs for international mitigation purposes other than the achievement of its NDC, consistent with decisions adopted by the CMA on Article 6, including on the annual level of anthropogenic GHG emissions by sources and removals by sinks covered by the NDC on an annual basis, reported biennially, a GHG emissions balance adjusted through CAs (an addition for ITMOs first-transferred/transferred and subtraction for ITMOs used/acquired) and any other information consistent with decisions adopted by the CMA on reporting under Article 6. Detailed guidance on reporting is explained in decision 2/CMA3 guidance, in chapter IV. Reporting. Parties participating in cooperative approaches are obliged to start with an Article 6.2 initial report containing comprehensive information on several issues that have to be made public in line with the principle of transparency. The guidance specifies the content and scope of the initial report. Parties engaged in cooperative approaches will have to submit such a report either before or in conjunction with the authorisation of ITMOs or in conjunction with the next BRT. The initial reports will be reviewed by Article 6 technical expert teams in line with guidance which is yet to be developed under SBSTA and adopted by CMA5. Article 6.2 authorization process is also under discussion, as well as tables for submitting annual information and the process of identifying, notifying and correcting inconsistencies. Negotiators are yet to agree on procedures and functionalities of the international registry to allow for transfers of Article 6.4 ERs and other working arrangements.

Article 6 implementation timeline initially envisaged the end of 2023 as the beginning of trading. This turned out to be overoptimistic as participating countries need to implement the institutional and regulatory frameworks on the ground, reflecting the CMA guidance (which is one of the conditions of participation in cooperative approaches[30]). Article 6.2 enables a decentralised framework for cooperative approaches as well as an option, for those parties that wish to use it, of a centralised accounting and reporting platform (CARP). At COP27 in Sharm el-Sheikh, negotiations on further operationalization of Article 6 market mechanisms resulted in a request to the UNFCCC Secretariat to develop the CARP, to implement the international registry and set up the Article 6 database.

**29** Decision 18/CMA3.

**30** "Each Party participating in a cooperative approach that involves the use of ITMOs (hereinafter referred to as a participating Party) shall ensure that its participation in the cooperative approach and the authorization transfer and use of ITMOs is consistent with this guidance and relevant decisions of the CMA and that it applies this guidance to all corresponding adjustments and cooperative approaches in which it participates." Paragraph 4, II. Participation, Annex: *Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement*, decision 2/CMA3.

In order to exchange mitigation outcomes, both, the host country and the buyer country/ies have to have registries to be able to record ITMOs independently from the international registry, and even if countries are technically capable of transferring MOs independently, to comply with the full set of procedures, countries will have to submit their *initial reports* and provide information in an agreed format to the *Article 6 database* which, in line with decision 6/CMA.4, paragraph 28 has in the interim been provided with an option for the parties participating in cooperative approaches to make submissions of their initial reports via unfccc.int website until the centralised accounting and reporting platform and the Article 6 database are released. As of November 17th of 2023, three countries: Vanuatu, Ghana and Switzerland, have submitted their initial reports that warrant initialisation of Article 6.2 transations[31]. Thus, for those countries that would want to use the central-level infrastructure rather than national registries, the former is still not fully operational. Having said that, parties to the Paris Agreement fulfilling all the conditions of participation in the cooperative approaches may engage in forward trading providing both, buyers and sellers with a predetermined price of the future mitigation outcomes. The operationalization of Article 6.4 mechanism is even less advanced and, in all probability, the mechanism will not take off before 2024.

Meanwhile, countries intending to participate in Article 6 mechanisms may continue with piloting projects, setting up their institutional frameworks and capacity building. In this context, to initiate engagement with Article 6, Azerbaijan should focus on institutional readiness, legal and regulatory framework, and capacity building first and to finalise its scoping of carbon market opportunities to prepare sectoral strategies and the pipeline of potential projects.

## 4. Carbon market potential of Azerbaijan energy sector: renewable energy

Unfortunately, the NDC of Azerbaijan does not provide information on the expected costs of the implementation of measures enabling the country to limit the growth of its carbon emissions to 65% of Azerbaijan's GHG emissions recorded in 1990. The numbers on cumulative reductions derived from modelling provide information on the maximum amount of reductions that could be generated within the NDC implementation period and up to 2050. However, the carbon market potential of the NDC should be evaluated in the context of carbon market standards and methodologies, preferably applicable to all the sectors included in the NDC, not just energy. This could be performed as the next

[31] Centralized accounting and reporting platform (interim solution) | UNFCCC

step, preparatory to revising the NDC before the next NDC submission deadline and be considered as one of the steps towards costing the NDC measures. Taking that into account, the efficiency of carbon markets' use will depend on the country setting the right strategy and implementing it effectively and without undue delay.

Decisions on key issues such as the types of projects, their scope, approval criteria, admissible methodologies, baselines, as well as the government expectations with regard to the revenue coming to Azerbaijan through either the share of credits, the share of proceeds, and/or price floors have to be taken in advance and divulged to all the interested parties, project developers, buyers and the public in a transparent and inclusive manner. One of the prerequisites of a successful launch of carbon markets in Azerbaijan will be a list of identified priority actions in the NDC sectors. The list could become a point of departure for formulating the carbon markets strategy until 2030. The success of Azerbaijan's carbon market strategy ultimately depends on the demand and supply of carbon credits in both, international and voluntary markets.

## 4.1. Carbon market potential of renewable energy investment opportunities in Azerbaijan

Over the period of the NDC implementation until 2030, the energy sector, according to the estimates provided in chapter 2, could generate a cumulative reduction of 6.1 Mt CO2e.[32] The reductions would come from renewables as, in line with the scope of the report, energy efficiency reduction potential is not considered for the purpose of this assessment. To fulfil the NDC target, the energy sector needs to keep its emissions below 47.1 Mt CO2e (within the 51.36 Mt CO2e emissions limit that will deliver a -35% reduction on the 1990 emission levels). Over the period of 2031-2050, the energy sector can generate cumulative reductions at the level of approx. 14.1 Mt CO2e (as indicated above, only renewable energy sector is considered).

Renewable energy uptake can be domestically boosted by green certificates, feed-in tariffs, or other support instruments, e.g. loans repayable from earnings on the produced solar energy, which, combined with a conducive investment regulatory framework would bring more renewable energy investment than just voluntary carbon markets. Upscaling of investment can be financed either from the state budget or the recycled carbon revenues. Domestic private investors may be interested in projects with acceptable rates of return which will improve as MACCs become lower and eventually negative (projects will become profitable and thus non-additional, so no longer suitable for carbon markets) and additional incentives to domestic private investors may be provided through regulatory framework and taxation.

[32] It is worth to note thst the estimated figure of this report is in line with the average estimates of IRENA. According to the IRENA, renewable energy and electrification alone can deliver 75% of energy-related CO2 emissions reductions needed.

Potential revenues from carbon markets should be considered in the context of the available projections of global carbon credits supply and demand, taking into account the preferences of the carbon credit buyers and their importance for carbon pricing and credit supply generation. Information about current prices in voluntary markets is available at voluntary carbon exchanges platform, e.g. carboncredits.com

The floor price that should be either negotiated by the government in bilateral negotiations (Article 6.2) or established for Article 6.4 transactions should reflect the cost of generating equivalent reductions to meet the NDC target. It should also be set above the MAC for sectoral activity considered as suitable as a project generating carbon revenues. The marginal abatement costs and investment costs for activities considered in the context of this assessment are provided in Chapter 1 of this report.

## 4.2. Carbon pricing

Despite one carbon credit being the equivalent of 1 tonne of CO2 abated, credits do not fetch the same price. The differences may come from the perception of the integrity (for example, CDM credits from industrial F-gases reductions, some renewable energy projects have been considered as non-additional, while certain forestry and large hydro credits have been associated in the past with negative environmental or negative social impacts), the reputation of the voluntary standard applied to the project, administrative costs (planning, implementation, monitoring, verification) and the investment costs, last but not least.[33] With regard to the latter, in Chapter 1 of the report, marginal abatement costs (MACs) have been calculated based on the underlying calculations carried out for the NDC communicated by Azerbaijan to the UNFCCC. The MACs help define a minimum price. However, the minimum price[34] should rather go higher than the average MACs developed for sectoral activities, including not only the administrative costs but also a premium that will proportionately contribute to further expansion of renewable energy (and other low carbon investments) in the country. This step belongs to the overall climate policy/NDC financing strategy, combining public budget transfers, carbon taxes (e.g. on fuel and gas), FDI, concessional loans, and carbon market revenues. The money could be channelled through a special Carbon Fund, for example. A discussion on this topic is not the subject of this assignment. However, it is mentioned in this context to underline the importance of the expected carbon market income for the overall feasibility of the NDC and the implementation of the future long-term low-carbon development strategy.

[33] A good but narrower description of carbon pricing can be found at the Gold Standard (GS) website.

[34] GS is proposing the use of the Fairtrade minimum price model for carbon credit pricing, but this approach is more suited to the project level in the least developed countries and looks at the value of credits from the buyers' angle. However, it is useful in understanding how buyers are guided to make choices.

Under Article 6.2, mitigation outcomes resulting from cooperative approaches between two or more parties to the Paris Agreement can already be traded or, to be precise, countries may already negotiate and conclude agreements between prospective host countries and buyer countries, setting the price of the future ITMOs. Japan and Switzerland are buyer countries that have already concluded such agreements with several developing countries that will act as host parties and will issue ITMOs. If both, host and buyer countries have registries in place, CAs are possible and the only remaining concluding step would be to comply with the reporting part of the Article 6.2 guidance contained in the Annex to decision 2/CMA3 and the latest decision on Article 6.2 from Sharm el-Sheikh.

It seems, however, that due to the slow progress of work on Article 6.4 operationalization, and the centralised character of Article 6.4 Framework, it is not likely that any Art.6.4ERs will be issued before 2024 at the earliest. Importantly, the Supervisory Body has yet to decide on key methodologies and other technical issues, including setting up the Article 6.4 registry that must be resolved before the Article 6.4 mechanism takes off. In this context of further work on the implementation of Article 6 at the SBSTA and CMA levels, it is difficult if not impossible to envisage what carbon price could generate Article 6.4 projects or programmes. Much will depend on both, supply and demand for Article 6.4 credits and it is expected that their price will reflect a premium based on the high environmental integrity and the implementation of the SDGs.

Credits from voluntary markets or CERs are the offsets that are readily available to buyers at present. In assessing carbon pricing, carbon offset originators (project developers) use internal pricing mechanisms to guide their investment decisions, while buyers, the category in which corporate buyers dominate, look at external carbon pricing, based on current market prices discovered through carbon market exchanges and publicly available information on carbon pricing platforms. Huge inefficiencies are created during project origination, financing, approval, validation, and verification. According to a recent study by Thallo, VCM projects can take between 1.5 years to 6 years from the first pre-feasibility study to the first credit issuance. The study claims that delays in the verification of VCM projects could lead to a 4.8 billion $tCO_{2e}$ loss globally in not implemented voluntary projects due to inefficiencies, while the cost to project developers could amount to US$ 2.6 billion globally.[35]

Once credits are issued and stay in a registry account, both, sellers and buyers can refer to websites offering real-time pricing of carbon credits for example, carboncredits.com,[36] or the World Bank carbon

[35] "High intermediary markups dragging on voluntary carbon market development, warns report", *Carbon Pulse*, October 18, 2022.

[36] carboncredits.com provides information on real-time pricing in compliance markets (EU, South Korea, California, Australia, New Zealand) and in voluntary markets (CORSIA, nature-based offsets and Tetch based offsets)

pricing dashboard[37], providing information from both, compliance and voluntary markets on current average and historical prices. At present, Art 6.4ERs and ITMOs are not quoted, for obvious reasons. The WB carbon pricing dashboard is a very comprehensive database, going beyond voluntary markets and covering all types of carbon pricing, including taxes, emissions trading, and carbon crediting mechanisms. It provides data on design, point of regulation, jurisdiction, historical prices, etc., starting from 1990 (the level of carbon taxes in Poland and Finland in that year are included). The information on emissions trading and taxes covers 68 carbon pricing initiatives in 46 selected national jurisdictions and 36 subnational jurisdictions. The information on carbon crediting covers 25 carbon crediting mechanisms already implemented and 6 mechanisms under development. This database is a go-to starting point in building an understanding of how the prices of carbon have been developing since the early years of carbon pricing.

Information on carbon pricing can be found at VCM standards websites such as Gold Standard. Gold Standard credits command higher prices than average. This is due to the perceived high quality of credits issued under this standard. Gold Standard certification body is also an advocate of carbon pricing as a means to incentivise emission reductions while supporting the implementation of the SDGs[38]. For example, in June 2023, the average price of GS carbon credits was US$ 14.7 per tCO2e, up from US$ 13.9 per tCO2e in May 2023.

Gold Standard website also promotes the so-called Fairtrade Minimum Prices for certain projects, translating Fairtrade category into a premium of around 1 euro on the actual average price. For example, a forest management carbon credit issued under GS with A Fairtrade label would cost EUR13/$tCO_{2e}$ + EUR1 Fairtrade premium.[39] The GS website provides a formula on how to calculate a Fairtrade Minimum Price for energy efficiency, renewable energy and afforestation/reforestation projects by adding together the investment costs, project costs, carbon administrative costs (of project validation, verification, etc) and business margin (10% for EE and RE, 5% for forestry), minus revenues. The monetary value of the projects' impacts is, of course, a separate matter which should be seen in terms of broader benefits to society or nature, and which is more difficult to estimate. However, the premium paid to carbon credits with co-benefits attempts to reflect some of that value. Ecosystem Marketplace reports that co-benefits are either integrated into some of the VM standards, e.g. Gold Standard, or carbon credits may be certified separately through third-party carbon certifications. For example, additional certification may be provided by the Sustainable Development Verified Impact

[37] When a buyer purchases a future, he is agreeing to buy the commodity (in this case, a carbon credit) on the specified future date. The price is locked on the date of trade. Geo futures contracts are based on high-quality carbon credits aligned with the CORSIA requirements. N-GEO are NBS futures while C-GEO are tech-based. Cf https://carbonpricingdashboard.worldbank.org./map_data

[38] Sustainable Development Goals.

[39] www.goldstandard.org

Standard (SD VISta) or the Climate, Community and Biodiversity (CCB) standards, both managed by Verra.

In compliance markets, the emitters that are unable to reduce emissions fast enough are obliged to purchase the missing credits to meet their GHG reduction targets. In the EU ETS, for example, a failure to comply with ETS obligations of reporting emissions and surrendering the equivalent number of allowances results in a penalty while the obligation remains and has to be met notwithstanding. Therefore, prices are reflecting this compulsory nature of compliance. Even though not all compliance markets accept voluntary credits, prices on those markets reflect on prices of voluntary credits. Compliance offsets are treated like any other commodity pricing. For example, they may be used in the futures markets and derivatives. As a mark of progressing convergence between compliance and voluntary markets, voluntary offsets are also increasingly used in futures trading: for example, nature-based VCS from projects from one of the AFOLU categories (Agriculture, Forestry and Other Land Use) are traded as N-GEO futures contracts, whereas futures technology-based offsets are traded on C-GEO.[40]

**Table 7. Real-time pricing (updates every 5 minutes) on 4 August 2022, carboncredits.com.**

| Live carbon prices carboncredits.com | Last | Change | Year-to-date |
|---|---|---|---|
| Compliance markets | | | |
| European Union | EUR 92.57 | +11.26% | + 15.71% |
| California | $29.33 | - | + 0.89% |
| Australia | $30.25 | - | -10.50% |
| New Zealand | $50.00 | - | -34.57% |
| South Korea | $5.97 | -5.32% | -51.06% |
| China | $8.35 | +3.45% | +3.81% |
| Voluntary markets | | | |
| Aviation industry offset | $0.97 | -4.90% | -74.74% |
| Nature based offset | $1.91 | +0.53% | -58.48% |
| Tech based offset | $0.79 | -1.25% | -30.70% |

Price differentiation on the voluntary carbon markets is based on market sentiments. In the short term, prices are fluctuating like those of other commodity prices. The long-term trend is that of growth,

[40] C-GEO futures are “standardized instruments for high-quality voluntary emissions offsets that align with the initial recommendations for the Core Carbon Principles, an emerging set of transparent and consistent standards around the supply of carbon credits to be overseen by the Integrity Council for the Voluntary Carbon Markets.” Cf. CBL Core Global Emissions Offset (C-GEO) Overview - CME Group

based on the growing certitude of the inevitable demand growth and the notion of the available supply not meeting that demand is among the main price drivers. The preferences of buyers are another important factor. Buyers are not only concerned about the integrity of credits (thus, the oversupply of older vintages of forestry credits in voluntary registries, despite the demand being directed chiefly towards NBS credits) but also they make choices based on where the money they spend goes, and are prepared to pay more if the proceeds go to finance further removals and to support associated social causes.[41] Nature-based credits have been in the last couple of years in especially high demand and between 2020 and 2021 FOLU transactions more than doubled.[42] Recently, the increase in the price of all voluntary credits was partly offset by prices falling in 2022 and in the first half of 2023. Prices of all carbon credits, including compliance markets, are generally growing, in line with the long-term trend. This is linked to the fact that the demand for high-quality emission reductions increases as the supply fails to match the demand. According to the World Bank,[43] in the first half of 2023 revenues from global carbon pricing reached US$100 billion but these figures include compliance markets such as emissions trading, and taxes.

The table below illustrates VCM transaction volumes, average prices, and market value by sector/category in the years 2020-2021 (1 January 2020 to 31 December 2021).[44] The data has been collected by Ecosystem Marketplace for its quarterly updates of the *State of the Voluntary Carbon Markets* reports. The market value of each sector is represented as volume-weighted on market data reported in a survey conducted by Ecosystem Marketplace for each report. The data indicate that non-carbon benefits or co-benefits, e.g. conservation of biodiversity, and support to local communities and smallholders translate into higher prices of carbon credits generated from projects delivering additional value.

**Table 8. VM carbon credits issuance, average price and market value by sector in the years 2020 and 2021. (source: Ecosystem Marketplace, State of the VCM 2022)**

| | Volume ($MtCO_{2e}$) | Price (US$) | Value (US$) | Volume ($MtCO_{2e}$) | Price (US$) | Value (US$) |
|---|---|---|---|---|---|---|
| FOLU | 57.8 M | $5.40 | $315.4 M | 227.7 M | $5.80 | $1,327.5 M |
| Renewable Energy | 93.8 M | $1.08 | $101.5 M | 211.4 M | $2.26 | $479.1 M |

[41] The GS provides the following guidance to buyers: where does the money go, how much goes to project developer and how much to credit supplier, does the project report on how the revenue is spent, are credits tracked in a publicly accessible registry?

[42] Buyers' preferences are a determining factor in price-setting, cf. WB 2023 Carbon Pricing Report.

[43] "State and Trends of Carbon Pricing 2023", The World Bank 2023

[44] This is the latest available Ecosystems Marketplace report (as on 4 August 2023)

| | | | | | | |
|---|---|---|---|---|---|---|
| Chemical processes/industrial manufacturing | 1.8 M | $2.15 | $3.9 M | 17.3 M | $3.12 | $53.9 M |
| Waste | 8.5 M | $2.69 | $.22.8 M | 11.4 M | $3.62 | $41.2 M |
| EE/fuel switch | 30.9 M | $0.98 | $30.4 M | 10.9 M | $1.99 | $21.9 M |
| Household/community services | 8.3 M | $4.34 | $36.2 M | 8.0 M | $5.36 | $43.3 M |
| Transport | 1.1 M | $0.64 | $0.7 M | 5.4 M | $1.16 | $6.3 M |
| Agriculture | 0.5 M | $10.38 | $4.7 M | 1.0 M | $8.81 | $8.7 M |

Ecosystem Marketplace reports that co-benefits are either integrated into some of the VM standards, e.g. Gold Standard, or carbon credits may be certified separately through third-party carbon certifications. For example, additional certification may be provided by the Sustainable Development Verified Impact Standard (SD VISta) or the Climate, Community and Biodiversity (CCB) standards, both managed by Verra. Additional value may result in a price premium of US$4.00/t$CO_{2e}$ over the global price benchmark.[45] However, these certificates do not apply to renewable energy and could be considered in the future, in nature-based solutions (NBS) projects.

## 5. Conclusions

Taking into account business-as-usual trends envisioned on the one hand and the need to implement ambitious policies and measures to contribute to the long-term goal of the Paris Agreement through incrementally progressive NDCs on the other hand, Azerbaijan is a country with a significant capacity for carbon markets that could help the country to co-finance its decarbonisation. By examining several pathways towards long-term carbon neutrality in line with the IPCC recommendations and estimating the potential for the application of abatement technologies in each NDC sector it will be possible to quantify the reductions that may be achieved through the deployment of each techonology and, based on the MAC assessments, identify technologies and projects that can be implemented as carbon market investment projects, at the same time identifying technologies and projects that have negative MACs and for that reason are not additional, unsuitable for carbon markets and therefore to be implemented by domestic investor. The energy sector is the key sector in the current 2030 NDC of Azerbaijan and it was possible to investigate renewable technology options that are technically feasible in Azerbaijan.

45 Ecosystem Marketplace Insights Brief. *The Art of Integrity. State of the Voluntary Carbon Markets 2022 Q3*, August 2022, p.9.

As a developing country, Azerbaijan will be approached by corporate buyers and sovereign buyers alike if the country can demonstrate competitive advantage in comparison with other carbon sellers. The reduced risks of doing business with a politically and economically stable country like Azerbaijan will be taken into account by prospective carbon buyers and constitute a premium that needs to be marketed. The buyers look for stability but also capacity of the host country to deliver on long-term promises, ensure good governance and compliance. In order to succeed on carbon market and use the existing and emerging opportunities provided by both, international carbon markets and voluntary carbon markets, it is neccesary to address a number of information gaps and needs, and prepare a comrehensive roadmap for the implementation of carbon market strategy of Azerbaijan, encompassing all NDC sectors and the FOLU sector.

1. ***Estimating cumulative carbon reduction potential of Azerbaijan for a number of scenarios, including one aligned with the pathway to climate neutrality compatible with the IPCC recommendations and providing fair contribution to the Long-Term Climate Goal of the Paris Agreement***

To prepare detailed carbon market strategies for all NDC sectors and the FOLU sector, not currrently included in the NDC, it is necessary to model aggregate mitigation potential of each sector on the pathway for climate neutrality. A number of (open access) modelling tools dedicated to each of those sectors should be examined, including the tools recommended by the UNDP and FAO, to strengthen the ambition of the NDC and examine options to address the increased ambition through carbon markets. It is advisable to look at the pathway towards climate neutrality in line with the IPCC recommendations and how (by what measures and technologies) it can be achieved, so that Azerbaijan contributes to the Long-Term Climate Goal of the Paris Agreement in line with its responsibility and capability.

The next step would involve calculation of the cumulative reduction potential for each sector, until 2030, and then, until 2040 to account for the next NDC, and, potentially, until 2050. Without the knowledge of the cumulative reduction potential, it is not possible to conjecture how many carbon credits may be generated until 2030 before the achievement of the current NDC could be impacted by corresponding adjustments. This approach would also help to determine the celing for the corresponding adjustments after 2030, in the future NDCs.

2. ***Determining the financial costs of implementing measures enabling Azerbaijan to address the potential financing gap***

Information on the costs of investment and implementation would enable the government to establish the scale of the potential financing gap and attempt an estimate of the potential financial contribution coming from the carbon markets, bearing in mind the need to safeguard the NDC budget in each NDC implementation period. The overall emissions reduction potential of activities that can result in carbon credits has to be linked to the cumulative reduction potential that Azerbaijan may be able to implement, increasing its ambition by tapping carbon market revenues that can be re-directed into further mitigation activities.

3. ***Addressing information gaps on all available technologies in NDC sectors other than energy and their potential for application in Azerbaijan NDC and the Long-term Low Emission Development Strategy.***

To confirm carbon potential of each NDC sector plus the FOLU sector and to address information gaps on the available mitigation technologies and their capacity for application in Azerbaijan, the approach used in this study for energy and renewable energy technologies should be used for non-energy NDC sectors and the FOLU sector. This study provides an initial list of potential technologies in agriculture and another one for forestry, as well as waste. The lists is less detailed as regards the IPPU sector, since many industrial sub-sectors may achieve substantial carbon reductions by implementing stringent energy efficiency measures and fuel switch, as well as through deployment of renewable energy technologies onsite, with energy storage. Industry should be looked at as well but energy efficiency and fuel switch activities may be not additional so the potential for industry reductions from these activities could be used in consecutive NDCs as domestic contributions. In these circumstances, the focus of further work should be directed at the process emissions. Only with a full picture in hand, a decision could be made whether to price the carbon from industry domestically or engage in international or voluntary markets.

Calculating MACCs for mitigation activities in agriculture, forestry and waste will help to rank these activities in line with their marginal abatement costs and assess their suitability for carbon markets as well as help identify carbon price floor for credits from these activities.
Regardless of the modelling tools used and methodological approaches that are based on the above data/information dimensions, calculations would always provide values that are average for the category. On the other hand, implementation of any carbon trade mechanism, irrespective of the institutional level, will finally relate to carbon credits generated in many various projects/actions that have their specificity and thus may diverge from the average.

Therefore, looking for appropriate procedures is advisable. Such procedures, while initially relying on MACs at the relatively high aggregation level, should consider providing some room (range) for projects where MAC values deviate from average. It seems clear that an expert-based, bottom-up approach to calculations for specific subcategories or individual projects should be applied.

### *4. Setting up carbon market architecture*

Azerbaijan may draw on the experience and knowledge on CDM to establish rules for the selection of projects, their approval and monitoring process on the national and subnational level. Article 6.4 will be regulated at the UNFCCC level and there are some detailed rules and procedure agreed by the CMA to follow up.

National level arrangements will have to be integrated into the international framework developed by the parties to the Paris Agreement through reporting Article 6 activities and registering ITMOs. In Sharm El-Sheikh, CMA4 provided further guidance on registries for tracking ITMOs and requested that the UNFCCC Secretariat develop the *Article 6 database* and the centralised accounting and reporting platform (*CARP*), implement the *international registry* and establish a voluntary forum of Article 6 registry administrators, among others. A capacity-building programme will help host countries to build up their reporting capabilities, integrating Article 6 reporting into the overall Transparency Framework stipulated under Decision 18/CMA1. Further work on the international level will focus on the relationship between the international registry to be set up under Article 6.2 and the *Article 6.4 registry* to be established under Article 6.4.

Among key considerations to include in the national institutional framework for Article 6, there is a functioning MRV system at the national level, incorporating elements of the enhanced transparency framework and the guidance for Article 6. Azerbaijan has yet to set up the MRV system tracking implementation of the NDC. Setting up new institutional structures should be considered, to provide a tailored administrative service to project developers and carbon buyers, ensure smooth implementation of the MRV, good bilateral cooperation with Japan and other country-level Article 6.2 partners under the MOU, and good oversight of all Article 6 activities.

Reporting on ITMOs will be performed annually, in the electronic format to the *Article 6 database* but it will also be part of biennial transparency reports (BTRs) in line with the agreed information in relation to parties' participation in cooperative approaches, as referred to in decision 2/CMA3 and further developed in Article 6.2 decision adopted by CMA4. (regular information defined in Annex VI and annual information defined in the agreed electronic format).

### *5. Setting the price of carbon*

Setting the price of carbon can be done on both, the domestic level and on the level ensuring that carbon credits deducted from the NDC budget are priced adequately to provide for additional financial revenue enabling the government and enterprises engaged in carbon projects to re-invest in modernisation of the economic sectors and further carbon reductions, as well as to support social programmes and education. Calculation of the MACs may provide information used to set the floor prices of carbon credits generated in each sector. For voluntary markets, information on current prices for credits from similar projects/categories, the available methodologies and their application under various standards, additional implied co-benefits or certification, and the use of more stringent methodologies enabling discounting and increased ambition over time may positively influence prices of carbon credits from projects that are perceived as meaningfully contributing to global ambition and providing valuable co-benefits. For mitigation outcomes achieved through bilateral or multilateral cooperation under Article 6.2, the price will be negotiable but information on the value of MACs may equip government negotiators with a reference level.

The government may decide to set up a positive list of activities that are market-ready, supplementing it with a list of preferred methodologies, with co-benefits and safeguards, eg. on adaptation co-benefits, contributions to SDGs, biodiversity credits, if such are set up.[46] All the proposed projects and activities generating carbon credits under Article 6 will be subject to a specific review and reporting process, while voluntary market projects will be developed and monitored in line with the adopted methodologies and standards of the VCM.

## *6. The relationship of Article 6 reporting to the NDC reporting*

Article 6 readiness work plan should look at Article 6 MRV integration with the MRV of the NDC for the ease of reporting or an alignment of the two. Parties to the Paris Agreement will continue negotiating functions of the international registry and other registries for tracking Article 6.2 ITMOs and their interoperability, the centralised accounting and reporting platform and the Article 6 database. Information will be transferred through the agreed electronic format (ATF) which is not yet elaborated and will continue to be negotiated in COP28 in Dubai. Further requirements may be agreed on by parties to the Paris Agreement. The Government of Azerbaijan is also advised to designate formally a national authority for Article 6.4 mechanism and communicate its decision to the UNFCCC Secretariat.

[46] Biodiversity credits are used by Australia in the Biodiversity Offset Scheme to offset the loss of biodiversity values on development sites (a credit obligation) by being traded (biodiversity credit transfer) and retired. Credits are bought by developers, government agencies and philantropies. The income from the sale of credits goes to the Total Fund Deposit to fund the management of the site. Any country is free to set up any domestic instrument to support the achievement of its climate and biodiversity goals.