The Lab
Global Innovation Lab for Climate Finance

RESERVOIR METHANE CAPTURE MECHANISM

INSTRUMENT ANALYSIS
SEPTEMBER 2022

The Lab
Driving Sustainable Investment

Reservoir Methane Capture Mechanism (RMCM)

LAB INSTRUMENT ANALYSIS
September 2022

DESCRIPTION & GOAL —
First-of-its-kind structure using blended funding to unlock investments into emerging methane capture technology. The technology will promote methane capture in the turbined waters of hydroelectric plants in the tropics to produce clean electricity and carbon credits.

SECTOR —
Electricity/power

FINANCE TARGET —
Grants for proof-of-concept: USD 6.5 million
Concessional Capital for pilot development: USD 27 million
Commercial Debt for pilot development: USD 27 million

GEOGRAPHY —
For pilot phase: Brazil
In the future: Latin America and other tropical areas

The Lab identifies, develops, and launches sustainable finance instruments that can drive billions to a low-carbon economy. The 2022 Lab cycle targets four thematic areas: sustainable food systems, nature-based solutions, zero-carbon buildings, and adaptation, in addition to three geographic regions: Brazil, India, and Southern Africa.

AUTHORS AND ACKNOWLEDGEMENTS

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CLIMATE POLICY INITIATIVE

SUMMARY

According to CPI (2022a), methane is responsible for nearly half of net global warming to date. However, despite its outsized contribution to climate change, finance for methane emissions reduction only accounts for less than 2% of international climate finance. A ten-fold increase in methane abatement finance is necessary to meet the more than USD 110 billion needed to reduce methane emissions on a global scale (CPI, 2022a). Considering the climate crisis, a financial solution that tackles methane abatement amidst an increase in hydropower generation is vital.

To accelerate this transition, **the Reservoir Methane Capture Mechanism (RMCM)** will increase the global climate financing towards methane abatement captured in the water discharge after turbines of hydroelectric plants. Proposed by **Bluemethane**, an impact focused company developing breakthrough technology to capture methane emissions from water, and **Open Hydro**, a mission-led organization to mobilize capital into climate action in the hydropower sector, RMCM will be the first methane capture Special Purpose Vehicle (SPV) in the world with a focus on unlocking private and public investments. This emerging technology will generate carbon credits and energy from a biodigester plant. It could remove methane from water permanently with an ambition to capture up to 6.8 million tons of CO_2e from hydropower reservoirs yearly.

The Lab Secretariat recommends endorsement of this instrument as it meets the Lab's four endorsement criteria:

- **Innovative:** A first-of-its-kind structure that will detach asset ownership from economic benefits, unlocking investment into a novel methane capture technology on hydropower station reservoirs. Hydropower operators will benefit from the technology without having to incur in any initial capex.
- **Financially Sustainable:** After a proof of concept (POC), the instrument will be able to draw in concessional and commercial capital within a few years, with revenues coming from the sale of carbon credits and energy.
- **Catalytic:** At scale, the instrument will avoid 6.8 million tons of CO_2e emissions per year, equivalent to 1.5 million automobiles or 3.7 million cattle heads.
- **Actionable:** There is consistent interest from the main leading hydropower operators in Brazil in hosting these projects. Especially from Eletrobras, who owns 9 of the 11 plants selected as an initial target market. Moreover, a considerable part of the instrument's monetization strategy is anchored on well-established biogas generation technology.

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CONTEXT

Methane emissions from hydropower station reservoirs are an overlooked problem as associated capture technologies have not yet been mainstreamed. However, COP26 has created momentum for methane abatement projects

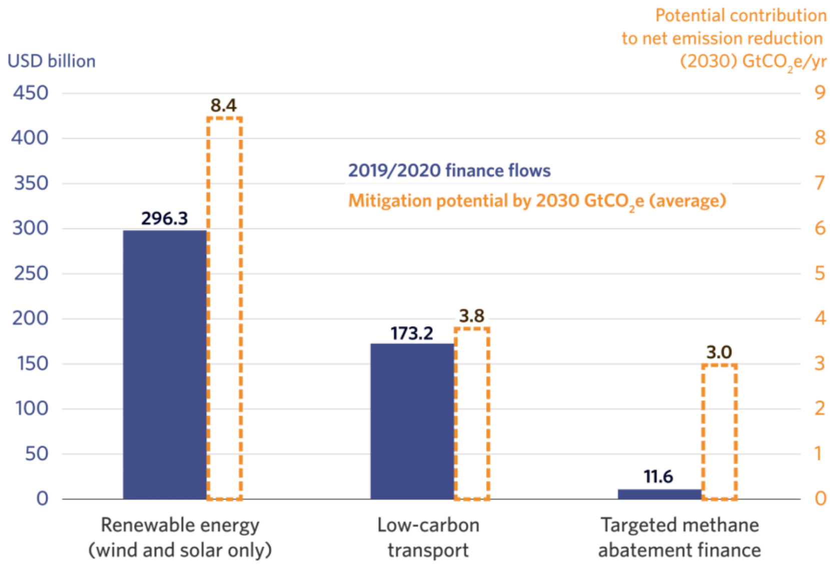
Sharp and rapid reduction in methane emissions this decade is essential to limiting global warming to 1.5°C (UNFCCC, 2016). While carbon dioxide has a longer-lasting effect, methane has an exponentially higher global warming potential (GWP) than CO2 in the first 20 years after emissions reach the atmosphere, meaning methane is setting the pace for near-term climate change (CPI, 2022a). On top of that, methane abatement finance has one of the highest ratios of global warming benefits per dollar invested (CPI, 2022a).

Although hydropower is a low-carbon renewable energy source, some reservoirs can emit large quantities of methane, especially in the initial years after impoundment, due to specific site conditions (Ubierna et al., 2021). Nevertheless, the potential of methane capturing from hydropower reservoirs has historically not had the same level of attention as methane capture in the agriculture and oil & gas sectors.

Evidence of this is that **methane capture technologies have not yet been mainstreamed and lack proper financing mechanisms**. Methane abatement solutions are severely underfunded considering their climate change mitigation potential (Figure 1). Nonetheless, some effort has been made during COP26, where a **Global Methane Pledge** was launched to make countries commit to collectively reducing methane emissions to 30% below 2020 levels by 2030 (European Commission & United States of America, 2021).

Since hydropower is considered the backbone of Brazil's electricity generation mix, with a total capacity of 109 GW and over 28 GW deployed in the last decade (ANEEL, 2022a), there is a relevant opportunity to consider methane abatement coming from reservoirs in the country. Thus, the **RMCM** proposes a **methane capture as a service** structure that generates carbon credits and energy. It separates ownership from economic benefits while enabling the technology mainstreaming that will ultimately allow hydropower plants to adopt it without incurring the associated risks. Hydropower operators will yield economic and environmental benefits without having to invest initial capex.

Figure 1: Methane abatement is underfunded when compared to other areas



CONCEPT

1. INSTRUMENT MECHANICS

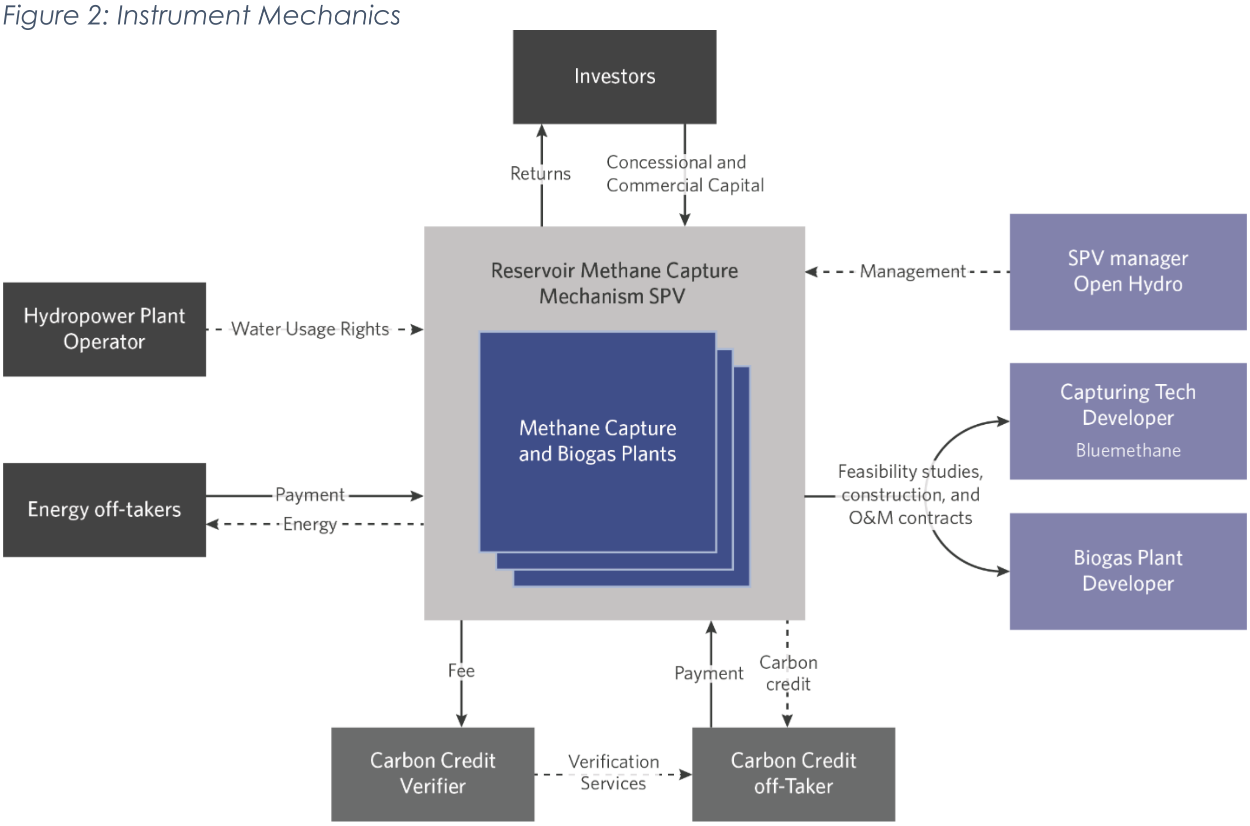
Methane is captured in the turbined waters of hydroelectric reservoirs, generating carbon credits, and fed into a biogas digestor. Energy and carbon credits produced are sold to third-party off-takers through a newly created SPV

A newly created SPV managed by one of the proponents, Open Hydro, will own all operating assets. This will enable **efficient management of the combined operations and absorption of potential risks**. The other proponent, Bluemethane, which created the technology solution, will then be responsible for developing the methane capture plant, while a local biogas developer will control the energy plant. Hydropower plant operators will provide water usage rights and host the project on their sites.

The methane capturing plant has the capacity to process around 10-50 m^3 of water per second using a **closed-circuit hydro cyclone-like tank** with methane concentration at an average rate of 4 g/m^3. This captured methane is then **fed into a biogas plant**, generating energy to be sold in the Brazilian market under the distributed energy framework (ANEEL, 2012).

Lastly, revenues based on carbon credits sales will rely on the proper measurement and monitoring of these assets by a third-party verifier. A new methodology must be developed to account for credits from this new methane abatement form (see section 4.3). Figure 2 represents the instrument mechanics described above:

Figure 2: Instrument Mechanics



2. INNOVATION

RMCM will unlock investments into an emerging methane capture technology, reducing emissions from a previously unaddressed carbon source

2.1 BARRIERS ADDRESSED: DE-RISKING AND MONETIZING A NEW METHANE CAPTURE TECHNOLOGY

The main barriers to investments in methane capture technology and the instruments and strategies to overcome them are described in Figure 3:

Figure 3: Barriers Addressed

Barriers	Novelty technology for methane capture	Monetization of methane capture is still incipient in the market	Carbon credit methodologies for methane capture are not yet in place
Solutions	Servitization displaces ownership from economic benefits. Potential grants for proof-of-concept.	Methane monetized through biogas plant. Development of carbon credit methodology. Blended finance structure.	Proponents have aligned the main steps for the development of the carbon accounting methodology.

2.2 INNOVATION: ESTABLISHING A MARKET FOR METHANE OFFSETS THROUGH A UNIQUE FACILITY STRUCTURE AND DESIGN

The instrument is the first structure to mainstream and commercialize methane capture technologies on hydropower plants. More than that, it pioneers methane capture from water at a scale like no other has done before. Other projects that focus on biogas generated from methane, such as CountourGlobal's KivuWatt, a 20MW power station at volcanic Lake Kivu (Rwanda), are designed for environments with exceptionally high methane concentrations and, thus, have unsuitable applicability for hydropower reservoirs. Alternatively, nature-based projects that target hydropower reservoirs, such as the Cloud Forest Blue Energy Mechanism (Global Lab alumni '17), usually have a long-term cash flow profile and, thus, lower actionability.

The RMCM, on the other hand proposes a **"methane capture-as-as-service" structure that displaces ownership from economic benefits**, enabling hydropower operators to adopt the systems without incurring the risks associated with new technology outside of their business scope.

2.3 BLUEMETHANE CAPTURE TECHNOLOGY

Bluemethane's methane capture technology is a **closed-circuit hydrocyclone-like tank based on passive and static principles** that promotes the quick release of dissolved methane from the turbine's discharge.

This technology processes **large volumes of water with low methane concentrations**, using minimal energy requirements thanks to the hydrophobic nature of methane that allows for mechanical separation (no reactions or feedstock) and, therefore, minimizes the need for additional treatment of the water and personnel for the operation.

The typical methane capture plant size would range **between 10 m³/s to 50 m³/s of water processed**. Methane capture efficiency can range between 30% to 70%. Bluemethane's process is designed to be net energy positive. At scale, constructing a facility able to process 10 m³/s of water takes two years with a CAPEX of USD 8.4 million. The operating costs are assumed to be 2% of the CAPEX.

A field test is under development in the Porce II hydropower plant in Colombia with Empresas Públicas de Medellín (EPM). Beyond hydropower reservoirs, the technology will be tested in different contexts: one at Lake Kivu, Rwanda, through a local energy partnership and a second at a ground water treatment plant in the Netherlands.

2.4 CHALLENGES TO INSTRUMENT SUCCESS

Some of the main challenges to instrument success relate to the **methane capture technology's novelty**. The current proofs concept under development by Bluemethane's will require up to a year before definitive parameters can be obtained.

When it comes to the **institutional arrangement for water usage and energy sales**, an ongoing validation process is being developed with local authorities and hydropower plant operators.

Moreover, the instrument relies on a **new carbon offset standard to certify captured emissions** into reliable carbon credits that will account for the larger part of the project's revenues. In this case, the **volatility of sales to voluntary carbon markets** should also be considered.

Furthermore, energy use as a secondary revenue source depends on the sales model and pricing. Until the technology is proven, methane captured might be **perceived as an intermittent source to feed the biogas plant**. Lastly, RMCM will likely need additional proof of concept funded by non-refundable grants, while a scale-up portfolio may require concessional capital permanently.

2.5 CARBON METHODOLOGY DEVELOPMENT

Proponents have aligned the main steps for developing the carbon accounting methodology with Gold Standard, a UNFCCC accredited Designated Operational Entity (DOEs) that carries out validation and verification of carbon offset projects. It will utilize parameters from the concept tested in Colombia's Porce II hydropower plant. This is expected to take approximately six months (from eligibility check to final Technical Advisory Committee (TAC) approval) and cost USD 90,000.

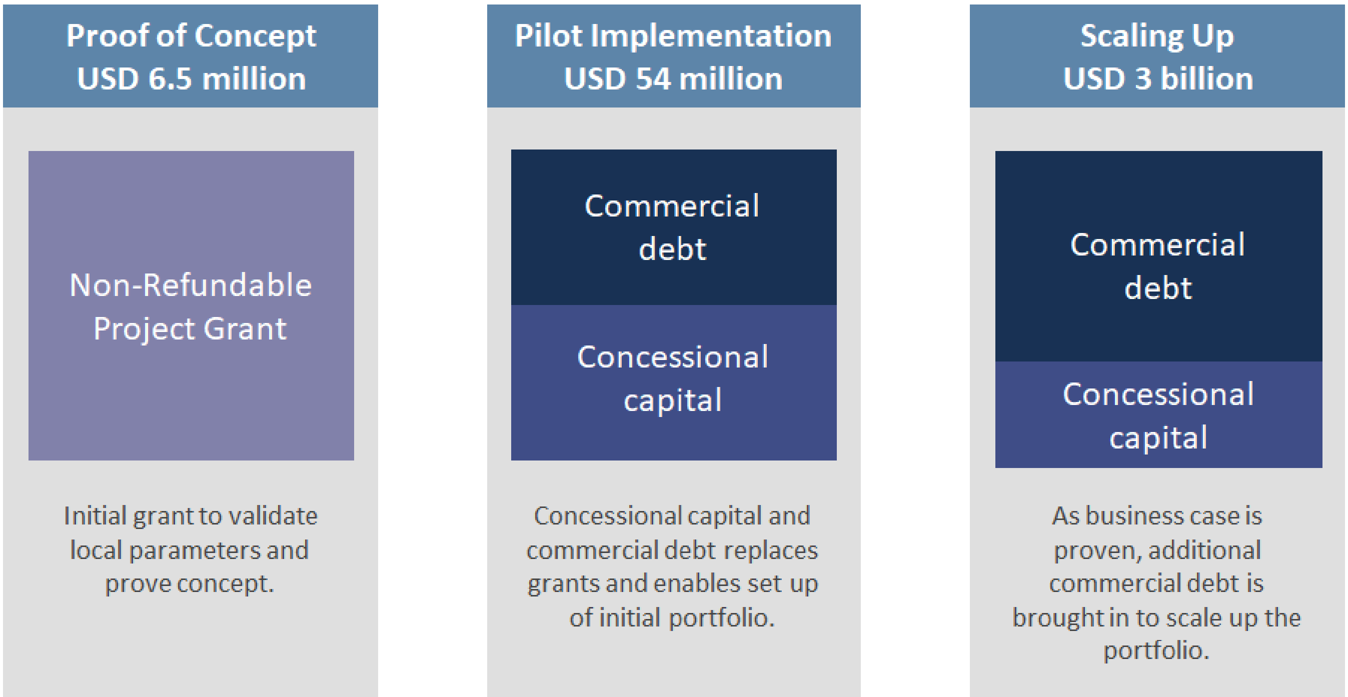
Developing the methodology with Gold Standard and adhering to their rules will ensure that the integrity of the credits and that finance will go to projects that demonstrate additionality and impact.

MARKET TEST AND BEYOND

3. IMPLEMENTATION PATHWAY AND REPLICATION

*A proof-of-concept will use **USD 6.5 million in grants** to validate local parameters for the technology. The pilot phase will comprise five projects (total investment of **USD 54 million**) to prove the business case.*

Figure 4: Implementation pathway



3.1 PROOF OF CONCEPT

Given the innovative technological aspect, the instrument will initially use early-stage grants to prove the concept and **validate local parameters**, such as methane concentration, capture efficiency and the energy balance of projects. Also, the technical challenges of installing and operating a biogas plant in close proximity to the methane capture infrastructure will be assessed, with a particular focus on the different levels of power tension and the stability of methane supply.

This POC will be conducted on a **single methane capture unit** capable of processing **7 m3/s of water, connected to a biogas plant with a capacity of 530 kW**. The size of this POC was defined mainly by the minimum size of a commercially feasible biogas plant (>500 kW). It is expected to capture 556 tons of methane per year, which translates into 17,500 tons of CO2e.

This first phase will require a **CAPEX of USD 6.5 million** for development, construction, equipment, assembly, and other management and implementation expenses including legal costs. For that, proponents are currently pursuing grant funding. One alternative would be to apply for local **R&D programs** that target the hydropower sector. One such case is the regulated R&D Program which mandates power companies to invest 1% of their revenues into innovative energy efficiency projects (Brazil, 2016). These investments are defined by the companies themselves and vetted by the Brazilian Energy Regulatory Agency (ANEEL).

RMCM presents a good fit for this program, as it deals with innovative technology for untapping a new source of energy in hydropower reservoirs from methane capture. Instituto Acende Brasil, a Brazilian research center specializing in the hydropower sector, has made a proposal to assist the proponents in the structuring, execution, and sponsor outreach for the R&D program.

3.2 PILOT IMPLEMENTATION

After the concept has been proven, a second stage of the structure will rely on concessional and commercial capital, enabling the set-up of the initial portfolio to **prove the business case**, already applying the instrument structure described in section 1. This pilot will be initially comprised of **five sets of methane and biogas plants**.

The set-up of the instrument's target market was based on the criteria of minimum size, age, reservoir presence, and methane concentration based on the literature review. Starting from 115 plants in Brazil with over 100 MW and selecting only those with high water-residence time and presence of sizeable reservoirs, a final target market of 11 plants was achieved (see Figure 5 below). This target has a **total capacity of 22 GW or approximately 54,000 m3/s of water flow, representing 20% of the total hydropower capacity in Brazil**.

A committed buy-in from hydropower operators is expected since they are highly incentivized to showcase sustainability projects and tackle any negative environmental impacts associated with their sector.

Finally, given that projects will sell energy in the distributed generation market, they must be housed in the same concessional area as their clients (ANEEL, 2012). Thus, projects near large urban and industrial areas will be prioritized.

Figure 5: Target market

The pilot will require approximately **USD 54 million** to invest in the five sets of plants described above. These plants will have an average capacity of **10 m³/s on the methane capture plant and 760 kW on the biogas system (~40% higher than the POC)**, aiming at a larger scale and commercial viability of energy generation. It is expected to capture 4,000 tons of methane (125,000 tons of CO_2e) every year.

3.3 SCALING UP/REPLICATION

As explained above, the total water flow capacity of the target market (11 hydropower plants – 22 GW) is estimated at **54,000 m³/s**. Considering a **5% penetration on this capacity would lead to a total of 273 methane capture projects of 10 m³/s each**. These projects could vary in size and shape but would, on average, replicate the structure laid out on the pilot. This would lead to a capital mobilization of **USD 3 billion, funded mainly by commercial investors.** Moreover, it would capture 217,000 tons of methane or 6.8 million tons of CO_2e each year, enabling the instrument to achieve its target **climate impact**.

According to IEA's net-zero pathway, hydropower capacity needs to double by 2050 (IEA, 2021). The instrument can be incorporated into these new hydropower reservoirs before their development, improving the productivity and climate impact of future projects, enhancing their ability to secure funding. It can also be used to unlock projects that have been stalled due to environmental concerns related to emissions. Beyond hydropower reservoirs, non-powered water reservoirs and other water bodies (ground/wastewater, rice cultivation, permafrost) could replicate the instrument.

4. FINANCIAL IMPACT AND SUSTAINABILITY

4.1 QUANTITATIVE MODELING

The pilot instrument is modeled as a 17-year roll-up fund investing in 5 different methane capture plants. Given the novelty aspect of the technology applied and the lack of visibility on the risk-return profile of the projects, the pilot stage will include both concessional and commercial capital. The total investment for an average 10 m³/s project includes USD 8.4 million for the methane capture plant and USD 958,000 for the 760-kW biogas generator. Adding other fees and costs, it will reach a **total of USD 10.8 million per project**.

The most important technical assumptions applied to the model are:

- A concentration of 4 g of methane per cubic meter of water. This reflects the average for the target market but will also function as the main hurdle for the proponents when selecting hydropower plants for project development.
- The global warming potential of methane, considered at 34x that of CO_2 (IPCC, 2013), relates to a 100-year average GWP[1].
- A carbon credits sale price at USD 20 per CO_2e ton as determined given recent market trends and the classification of methane capture as mitigation.
- Electricity price is assumed to be USD 140 per MWh considering sales to distributed energy customers, which currently pay on average USD 190 per MWh (ANEEL, 2022b), and thus, could obtain a discount.

[1] Methane is a powerful greenhouses gas with a 100-year global warming potential of 28-34 times that of CO_2. Measured over a 20-year period, that ratio grows to 84-86 times (IPCC, 2013). The latest IPCC Sixth Assessment Report uses a 100-year global warming potential of 29.8 times that of CO_2 (Foster et al., 2021). CO_2e equivalent estimations may vary depending on the global warming potential parameter used. Throughout this report we have used the ratio of 34 times based on IPCC Fifth Assessment Report (IPCC, 2013)

Moreover, a buffer of 5% of its total capital will be retained by the fund as contingency, and a management fee of 1% will be paid to the fund's manager (Open Hydro). As the main technology provider, Bluemethane will charge a 10% development/licensing fee on the total CAPEX. Finally, a blending of 50% private and 50% public capital was assumed, with public investors taking concessional capital while private investors are paid a 12.5% coupon, as shown in Table 1.

Table 1 – Main Financial Inputs and Outputs

Main Inputs (Pilot Instrument)	Value
CH_4 to CO_2 Conversion (GWP)	34x
Total Initial Investment (5 projects)	USD 54 M
Carbon Credits Sales Price	USD 20 per ton
Electricity Price	USD 140 per MWh
Methane Capture	4,000 tons/year
Capacity of Biogas Plant	0.76 MW
Main Outputs	**Value**
Concessional Capital IRR	5.2%
Commercial Capital Coupon	12.5%
Share of Revenues from Electricity	52%
Share of Revenues from Carbon Credits	48%
CO_2e Mitigated	125,000 tons/year

4.2 INVESTMENT OPPORTUNITIES

The instrument will provide the following investment opportunities at the stages described in table 2.

Table 2 – Investment Opportunities

Phase	Investment Opportunities	Value
Proof-of-Concept	Grant	USD 6.5 million
Pilot	Concessional Capital	USD 27 million
Pilot	Commercial Debt	USD 27 million

4.3 RISKS TO FINANCIAL SUSTAINABILITY

The main risks to the instrument's financial sustainability are as follows:

- **The instrument's underlying technology is still being tested.** Operational, financial, and carbon abatement parameters might still change the instrument's financial outputs and bankability. For this reason, a three-part implementation plan has been laid out to de-risk the technology, prove the business case and, finally, scale up for impact.

- **Approximately 50% of the instrument's revenues will come from the sale of carbon credits in the voluntary market.** The carbon methodology that will underpin these revenues is yet to be developed, and voluntary markets' high price volatility may impact cash flow generation. The verification and validation of the methodology by Gold Standard is being sought out, which will help mitigate these risks.
- **Hydropower plant operators may not be willing to host methane capture projects.** The instrument relies on the willingness of plant operators to host these projects. Although there are no material costs to the operators associated with the projects, lack of familiarity with the technology may prevent adherence.

4.4 PRIVATE FINANCE MOBILIZATION AND REPLICATION POTENTIAL

At scale, the instrument will have immense potential in Brazil alone. As described above, considering the largest hydropower reservoirs applying **a ratio of 2.48 m^3/s for each MW of hydropower capacity**, the 22 GW selected as the target market in Brazil would lead to an addressable 54,000 m^3/s. Considering that only 5% of this volume is converted into projects would already lead to an investment of USD 3 billion. The technology will have matured at this stage, and scale economics will lead to improved results compared to the pilot, crowding in private capital.

5. ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT

RMCM has the potential to reduce 135,000 tons of methane per year in Brazil, equivalent to 6.8 million tons of CO_2 or 922,000 average cars, while also fostering clean energy generation

5.1 ENVIRONMENTAL IMPACT

Even though hydropower is a low-carbon technology, site-specific conditions can lead to some hydropower reservoirs being sinks of emissions or high emitters. Even when hydropower plants generate low-carbon electricity, it does not prevent them from emitting methane, which could be exploited for more energy generation. Hydropower reservoirs in tropical latitudes emit **394 million tons of CO_2e per year** from methane degassing (Harrison et al., 2021). Considering the additional hydropower capacity required of 850 GW by 2050 (IEA, 2021), up to **1.2 billion tons of CO_2e** could be removed from hydropower reservoirs during their first years of operation (using the 20-year GHG warming potential).

In the Brazilian context, methane capture could reduce the peak emissions that occur decades after impoundment and contribute to achieving the national climate targets. In 2005, according to Brazil's Fourth National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), Brazil emitted 2.5 billion tons of CO_2e. The last Brazilian NDC committed to reducing 50% of the absolute emissions of 2005 in 2030, representing 1.3 billion tons of CO_2e.

In its pilot phase, the instrument has the potential to abate 125,000 tons of CO_2e per year, while the scale-up phase could reach north of **6.8 million tons of CO_2e per year**, equivalent to the yearly emission of **1.5 million cars or 3.7 million cattle heads**.

Table 3 – Summary of Environmental and Social Impact

Item	Proof-of-Concept	Pilot	Scale-Up
Goal	**De-risking tech**	**De-risking business case**	**Climate Impact**
Number of Projects	**1**	**5**	**273**
Penetration in Brazil Target Market (27 GW)	-	0.1%	5%
Capital Mobilized	USD 6.5 million	USD 54 million	USD 3 billion
Methane Capture (tons/year)	556	3,974	216,702
Carbon Abated Per Year (tons CO_2e)	17,459	124,708	6,801,103
Cattle Heads (associated yearly emissions)	9,625	68,749	3,749,326
Automobiles (associated yearly emissions)	3,795	27,110	1,478,501
Households Benefited	530	3,800	207,238
Permanent Jobs Created	5	25	1365
Temporary Jobs Created	45	225	12,285

5.2 SOCIAL-ECONOMIC IMPACT

The urgent need to tackle the climate crisis, combined with resource depletion and the aftermath of the 2008 economic crisis, presents social and economic challenges that include fighting unemployment in developing countries while simultaneously transitioning to a low-carbon economy. Yet countless opportunities lie ahead to boost the economy and improve the quality of working lives. The International Labor Organization (ILO) shows that implementing the Paris Agreement on Climate Change could create a net gain of 18 million jobs by 2030 in the energy sector (ILO, 2018).

RMCM could significantly contribute to that inclusive transition by creating around **50 permanent and temporary jobs for each project, 250 during the pilot phase, and up to 13.650 jobs in its scaled-up form** (see table 4). Considering that hydroelectric power plants impact numerous human activities, RMCM will also count on developing a Local Community Technical Assistance (LCTA). The facility will work alongside the SPV to assist populations close to the targeted reservoirs, as the watercourse often represents an essential means of subsistence for most of them. On top of that, the limited access to basic infrastructure and services, including energy, internet, education, and healthcare, is a common scenario for most riparian populations. With the ambition to also tackle this issue with a yearly budget of USD 500,000, the LCTA aims to:

1. Conduct an inclusive process to assess the main social and economic needs of the community where the hydroelectric plant is located.
    a. Considering the dimensions of Brazil and that hydropower stations are spread around the national territory, there is no standard solution for creating local benefits.
    b. Provide a broader set of investments to support the communities in a tailored way.
2. Some possibilities include investing in quality energy access for local communities that lay outside of the standard national grid (CPI, 2022b);
    a. Purchasing refrigerators for the fishermen of the riparian populations;
    b. Capacity building to develop technicians to take on the jobs RMCM will create.

Also, energy generation from degassing captured methane improves existing infrastructure, enabling more households to access renewable energy sources. It is estimated that each 1 MW of renewable energy added to the matrix benefits 1,000 households. Thus, the instrument's pilot phase would benefit approximately 3,800 households while, at scale, this number could reach 207,238. Moreover, the instrument will sell energy at an estimated 25% discount to the market, freeing up disposable income for these households.

RMCM has as front of mind diversity and inclusion considerations for not only the employment at the facility and the hydropower operator's team but also on the management of the newly created SPV (both proponents are women-led organizations).

The instrument will encourage hydropower operators to develop a diverse GHG emissions team, as organizations with a higher diversity rate have a 75% probability of implementing innovative ideas and improving productivity (EY, 2019).

RMCM is aligned and contributes to achieving several of the Sustainable Development Goals (SDGs), including the ones represented in figure 6:

Figure 6 RMCM addresses four Sustainable Development Goals

NEXT STEPS

The following steps for the instrument include developing and broadening the partnerships with hydropower operators and obtaining funding for the proof-of-concept. This will be essential to determine the key metrics of the instrument, which will be applied in its pilot phase. Moreover, the development and acceptance of a new carbon methodology for the capture and utilization of methane from hydropower reservoirs will play an important role.

REFERENCES

ANEEL (2012). Resolução Normativa ANEEL nº 482, de 17-04-2012. *Agencia Nacional de Energia Eletrica (ANEEL)*, Brasília. Retrieved from: https://www.legisweb.com.br/legislacao/?id=342518

ANEEL (2022a). Sistema de Informações de Geração (SIGA). *Agencia Nacional de Energia Eletrica (ANEEL)*, Brasília. Retrieved July 26 from: https://app.powerbi.com/view?r=eyJrIjoiNjc4OGYyYjQtYWM2ZC00YjllLWJlYmEtYzdkNTQ1MTc1NjM2IiwidCI6IjQwZDZmOWI4LWVjYTctNDZhMi05MmQ0LWVhNGU5YzAxNzBlMSIsImMiOjR9

ANEEL (2022b). Portal Relatorios: Luz na Tarifa. *Agencia Nacional de Energia Eletrica (ANEEL)*, Brasília. Retrieved July 17 from: https://portalrelatorios.aneel.gov.br/luznatarifa/basestarifas

Brazil (2016). Lei nº 13.280, de 3 de Maio de 2016. Brasília, DF, 2016. Retrieved from: http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2016/lei/l13280.htm

CPI (2022a). The Landscape of Methane Abatement Finance. *Climate Policy Initiative (CPI)*. Retrieved from: https://www.climatepolicyinitiative.org/publication/the-landscape-of-methane-abatement-finance/

CPI (2022b). Rios de Diesel na Amazônia Legal: Por que a Região com as Maiores Hidrelétricas do País Depende de Combustível Caro e Poluente?. *Climate Policy Initiative (CPI)*. Retrieved from: https://www.climatepolicyinitiative.org/pt-br/publication/rios-de-diesel-na-amazonia-legal-por-que-a-regiao-com-as-maiores-hidreleticas-do-pais-depende-de-combustivel-caro-e-poluente/

European Commission and United States of America (2021). Global Methane Pledge. *Climate and Clean Air Coalition (CCAC)*, Paris. Retrieved from: *https://www.ccacoalition.org/en/resources/global-methane-pledge*

Ernst & Young Global (2019). Could gender equality be the innovation boost utilities need? Retrieved from: *https://www.ey.com/en_gl/women-power-utilities/could-gender-equality-be-the-innovation-boost-utilities-need*

Forster, P., T. Storelvmo, K. Armour, W. Collins, J.-L. Dufresne, D. Frame, D.J. Lunt, T. Mauritsen, M.D. Palmer, M. Watanabe, M. Wild, and H. Zhang (2021). The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In Climate Change (2021). The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 923–1054, doi:10.1017/9781009157896.009. Retrieved from: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07.pdf

Harrison, J. A., Prairie, Y. T., Mercier-Blais, S., & Soued, C. (2021). Year-2020 Global Distribution and Pathways of Reservoir Methane and Carbon Dioxide Emissions According to the

Greenhouse Gas From Reservoirs (G-res) Model. *Global biogeochemical cycles*, 35(6), e2020GB006888. Retrieved from: https://doi.org/10.1029/2020GB006888

IEA (2021). Net Zero by 2050: A Roadmap for the Global Energy Sector. IEA, Paris. Retrieved from: https://www.iea.org/reports/net-zero-by-2050

ILO (2018). World Employment Social Outlook 2018. *International Labour Organization (ILO),* Geneva. Retrieved from: https://www.ilo.org/global/publications/books/WCMS_628654/lang--en/index.htm

IPCC (2013). Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp. Retrieved from: https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf

Ubierna, M., Diez, C., Mercier-Blais, S. (2021). Chapter 5 Water Security and Climate Change: Hydropower Reservoir Greenhouse Gas Emissions. A. K. Biswas and C. Tortajada (eds.) Water Security Under Climate Change. Water Resources Development and Management. Springer Nature Singapore Pte Ltd. Retrieved from: https://doi.org/10.1007/978-981-16-5493-0

UNFCCC (2016). The Paris Agreement. *United Nations Framework Convention on Climate Change (UNFCCC)*, New York. Retrieved from: https://unfccc.int/documents/184656