



Verified Carbon Standard

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EXPERT ASSESSMENT REPORT: ALTERNATIVE LOW-CARBON FUELS FOR SHIPPING

Methodology Title	Alternative Low-Carbon Fuels for Shipping (M0191)
Version	1.0
Sectoral Scope(s)	7 - Transport
Document Reviewed	Draft methodology
Date of Issue	April 28, 2025
Expert Assessor	Dr. Gautam Dutt and Mrs. Alison Morris, The FReMCo Corporation Inc.
Contact	Alison Morris, amorris@fremco.com

1 INTRODUCTION

Verra is working with Iino Kaiun Kaisha Ltd., on the development of a new VCS Methodology for Alternative Low-Carbon Fuels for Shipping (ID#M0191). Per section 2.1.2 of the *Methodology Development and Review Process, v4.4*, this methodology is being developed through an alternative process that has been deemed more efficient and equally robust. The alternative process included:

- Replacement of Section 3.5 Step 5: Validation/verification body assessment of methodology with review by a group of independent experts.
- Conducting the review by a group of independent experts in parallel to the public consultation

Based on their experience in the shipping industry and the development of measurement, reporting and verification requirements for emission reduction projects in the shipping industry, Verra hired Alison Morris and Gautam Dutt of The FReMCo Corporation Inc. to provide an expert assessment of the proposed methodology. The independent expert's assessment focused on:

- 1) Scientific rigor: Assessment of whether the methodology reflects the most recent scientific knowledge of GHG emission reductions from fuel switching in the shipping industry
- 2) Technical robustness and consistency to ensure accurate/conservative outcomes:

Relevancy and completeness of GHG sources and carbon pools included in the project boundary

Appropriateness of equations for quantifying baseline emissions, project emissions, leakage emissions, and GHG emission reductions

Validity of assumptions, calculations, and data sources

Appropriateness and technical soundness of the monitoring approach

Fuel types considered as alternatives to conventional shipping fuels

The methods used to determine the default emission intensities of alternative fuels

2 ASSESSMENT APPROACH & FINDINGS

The expert assessor reviews the draft methodology and will provide feedback to Verra (using section 6 of this document). Verra in turn will share that feedback with Grutter Consulting AG (the developer's consultant) who will prepare responses to the expert assessor's findings and update the methodology accordingly. The expert assessor will review the responses from the consultant and provide confirmation that the planned updates address the findings.

3 ASSESSMENT CONCLUSION

The expert assessor completes the expert assessment of the draft *Alternative Low-Carbon Fuels for Shipping (M0191)* and confirms the draft methodology adheres to the criteria established.

4 EXPERT QUALIFICATIONS

The CVs of the expert reviewers, Alison Morris and Gautam Dutt of The FReMCo Corporation Inc., are included at the end of this report as Appendix 3.

5 SIGNATURE

Signed for and on behalf of:

Name of entity: The FReMCo Corporation Inc.

Signature: 

Name of signatory: Alison Morris

Date: April 28, 2025

6 EXPERT FEEDBACK FORM

Section 2 – Summary Description of the Methodology

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
1	This methodology applies to project activities that involve a fuel switch from traditional fossil fuels to alternative low-carbon fuels in ships.	<p>Suggest a minor rewording of this sentence, since new ships may not “switch” from fossil to alternative fuels, but may use alternative fuels from the outset. Granted this likely won’t be the case for many years whilst, in the interim, most ships are built for dual-fuel use so that they can transition to alternative fuels once sufficient volumes become available.</p> <p>We have the following suggestion for a rewrite:</p> <p>“This methodology applies to project activities that involve the use of alternative low-carbon fuels in ships instead of traditional fossil fuels, including: [List fuels]. The methodology applies to the partial or complete replacement of fossil fuels in existing ships as well as the use of alternative low-carbon fuels in new ships.”</p>	OK, text has been updated
2	1) low-carbon hydrogen produced by electrolysis of water, using dedicated renewable energy or low-carbon grid electricity;	“Low-carbon grid electricity”, mentioned twice in the Summary section is not mentioned in the main body of the methodology and not defined anywhere.	We have deleted the term “low-carbon” from the summary. Emission reductions will only be granted if project emissions are below baseline emissions and this will only be possible if grid electricity used is low-carbon. However, there is no definition of what low-carbon means and also the exact level at which PE = BE will also depend on the type of alternative fuel and the transformation efficiency.
3	Methodology applies to low carbon hydrogen and ammonia and “e-fuels including e-liquefied natural gas (e-LNG), e-liquefied petroleum gas (e-LPG), e-diesel, and e-methanol.”	The terms “e-liquefied natural gas (e-LNG)” and “e-liquefied petroleum gas (e-LPG)” could mean these fossil fuels that are liquefied using low carbon electricity. If so, why is biogenic methane (with or without low carbon	Biomethane is a bio-fuel which is not part of this methodology. There are other methodologies which have been designed for usage of biomethane.

Section 2 – Summary Description of the Methodology

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
		liquefaction) not included as a low-carbon fuel? While liquifying NG is energy intensive, liquifying LPG is not. Perhaps, “e-liquefied natural gas” refers to LNG equivalent produced entirely from low-carbon raw materials and electricity. To avoid misunderstanding, please include all low carbon fuels in the “Definitions” section.	<p>The methodology is not in general about all low-carbon fuels but only about the listed ones which are e-fuels. Biomethane is not an e-fuel but a biogenic fuel.</p> <p>In the definitions we first have a general definition and then state specifically what alternative low carbon fuels are in the context of this methodology. We do not want to expand that.</p>
4	“...domestic and international shipping”	Just to be clear, I believe the text should read: “domestic inland and intercoastal shipping as well as international shipping”	OK, the text has been amended
5	Last paragraph of Summary section	Suggest adding wording in the Summary section as follows, since this is a key point in the methodology – “Projects will use a well-to-wake approach including well-to-gate emissions (refinery and extraction for production of baseline and project fuels), gate-to-tank emissions (transport emissions), and tank-to-wake emissions (combustion emissions).”	OK has been added
6	Sources section	Minor formatting correction - we believe the following item should be included in the bullet list, rather than notated with a numbered bullet item – “4) IMO. 2022. Energy Efficiency of Ships MEPC 79/6/1 of 10/09/2022”; i.e. “4)” should instead be a bullet	OK has been corrected
7	Sources section This methodology uses the most recent versions of the following tools and modules:	Since newer versions may appear, I recommend that the version numbers of the cited tools and modules be listed.	OK has been added

Section 3 – Definitions			
#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
8	Electrofuels (e-fuels)	Good definition. However, e-ammonia is not listed here. Green ammonia is defined separately. Please add definitions for “e-ammonia” and “e-hydrogen”, mentioned elsewhere.	We have amended the definitions
9	Green ammonia A zero-carbon, renewable energy carrier produced from green hydrogen and nitrogen	Should there be a comment on how the nitrogen is produced? Nitrogen is normally produced by liquefaction of air, which can be done using renewable electricity or not. Should there be separate categories for “green” nitrogen and normal nitrogen?	We have included in the definition
10	Liquefied petroleum gas “...volatile hydrocarbons like propene, butene, and butane”	Also propane. Included in the Britannica definition.	Has been included
11	Well-to-tank (WTT) emissions “...point of fueling <u>a vehicle or equipment</u> ”	For completeness and consistency with “Tank-to-wake (TTW) emissions”, please replace highlighted phrase with “vehicles, vessels, aircraft, or other equipment,”	Has been amended
12	Methanol	Methanol is defined but e-methanol is not. It is defined within the applicability conditions, see below. However, since e-methanol is an alternative fuel, perhaps it can also be explicitly defined in this section. A possible definition, from Methanol Institute (2022), cited in the methodology, is “ <i>E-methanol is produced by combining green hydrogen using renewable electricity and water electrolysis with a source of carbon dioxide.</i> ”	e-methanol is included in the definition of e-fuels. Therefore thereafter we only put the methanol definition separate (ide to e.g. Diesel fuel separate or LNG separate and not a specific definition of e-methanol)

Section 4 – Applicability Conditions

#	Paragraph from Draft Methodology	Comment	Developer's Response and/or Update
13	This methodology applies to project activities that involve a fuel switch from traditional fossil fuels to alternative low-carbon fuels in ships.	Please see suggestions for rewriting in the Summary section above, to cover partial or complete use of alternative fuels, in existing or new ships.	OK has been changed
14	<p>4) The engine of the ship (including all its components and the connected hardware/machinery) is not altered in any manner¹¹ and remains the same for the baseline and the project scenario.</p> <p>¹¹ Alterations include capacity additions, retrofits, replacements (partial or full), and unscheduled rehabilitations/repairs that could enhance the installed power generation capacity or the efficiency of the engine.</p>	<p>We believe this condition should be removed for the following reasons:</p> <ol style="list-style-type: none"> 1) A carbon-credit methodology should not inhibit climate change mitigation; 2) Since alternative fuels are more expensive, energy efficiency improvements help the introduction of these alternative fuels; 3) Most important: an energy efficiency measure would reduce project fuel consumption. Since, in this methodology, baseline fuel consumption is determined from project fuel consumption, baseline fuel consumption would also go down. Thus applying the methodology in the presence of energy efficiency measures would simply mean that no emissions reductions are obtained from the energy efficiency measures. 4) Note also that the footnote (see text in left column) does not include many types of energy efficiency measures, for example, if a ship installs EcoNozzles (improves combustion control and reduces fuel use), a waste heat recovery system, advanced 	We agree

Section 4 – Applicability Conditions

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
		hull coatings or monitoring/optimization software. 5) If a project proponent wishes to claim credits for the energy efficiency retrofits, they are invited to use a separate methodology to this effect, keeping in mind that the emissions reductions from fuel replacement and energy efficiency measures would be sub-additive.	
15	Double counting and/or double claiming	Typical CDM and other carbon credit methodologies tend to assign carbon credits to the fuel producer, not the fuel consumer. Therefore, we propose that the methodology should include a clause to ensure double counting and claiming are avoided at the project level, i.e. project proponent must demonstrate that the emission reductions are not being claimed by another party in the supply chain of the e-fuels.	Has been added
16	2. Where alternative fuels are produced using CO ₂ captured from biogenic sources, there are no competing uses of the CO ₂ in the baseline or the competing end users have agreed to (partial or full) CO ₂ usage by the project, demonstrated with valid evidence.	Not sure why we need this condition. There are many sources of recoverable biogenic CO ₂ . Also, should CO ₂ from fossil sources, e.g. cement production, refineries, etc. be excluded? How would the methodology text related to “competing uses of CO ₂ ” be determined? The concern appears to be for competing uses for the CO ₂ . But there are also competing uses for renewable electricity, which is not	This was included due to recommendations of Verra in the design stage. The reason for not including the usage of fossil CO ₂ was the fear CO ₂ capture could be financially so attractive that fossil fuels are burnt for the sake of capturing thereafter CO ₂ . We want to exclude fossil CO ₂ sources to prevent creating potentially perverse incentives for continuing usage of fossil fuels. See Verra Finding 13 dated 27.10.2022. Verra finding 13 dated 10.02.2023 also states: a) Please note that sourcing CO ₂ from biological processes can only be permitted in the proposed

Section 4 – Applicability Conditions

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
		precluded. This point is discussed in more detail in the next row and comment.	<p>methodology if there are no competing uses of the CO₂ in the baseline or if the competing end users have agreed to (partial or full) CO₂ usage by the project (valid evidence should be provided by the project developer of this agreement).</p> <p>Therefore we have adjusted to Verra requirements</p>
17	1. b) c) e-LNG, e-LPG, e-diesel, or e-methanol ² produced with green or low carbon hydrogen and captured CO ₂ sourced from ambient air or biogenic sources only. ³	<p>Note that “low carbon hydrogen” is defined in the Summary section as: “low-carbon hydrogen produced by electrolysis of water, using dedicated renewable energy or low-carbon grid electricity; In the Definitions section it is defined as: “An energy carrier produced by electrolysis of water with grid electricity, that results in a fuel with emissions intensity significantly lower than the global average for produced hydrogen”</p> <p>There is therefore an ambiguity in the definition of “low carbon hydrogen” insofar as the text boldfaced/highlighted above is not clearly defined.</p>	<p>1. We have replaced the term low-carbon grid and unified the definition.</p> <p>2. we prefer not to put a specific threshold as e-hydrogen and e-ammonia production efficiencies might improve with more efficient electrolyzers. The generic definition of low carbon fuels states that they need to have lower emissions than conventional fossil fuels. This is the threshold.</p> <p>3. We agree that it is strict to rely on DAC. See conditions imposed to us from Verra based on previous reviews (cited above under point 16)</p>

² These fuels are chemically identical to their fossil counterparts and can be burned in existing fossil-fueled ships and can utilize the existing network of supply infrastructure

³ CO₂ captured from biomass or liquid sources (e.g., from bioethanol) is not permitted under the current version of this methodology. Capture from the decomposition of organic material (gaseous source) is permitted (e.g., CO₂ captured from a biogas plant).

Section 4 – Applicability Conditions

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
		<p>The same argument would apply to “low-carbon ammonia”, and may appear for e-LNG, e-LPG and e-diesel.</p> <p>Perhaps a specific threshold can be used, e.g. emissions in the production and transport of e-fuels should not exceed 10 g CO₂-eq per kg of fuel. (This value suggested by Figure 12 of Methanol Institute (2022). It is possible that e-fuel certification already includes a quantitative definition. However, since many different standards are cited, a uniform definition may be useful.</p> <p>The second footnote here (10 in the methodology) says the following: ¹ CO₂ captured from biomass or liquid sources (e.g., from bioethanol) is not permitted under the current version of this methodology. Capture from the decomposition of organic material (gaseous source) is permitted (e.g., CO₂ captured from a biogas plant).</p> <p>This requirement that CO₂ should be sourced from ambient air (Direct Air Capture) or biogenic sources seems excessively strict. CO₂ is available from a variety of industrial sources at high concentrations, making this much easier to capture compared to that from ambient air.</p> <p>Direct Air Capture requires the consumption of large amounts of electricity in fans, etc.</p>	

Section 4 – Applicability Conditions

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
		We propose that the Methanol Institute definition may be the basis for defining e-methanol.	

Section 5 – Project Boundary

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
18	Table 1 notes that CH ₄ is excluded from baseline fuel GHG emissions boundary in both the Baseline and Project scenarios.	We believe that CH ₄ emissions should be included in the case of ships using LNG or e-LNG, i.e. methane slip emissions.	Methane slip emissions are not included as they are in baseline and project conditions the same. The LNG baseline fuel is replaced with e-LNG. Both fuels result in the same methane slip. If fossil LNG is replaced with another alternative low carbon fuel methane slip in the baseline is considered a leakage and non-consideration would be conservative.
19	N ₂ O emissions	<p>Unlikely to be significant in most cases. Suggest exclude from both baseline and project, except when ammonia is the alternative fuel.</p> <p>Ammonia combustion will produce nitrous oxide emissions. This is recognized in the CDM insofar as there were two methodologies for abating N₂O emissions in nitric acid manufacture (which involves ammonia oxidation). These two were AM28 and AM34 (of which one of the reviewers, Dr. Gautam Dutt, was a coauthor) now combined in the consolidated CDM methodology ACM0019: N₂O abatement from nitric acid production — Version 4.0.</p>	We have adjusted

Section 5 – Project Boundary

#	Paragraph from Draft Methodology	Comment	Developer's Response and/or Update
		<p>The use of ammonia as a fuel has also generated studies of nitrous oxide production in its combustion. See, e.g.</p> <p>Krister A. Pedersen, Michał T. Lewandowski, Corinna Schulze-Netzer, Michał Pasternak, Terese Løvås, "Ammonia in dual-fueled internal combustion engines: impact on NO_x, N₂O, and soot formation" Energy and Fuels, vol. 37, no. 22, 2023.</p> <p>More specifically for shipping, please see "Managing emissions from ammonia-fueled vessels", Maersk McKinney Moller Center for Zero Carbon Shipping, 2023. https://cms.zerocarbonshipping.com/media/uploads/documents/Ammonia-emissions-reduction-position-paper_v4.pdf</p> <p>This paper provides reference values for nitrous oxide emissions Section 3.2, Figure 4, and Table 2.</p> <p>We encourage the methodology to allow for nitrous oxide emissions abatement with reference to the CDM methodology ACM19 or other sources.</p>	

Section 6 – Baseline Scenario

#	Paragraph from Draft Methodology	Comment	Developer's Response and/or Update
20	Typo below table, bullets should be 1) and 2) as referenced in next sentence, but show as 1) and 5)		Has been corrected

Section 7 – Additionality			
#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
21	Regulatory surplus	Since VCS regulatory surplus is focused on the assessment of ‘country’ regulations, perhaps it would be best to insert some wording related to IMO regulations, which govern shipping globally.	We have included a phrase
22	Positive List	<p>Might be prudent to insert wording to state how often the positive list will either be reassessed or updated as required.</p> <p>Since we are starting from a very low baseline, and no one expects any significant adoption up to 2030, perhaps a 2030 first revision be suggested, or 5 years from methodology publication.</p>	To our understanding this is a decision to be taken by Verra.

Section 8 – Quantification of Estimated GHG Emission Reductions			
#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
23	8.1. Baseline emissions are calculated based on the usage of conventional (fossil) fuels for shipping (i.e., LNG for LNG carriers and gas carriers and HFO, LFO, MDO, or MGO for other ships). For ships using LFO, MDO, and/or MGO, GHG emission reduction calculations are based on HFO which has the lowest emission factor of the diesel fuels.	<p>This sentence is correct but perhaps difficult to read. Here is a suggested rewrite:</p> <p>8.1. Baseline emissions are calculated based on the usage of conventional (fossil) fuels for shipping. For LNG carriers and gas carriers, the conventional fuel is considered to be LNG, since this has the lowest emissions factor. For all other ships, the conventional fuel is considered to be HFO, which has the lowest emissions factor among possible alternatives: HFO, LFO, MDO, and MGO.</p>	We have changed

Section 8 – Quantification of Estimated GHG Emission Reductions

#	Paragraph from Draft Methodology	Comment	Developer's Response and/or Update
24	Baseline emissions $E_{Fi,y}$ = Emission factor of fossil fuel type i in year y (t CO _{2e} /t fuel)	The description should note that the emissions factor considers well-to-wake emissions, since most methodologies present only tank-to-wake emissions factors. Also elsewhere, where "Emissions factor" is mentioned.	We have included although the appropriate section is where the EF is explained and not in equations
25	Project Emissions	Wording states that "Calculations are based on a well-to-wake approach and include production emissions (well-to-gate), transport emissions (gate-to-tank), and tank-to-wake or combustion emissions. Combustion emissions of alternative low-carbon fuels are considered to be zero." The methodology goes on to list "Well-to-gate" emission sources with three bullet points. Is the intention that the transport emissions (gate-to-tank) are included in those three bullets, as this is not clear? If so, the wording ahead of the bullets should be edited to state "well-to-wake" and specific mention of transport emissions and how those are to be calculated, perhaps in both the bullets and the formula. There is some wording at the end of clause 8.2.1 that addresses transport emissions – perhaps this would cover the comment above, but the wording is somewhat hidden or buried.	We have clearly stated well-to-gate. The text states these are the sources. Thus it is clear from the text that these are not gate-to-tank emissions and not transport emissions. We have specified the sources of WTG emissions to make clear what needs to be included. We do not see the reasoning why the formulation should be changed. We have re-structured a bit to make it clearer.
26	Project emissions, 8.2. Equation (4)	Can we be sure that there are emissions only from electricity use in the production of the alternative fuels? Could there not be some other chemical input, e.g. a catalyst, which implies fossil fuels in its production?	That's upstream emissions which are not included in any carbon credit methodology.

Section 8 – Quantification of Estimated GHG Emission Reductions

#	Paragraph from Draft Methodology	Comment	Developer's Response and/or Update
27	Project emissions, 8.2. "...Combustion emissions of alternative low-carbon fuels are considered to be zero."	<p>Low-carbon fuels that contain carbon emit CO₂ when burnt. If the carbon was produced by photosynthesis, then there are no net CO₂ emissions. How do we ensure that the CO₂ emissions for e-methanol, e-diesel, e-LPG, and e-LNG are fully compensated? LNG combustion would also leave some methane unburnt. How is this "methane slip" accounted for?</p> <p>Similarly, there are nitrous oxide emissions from ammonia combustion and their abatement. Discussed earlier.</p>	<p>CO2 is based on DAC and releasing it again to the atmosphere is net-zero.</p> <p>Methane slip is not included as it is also not included in the baseline with e-LNG replacing fossil LNG and thus the same baseline as project CH4 methane slip emissions</p> <p>N2O has been included for ammonia (see sources of GHG emissions). We have explicitly added that in project emissions.</p>

Section 9 – Monitoring

#	Paragraph from Draft Methodology	Comment	Developer's Response and/or Update
28	9.1 EFi,y. Emission factor of fossil fuel type i in year y	Remind readers that this emissions factor considers well-to-wake emissions. See comment above, since most methodologies present only tank-to-wake emissions factors.	Has been added
29	9.1 EFi,y. Description: Emission factor of fossil fuel type i in year y	Suggested rewrite: Emission factor of (baseline) fossil fuel type i in year y	OK
30	9.1 EFi,y. Value applied: LNG: 3.277 HFO (used for all diesel fuels): 3.376	Suggested rewrite as follows: For LNG carriers and gas carriers, LNG: 3.277 For all other ships, HFO: 3.376	OK
31	9.1 EFi,y. Justification: Values for tank-to-wake as provided and used for reporting GHG emissions from shipping to IMO. Upstream fossil	Suggest cite the references for IMO and CDM. If IMO, CDM or UNFCCC updates values, should the methodology be updated?	The references are cited under source of data and the detail is in section 10 references;

Section 9 – Monitoring			
#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
	fuel emissions for LNG and diesel as provided by the CDM.		Update of methodologies and cycle of update is a decision to be made of Verra. FYI the CDM tool cited with upstream emissions has not been updated for >15 years
32	9.1. NCVi. Description: Net calorific value of fossil fuel type i	Suggested rewrite: Net calorific value of (Baseline) fossil fuel type i	OK
33	9.1. NCVi. Source of data <i>Option 2: Use IPCC default values for fossil diesel fuels and LPG</i> as provided in Table 1.2, Chapter 1, Vol. 2 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. For ammonia, hydrogen, LNG, and methanol, use default values provided in Table 3 of IRENA (2021). Option 2 must be applied conservatively such that the lower IPCC default values are used for baseline fuels and upper IPCC default values are used for alternative fuels.	At the time of IPCC (2006), low-sulphur HFO and Very-low-sulphur or even lower sulphur levels were not in use and were not reported. The 2019 update of IPCC (2006) did not include them either, since the section on Shipping was not revised. If the baseline fuel is assumed to be LNG or HFO, then perhaps the methodology does not need the NCV of other fuels. If so, see next row.	We still need it. This is not related to low-sulfur fuels. Its related to potential differences between NCVs of fossil and alternative low carbon fuels. See equation (2)
34	9.1. NCVi. Value applied Fossil fuels: <ul style="list-style-type: none"> Gas/diesel oils (includes LFO): 41.4 LNG: 46.5 HFO/residual fuel oil: 39.8	To be conservative, the baseline fuel is assumed to be LNG or HFO, as noted earlier in the methodology, since these have the lowest emissions factors. If so, why would we need the NCV of Gas/diesels? In my opinion, there should be only two rows LNG and HFO.	See equation (2). The NCVs of fossil fuels are needed to adjust the quantity of fuel used if the baseline fossil fuel has a different NCV than the alternative low carbon fuel
35	9.2. PFz,y Description of measurement methods and procedures to be applied: ... The fuel supplier states the quantity of fuel supplied per fuel type and the	How does the certificate address the possibility of double counting, i.e. that no other party has claimed carbon credits for the fuel production?	The certification is to ensure the emissions. It does not certify if the company is engaged in carbon trading. This is not an issue of the methodology and a concern applicable to any carbon credit methodology and any carbon credit project. This is therefore not an element which is discussed at methodology level but a generic issue discussed at the Project Development level, specifically in the VCS PD

Section 9 – Monitoring

#	Paragraph from Draft Methodology	Comment	Developer's Response and/or Update
	emission intensity per fuel type or the amount of electricity used per unit of fuel with a corresponding certificate. This must be linked with a certificate issued by a third party using for certification a book-and-claim model ⁴ or a mass balancing model which links the certificate to the respective physical delivery of the product. ⁵		under point 1.16 and 1.17 under guidance of the latest version of the VCS Standard.
36	Section 9.2, Data/Parameter EF _{z,y} (Emission factor of alternative fuel type z in year y)	In Source of Data box of table, the wording states: "The certificates must include all relevant emission sources as detailed in Section Error! Reference source not found.... " Should this be Section 8.2.1?	Has been corrected
37	9.2. EF _{z,y} . Description Emission factor of alternative fuel type z in year y	Suggested rewrite: Emission factor of alternative (project) fuel type z in year y	OK
38	9.2. EF _{z,y} . Description of measurement methods and procedures to be applied ... The objective of the TÜV Rheinland Standard H2.21 (Carbon-Neutral Hydrogen) is to validate that the carbon footprint (PCF)	Should this be Product carbon footprint (PCF)?	corrected

⁴ The producer delivers a product meeting certain environmental criteria to the market (e.g., hydrogen below a certain emissions intensity threshold), and at the same time, books an equivalent amount in a certificate platform. Buyers of the product can acquire a certificate and thus claim that an equivalent amount of the product purchased meets the environmental requirements. This model allows certificates to be traded separately from the physical product, thus providing flexibility, but does not ensure any physical tracking of the product.

⁵ The mass of the product is accounted for by tracking the mass at the input and output sides of the delivery steps involved, which provides some traceability of the physical product.

Section 9 – Monitoring

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
	<p>... The emission factor must be determined for the project boundary (i.e., well-to-wake, sometimes also expressed as well-to-wheel).</p> <p>All alternative low-carbon fuels included in this methodology have zero combustion (TTW) emissions.</p> <p>For each type of fuel, information must be provided by the fuel supplier stating the quantity of fuel supplied and the emission intensity of the fuel with a corresponding certificate (or alternatively, the quantity of electricity used per fuel unit – see next parameter table).</p>	<p>Not clear what this means. “Well-to-wheel” is not defined in section 3. It refers to land-based transport.</p> <p>Any alternative fuel that contains methane would have some combustion emissions in terms of unburnt methane “methane slip”. This should be included.</p>	<p>Have deleted well-to-wheel</p> <p>Unburnt methane are not combustion emissions. The term “combustion” refers to fuels being burnt. They are considered as leakage emissions. Their non-inclusion has been explained previously and is related to having the same level of CH4 methane slip emissions with baseline LNG or e-LNG</p>
39	ECPFPz,y Description Electricity consumption for production of alternative fuel type z in year y per unit of fuel type z	Suggested rewrite: Electricity consumption for production of alternative (project) fuel type z in year y per unit of fuel type z	OK
40	References	<p>Within the list of References, there are two “internal” or private documents that readers would not be able to access, namely:</p> <ul style="list-style-type: none"> • “Grütter Consulting. 2023a. <i>Emission Factors Fossil Fuels</i>. Internal calculation sheet. Grütter Consulting” and • “Grütter Consulting. 2023b. <i>Overview of Existing and Planned Certification</i> 	Have been deleted

Section 9 – Monitoring

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
		<p><i>Systems and Regulatory Frameworks for Hydrogen, Ammonia and Other Hydrogen-based Fuels</i>. Internal document.”</p> <p>Suggest these are excluded since not publicly available.</p>	

Appendix 1

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update
41	Table 4 and text below	<p>A single space is used as a thousands separator. This is OK. However, in the equation below the table, the denominator shows three spaces in</p> $212\ 230\ 077\ t$ <p>We suggest that this be:</p> $212\ 230\ 077\ t$	We have adjusted the numbers in the table and the equation

Appendix 2

#	Paragraph from Draft Methodology	Comment	Developer’s Response and/or Update

Appendix 3 – Expert Reviewer CVs

Alison Morris | 9 John Martin Cres. Millgrove ON L8B 0Z9 Canada | amorris@fremco.com | +1.905.320.8181

EXPERIENCE

The FReMCo Corporation Inc. (1999-Present)
President

President of FReMCo, a privately held, global business and environmental consultancy founded in 1981. Providing management consulting services to clients in the areas of climate change mitigation, climate finance, methodology and project development and related business and marketing development strategies. Responsible for business development, executive leadership, growth strategy, project delivery and client engagement globally.

Selected engagements:

Daphne Technologies S.A.	<ul style="list-style-type: none"> – Feasibility Study for carbon credit potential of methane slip emission reduction technology – New methodology development leading to Gold Standard approval “Methodology for Reducing Methane Emissions from Combustion Engine Exhaust” methodology – Feasibility Study for carbon, NOx and SOx credit potential in pilot project in Oman to build-own-operate an H₂S treatment facility reducing methane, sulphur and toxic gas emissions and to produce fertilizer
TMS Tankers Ltd.	<ul style="list-style-type: none"> – Feasibility Study for carbon credit potential from energy efficiency retrofits on a fleet of 47 vessels – Gold Standard project development for first project and fleet of ships
d’Amico Società di Navigazione SpA	<ul style="list-style-type: none"> – Feasibility Study for carbon credit potential from energy efficiency retrofits on a fleet of 11 vessels – Gold Standard/SustainCERT project development for first project and fleet of ships
Golden Union Shipping Company S.A.	<ul style="list-style-type: none"> – Feasibility Study for carbon credit potential from energy efficiency retrofits on a fleet of 19 vessels – Gold Standard project development for first project and fleet of ships; developed Deviation Request for emission reduction calculation model, approved by GS – Project resulted in the first carbon credits to be issued under GS “Methodology for Retrofit Energy Efficiency Measures in Shipping”
Neptune Robotics	<ul style="list-style-type: none"> – Feasibility Study to assess the carbon credit potential of advanced robotic hull cleaning for shipping
Barry Rogliano Salles (Genève) SA	<ul style="list-style-type: none"> – Contracted as a subject matter expert to develop and promote tools for carbon credits and climate change mitigation for BRS Shipbroker clients and other third parties; assisted BRS to set up first shipbroker in-house Carbon Desk – Development of GS Programme of Activities based on “Methodology for Retrofit Energy Efficiency Measures in Shipping”
Innospec Canada Ltd.	<ul style="list-style-type: none"> – Regulatory (Canadian Clean Fuel Standard) review and business development project related to low temperature biodiesel additives in stationary and mobile sources in the industrial marketplace
Innospec Fuel Specialties LLC	<ul style="list-style-type: none"> – Training webinar and discussion on carbon markets and environmental strategies – Feasibility study to assess the opportunity related to carbon credits or similar products for diesel detergent additives in the mining and bus fleet sectors
Nautilus Labs Inc.	<ul style="list-style-type: none"> – Feasibility Study to assess the potential to create carbon credits from marine voyage optimization software
Blue-Zone Technologies Ltd.	<ul style="list-style-type: none"> – Feasibility Study to assess the potential to create carbon credits from technology to capture, recover and remanufacture (circular economy) waste anaesthetic gases
Marsoft Inc.	<ul style="list-style-type: none"> – Research and review project of Gold Standard requirements and shipping methodology – Consulting to develop and submit a revision to Gold Standard of the “Methodology for Retrofit Energy Efficiency Measures in Shipping” methodology; approved by GS
International Paint Limited / AkzoNobel	<ul style="list-style-type: none"> – Feasibility Study to assess the potential to create carbon credits from the use of advanced hull coating technology in the marine sector – New methodology development leading to the approval of the first ever methodology for maritime shipping, Gold Standard’s “Reducing Vessel Emissions Through the use of Advanced Hull Coatings” – Programme of Activities development and project development leading to first ever credits issued in the maritime sector – Business strategy and market development consulting services regarding client’s full product line for the marine sector
Climate Bonds Initiative	<ul style="list-style-type: none"> – Member of Technical Working Group tasked with developing criteria for shipping sector Climate Bonds standard and certification process
Owens Corning Sales, LLC	<ul style="list-style-type: none"> – Feasibility Study to assess the opportunity to create carbon credits from the use of lower global warming potential blowing agents for extruded polystyrene insulation

	<ul style="list-style-type: none"> - Follow on business development and opportunity assessments for various geographic regions based on environmental regulations and other methodologies
Carbon War Room	<ul style="list-style-type: none"> - Development of a new Gold Standard multi-strategy marine carbon credit methodology - Led to approval of GS "Methodology for Retrofit Energy Efficiency Measures in Shipping"
Honeywell Specialty Materials and Honeywell Energy Performance Contracting	<ul style="list-style-type: none"> - Feasibility Study to assess the opportunity to create carbon credits from the use of very low GWP blowing agents to replace HFCs in rigid polyurethane foam systems, specialty solvents, novelty aerosols, extruded polystyrene and refrigerants - Training webinar and discussion related to cap-and-trade programs in Canada and the relevance to Honeywell and its customers
Procter and Gamble	<ul style="list-style-type: none"> - Feasibility Study to assess the opportunity to create carbon credits from low temperature detergent
BP, DuPont, Shell, Afton Chemicals, PPG Industries Inc., Air Products, Eastman Chemicals, Nalco Company, Dow Corning, GlaxoSmithKline	<ul style="list-style-type: none"> - Various consulting projects related to business development, broad environmental topics, market development, research and guidance and more.

PRIOR EXPERIENCE

Connor Clark Private Trust Company	<ul style="list-style-type: none"> - Vice President - Helped to set up, grow and develop newly formed financing subsidiary, Merchant International Capital Inc. Providing institutional financing services to the MUSH sector (municipalities, universities, schools, hospitals) 	1997-1999
Newcourt Credit Group Inc.	<ul style="list-style-type: none"> - Sales Manager - Provided advice and lease/loan financing to healthcare professionals and healthcare institutions 	1996-1997

EDUCATION

- University of Toronto (BComm, Commerce & Finance, Major: Economics, Concentration: Marketing) 1992

COURSES/TRAINING/RECOGNITION

- Oxford Climate Society's Oxford School of Climate Change Course, 2025
- Greenhouse Gas Protocol (GHG Protocol) Corporate Standard Training e-learning course, 2020
- GHG Protocol Scope 2 training course, 2020
- Best Offsetting Project and Best Project Developer – Energy Efficiency, 2015 Environmental Finance awards
- Institute of Law Clerks of Ontario certification in litigation, real estate, trusts and estates, torts and contracts, criminal and family law, 1994-1995

ADDITIONAL NON-PROFESSIONAL INFORMATION

- Team manager, player multiple soccer teams
- PanAm Masters Games, Cleveland 2024, Women's soccer gold medal winners
- World Masters Games, Torino, Italy, 2013, Women's soccer

NAME Gautam Shankar DUTT

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Buenos Aires, Argentina
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PERSONAL DATA

Born 24 October 1949 in Calcutta, India; Citizenship: Indian

EDUCATION

1977 Ph.D. Princeton University Dept. of Aerospace and Mechanical Sciences
1970 B.Sc. (Engineering) University of London

ACADEMIC ACHIEVEMENTS

1970 First Class Honors in B.Sc. (Engineering)
1965 Jagadish Bose National Science Talent Search Scholar (India)

OTHER DISTINCTIONS

2007 Nobel Peace Prize, as Member of the Intergovernmental Panel on Climate Change (IPCC)

TEACHING EXPERIENCE

Dept. of Electrotechnology, Facultad de Ingeniería, Universidad de Buenos Aires:

- Undergraduate and postgraduate courses on *Efficient Use of Electricity*, 1995-2002.
- A part of undergraduate and postgraduate courses on *Renewable Energy*, 1992-2002.

Instituto Tecnológico de Buenos Aires: a postgraduate course on *New Energy Technologies*, with emphasis on the efficient use of electricity and new generation technologies, 1992.

Masters in Energy Engineering program, División de Estudios de Posgrado, Facultad de Ingeniería, Universidad Nacional Autónoma de México, taught the following courses, between 1988 and 1990: *Energy from Biomass*; *Applied Thermodynamics*; and (a part of) *Technology and Economics of Electrical Energy*

Doctoral thesis advisor

- **Fernando L. Ponta**, 1994-2000. Depto de Electrotecnia, Facultad de Ingeniería, Universidad de Buenos Aires. Ponta is currently Richard and Elizabeth Henes Professor in Wind Energy, Michigan Technological University.
- **Leonardo Assaf**, 1997-99. Depto de Luminotecnia, Luz y Visión, Universidad Nacional de Tucumán.

Master's thesis advisor

Claudia Sheinbaum Pardo, 1989-90. Eficiencia energética en la iluminación de edificios comerciales y públicos (Energy-efficient lighting in commercial and public buildings), Universidad Nacional Autónoma de México, 1990. This was the first lighting efficiency research project undertaken in Mexico. Later, Sheinbaum Pardo was Environment Secretary of Mexico City (2000-06), **Head of Government of Mexico City (2018-23) and President of Mexico since October 2024.**

RESEARCH EXPERIENCE

- | | |
|------------|--|
| 2004-05 | Design and construction of two low-cost, low energy houses in Buenos Aires province |
| 9/87-2002 | Exploring alternatives for the generation and efficient use of electricity. |
| 9/78-2002 | Renewable sources and energy efficiency in developing countries. |
| 2/76-2002 | Experimental and theoretical investigation of residential energy consumption and conservation. |
| 9/79-4/81 | Design and implementation of a large scale study to determine the energy savings in residential buildings from instrumented energy analysis and retrofits. |
| 9/79-4/80 | Development of procedures for conducting residential energy analysis and retrofit quality control. |
| 7/78-9/84 | Development of procedures for evaluating energy efficiency of wood and charcoal burning cookstoves. |
| 9/73-12/75 | Experimental investigation of the prospects for high-power laser operation in recombining plasma flows created by a modified electromagnetic arcjet. |
| 9/71-8/73 | Development of piezoelectric pressure probes suitable for a high-temperature plasma environment. |

EMPLOYMENT HISTORY

- | | |
|----------------|--|
| 1/2022-present | Consultant, The FReMCo Group. |
| 7/09-present | Vice President, Science and Technology, MGM Innova. www.mgminnova.com |
| 9/87-2007 | Energy consultant, working on energy analysis and technology assessment of energy conservation and renewable energy. |

- 6/05-2013 Editor-in-Chief, *Energy for Sustainable Development*, the journal of the NGO International Energy Initiative. Published by Elsevier. Continues as Associate Editor. <http://www.sciencedirect.com/science/journal/aip/09730826>
- 8/02-6/09 Senior Technical Advisor, MGM International Inc., a company that designed projects to mitigate climate change. Company was voted *Best CDM/JI Project Developer* by the Carbon Industry. Point Carbon Awards, 2005.
- 11/99-9/01 Technical advisor to the GEF project “Efficient Lighting Initiative” at EDESUR, project executor for International Finance Corporation (IFC).
- 12/92-12/02 Teaching and Research, Dept. of Electrotechnology, Facultad de Ingeniería, Universidad de Buenos Aires; full time: 6/94-1/97; part time 12/92 to 6/94 and from 2/97 on.
- 2/97-12/98 Consultant, Directorate for the Rational Use of Energy, Secretary of Energy, Argentina.
- 7/89-6/90 Visiting professor, Energy Engineering, Postgraduate Studies Division, School of Engineering, National University of Mexico.
- 9/86-8/87 World Bank McNamara Fellow at the National University of Mexico, working on alternative cooking energy technologies based on renewable and fossil fuels.
- 9/76-8/86 Center for Energy and Environmental Studies, Princeton University in the following capacities:
 7/83-8/86 Research Engineer
 7/77-6/83 Member of the Research Staff
 9/76-6/77 Post Doctoral Research Associate
- 9/66- 9/71 Engineering trainee at Rolls Royce Aero Engine Division-assigned to various departments including final year in Operational Research Group.

ADVISORY AND CONSULTING ACTIVITIES:

Since 1979, Dutt has participated in various panels, been an advisor or consultant to a number of government and private organizations including US National Laboratories. Some of these are listed below:

Member of a panel organized by the World Bank and Volunteers in Technical Assistance (VITA) to review the technology of wood cookstoves for use in rural areas of less developed countries. (1979)

Member of a panel organized by the Volunteers in Technical Assistance (VITA) and Washington University Center for Development Technology (CDT) to review U.S. position paper to be presented at the U.N. Conference on Science and Technology for Development. (1979)

Consultant to the University of California's Lawrence Berkeley Laboratory Energy and Environment Division: for estimating savings from low-cost retrofits. (1979)

Consultant to the New Jersey Department of Energy: made policy recommendations for facilitating present residential energy conservation in New Jersey. (Various occasions)

Consultant to the Tennessee Valley Authority: reviewed their residential energy conservation program. (1979)

Organizer for workshop to train energy auditors from gas and electric utilities in conducting instrumented energy analysis. (1979)

Volunteer-consultant to Volunteers in Technical Assistance (VITA, Maryland and Virginia) to develop stoves and testing procedures, and review development efforts related to wood cookstoves for the Third World. Consultancy has included visits to Upper Volta (now Burkina Faso, in 1980), Somalia (1983), and Guinea (1984).

Consultant to the Analysis Center of the Wharton School of Management (University of Pennsylvania): on estimating energy savings in retrofit experiments. (1981)

Consultant to the People's Counsel of the District of Columbia to prepare testimony in a utility case on energy conservation. (1981)

Consultant to Princeton Energy Group (project sponsor: Control Data Corp., Minnesota) to design residential energy saving retrofit data base for computerized information network. (1981)

Co-founder of and a principal stockholder of Princeton Energy Partners, Inc., and energy management and training company that franchised an instrumented energy analysis and retrofit techniques known as house doctoring. (1981-91)

Member and task group leader of Research Coordinating Committee on Moisture in Buildings of the Building Thermal Envelope Coordinating Council (BTECC), Wash. D.C. (1982-1986)

Panel co-chairman at the second (1982) and third (1984) Summer Studies on Energy Efficient Buildings, Santa Cruz. Panel chairman of the fourth Summer Study (1986).

Participant in an international panel to develop standardized procedures for testing wood stoves, convened at Arlington, VA. (1982)

Consultant to Cigna Services Co. to evaluate ventilation efficiency in a Philadelphia office building with suspected health problems related to indoor air pollution. (1983)

Consultant, through Energy Systems Research Group, to the Massachusetts Executive Office of Energy Resources in critiquing state residential energy conservation programs. (1984)

Consultant to Energy Utilization Laboratories, Maryland: dynamic thermal modeling of large buildings, based on measured data. (1986-1987)

Member of the advisory board of Minnesota's Enhanced Low Income Weatherization Program. (1986-1990)

Consultant to Princeton University Center for Energy and Environmental Studies: development of diagnostic techniques and energy audit procedures for multifamily buildings. (1987-1988)

Consultant to Grass Roots Alliance for a Solar Pennsylvania (GRASP) on experimental design for a study of alternative technologies for low income weatherization. (1987)

Member of the editorial board of the magazine "Desarrollo y Medio Ambiente" (Development and Environment) published by the Mexican Institute of Appropriate Technologies (IMETA). (1987-89)

Consultant to the University of Minnesota: development of an upgraded procedure for diagnostics and retrofits in low-income housing; training of participants in pilot program to test new procedure; preparation of manual and videotape training materials. (1988-90)

Consultant to the Center for Energy and the Urban Environment, Minneapolis: technology and economics of high efficiency gas heating systems. (1990)

Member of the editorial board of the journal "Energy Environment Monitor", published by Tata Energy Research Institute, New Delhi.

Consultant to the Energy Conservatory, Minneapolis: production of four training videotapes on energy conservation in buildings. (1990-91)

Consultant to Asian Development Bank, Manila, Philippines: Review of end-use oriented energy strategies for India; estimation of end uses of electricity, conservation potential, and implementation strategies. (Considered electricity, transport, and biomass energy.) (1990-91)

Consultant to Princeton University Center for Energy and Environmental Studies (project sponsor: U.S. Agency for International Development): review manufacturing capability of energy efficient pumps and motors in India. (1990-91)

Consultant to the American Council for an Energy-Efficient Economy (project sponsor: U.S. Agency for International Development and the World Bank): estimating magnitude of electricity consumption by end uses in India. (1991)

Consultant to International Institute for Energy Conservation, Washington, DC (project sponsor: U.S. Environmental Protection Agency): Collaborate in preparing the report: The Least Cost Energy Path for India: Energy Efficiency Investments for the Multilateral Development Banks. (1991)

Consultant to Proctor Engineering Group, San Francisco, Calif.: Design experiment for field monitoring of energy-efficient refrigerators, and conduct preliminary data analysis, for Pacific Gas and Electric Company (a California utility). (1991) Retained as consultant. (1992-)

- Consultant to Princeton University Center for Energy and Environmental Studies: prepare a manual on methodologies for electricity end-use analytical techniques, adapted to India. (1991-93)
- Consultant to Florida Solar Energy Center, Cape Canaveral, Florida: Review and rewrite manual on new techniques for diagnosing and sealing air distribution systems in houses for energy conservation and improved indoor air quality. (1991-92)
- Consultant to Wisconsin's Environmental Decade in an Intervention Request to the Wisconsin Public Service Commission: propose mechanisms to improve reliability and persistence of energy savings in utility energy conservation programs. (1991-92)
- Consultant to Lawrence Berkeley Laboratory (University of California) to review Argentina's electricity supply plan for the 1990s. (1992)
- Consultant to RCG/Hagler, Bailly, Inc, Arlington (VA): Prepare a preliminary action plan for a Demand-Side Management (DSM) program for Calcutta Electric Supply Corp (CESC), a private electric utility serving Calcutta, India. (1993)
- Lead author of the 2nd Report of the Intergovernmental Panel on Climate Change (IPCC), convened by the World Meteorological Organization (WMO) of the United Nations. (1994-95)
- Consultant to the Global Environment Facility (GEF) program of the United Nations Development Program (UNDP). (1994-)
- Consultant to the GEF project "Argentina Street Lighting Program", managed by the International Institute for Energy Conservation for the International Finance Corporation. (1999-2001)
- Member of Adjustments Committee, International Performance Measurement and Verification Protocol (IPMVP). (1999-)
- Consultant to the Government of El Salvador for the Development of a Program for the Efficient Use of Electricity in Public Buildings. Contract was undertaken within the Project for the de Modernization of the Public Sector, World Bank Loan BIRF-3920-ES. (5/2002-3/03).

ACTIVITIES RELEVANT TO CLIMATE CHANGE

Intergovernmental Panel on Climate Change (IPCC)

Dutt was a Lead Author of “Mitigation Options for Human Settlements”, Chapter 22 of Climate Change 1995. Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses, Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, 1996, pp. 713-743.

Dutt was a coauthor of Technologies, Policies and Measures for Mitigating Climate Change (Robert Watson, Marufu Zinyowera and Richard Moss, Eds.), Intergovernmental Panel on Climate Change (IPCC) Technical Paper 1, Nov. 1996.

As a consequence of the above activities, and as Member of the Intergovernmental Panel on Climate Change, Dutt shared Nobel Peace Prize, 2007.

Development of methodologies for carbon markets

New CDM (Clean Development Mechanism) methodologies

Dutt has co-authored several new baseline and monitoring methodologies that have been approved by the Methodology Panel and the CDM Executive Board:

- AM0008: Industrial fuel switching from coal and petroleum fuels to natural gas;
- AM0014: Natural gas-based package cogeneration;
- AM0030: PFC emission reductions from anode effect mitigation at primary aluminium smelting facilities; and
- AM0034: Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants.

Additional baseline and monitoring methodologies developed by MGM with a significant participation by Dutt:

- NM0068: Changes in industrial processes, energy efficiency, fuel switching, self-generation, and cogeneration equipment at an aluminium smelting facility. This methodology was rejected. A simplified version of this methodology was presented as NM0122, see below.
- NM0077: Fuel switching, and changes in self-generation and/or cogeneration at an industrial facility. This methodology was rejected. A version of this methodology with reduced scope was presented as NM0124, see below.
- NM0100: Activities for the promotion of electricity efficiency, through the replacement of unitary equipment, by parties that are not the energy consumers. Program sponsor: FIDE (Fideicomiso para el Ahorro de Energía Eléctrica, Mexico’s Electricity Efficiency Trust Fund). This methodology received favorable comments from the Methodology Panel, but requested additional details on the program. The methodology has not been re-submitted for commercial reasons associated with the project.

- NM0124: Cogeneration at an industrial facility. This methodology received favourable comments, but the Meth Panel required some changes. The methodology was resubmitted as NM0160, see below.
- NM0138: Fuel switching from coal and/or petroleum fuels to natural gas and cogeneration at an industrial facility. This methodology received favorable comments and a conditional approval. A revised version NM0138-rev was submitted and rejected. Further modifications are called for. However, client decided not to present the methodology and project through CDM.
- NM0160: Cogeneration at an industrial facility. The methodology was also rejected, requiring further modifications and possible consolidation with NM0138-rev. Client decided to use another consultant, whose methodology submission was rejected. Client decided not to present the project through CDM.
- NM0336: Introduction of a new, natural gas fired combined cycle power plant for supplying heat (for space and water heating and heat for cooling) to a district heating system and electricity to a power grid. Methodology was rejected.

Dutt also has collaborated and contributed to the following methodologies and tools:

- AM0002: Greenhouse gas emission reductions through landfill gas capture and flaring where the baseline is established by a public concession contract. This was the first approved methodology in the landfill area;
- ACM0001: Consolidated baseline methodology for landfill gas project activities;
- Tool for the demonstration and assessment of additionality. Approved by the CDM Executive Board.

Furthermore, Dutt has submitted public comments to the following methodologies:

- AM0001: Incineration of HFC 23 waste streams;
- ACM0002: Consolidated baseline methodology for zero-emissions grid-connected electricity generation from renewable sources.

Methodologies for the Gold Standard

Dutt drafted a new methodology that was approved by the Gold Standard in 2012. In 2014, Dutt presented a revised version, which was approved as Version 2. The methodology is:

- Reducing vessel emissions through the use of advanced hull coatings (2012, 2014).

Methodologies for Verified Carbon Standard (VCS)

- Methodology to reduce enteric methane emissions in beef cattle using organic or natural feed supplements (did not complete approval).

Methodologies for Japanese Bilateral Crediting Mechanism

- New baseline and monitoring methodology for energy efficient residential lighting through the use of compact fluorescent lamps (2011)
- New baseline and monitoring methodology for replacement of residential refrigerators with energy efficient models and destruction of CFCs and HFCs from recycled refrigerators (2011)
- New baseline and monitoring methodology for replacement of air conditioners with energy efficient models and destruction of CFCs and HCFCs from recycled air conditioners (2011)
- Installation of photovoltaic power generation for supply to electricity grid (2014).

CDM Project Design Document (PDD) preparation where Dutt had a significant participation

1. Candelaria Hydroelectric, Guatemala. Registered.
2. Aquarius Hydroelectric, Brazil. Registered.
3. Optima Energía (energy efficiency), Mexico. This PDD was not submitted for validation for commercial reasons.
4. Graneros Fuel Switching, near Santiago, Chile. Registered.
5. Metrogas Watt's Alimentos Package Cogeneration, Santiago, Chile. Registered.
6. Shell Cogeneration, Argentina. Project proponent decided not to pursue CDM after methodology was not approved in several rounds.
7. FIDE (Energy Efficiency Trust), Mexico. This New Methodology and PDD have not been resubmitted for commercial reasons.
8. PFC emission reductions at ALUAR Aluminio Argentino, Puerto Madryn, Argentina. Methodology approved. Registered.
9. Loma Los Colorados landfill gas recovery project, Santiago, Chile. Registered.
10. El Henequén landfill gas recovery project, Barranquilla, Colombia. In Validation. Because of conflicts between the project sponsor and another company, project development stopped.
11. American Israel Paper Mill (AIPM) Natural Gas Cogeneration Project. Client withdrew project after methodology was not approved in several rounds.
12. Sasol Nitrous Oxide Abatement Project, Sasolburg and Segunda, South Africa. Registered.
13. Feira de Santana Landfill Gas Project, Bahia, Brazil. Registered.
14. Centro Industrial del Sur Organic Waste Project, Colombia. Registered.

15. Biorganicos Organic Waste Project, Colombia. Registered.
16. Nimoo Bazgo Hydroelectric Project, India. Registered.
17. Chutak Hydroelectric Project, India. Registered.
18. Hasars Landfill Gas Project, Mexico. Registered.
19. El Empalme Landfill Gas Recovery Project, Chile. Registered.
20. Lubanshan North and South Coal Mine Methane Utilization Project, China. Registered.
21. Fundo Las Cruces Landfill Gas Recovery Project, Chile. Registered.
22. Landfill Gas Recovery and Flaring Project in the El Verde Landfill, León, Mexico. Registered.
23. Reconstruction of Pervomayskaia CHP -14 with installation of combined cycle units. Russia. New methodology and PDD registered, called “determination” in Joint Implementation.
<http://ji.unfccc.int/JIITLProject/DB/RXTCKIAJBFSPIF26XASN56UUOV7VKA/details>
24. New Energy Efficient Buildings, Beijing, China, prepared but not formally submitted.
25. [Palo Viejo Hydroelectric Project](#). Mexico, Registered.
26. Sable Chemicals Tertiary N₂O Abatement Project in Zimbabwe. Registered.
27. [Quilvio Cabrera Wind Farm Project](#), Dominican Republic. Registered.
28. [Los Cocos Wind Farm Project](#), Dominican Republic. Registered.
29. [Dominica Wind Farm Project](#), Mexico, Registered.
30. [Los Cocos II Wind Farm Project](#), Dominican Republic. Registered.

Nationally Appropriate Mitigation Actions, NAMAs

Dutt has prepared a number of NAMAs:

- Road freight transport in Colombia (2013)
- Urban mobility in Quito, Ecuador (2013)
- Renewable energy and energy efficiency in Ecuador (2013)
- Scheme for NAMA in road freight transport in Argentina (2014-15)

Dutt has collaborated on the development of other NAMAs:

- NAMA for Grupo México (a conglomerate) (2012)
- NAMA for the pulp and paper industry in Mexico (2012)
- NAMA for energy efficiency and reduction in emissions of refrigerants with ozone depleting substances and with high global warming potential in units and systems of air conditioning in Colombia (2017-19)

Dutt has developed Monitoring, Reporting and Verification (MRV) procedures for the following NAMA:

- NAMA for individual energy efficiency measures in small and medium enterprises (Mexico, 2013)

Manual on Climate Change Mitigation and its Monitoring:

Dutt was co-author of the following handbook, published by the Inter-American Development Bank in 2013:

- Mitigation Strategies and Accounting Methods for Greenhouse Gas Emissions from Transportation

Studies on integrated climate strategies

Dutt was lead analyst in the development of a corporate climate change strategy for the utility, Empresas Públicas de Medellín (EPM, Colombia). The strategy included vulnerability and adaptation to climate change, besides undertaking GHG emissions inventories and mitigation options including electricity generation, energy efficiency, alternative transport fuels, waste management, etc. Subsequently, a number of the projects was implemented by EPM.

Dutt developed a national MRV system including inventories and mitigation, specifically for Trinidad and Tobago (2016). The system would be applicable to all countries, since few have a national MRV system.

Technology Reviews

At MGM International, Dutt was responsible for evaluating technical options for GHG mitigation and the aptitude of such options within the CDM framework. Such evaluations covered the following areas:

- Wind energy potential and economics for potential investors looking for CDM (Clean Development Mechanism) projects. (2001)
- Energy efficiency in office buildings, hotels and resorts. (2002)
- Transport and the CDM. (2003)
- Landfill gas capture, flaring and use. Besides the technology review (2003), Dutt directed prefeasibility studies on 15 landfills in Latin America and India, as well as preliminary screening analysis on another 10 landfills that were later judged unsuitable for financing under the CDM. (2003-2004)
- Methane emissions from ruminant livestock and from animal waste. (2004)
- Cement industry. (2004)
- Aluminium smelting. (2004)

- Animal manure treatment (2004)
- Alternative treatment options for solid waste (2005)
- Waste water treatment (2006)
- Semiconductor production (2007)
- Alternative automotive refrigerants (2008)

Later, with MGM Innova, Dutt undertook other technology reviews, including those associated with all the NAMAs listed above. A recent review, including spreadsheets for technical and economic comparison of alternatives:

- Options for solar photovoltaic energy storage in Costa Rica (2017)

Publications related to the CDM

- (with colleagues at MGM), “The market for greenhouse gas emissions reduction through the Clean Development Mechanism,” Nov. 2003.
- (with Marco Monroy), “Clean Development Mechanism: Getting ready for market” in *Carbon Finance* magazine, Jan. 2004.
- (with colleagues at MGM), “World CDM project review”, prepared for GHG Solutions website (in Japanese), April 2004.
- (with colleagues at MGM), “Obstacles in developing CDM projects: lessons learnt through experience,” prepared for GHG Solutions website (in Japanese), Sept. 2004.
- (with colleagues at MGM), “Developing new methodologies for the CDM”, prepared for GHG Solutions website (in Japanese), Oct. 2004.
- (with Marco Monroy), “CDM: Expectations and reality,” IETA 2004 GHG Market Review, International Emissions Trading Association, Dec. 2004.
- (with Marco Monroy), “Now that the Kyoto Protocol has been ratified, saving the Clean Development Mechanism should be the next priority,” *Environmental Finance*, April 2005.
- (with Marco Monroy), “Is time running out for the Clean Development Mechanism to mitigate climate change?” *Carbon Market Update* No. 2, September 2005.
- (with Marco Monroy), “Last chance for the CDM,” *Carbon Finance* magazine, Nov. 2005.
- “Thinking beyond 2012: Climate change mitigation and the CDM,” IETA 2005 GHG Market Review, International Emissions Trading Association, Dec. 2005.
- “What is worse than getting a CDM methodology rejected? Getting it approved: A CDM morality tale,” *Carbon Finance*, Nov. 2006.
- (with Maria Pia Iannariello, Fabian Gaioli, and Shanti Jain, “CDM at crisis point”, *Environmental Finance*, Nov. 2008.

Presentations related to the CDM

- “Sustainable transport and the CDM”, Sao Paulo, Brazil, Dec. 2002.

- “Experiencias concretas de proyectos MDL en América Latina (Specific experience with CDM projects in Latin America)”, Montevideo, Uruguay, July 2003. Seminar organized by the Uruguay Government Environment Department.
- “El mercado de carbono: la perspectiva del comprador (Buyers’ perspective in the CDM)”, Montevideo, Uruguay, July 2003. Seminar organized by the Uruguay Government Environment Department.
- “Financiando Proyectos de Recuperación de Biogás en Rellenos Sanitarios Mediante el Mecanismo para un Desarrollo Limpio (Financing landfill gas recovery projects through the Clean Development Mechanism),” ISWA (International Solid Waste Association) Beacon Conference: Sanitary Landfills for Latin America Buenos Aires, March 2004.
- “Eficiencia energética: estudio de certificación de bonos de carbono (Energy efficiency and certification of carbon credits)” FIDE (Energy Savings Trust), Mexico, Sept. 2004.
- “Can we measure the success of CDM”. Presentation made by Marco Monroy at Swiss Re in Zürich, Nov. 5, 2004.
- “Experience with methodology development and approval process” in CDM Methodologies and Project Design, Workshop for CDM Project Developers, World Bank Carbon Finance Business, Buenos Aires, Dec. 5, 2004.
- “Experience with consolidated methodology approval and application”, IETA (International Emissions Trading Association) Side Event on Consolidated Methodologies, at UNFCCC COP-10, Buenos Aires, Dec. 7, 2004.
- “Carbon Credits: An introduction to the Clean Development Mechanism”, presentation at Seminar organised by the Dept. of Mechanical Engineering, University of Buenos Aires, May 17, 2006. (In Spanish).
- “What can California do to mitigate climate change”, presentation to California Forum on Energy and Environment, Buenos Aires, Nov. 15, 2006.
- "Financing municipal solid waste treatment through the Clean Development Mechanism", presentation at Iberoamerican Congress on Recuperation and Recycling of Urban Solid Waste, Buenos Aires, June 5, 2007. (In Spanish).

Global Environment Facility

Dutt has been in the Roster of Experts on Climate Change of the Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility (GEF), since the very beginning.

Since 1994, Dutt has conducted reviews of the following GEF projects.

GEF Reviews in Focal Area: *Climate Change*

Year	Implementing Agency	Project Name

2006	UNDP	Barrier Removal to the Cost-Effective Development and Implementation of Energy Efficiency Standards and Labeling Project (Asia)
2006	World Bank	Optimizing Energy Efficiency in India
2006	UNDP	Market Transformation for Solar Thermal Heating in Albania
2006	UNDP	Solar Water Heating Market Transformation and Strengthening Initiative (Global)
2005	UNDP	African Microhydro Initiative (West Africa)
2005	World Bank	Renewable Energy in Armenia
2004	UNDP	Energy Efficiency in El Salvador, Nicaragua, Costa Rica, Panama
2002	UNDP	Georgia – Promoting the Use of Renewable Energy Resources for Local Energy Supply
2001	UNDP	Philippines Capacity Building to Remove Barriers to Renewable Energy Development
2000	UNDP	Caribbean Renewable Energy Development Programme
2000	UNDP	Enabling Activity for the Preparation of Uruguay’s Second National Communication to the UNFCCC
1999	World Bank	Uruguay Methane Recovery Project
1999	UNDP	Energy conservation and GHG emission reduction in Chinese Township and Village Enterprises (TVE), Phase 2
1998	UNDP	Renewable energy based rural electrification in Peru
1995	UNDP	Lao PDR National Greenhouse Inventory Project
1995	UNDP	Lebanon Enabling Activity (Building Capacity for GHG Inventory and Action Plans in Response to UNFCCC Communications Obligations)
1995	UNDP	Pacific Island Climate Change Assistance Program (PICCAP)
1995	UNDP	Sri Lanka National Greenhouse Project (GEF enabling activity)
1995	UNDP	Uzbekistan Country Study on Climate Change
1995	UNDP	(Venezuela) Strengthening institutional capacity for addressing climate change issues at national level
1995	UNDP	Enabling activities in Chile to respond to the Climate Change Convention
1994	UNDP	(Uruguay) Institutional strengthening for the application of the Climate Change Convention (Fortalecimiento institucional para la aplicación de la convención sobre cambio climático)

1994	UNDP	(Costa Rica) Enhancement of national technical capacity for greenhouse gas assessment and abatement strategy development
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In 1994, Dutt designed a GEF project on a comprehensive Climate Change Mitigation project in Peru, for the UNDP. This ambitious project, that included reduced greenhouse gas emissions from fossil fuel use, deforestation and structural changes, was not implemented in the form proposed.

During 1998 and 1999, Dutt provided considerable input to the Project Brief of the Efficient Lighting Initiative (ELI), a GEF project currently being implemented by the International Finance Corporation (IFC) in seven countries. This included estimates of GHG emissions reductions to be expected from program implementation.

Technical Advisor to the Efficient Lighting Initiative (ELI) project in Argentina (1999-2003). This project had a GEF grant of USD 2.1 million and leveraged investment in energy efficiency, especially in residential lighting. Total investment estimated to be about USD 50 million.

From mid 1999 to early 2001, Dutt was Technical Advisor to Argentina Street Lighting Program (ASLP), another GEF project implemented by the IFC.

In 2002, Dutt was consultant to the World Bank, involved in the design of a GEF project on energy efficiency involving a GEF grant of USD 8 million and investment of about 35 million.

Dutt was co-author of the GEF study “Proyecto de eficiencia de energética en la República Argentina, diseño de un programa de etiquetado y normalización de eficiencia energética” (Argentina energy efficiency project, design of a system of labeling and standards). The study was undertaken through Adviesbureau voor Energiestrategie (AES), with the participation of the NGO, Collaborative Labeling and Appliance Standards Program (CLASP). Final Report: June 2008. Most of the measures recommended were implemented, with substantial energy savings. Total investment unknown.

Dutt was co-author of another GEF study, for the Energy Secretariat of Argentina: “Proyecto de Eficiencia Energética en Argentina. Estudio de Regulaciones, Señales Tarifarias e Incentivos Económicos para el Uso Eficiente de la Energía.” (Energy efficiency in Argentina. Study of regulations, tariff signals and economic incentives for the efficient use of energy). Final Report: junio del 2007.

Dutt collaborated with the Inter-American Development Bank on a GEF project: “Demonstration and assessment of battery-electric vehicles for mass transit in Colombia” involving articulated electric buses to be developed and deployed in Bus Rapid Transit (BRT) systems in Colombia, 2013.

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2. (with T.H. Woteki and J. Beyea) "The two-resistance models for attic heat flow: implications for conservation policy," *Energy - The International Journal*, 3, 657, 1978.
3. (with D.T. Harrje and J. Beyea) "Locating and eliminating obscure but major energy losses in residential housing," *ASHRAE Transactions*, 85, Part II, 1979. Winner of an Outstanding Paper Award.
4. (with C.R. Prasad, S.R.C. Sathyanarayana, and V. Kuppu Rao) "Studies in sky-therm cooling," *Proc. Indian Acad. Sciences*, Vol. C2, Part 3, p. 339-356, 1979.
5. "Condensation in attics: are vapor barriers really the answer," *Energy and Buildings*, 2, 251, 1979-80.
6. (with R. Datta) "Producer gas engines for villages of less developed countries," *Science*, 213, 731, 1981.
7. (with L.W. Wall, C.A. Goldman, and A.H. Rosenfeld,) "Building energy use compilation and analysis (BECA) Part B: retrofits of existing North American residential buildings," *Energy and Buildings*, 5, 151-170, 1983.
8. (with R.H. Williams and H.S. Geller) "Future energy savings in U.S. housing," *Annual Review of Energy*, 8, 269, 1983.
9. (with H.S. Geller, S. Baldwin, and N.H. Ravindranath) "Improved woodburning cookstoves: signs of success," *Ambio*, 14, 280-287, 1985.
10. (with D.T. Harrje, D.L. Bohac, and K.J. Gadsby) "Documenting air movements and infiltration in multicell buildings using various tracer gas techniques," *ASHRAE Transactions*, Vol. 91, Part 2, 1985.
11. (with M.L. Lavine, B.G. Levi, and R.H. Socolow) "The modular retrofit experiment: design, scorekeeping and evaluation," *Energy and Buildings*, 9, 21-36 (M.F. Fels, ed.), 1986.
12. (with J.M. DeCicco, D.T. Harrje, and R.H. Socolow) "PRISM applied to a multifamily building," *Energy and Buildings*, 9, 77-88, (M.F. Fels, ed.), 1986.
13. (with D.I. Jacobson and R.H. Socolow) "Pressurization testing, infiltration reduction, and energy savings," *Measured Air Leakage*, STP 904, Amer. Soc. for Testing and Materials, Philadelphia, PA, 265-293, 1986.

14. (with D.L. Bohac and D. Feuermann) "Approaches to estimating air flows in large multifamily buildings," *ASHRAE Transactions*, 93, Part 1, 1987.
15. "La problemática de la contaminación atmosférica y estrategias para su control", *Desarrollo y Medio Ambiente* (Mexico), Vol. 2, No. 1, 11-17, 1989.
16. (with J. Navia and C. Sheinbaum) "Cheranatzicurin: tecnología apropiada para cocinar con leña", *Ciencias* (Mexico), no. 15, p. 43-47, 1989.
17. (with O. Masera) "A thermodynamic analysis of energy needs: a case study in a Mexican village", *Energy*, Vol. 16, No. 4, 763-769, 1991.
18. "Illumination and sustainable development, Part I: Technology and economics", *Energy for Sustainable Development*, Vol. 1, No. 1, pp. 23-35, May 1994.
19. (with Evan Mills) "Illumination and sustainable development, Part II: Implementing lighting efficiency programs", *Energy for Sustainable Development*, Vol. 1, No. 2, 17- 27, July 1994.
20. "Energy-efficient and environment-friendly refrigerators", *Energy for Sustainable Development*, Vol. 2, No. 5, 57-68, Jan. 1995.
21. (with C. Sheinbaum) "The structure of residential energy consumption in the Mexico City Metropolitan Area", *Energy for Sustainable Development*, Vol. 2, No. 3, 43-48, Jan. 1997.
22. (with F.G. Nicchi and M. Brugnoli) "Power sector reforms in Argentina: an update", *Energy for Sustainable Development*, vol. III, n° 6, March 1997, pp. 36-54.
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25. (with F. Gaioli) "Coping with climate change", *Economic and Political Weekly*, vol. XLII, No. 42, 4239-50, 20-26 Oct. 2007. www.epw.org.in.
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(coauthor) “Mitigation Options for Human Settlements”, Chapter 22 of *Climate Change 1995. Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses*, Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, 1996, pp. 713-743.

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