GLOBAL STAKEHOLDER CONSULTATION FORM FOR PROPOSED NEW BASELINE AND MONITORING METHODOLOGY OR METHODOLOGICAL TOOL
(version 01.0)

Name of submitter	Dr Injy Johnstone
Affiliated organization of submitter (if any)	Max Planck Institute
Email of submitter	Injy.johnstone@ip.mpg.de
Reference number of proposed new methodology or methodological tool	A6.4-PMM009 - GHG emission reductions through shifting to a low carbon navigation route for passenger vehicles
Based on an assessment of information in the A6.4-FORM-METH-002 and its application in sections A to C of the submitted draft project design document (A6.4-FORM-AC-020), provide your comments to the proposed new methodology using the tabular format below. Please indicate the sections or issues to which your comments refer to.	
Date received by the secretariat	

#	Section / Para no./ Annex / Figure / Table	Type of comment ge = general te = technical ed = editorial	Comment (including justification for change)	Proposed change (including proposed text)
1	Methodology sections 10.2.1 and 10.2.2; paras. 54-58; Eq. 1; PDD B.5.1 and B.8.1.1	te	The baseline route counterfactual is insufficiently demonstrated and may materially over credit emission reductions. The methodology defines the baseline scenario as continuation of drivers' existing route adoption behaviour, yet baseline emissions are quantified using the distance travelled on the low carbon route identified by the project navigation platform. This creates a fundamental attribution problem: the route actually travelled after a low carbon prompt is not necessarily different from the route the driver would have selected without that prompt. This is an essential issue because the proposed mitigation mechanism is behavioural and informational, not a physical technology change. In such cases, Article 6.4 environmental integrity depends on demonstrating incremental behavioural change caused by the activity. Route choice literature shows that drivers select routes based on heterogeneous preferences including travel time, congestion, reliability, tolls, distance, habit, familiarity and information presentation. Chorus et al. (2006) show that traveller responses to information are context-specific; and Prato (2009) concludes that observed route choice frequently diverges from deterministic optimal route assumptions. If a material share of drivers would have selected the same low carbon route anyway because it was also faster, shorter, cheaper, familiar or less congested, then the methodology would credit non-incremental reductions. The risk is amplified by large-scale platform deployment: even small attribution errors applied across millions of trips can create substantial over-crediting. The methodology should therefore not infer causation from observed adoption alone.	Add a mandatory causal attribution requirement. Proposed text: "Activity participants shall quantify the incremental adoption of low carbon routes attributable to the low carbon route prompt through randomized controlled trials, phased deployment experiments, matched control groups, difference in differences analysis, or other statistically robust causal inference approaches acceptable to the DOE. Only the proportion of route adoption demonstrated to be caused by the low carbon prompt shall be eligible for crediting. Baseline emissions shall be calculated using the most likely route that would have been selected in the absence of the low carbon prompt, supported by observed historical route-choice behaviour, validated route-choice models, or other evidence acceptable to the DOE. Where attribution uncertainty exceeds +/-10% at the 95% confidence level, a conservative adjustment shall be applied using the lower bound of attributable emission reductions."

#	Section / Para no./ Annex / Figure / Table	Type of comment ge = general te = technical ed = editorial	Comment (including justification for change)	Proposed change (including proposed text)
2	Methodology section 9.3; paras. 26-49; PDD B.6.3 and B.6.4	te	The additionality test is too permissive for a software-based activity implemented by a large navigation-platform operator. The methodology assumes that Article 6.4 revenue is necessary because fuel cost savings accrue to drivers rather than to the activity participant. This framing is incomplete. Navigation platforms may have strong commercial incentives to introduce low carbon, eco-routing or fuel saving functionality even without carbon credit revenues, including customer retention, product differentiation, ESG branding, regulatory preparedness, congestion-management partnerships and data-service opportunities. Peer-reviewed transport literature shows that eco-routing has long been developed for fuel and emissions reduction independent of carbon-market incentives. Ahn and Rakha (2008) demonstrated that route choice can materially affect vehicle fuel consumption and emissions, while Boriboonsomsin, Vu and Barth (2012) developed an eco-routing navigation system using historical and real time traffic information. These studies illustrate that the underlying concept is a commercially and technically plausible platform feature, not a mitigation option that necessarily depends on carbon finance. Simple cost analysis is therefore insufficient unless it demonstrates that non-carbon benefits, strategic value and platform level revenues are absent or immaterial. In digital platform contexts, incremental software-development costs may be modest relative to platform scale. The methodology risks deeming ordinary product development additional simply because the specific carbon-credit revenue stream is new. Article 6.4 additionality should be demonstrated from the perspective of the actual implementing entity and should show that the mechanism incentive is decisive, not merely supplemental.	Strengthen the additionality requirements. Proposed text: "Activity participants shall demonstrate, using contemporaneous documentary evidence, that the low carbon route identification and prompting functionality was not planned, budgeted, mandated, scheduled or commercially justified prior to consideration of Article 6.4 revenues. The investment analysis shall include all direct and indirect non-carbon benefits to the navigation platform, including user growth, retention, advertising, data monetization, fuel saving service value, ESG or regulatory compliance value, and partnerships with public authorities. A simple cost analysis may be used only where the DOE validates that these benefits are absent or immaterial. Carbon revenue shall be shown to be decisive for implementation."

#	Section / Para no./ Annex / Figure / Table	Type of comment ge = general te = technical ed = editorial	Comment (including justification for change)	Proposed change (including proposed text)
3	Methodology section 9.3.3; paras. 37-49; PDD B.6.4	te	The common-practice analysis is likely to underestimate market penetration because "similar activities" are defined too narrowly. The methodology defines similar activities as low carbon route identification and prompting. This wording may exclude functionally equivalent navigation services that reduce fuel consumption or emissions but are labelled as eco-routing, fuel saving routes, energy-efficient routing, congestion avoidance, green travel, or route optimization. The result could be an artificially low Psim and a conclusion that the activity is not common practice even when comparable measures are commercially deployed. The fixed 10% threshold is also insufficiently justified. The methodology invokes innovation-diffusion language, but does not provide empirical evidence that 10% is an appropriate universal boundary between innovative and common practice for navigation platforms. Digital features can scale very rapidly once deployed by a dominant platform, and market penetration may depend more on interface design and default settings than on infrastructure diffusion. A time-bound one-year assessment may also miss platform features under development or deployed in comparable markets. Because common-practice analysis is used to support additionality, a narrow definition creates non-additionality risk. Peer-reviewed eco-routing literature demonstrates that fuel and emission-reducing navigation functions have been researched and demonstrated for more than a decade (Ahn and Rakha, 2008; Boriboonsomsin et al., 2012). The common-practice test should therefore capture functional equivalence, not merely the exact label "low carbon route".	Revise the common practice approach. Proposed text: "Similar activities shall include any navigation-based intervention, platform feature, algorithmic route ranking, prompt, default option or user-interface design that influences route selection primarily or materially to reduce fuel consumption, energy use, greenhouse gas emissions, or congestion-related emissions, irrespective of whether the service is labelled as low carbon routing. The activity participant shall provide market evidence for the host city and comparable navigation markets, including platform documentation, public product announcements, app features, government programmes and published studies. The 10% threshold shall be justified with empirical evidence or replaced by a threshold approved by the DOE based on market-specific data."

#	Section / Para no./ Annex / Figure / Table	Type of comment ge = general te = technical ed = editorial	Comment (including justification for change)	Proposed change (including proposed text)
4	Methodology section 8 and leakage provisions; Table 2; PDD B.4.3 and B.8.3	te	The assumption that leakage is zero is not sufficiently supported for a network-based transport intervention. Low carbon routing does not only affect the vehicle receiving the prompt; it can redistribute traffic flows across the urban road network. If many users are directed to the same lower-emission route, congestion and speeds may change on both the selected route and alternative routes. Emissions from non-participating vehicles may therefore increase or decrease outside the credited trips. The methodology currently evaluates the participating vehicle-route outcome but does not assess system-wide changes in congestion, speeds or induced reassignment. This issue is material because road-transport emissions are nonlinear with respect to speed and congestion. Barth and Boriboonsomsin (2008) show that real world CO2 emissions are strongly affected by congestion and speed patterns. Network equilibrium and traffic-assignment literature also demonstrates that individual route optimisation can have system level effects that differ from the private optimum (Nagurney, 2000). A route that is lowest-emission before widespread adoption may not remain lowest-emission after substantial traffic shifts. Setting leakage to zero may be appropriate only below a demonstrated materiality threshold. Without such assessment, the methodology risks crediting reductions for participating drivers while ignoring offsetting increases in emissions from non-participants or on adjacent corridors. Article 6.4 methodologies should account for leakage where an activity changes emissions outside the project boundary in a measurable and attributable way.	Replace the blanket zero leakage assumption with a materiality screen and deduction procedure. Proposed text: "Activity participants shall assess, at validation and each verification, whether the activity materially changes traffic volumes, speeds, congestion or emissions on road links outside credited trips. The assessment shall use traffic observations, platform data, transport-network modelling, or other evidence acceptable to the DOE. Where activity-induced traffic redistribution increases emissions of non-participating vehicles or on non-credited routes above a materiality threshold of 1% of claimed annual emission reductions, such leakage emissions shall be quantified and deducted. Leakage may be set to zero only where the DOE validates that network level effects are immaterial."

#	Section / Para no./ Annex / Figure / Table	Type of comment ge = general te = technical ed = editorial	Comment (including justification for change)	Proposed change (including proposed text)
5	Methodology section 11.1; paras. 75-77; monitoring framework; PDD A.4.2 and B.8.2	te	The monitoring system is self-referential and requires stronger independent audit safeguards. The same navigation platform identifies candidate routes, predicts the low carbon route, prompts drivers, records compliance, accumulates link distance, performs QA/QC, and generates the primary data used for credit issuance. This creates a concentration of methodological functions within the activity participant's controlled digital system. While DOE verification occurs ex post, the methodology does not sufficiently require independent technical audit of algorithm versions, route-ranking logic, emissions-calculation engines, data-processing scripts, or software changes during the crediting period. This is a central environmental integrity issue for digital MRV. If the algorithm, prompt design, exclusion rules, speed predictions or data-cleaning procedures change over time, credited reductions may change even if real world mitigation does not. Without version-controlled audit trails and reproducible computation, the DOE may be unable to determine whether emission reductions are calculated consistently with the validated methodology. Schneider and La Hoz Theuer (2019) emphasise that environmental integrity in carbon market mechanisms depends on robust accounting, conservative quantification and avoidance of perverse incentives. These principles are particularly important where the credit generator controls both intervention and measurement systems. The methodology contains useful QA/QC concepts, but these should be upgraded into mandatory digital governance requirements suitable for algorithmic MRV.	Add independent digital MRV governance requirements. Proposed text: "The activity participant shall maintain auditable, immutable records of all algorithm versions, route-ranking rules, prompt designs, parameter updates, emissions-calculation code, data cleaning procedures, exclusion rules and software releases used during each monitoring period. Independent technical audits of the routing algorithm and emissions calculation engine shall be conducted at validation, at least once per crediting period, and after any material software change. The DOE shall be able to reproduce credited emission reductions from retained raw data and archived code. Any undocumented material algorithm change shall trigger exclusion of affected data unless conservativeness is demonstrated."

#	Section / Para no./ Annex / Figure / Table	Type of comment ge = general te = technical ed = editorial	Comment (including justification for change)	Proposed change (including proposed text)
6	Methodology sections 10.3 and 10.4.1; Eq. 7, 9, 11 and 13; PDD B.8.1.2 and B.8.1.3	te	The downward adjustment and conservative BAU equations are ambiguous and should be corrected with explicit parentheses and worked examples. Equation 7 is written as BEadj,min,y1 = BEhistory,y1 - BEhistory,y1 - AEy1 x 0.1. Read literally, this equals -0.1 x AEy1, which is not a meaningful downward-adjusted baseline. The PDD numerical application appears to intend BEhistory,y1 - (BEhistory,y1 - AEy1) x 0.1. The same ambiguity appears in the conservative BAU formula, BAUcons,min,y = BAUy - BAUy - AEy x 0.1, where the intended meaning appears to be BAUy - (BAUy - AEy) x 0.1. This is not a merely editorial issue. The downward adjustment is the core mechanism for aligning an existing or historical emissions baseline with Article 6.4 baseline conservativeness requirements. If implemented literally or inconsistently by different activity participants, the methodology could produce severe under-crediting, over-crediting, or non-comparable results across projects. The comparison between downward-adjusted baseline and conservative BAU baseline also depends on both equations being mathematically unambiguous and dimensionally consistent. The PMM009 PDD appears to apply the intended parenthesised version, but the methodology text should not require implementers or DOEs to infer the intended calculation from examples. Formula clarity is essential for reproducibility and auditability.	Correct the equations and add worked examples. Proposed text: "The minimum downward-adjusted baseline emissions in the first calendar year shall be calculated as BEadj,min,y1 = BEhistory,y1 - [(BEhistory,y1 - AEy1) x 0.10]. The minimum conservative BAU baseline emissions shall be calculated as BAUcons,min,y = BAUy - [(BAUy - AEy) x 0.10]. The initial downward adjustment DAy1 shall equal BEhistory,y1 - BEadj,min,y1. For subsequent years, BEadj,y = BEhistory,y - [DAy1 + BEhistory,y x INDA x (y - y1)]. The methodology shall include a worked numerical example for the first year and all subsequent years, and the PDD and monitoring reports shall present both ex ante and ex post calculations."
7	Methodology section 11.1; paras. 76-77; Eq. 15-19 and 20-33; PDD B.8.2	te	The methodology relies heavily on predicted link speeds and route-emission estimates but does not establish sufficient performance thresholds for prediction error and uncertainty propagation. The low carbon route is selected ex ante based on predicted speed for each link and speed-emission factors. The methodology then uses ex post verification to exclude incorrectly predicted routes and deduct some excess emissions. This is a useful safeguard, but it does not address systematic prediction bias, error clustering during peak periods, or persistent underestimation of emissions on specific road types or origin-destination pairs. Prediction uncertainty is material because vehicle CO2 emissions vary nonlinearly with speed, congestion and stop-start conditions. Ahn and Rakha (2008) and Barth and Boriboonsomsin (2008) show that route choice and congestion conditions can materially affect energy use and emissions. If predicted speeds systematically differ from realized speeds, the platform may misclassify the lowest-emission route, and credited reductions may be biased. Sampling	Add prediction-performance and uncertainty requirements. Proposed text: "Activity participants shall annually validate route emission prediction performance by comparing predicted and observed route emissions across representative spatiotemporal strata. The monitoring report shall disclose error distributions, bias, root mean squared error, false low carbon-route classification rates, and performance by peak/off-peak period and origin-destination stratum. Where systematic bias exceeds 5% or false classification exceeds a DOE-approved materiality threshold, a conservative correction factor shall be applied to all affected emission reductions. Combined uncertainty from sampling, speed-emission factors and prediction error shall be quantified at the 95% confidence level and credited reductions shall use the conservative lower bound."

#	Section / Para no./ Annex / Figure / Table	Type of comment ge = general te = technical ed = editorial	Comment (including justification for change)	Proposed change (including proposed text)
			uncertainty in EFAE,y, uncertainty in speed-emission factors, and prediction uncertainty should be combined rather than treated separately or assumed inherently conservative. The methodology's large sample sizes are helpful, but large samples do not eliminate model bias. Article 6.4 crediting should be based on conservative estimates where uncertainty is material. A quantitative prediction-performance threshold and correction procedure is therefore needed.	
8	Methodology section 6; PDD B.3; data management and monitoring records	te	The avoidance of double counting and data-retention provisions should be strengthened for a distributed digital activity. The methodology requires agreements with drivers and demonstrations that reductions are not credited elsewhere. This is a useful starting point, but contractual arrangements alone may not prevent overlapping claims by corporate fleets, municipal transport programmes, voluntary climate initiatives, app-based green travel schemes, or host-party reporting systems. Because the same trip level mitigation outcome may be relevant to several accounting frameworks, double claiming risk should be managed through auditable records and registry level reconciliation where applicable. The methodology also depends entirely on digital records generated by the navigation platform. To support verification and future audits, raw data retention must include the information required to reproduce emission-reduction calculations: trip identifiers, route alternatives, prompts shown, user selection, trajectory records, link lengths, predicted and observed speeds, emission factors, software versions, exclusion flags and calculation outputs. Schneider and La Hoz Theuer (2019) emphasize that robust accounting and transparency are necessary for environmental integrity in international carbon markets. These requirements are particularly important where millions of small behavioural events are aggregated into credited units. Without stronger safeguards, the DOE may be unable to verify whether a credited trip was also claimed elsewhere or whether later software or data-processing changes affected the calculation.	Strengthen double-counting and data-governance provisions. Proposed text: "For each credited trip or aggregated trip batch, the activity participant shall maintain auditable records demonstrating that the same emission reduction has not been claimed under another carbon crediting programme, environmental market, corporate climate claim, municipal mitigation programme or domestic mitigation scheme. Where any overlapping programme exists, registry level or programme level reconciliation shall be performed. The project database shall retain raw routing records, route alternatives, prompts, user-selection records, GPS trajectories, emission factors, software versions, algorithm logs, QA/QC exclusions and calculation outputs for at least two crediting periods after issuance. The DOE shall verify a risk-based sample weighted toward high-volume and high-reduction trip categories."

(Please add rows as required)

Peer-reviewed references cited in comments:

- Prato, C. G. (2009). Route choice modeling: past, present and future research directions. Journal of Choice Modelling, 2(1), 65-100.
- Chorus, C., Arentze, T., and Timmermans, H. (2006). Information impact on quality of multimodal travel choices: conceptualizations and empirical analyses. Transportation, 33, 625-645.
- Ahn, K., and Rakha, H. (2008). The effects of route choice decisions on vehicle energy consumption and emissions. Transportation Research Part D: Transport and Environment, 13(3), 151-167. https://doi.org/10.1016/j.trd.2008.01.005
- Boriboonsomsin, K., Vu, A., and Barth, M. (2012). Eco-routing navigation system based on multisource historical and realtime traffic information. IEEE Transactions on Intelligent Transportation Systems, 13(4), 1694-1704. https://doi.org/10.1109/TITS.2012.2204051
- Barth, M., and Boriboonsomsin, K. (2008). Realworld carbon dioxide impacts of traffic congestion. Transportation Research Record, 2058(1), 163-171. https://doi.org/10.3141/2058-20
- Nagurney, A. (2000). Congested urban transportation networks and emissions. Transportation Research Part D: Transport and Environment, 5(2), 145-151.
- Schneider, L., and La Hoz Theuer, S. (2019). Environmental integrity of international carbon market mechanisms under the Paris Agreement. Climate Policy, 19(3), 386-400. https://doi.org/10.1080/14693062.2018.1521332

Document information

Version	*Date*	*Description*
01.0	23 May 2025	Initial publication of form template.

Decision Class: Regulatory
Document Type: Form
Business Function: Methodology
Keywords: A6.4 mechanism, developing methodologies and tools, stakeholder consultation