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Paper 2: An Introduction to Assessing Planned Greenhouse Gas Impact

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About
Project Frame is a collaboration of investors in climate solutions who are working together to build frameworks and tools to assess the impact that today's climate investments will have on global greenhouse gas emissions in the future.

This brief provides a high-level overview of how investors assess what we call "planned impact," the change in future greenhouse gas (GHG) emissions that a specific business could realistically deliver, compared to a status quo and relating to its activities. Once the past impact is delivered we report that as "realized impact" or actual impact. Planned impact differs from the "potential impact" that a new breakthrough technology may have as it takes market share away from a status quo technology. Planned impact can be compared to the financial concept of Serviceable Obtainable Market (SOM). Potential impact is aligned with the Total Addressable Market (TAM).

This document offers a high-level methodological framework that investors can follow to assess and categorize their investment impact quickly. The framework is a foundation upon which Frame plans to discuss more complex concepts, such as classifying impact, choosing baselines, and attribution. Those topics are highlighted where they enter the process. We'll link to them as they're developed. Frame assessment materials are subject to regular edits. We revisit content annually or as needed to respond to emerging ideas. See the "last edited" date for recency and visit our **evolving glossary** for terms in **blue** referenced in this report.

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Overview

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In assessing the future GHG impact of a company investment ("planned GHG impact"), investors can work through the structure described in this brief: from developing a theory of change on how emissions reductions could occur as a result of an innovation, to estimating those reductions in measurable terms and tracking results as they unfold. The audience for this workflow is likely to be staff responsible for carrying out a forward-looking impact assessment of innovations that aim to reduce future GHG emissions.

The methodology builds on existing work from the GHG Protocol, Mission Innovation, Prime Coalition, and ECT Alliance (a collaboration between Breakthrough Energy Catalyst and CDP). In addition, we seek to simplify the process and delve deeper into specific topics where people disagree or different kinds of innovation require different approaches. In the end, we hope that even the leanest institution or company can quickly get started in assessing their planned impact.

Future GHG Impact: Key Takeaways

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There are many ways to assess impact: Investors make different choices that shape the calculations they use, how they report, and more. Frame is examining multiple practices, documentation standards, areas of disagreement, and outstanding questions. We are working through these as a community to standardize and improve impact assessment.

Details matter: Behind each step described at a high level here is further complexity. Future briefs will dive into these complexities in more detail. For example: how should investors choose the appropriate status quo "baseline" scenarios against which to compare future emissions reductions?

Assumptions: Qualitative analysis and perspectives on how the change may occur fundamentally affect calculations and should be documented clearly.

Transparency is essential: While practices vary, Frame working group members agree that investors should share the reasoning and assumptions behind their emissions reductions figures when publicly reporting. Only then can impact assessment begin to improve as a field and guard against impact washing and "gaming" based on opaque methods.

Balance optimism: While hopes for emissions reduction and commitment to climate solutions stem from optimism, FRAME members recommend conservatism in assessing impact - better to under-promise and over-deliver!

Processes improve by testing against examples: The details described may apply to some innovations more than others. Frame will continue to evaluate and refine impact assessment workflows against case studies as they develop.

Theory of Change
Define Units
Estimate Emissions Per Unit
Calculate Unit Impact
Commercial Volumes
Report
Update

Step 1: Articulate the Theory of Change

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The first step in the impact assessment is to specify a **theory of change** (i,.e., "impact hypothesis") articulating how the innovation could reduce GHG emissions. The theory of change provides the underlying foundation for all assessments. Therefore, we recommend that the theory includes a description of:

- Impact Type: For example, does the innovation avoid the drivers or demand of today's emissions, reduce emissions from existing or future demand (e.g., energy efficiency) or directly work on GHG emissions by capturing and recycling or storing them?
- System boundaries: How wide is the system you are considering? Are you considering potential knock-on effects upstream and downstream of the innovation?
- Impact attribution: How does the innovation work as part of a larger ecosystem or value chain? The innovation may require several products or services delivered by other factors to trigger the GHG emission reduction (e.g., an electric car needs low carbon electricity). Is the impact directly induced by the innovation or purely "enabled" by it as part of a larger system?
- Timeframes: What time frame are you considering in your analysis? Why?
- Different sources of impact: Are there several sources of impact from the same innovation? If so, these should be separately articulated in your theory of change.

Relevant Topics Discussed in Future						
Impact Type	System Boundaries	Impact Attribution	Timeframes			

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Step 2. Define Units of Impact

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The second step is to define an individual unit of the innovation **(I)**. This could be a product (e.g., heat pump), service (a software license), or measurement (e.g., quantity of a commodity, such as power). The status quo or incumbent unit **(S)** to compare the innovation should also be defined. The concept of the status quo is also linked to the "Baseline," the emissions produced over time if a specific innovation or intervention does not occur.

- ***Example 1: Residential heat pump***: in this case, "I" is a single installed residential heat pump of defined power output and -- depending upon your market ~ "S" could be a gas-fired boiler with average market performance.
- ***Example 2: Electric vehicle***: in this case, "I" is the new EV and "S" could be a standard passenger vehicle. In this case, an assumption around the status quo of the grid power that the electric vehicle will use is also required.

If the innovation does not have an apparent comparative status quo, consider how to make a reasonable comparison. Selection of the best Baseline and status quo is very important. We will explore this subject in more detail in a future paper.

Relevant Topics Discussed in Future						
Impact Type	System Boundaries	Impact Attribution	Timeframes	Baselines		

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Step 3. Estimate Emissions Per Unit

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The next step is to estimate the GHG emissions per unit **(E)**, for the innovation **(IE)** and the incumbent or status quo **(SE)**. In both cases, background research may be required to gather quality data. Fortunately, many good data sources are available such as the following: LCA databases (Ecoinvent), general energy related data providers (IEA), and even governmental emission conversion factors can be helpful from organizations like BEIS in the UK. Frame will develop a set of links to reports that can be used for emissions data.

The emissions analysis should:

- **State key assumptions and sources:** GHG emissions are quoted in kg or metric tonnes of CO_2 equivalent. If the emissions are related to GHGs other than CO_2 (e.g., methane), then the assumed Global Warming Potential (GWP) should be quoted. GWP is the ratio of the target GHG's warming potential per kg relative to CO_2.
- **Be clear on timeframes:** Some firms like to consider annual emissions reductions; others want to calculate cumulative savings. The analysis and data should be presented so that the time frame is clear.
- **Consider the life cycle emissions for the innovation and incumbent:** If "embedded emissions" or "end of life emissions" are significant relative to the operational emissions, then a life cycle analysis should be considered where the GHG impact of producing the innovation (and disposing of it!) is built into the calculations.

Relevant Topics Discussed in Future						
Impact Type	System Boundaries	Impact Attribution	Timeframes	Baselines	Life cycle analysis	

Step 4. Calculate the Unit Impact

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In the next step, the emissions reduction on a per-unit basis may be calculated by subtracting the emissions per unit for the innovation **(IE)** from the incumbent or status quo **(SE)**:

Unit impact = **(SE-IE)**

Where a life cycle analysis has been conducted, a time-series can be modeled where the one-off embedded emissions are netted off the operational savings in year one, and the end-of-life emissions are modeled in the last year of the innovation's life.

Illustration of a life cycle impact calculation for a single "unit" sold in year 1

In this scenario, we kept the baseline static, but the reality may be that the baseline will evolve over time. We return to this question in a future paper.

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Step 5. Commercial Volumes

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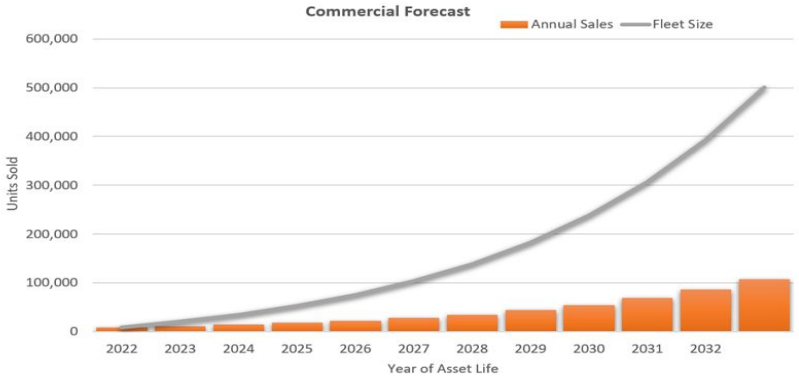
To assess planned impact, integrate the unit impact with an assessment of commercial volumes of the innovation unit. Forecasts may come from the company. The investor could use different scenarios, asking:

- How quickly will the market accept the innovation in the next 5, 10, or 15 years?
- How will the incumbent respond to the innovation (e.g., lower prices/improved performance)?
- How might the market change as a result of the innovation or due to unrelated factors?

It is important to understand whether the innovation delivers one-off emission reduction, or if it helps reduce emissions every year after it is implemented.

Illustration of Commercial Forecast Across a Fleet



Installed fleet grows, accelerating the growth of impact until the earliest units reach end-of-life

Relevant Topics Discussed in Future
Risks and Scenarios

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Steps 6. Report Realized Emissions Reductions and Share Methodology & Assumptions

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As the company or investment progresses, the planned impact is realized. Each investee company can report its realized impact in an annual report that provides all the information necessary for readers to understand and evaluate the approach easily. Investors should also clarify whether they are reporting annual or cumulative emissions reductions and what time frames these relate to.

While an investee reports 100% of its impact, there is some debate about whether an investment manager should "weight" this impact according to the shareholding within their portfolio. We will be exploring this question in a future paper.

Although no formal accounting rules apply to planned or realized impact, companies and investment firms are increasingly asking consultants to review their impact calculations to provide further comfort that their approach is reasonable.

Over time, as the innovation moves from early deployment to commercial scale, investors learn from comparing their assessments of planned innovation emissions reductions with actual emissions reductions and incorporating the latest assessments regarding the best baseline.

Relevant Topics Discussed in Future						
Impact Type	System Boundaries	Impact Attribution	Time Frames	Baselines	Life cycle analysis	Risks and Scenarios

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Step 7. Update your Estimates

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Just as with financial performance, it is good practice to update your impact numbers regularly (at least annually), setting up an efficient process to:

- Collect actual data on both commercial volumes and -- if possible -- unit GHG reductions to determine the realized impact, a topic for future Frame content.
- Update planned impact calculations by incorporating the latest commercial forecasts and any new information about the product performance.

Consider planning periodic reviews or audits of your methodology with third parties to improve the process. It is worth seeking evidence for actual emissions reductions to support your impact estimates.

There are some simple tools available to help make quick progress on impact reporting: such as the SERC tool for up-front screening of projects or products using a simple methodology along the lines of what is described here, and the CRANE tool for more detailed analysis.

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Planned Impact Example: Electric vehicle

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Theory of Change

Company X makes battery electric vehicles (EVs) that enable a reduction per mile of CO2 emissions by utilizing partially decarbonized power from the grid. While the EV relies on the grid to access the power (and thus is not a unique solution), it is a critical value chain element; the impact can be considered as direct GHG reduction.

Define Unit

One unit of the innovation from Company X is a battery-electric passenger vehicle, which is charged with power from the grid and has the appropriate carbon intensity for the geographic focus of Company X. The incumbent unit is a comparable internal combustion engine passenger vehicle (ICE) that runs on gasoline. Therefore, the innovation of Company X is intended to displace the incumbent.

Define Emissions Per Unit

- Operational emissions from running on gasoline for the incumbent ICE passenger vehicle is about **5,000 kg-CO2e per year** in the **US**. Operational emissions from charging Company X's EV in an assumed United States roll-out is **1,000 kg-Co2e per year**.
- Total embedded emissions (emissions embedded in a product from its entire supply chain, including materials extraction, manufacturing and distribution) for the ICE vehicle is **5,000 kg-CO2e per unit**. However, the EV's total embedded emissions are higher: **7,500 kg-CO2e per unit**.
- These emissions estimates are based on technical assessments of both the incumbent and the solution, with assumptions sourced from reliable and easily accessible sources such as the EPA, IEA, or peer-reviewed research papers.

Note that this example is given for the US case; the estimate could be very different in different markets (e.g., China) where the grid has higher carbon intensity.

Example: Electric vehicle (cont.)

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Calculate Unit Impact

Based on our unit emissions assumptions:

- Operation of the EV innovation reduces **operational emissions** by 4000 kg-CO2e per year.
- Production of the EV results in 2500 kg-CO2e more **embedded emissions** than the incumbent.
- The EV is designed to have a 10-year life, and we make assumptions about the GHG impact of its recycling or disposal relative to the conventional vehicle of 2,500 kg-CO2e. In aggregate, the EV creates a ~35,000 kg-CO2e per unit GHG emission reduction in this market. This case is depicted graphically on p. 7 of this document.

Commercial volumes

- Since the electric vehicle will reduce emissions each year of its operating life, we aggregate the units sold into the overall fleet size. For each year of the analysis, we multiply the size of the fleet by the average annual impact per unit per year. This is illustrated on page 8.
- In this example, we assume that the unit impacts of the innovation and incumbent are not expected to change, and external factors -- such as the emissions intensity of the grid -- are held constant. However, if these changes are deemed material for the evaluation, the IE, SE and unit impact are adjusted for each year in the calculation.

FRAME Discussion Topics & Forthcoming Subjects

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Forthcoming: Methodology deep-dives

- Impact type
- System boundaries
- Impact attribution
- Timeframes
- Baselines
- Life cycle analysis
- Risk and scenarios

Supporting resources

- Investor benchmarking
- Investor case studies
- Landscape assessment
- Glossary
- Data sources