



CRANE User Report 2021

Providing takeaways from a dialogue with our users
and the broader climate impact community

A Note from Prime Coalition

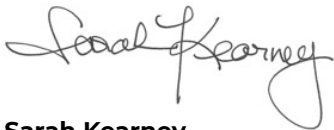
Prime started assessing the “emissions reduction potential” of our own investments because it has been one of our three core underwriting criteria since formation in 2014. It is a privilege to be able to share what we’ve learned with others who might be interested in considering future emissions reduction, no matter their own respective reasons for doing so.

We recognize that emissions as one metric is too narrow in the context of climate justice. We recognize that forward-looking estimates are fraught with uncertainty. We recognize that CRANE v1 was the beginning of many years of development to serve many investors’ needs. We recognize that a software tool is one small aspect of this work, and that it will take much more work for the community of users to come together around a shared sense of how to use tools toward shared principles.

Despite all of this, we felt it was important to try. To start. And we’re deeply grateful to our talented and generous partners for getting started with us, and to CRANE’s users for logging in. CRANE’s Theory of Change depends on active users who make investment and strategy decisions with better GHG outcomes than they would have otherwise been able to make, and for those companies assessed to realize their potential through large-scale market adoption — all of this depends on CRANE being actually useful to its users.

Please stay tuned for continued tool development and an opportunity to contribute to our growing community of asset owners, asset managers, and corporate investors tackling this hard work in their firms’ own ways. We want to listen to what you need, and we’ll all get better together.

With continued hope for a more safe and equitable future for all people,



Sarah Kearney

Founder & Executive Director, Prime Coalition

A Note from Rho AI

Nearly 5 years ago, in early 2017, Rho AI's journey toward applying software and data science to global climate challenges began by trying to help spur investment in the clean energy sector. Founded 5 years before that, Rho AI had always exhibited a passion for applying data to real world problems, but it was our direct exposure to the needs of the clean energy sector that opened our eyes to the broad impact software and data could have on efforts to address climate change.

Our involvement in what is now the CRANE Tool is the direct result of our partnership with Prime Coalition, which has long been a foundational leader in advancing the field of catalytic capital, but which has also supported ambitious initiatives to bring the entire investment community along on its impact measurement and management journey. In 2018 Prime and NYSERDA published a seminal report entitled, "Climate Impact Assessment for Early-Stage Ventures," in which they laid the foundation for everything that has been built today.

I believe one of the great strengths of Prime Coalition is in their name: their ability to form genuine coalitions and partnerships in order to tackle big, difficult problems. On behalf of our team, I would like to express how thankful we are for the exceptional sense of collaboration we have experienced in this endeavor. This includes all stakeholders, comprising those that are nonprofit and for-profit, domestic and international, large and small. Everyone is willing to provide their time, constructive input, and valuable attention.

While this report represents a tremendous milestone and is a testament to the dedication of all contributors, it is also a clear indication of the large scope of work yet to be done. Tackling climate change is a significant challenge, and it will take continued teamwork to meet our shared goals of achieving net-zero emissions, addressing global climate change, and identifying, supporting, and accelerating the people and organizations that will get us there.



Gilman Callsen
Founder & CEO, Rho AI

About this Report

This report captures data and insights from interactions with users since CRANE's release in April 2020, with targeted solicitation of feedback in the form of user interviews and surveys conducted from April to June 2021. For the user interviews and surveys, the CRANE team reached out directly to respondents who had previously registered an account through CRANE. Respondents were not required to be current or active users of CRANE. Over 1,500 users were invited to participate in this study. Of those, 33 participated in a 45-minute one-on-one interview conducted by One Point Five, an impact strategy and research consultancy hired by Rho AI and Prime Coalition to assist in implementing the study. An additional 33 completed a 10-minute online survey. The original survey questions and optional responses, along with the number of responses per question, can be found in the Appendix. In addition to the interviews and surveys, we reviewed 63 incoming requests sent to the team through the CRANE landing page or sent directly to our support email address (info@cranetool.org), as well as recurring themes from other interactions with multiple organizations concerned with estimating, measuring, and managing climate impact. Where applicable, we also drew insights from basic usage statistics of the tool. We plan to conduct a user study and publish the corresponding insights annually.

Acknowledgments

CRANE and this report exist thanks to our community. Thank you to NYSERDA, the John D. and Catherine T. MacArthur Foundation, and Massachusetts Clean Energy Center for supporting the beginnings of this project. Clean Energy Trust and Greenometry played critical roles in designing and developing the first version of the software, with Ben Gaddy, Erik Birkerts, and Ory Zik as primary representatives from those organizations. Project Drawdown, represented by Chad Frischmann, facilitated the implementation of many of our original models.

Thank you to the members of the Academic Advisory Group (AAG), who volunteered their time and expertise to review the CRANE methodology for assessing emissions reduction potential: Ellen Williams (Chair), Todd Cort, Michael Wilshire, Beth Zotter, Ben Leibowicz, Granger Morgan, and Scott Burger.

Thanks to the members of our User Group and those who provided additional user perspectives during our working session at the 2019 ARPA-E conference: Ben Gaddy, Ariel Horowitz, Dan Miller, Dawn Lippert, Eric Smith, Johanna Wolfson, Libby Wayman, Nick Querques, Ramsay Huntley, Jason Salfi, Richard Adams, Dave Smith, Nate Gorence, Dax Stephens, Lou Schick, Jeff Weiss, Pelakesh Mukherjee, Josh Posamentier, Georges Sassine, and Lara Pierpoint.

Our gratitude also goes to past and current CRANE Research Fellows, who have built, and continue to build, the majority of our technology models: Ben Abraham, Simi Barr, Sean Corcoran, Mikaela Derousseau, Connor Finn, Jeff Goby, Shanbor Gupta, Andrew Harrison, Jonathan Haskett, Erick Jones, Matt Kirley, Rajeev Kotha, Nelson Lin, Nadia Madden, Walid Rahman, Zachary Thomas, and Dan Zachary.

Thanks to Neil Yeoh and Matthias Muehlbauer from One Point Five for engaging with our user-interviewees for this report. Thanks to the following organizations for taking the time to participate in our user interviews to provide their insightful feedback: Analog Devices, Autodesk Foundation, BCG, Breakthrough Energy, Caprock, CleanTech Open, Cleantech Scandinavia, EarthShot, Ecosia, Elemental Exceleator, Energetix Climate, ESG Capital Group, Generation IM, GIIN, Impact Beacon (City Light Ventures), Load AI, MaRS Discovery District, Mars Materials, MassCEC, Muon Vision, OGCI, Prime Impact Fund, CEA Consulting, RenewCO2, RSK Labs, SYSTEMIQ, Zero Carbon, and Climate-KIC.

Lastly, thank you to those who took the time to complete our online user survey, those who have provided feedback to us over the last few years, and everyone using CRANE.

Your ideas and suggestions have been invaluable and will continue to guide CRANE's evolution.

Contributing authors

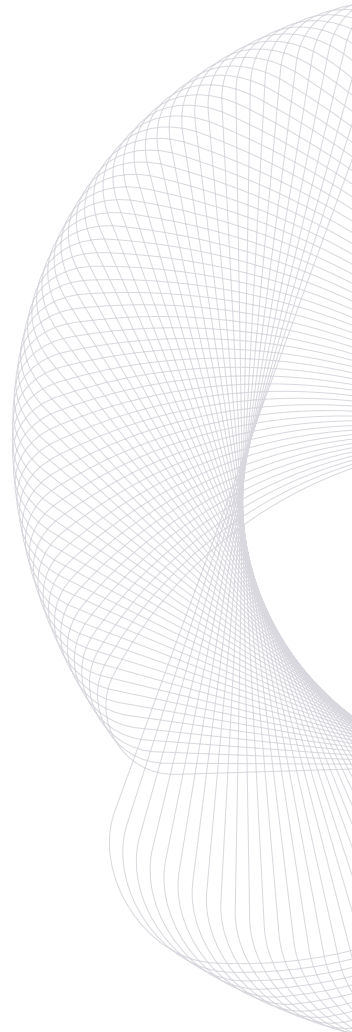
Cassie Borish, Amber Gold, Seth Sheldon

Additional support

Maggie Cutts, Aral Tasher, Santiago Roig

Preferred citation

Prime Coalition and Rho AI, *CRANE User Report 2021*, 2021.



CRANE User Report 2021

Providing takeaways from a dialogue with our users
and the broader climate impact community

Contents

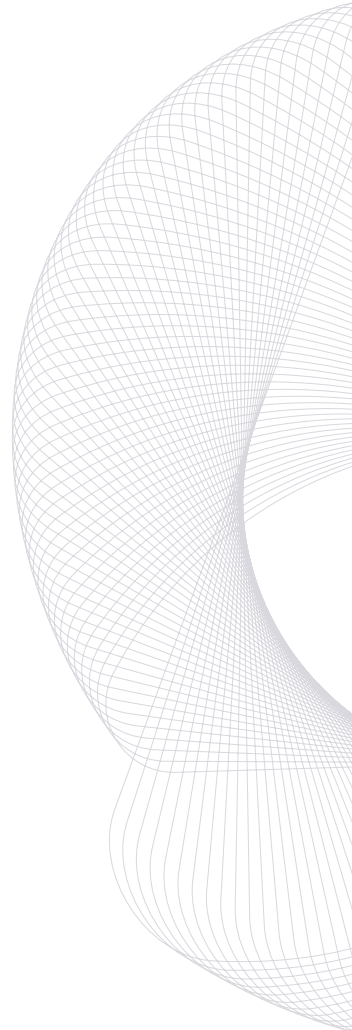
8	Executive Summary
11	Introduction
12	Background to CRANE
14	User Segments
15	Geographic Representation
16	Takeaways
20	1. Starting lines are different.
24	2. Finish lines are different.
27	3. Finding the right points of leverage is key.
29	4. There is still no common language.
31	5. We all have a lot to learn (and teach).
33	6. Time is treasured.
35	7. Accountability is a top priority.
38	8. More data, please.
40	9. Modeling portfolio impact is messy.
42	10. Net Zero 2.0 is here.
43	Additional Insights
45	Conclusion
46	References Cited
49	Appendix
49	Voices

Figures

15	1. User Segment Representation by Response Type
15	2. Geographic Location of Survey Respondents
20	3a. Level of Carbon Accounting Experience
21	3b. Level of Carbon Accounting Experience (by User Segment)
21	3c. Forward-Looking Carbon Accounting Experience (by User Segment)
22	4a. Fund Size (USD)
22	4b. Pipeline Size (Number of Companies)
23	5. Likelihood to Recommend CRANE by Carbon Accounting Experience
24	6. Tracking of Climate Impact by User Segment
25	7. Type of Carbon Accounting Tools Used
26	8. Current Uses of CRANE
28	9. Quality of CRANE's Documentation Standards
29	10. Commonly Used IMM Frameworks and Guidance
31	11. Incoming Message Requests
32	12. CRANE Limitations
33	13. User Activity
35	14. Importance of CRANE Principles
37	15. Most Valuable CRANE Features
38	16. Most Requested Additional CRANE Features
40	17. Most Requested Additional CRANE Modules

Acronyms

AAG	Academic Advisory Group (CRANE)
AEF	Avoided Emissions Framework
API	application programming interface
AUM	assets under management
CDP	(formerly Carbon Disclosure Project)
CERF	Catalyzed Emissions Reduction Framework
CO ₂ e	carbon dioxide equivalent
CRANE	Carbon Reduction Assessment for New Enterprises
CRI	Chain Reaction Innovations
DEI	Diversity, Equity, and Inclusion
ERP	emissions reduction potential
ERR	emissions reduction realized
ESG	Environmental, Social, and Governance
GIIN	Global Impacting Investing Network
GHG	greenhouse gas
GRI	Global Reporting Initiative
Gt	Gigatons (metric)
IIRC	International Integrated Reporting Council
IMM	impact measurement and management
IMP	Impact Management Project
ISO	International Organization for Standardization
LCA	life cycle assessment/analysis
MMT	million metric tons
PIF	Prime Impact Fund
SASB	Sustainability Accounting Standards Board
SBTi	Science Based Targets Initiative
SEC	(United States) Securities and Exchange Commission
UN SDGs	United Nations Sustainable Development Goals
UN PRI	United Nations principles for responsible investment





Executive Summary

Humanity is at a critical juncture as we strive to address climate change.

Within the past year alone, there has been a marked increase in activity: policies requiring companies and nations to cut greenhouse gas emissions, more net zero commitments than ever before, accelerated discussion and participation in carbon offset programs, and intense critiques of the science supporting all of the above. In fact, a gap still exists in verifiable and broadly comprehensible climate impact reporting.

The CRANE (Carbon Reduction Assessment for New Enterprises) tool was designed and released in the midst of this timely conversation. Urgent action on climate change is needed, but such action must not come at the expense of accountability and data-driven analysis. CRANE is itself an open access, web-based application that allows users to evaluate the greenhouse gas reduction potential of emerging technologies. Since the tool's release in April 2020 and through this user study, the CRANE research and development team has begun to arrive at a clearer understanding of the challenges and opportunities facing our user base, a microcosm of the climate impact innovation and investment community. This report outlines and attempts to give context to these insights.

CRANE's user base is broadly divisible into three distinct segments: "Investors," "Investees," and what we identify as "Enabling Organizations." Despite the varied organizational goals among these groups and their subgroups, they share similar views regarding the strengths and weaknesses of the tool as well as the current state and practice of GHG emissions accounting. With respect to CRANE's strengths, they noted its uniqueness and its value as a reference for market and emissions data. While the CRANE software was developed as a calculation tool, it is seen as evolving into a valued data platform, and one that provides the benefit of being a third-party analytical tool (i.e. CRANE has no stake in the resulting emissions projections). It helps provide both credibility and a standardized process that saves time for many users.

We received valuable feedback on how CRANE might be improved, largely expressive of the day-to-day hurdles faced by each of the user segments. These are summarized in the following 10 takeaways:

- 1. Starting lines are different.** Existing expertise and available resources for estimating potential GHG impact vary widely from organization to organization. This variability creates barriers to using CRANE and other IMM tools as they currently exist.
- 2. Finish lines are different.** Despite an overarching goal of addressing climate change, every organization has its own specific objectives, workflows, and definitions of success. This means that the specific function of emissions-related research varies from firm to firm (as do expectations and requirements about the depth and quality of the research). CRANE is unlikely to satisfy the majority of user needs from end to end, but it can be designed to integrate with numerous existing workflows.
- 3. Finding the right points of leverage is key.** The best impact models will illuminate where users can intervene based on their missions, expertise, time, and other resources. CRANE highlights underlying assumptions that provide a range of results, but there is room for improvement to allow users to more quickly and clearly model the potential effects of particular interventions.
- 4. There's still no common language.** Multiple frameworks, metrics, standards, tools, requirements, and lexicons within and external to each organization present a major challenge. CRANE can help to establish a common practice among different entities as it applies to forward-looking carbon accounting, but it will also help for CRANE to demonstrate direct correspondence with existing frameworks and standards.
- 5. We all have a lot to learn (and teach).** The outputs of any calculator aren't meaningful unless the inputs and intermediate computations are understood. It is our hope that CRANE will not only exist as an analysis and research tool, but also as an educational tool to help individuals understand and perform emissions impact analysis.
- 6. Time is treasured.** Whether individuals expect to spend 40 minutes or 40 hours performing an ERP assessment, they are looking for tools that will save time and other resources without sacrificing quality. CRANE helps by providing a uniform calculation with consistent reporting and documentation standards, but it's clear from feedback and a review of user activity that the tool can do more to meet users at their starting point, wherever that might be, so that it becomes a genuine time saver.
- 7. Accountability is a top priority.** Clear accounting of credit and blame — and underlying rationales for assigning each — has become important across the board. CRANE strives to provide credibility to its results by linking the output to the underlying data.
- 8. More data, please.** Everyone would like to see more technology models and more market and emissions data for more geographies — ideally in a standardized format and all in one place. CRANE is scratching the surface of what our users need in order to generate forward-facing emissions estimates. The addition of the Custom Technology module allows the community to continue expanding this database.
- 9. Modeling portfolio impact is messy.** It is generally agreed that allocation of credit for positive impacts should be fair and that double counting should be avoided, but there are no widely accepted practices for how to do either. The CRANE team has initiated preliminary concept design around a portfolio-level tool.

10. Net Zero 2.0 is here. Net zero commitments are on the rise, but with few real plans for how to achieve them. Analysis of potential impacts can (and should) be used to set goal posts for measuring actual impact through time. CRANE should seek to strengthen the bridge connecting climate ambitions to climate actions

The overarching themes may be further summarized in this way: The set of challenges, needs, resources, and objectives are as varied as the stakeholders. Better data, enhanced analytics, and novel methodological approaches are as sorely needed as ever. We should be encouraging a culture of collaboration, humility, urgency, and accountability as we undertake impact innovation, investing, planning, measurement, and management. Lastly, society is ready for a new kind of impact reporting that focuses on positive and verifiable interventions and resulting outcomes rather than on paperwork.

We intend to continue developing CRANE and related resources to help the community build a better future.



Introduction

Humanity's race to avoid climate disaster has never been more animated. Consider the following:

- In its "Report on US Sustainable and Impact Investing Trends: 2020," US SIF estimates that the "total US-domiciled assets under management using sustainable investing strategies grew from \$12.0 trillion at the start of 2018 to \$17.1 trillion at the start of 2020, an increase of 42 percent," accounting for 33 percent of total US assets under professional management (US SIF Foundation, 2020).
- In September of 2020, the Climate Action 100+ Steering Committee, representing more than 500 global investors and \$47 trillion in assets, sent a letter to CEOs and Board Chairs at 161 of the world's largest corporate emitters, calling on them to commit to net-zero business strategies (Ceres, 2020). That same month, five of the leading global impact reporting and guidance organizations committed to begin aligning their frameworks (CDP et al., 2020).
- In January of this year, the "Taskforce on Scaling Voluntary Carbon Markets: Final Report" was released, estimating a carbon market size of upwards of \$30 billion, and assuming a demand reaching 1-2 GtCO₂e by 2030 (TSVCM et al., 2021), amidst predictions that the average price paid for offsets will increase tenfold (i.e. from \$3-5 to \$30-50 per metric ton CO₂e) within the decade (Holder, 2021).

And most recently:

- On Tuesday, June 8, 2021, the U.S. House of Representatives narrowly passed the ESG Disclosure Simplification Act of 2021, mandating that the Securities and Exchange Commission (SEC) require public companies to define ESG metrics and publish such metrics alongside audited financial statements (Quinlivan, 2021; ESG Disclosure Simplification Act, 2021).¹
- On Tuesday, June 15, 2021, professional services firm PwC announced that it plans to commit \$12 billion through 2026 to hire 100,000 new employees to better address ESG auditing and reporting for their clients (Dinapoli, 2021).
- On Monday, June 28, the European Council "adopted a climate change law...that legally obliges its 27 nations to collectively slash greenhouse emissions by 55% by 2030" from 1990 levels, and "to become a net-zero-emissions economy by 2050" (Dewan, 2021; European Council, 2021).

¹ Earlier in the year (March 15, 2021), U.S. SEC Commissioner Allison Herren Lee announced that the agency is actively soliciting feedback from the public related to ESG disclosures (Herren Lee, 2021).

This increase in activity has also generated a critical and constructive backlash. A growing number of sustainability veterans are distressed by the poor quality of the science and the questionable motivations underpinning much of the investment and many of the schemes lately proposed to address climate change.² In “Overselling Sustainability Reporting,” Ken Pucker, senior lecturer at the Fletcher School at Tufts University and former COO at Timberland, throws down the gauntlet with one incontrovertible fact: “During [the] same 20-year period of increased reporting and sustainable investing, carbon emissions have continued to rise, and environmental damage has accelerated” (Pucker, 2021).³ In other words, our conventional methods of climate impact reporting haven’t worked well enough to justify their preservation; nor is there strong empirical evidence that the climate-focused fraction of the \$17.1 trillion committed to “sustainable investments” in 2020 materially overlaps with what the IPCC has identified as the \$830 billion needed to limit warming to 1.5°C (Rogelj et al., 2018).

Background to CRANE

CRANE is itself an outgrowth of a natural tension within the much broader conversation on climate — the critical need for science-based analysis balanced by the urgent need for action — and its story begins a few years ago. With the ultimate aim of building a more practical climate impact assessment tool, Prime Coalition (“Prime”) partnered with NYSERDA in 2017 to publish a paper entitled Climate Impact Assessment for Early Stage Ventures, laying out a framework for evaluating the “emissions reduction potential” or ERP of new technologies (Burger et al., 2017). Following publication of the report, Prime Coalition received grants from the John D. and Catherine T. MacArthur Foundation, NYSERDA, and the Massachusetts Clean Energy Center (MassCEC) to bring the framework to life as an open access tool. Rho AI, Clean Energy Trust, and Greenometry were brought in for software development, user engagement, and methodological development, respectively. Additional data and analysis support was provided by Project Drawdown. The result of this collaborative effort was the CRANE (Carbon Reduction Assessment for New Enterprises) tool.

CRANE is an open access, web-based application that allows users to evaluate the greenhouse gas (GHG) reduction potential of emerging technologies. The goal of the software is to greatly reduce the time and resources required for investors, entrepreneurs, government agencies, incubators, philanthropies, and others to perform forward-facing, rigorous, and transparent climate impact assessments. The key result is an emissions reduction potential (ERP) range for the technology or company, which is the magnitude of the greenhouse gas emissions measured in million metric tons of carbon dioxide equivalent (MMtCO₂e) that have the potential to be avoided or abated as a result of deploying the new technology. Every analysis includes a summary report that provides additional metrics, detailed assumptions, references, and calculations. Each analysis can be downloaded in multiple formats and shared among multiple stakeholders for further review and improvement. CRANE’s mission is to make GHG modeling capabilities publicly and globally available, while contributing to a digital constellation of organizations and people working on real climate solutions.

² Tempering the same US SIF report is this statement by CEO Lisa Woll: “Amidst the rapid growth and profile that sustainable investing has garnered in recent years, we continue to see a significant increase in ESG assets for which limited information is disclosed [emphasis added]” (US SIF Foundation, 2020).

³ See also: “The World Needs Better Climate Pledges” (Foley, 2021); “The net-zero backlash has arrived” (Makower, 2021); in direct response to TSVC’s initial recommendations, “Comments on the Initial Recommendations of the Taskforce on Scaling Voluntary Carbon Markets” (Goldberg et al., 2021); and Tariq Fancy’s rebuke of asystemic, private sector-led solutions to the climate crisis in “BlackRock hired me to make sustainable investing mainstream. Now I realize it’s a deadly distraction from the climate-change threat” (Fancy, 2021).

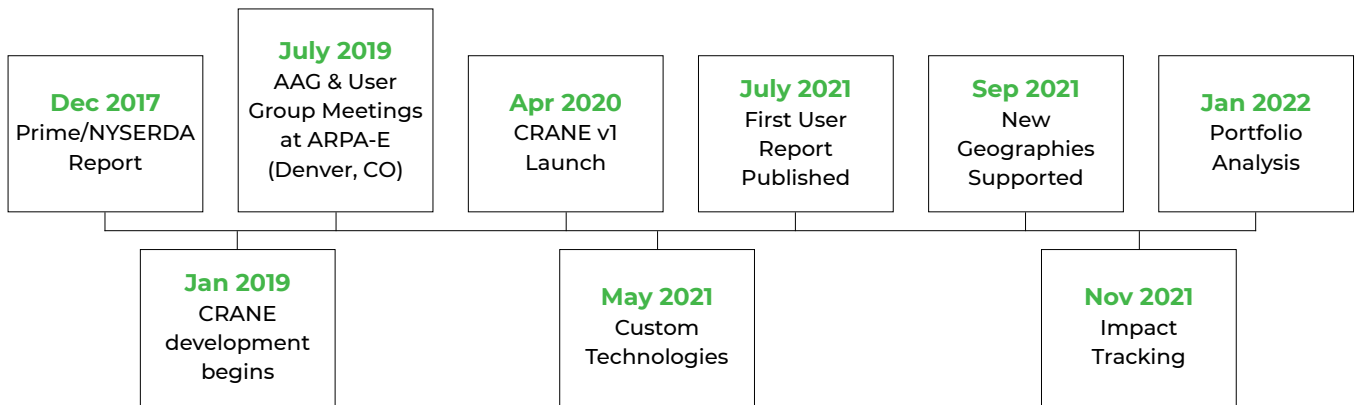
CRANE was released to the public in April of 2020, following a year of development and three months of beta testing. We intentionally released CRANE as a work in progress, with the goal of continuing to develop CRANE according to the unmet needs of the users. CRANE currently supports over 2,000 users, with roughly 200 active users per month.⁴ CRANE contains 208 verified technology models and an additional 40 that are undergoing final verification. Each of these models includes market and emissions data that users can customize to fit their analysis needs. In addition to educational materials in the form of tutorial videos, an FAQ, a glossary, and a Slack community, the CRANE team has begun hosting free, live webinars as a way to directly engage with our users.

After over a year of listening, collaborating on a number of projects utilizing the CRANE software in different ways, and undertaking small development improvements, we felt that this was an appropriate time to conduct a more structured assessment to document the CRANE community’s needs. These findings will provide the basis and justification for future CRANE development.

CRANE principles:

- Transparency
- Simplicity
- Clarity
- Accountability
- Modularity
- Accuracy
- Stability
- Evolvability

CRANE Development Timeline, 2017-2022



⁴ Averaged across the three months preceding the publication of this report.

User Segments

CRANE has three major user segments: Investors (used here as shorthand for organizations that provide financial resources), Investees (those who receive funds), and Enabling Organizations (facilitators, experts, regulators, and others). Investors are those looking to evaluate and drive climate impact with their funds. This segment includes philanthropic and government investors and grant-makers, venture capital firms and banks, as well as other asset managers. Investees are those receiving funds to develop impactful technologies. This category includes entrepreneurs, startups, and other corporations. Enabling organizations are those who help to accelerate development for multiple technologies and/or contribute to the field. This may include accelerators, incubators, and academic institutes, among others. Table 1 provides a breakdown of user segments and subsegments. We divided specific responses into these segments because the objectives and backgrounds of these segments were found to be distinct.

Table 1. Breakdown of CRANE user segments and subsegments

Segment	Subsegment
Investors	<ul style="list-style-type: none"> • Philanthropic investors/grant-makers • Government investors/grant-makers • Early stage investors • Venture capitalists • Commercial banks • Investment banks • Academic investment portfolios/ University endowments • Corporations (as investor)
Investees	<ul style="list-style-type: none"> • Entrepreneurs • Startups • Corporations (as investees, e.g. R&D group)
Enabling organizations	<ul style="list-style-type: none"> • Incubators • Accelerators • Academic researchers/labs/institutes • Climate impact research and reporting • Government • Advocacy groups • Think tanks
Other	<ul style="list-style-type: none"> • Organizations that do not fit within the subsegments listed previously

User interviews consisted of more investors and enabling organizations, whereas respondents to the survey were more evenly represented across the different user segments (see Figure 1). Based on an initial review of current CRANE users, the distribution of respondents amongst the user segments appears to be fairly representative of the CRANE user population. We note that the low response rate to the survey (~2%) means that the majority of the conclusions based on quantitative responses are not statistically significant. That said, we believe that the combination of data from the survey, interviews, and messages, which includes feedback from approximately 8% of the CRANE user population at the initiation of the study, provides results which are both thematically meaningful and quantitatively suggestive.

Figure 1. User Segment Representation by Response Type

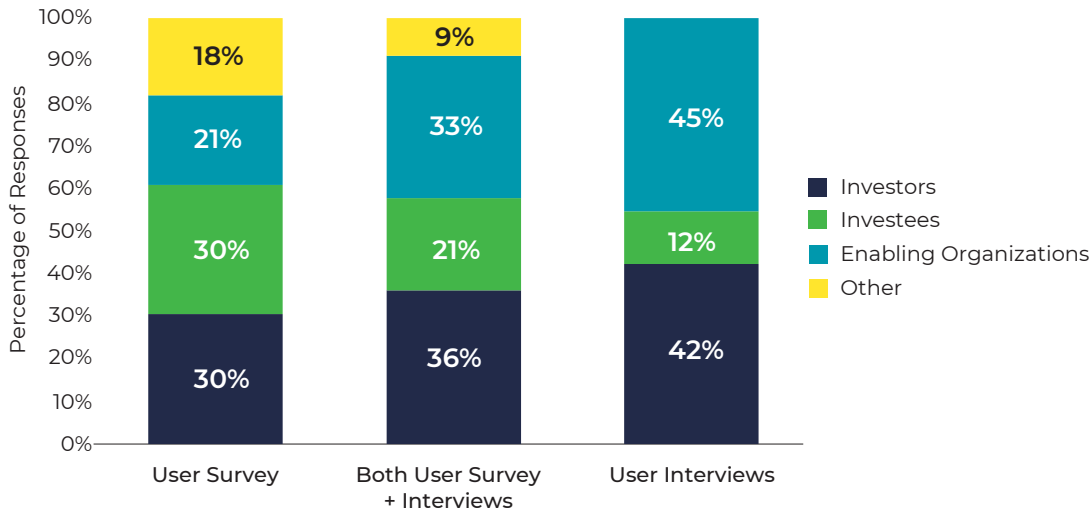


Figure 1 shows the breakdown of respondents for the user survey, the user interviews, and the combination of those response types by user segment (see Table 1 for more information on user segments). Enabling organizations had a smaller representation in the survey responses, but were the largest representation in the interviews. Conversely, Investees had smaller representation in the user interviews, but were more represented in the survey responses. In total responses (as a combination of user interviews and the survey), there was a relatively even distribution between each of the user types. The distribution of the feedback was important as we found different (although often overlapping) themes in the feedback that emerged based on the user type.

Geographic Representation

CRANE currently has geographic support for the United States and at the Global scale, but our intention is to expand this coverage (i.e. for technologies, markets and emissions) and accessibility (with more servers and languages) to additional geographic regions. To that end, we were interested in understanding the current geographic distribution of our users. Figure 2 shows the geographic distribution of survey respondents. While the majority of these users were based in the United States, there is significant representation from other regions, and especially Europe.

Figure 2. Geographic Location of Survey Respondents

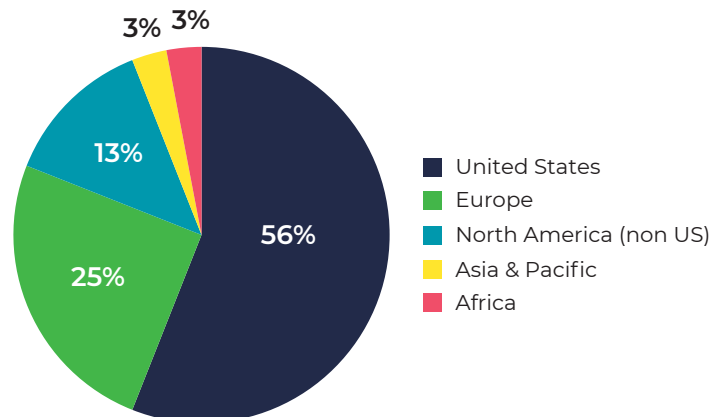


Figure 2 illustrates the geographic location of 32 survey respondents. The majority of respondents are based in the United States, which is not surprising since that has been the geographic focus of the CRANE tool thus far. However, there are a substantial number of respondents located in Europe and other North American countries. This highlights the need for a broader distribution of geographic data in CRANE.

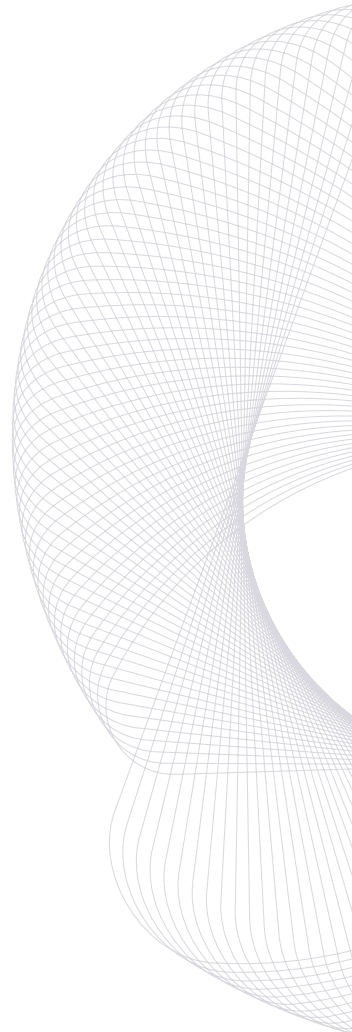


Takeaways

Since CRANE's release, users and supporters have noted similar strengths of the tool. They have remarked on its uniqueness, particularly in the area of forward-facing emissions assessments, and they expressed appreciation for having the baseline market and emissions data available by sector. While the CRANE software was developed as a calculation tool, it is seen as evolving into a valued data platform, and one that provides the benefit of being a third-party analytical tool (i.e. CRANE has no stake in the resulting emissions projections). It helps provide both credibility and a standardized process that saves time for many users. Lastly, we were pleased to see that the Custom Technology module was highly requested. Its recent release is consistent with our goal of continuing to develop CRANE to better address user needs.

Other themes emerged over the course of the study including observations about how CRANE can be improved as well as broader insights into the state of climate impact innovation, investing, and impact measurement and management (IMM). For instance, while there is unprecedented urgency and a broad goal of tackling climate change through innovation, the perspectives, objectives, and methods used by stakeholders are extremely diverse. Likewise, "greenwashing" has moved from simply being a reputational risk, to being both a financial and regulatory risk for companies whose carbon accounting fails to add up.

These themes provide the context for more specific barriers to practicing robust IMM within the realm of climate innovation and investment. Since CRANE is predicated on the idea that positive intent must be met with robust data and tools if it is to be translated into positive outcomes, we further ground these themes into specific takeaways that focus on implementation challenges:



Top 10 Takeaways

Takeaway	Summary	Upshot for CRANE
1. Starting lines are different.	Existing expertise and available resources for estimating potential GHG impact vary widely from organization to organization.	<ul style="list-style-type: none"> • Take into account the varying abilities and needs of users related to those abilities. • Add different modes that enable multiple levels of analysis (e.g. Simple, Classic, and Advanced modes). • Add more automated “sense checks” and other quality assurance features.
2. Finish lines are different.	Despite an overarching aim of addressing climate change, every organization has its own specific objectives, workflows, and definitions of success. This means that the specific function of emissions-related research varies from firm to firm (as do expectations about the depth and quality of the research).	<ul style="list-style-type: none"> • Simplify navigation required to investigate results and to share and export data in familiar formats. • Align with (and communicate CRANE's relevance to) well established standards, frameworks, metrics, guidance, and best practices.
3. Finding the right points of leverage is key.	The best impact models will illuminate where users can intervene based on their mission, expertise, time, and other resources.	<ul style="list-style-type: none"> • Provide users with the ability to more quickly and clearly model interventions as well as the sensitivity of the results to those interventions. <p><i>The newly released Custom Technology module allows users to upload Excel-based background notes to their model, enabling deeper documentation of underlying assumptions, data transformations, and references.</i></p>
4. There's still no common language.	Multiple frameworks, metrics, standards, tools, requirements, and lexicons within and external to each organization present a major challenge.	<ul style="list-style-type: none"> • Enhance the glossary and include terms from outside of CRANE. • Demonstrate direct correspondence with other frameworks and standards. This may require additional certification work to validate across frameworks. • Provide emissions avoidance results using equivalencies (e.g. number of cars taken off the road). • Rely on more visuals and infographics instead of text.

Top 10 Takeaways

Takeaway	Summary	Upshot for CRANE
5. We all have a lot to learn (and teach).	The outputs of any calculator aren't meaningful unless the inputs and intermediate computations are understood.	<ul style="list-style-type: none"> • Provide additional documentation, training and educational materials to support carbon fluency. • Provide more technical documentation. • Conduct an annual user study to listen, learn, and correspond with the IMM and clean tech investment community. <p><i>We have initiated monthly webinars to educate our users about the tool and better understand their needs. We will also look to develop the tool to meet users at varying levels of expertise by tailoring how much assistance and customization the tool allows.</i></p>
6. Time is treasured.	Whether individuals expect to spend 40 minutes or 40 hours performing an ERP assessment, they are looking for tools that will save time and other resources without sacrificing quality.	<ul style="list-style-type: none"> • Focus research and software development on user experience (i.e. UX). • Strive for better understanding of user abilities, workflows, time pressures, intermediate goals, and desired outcomes in order to establish the CRANE software as a time saver.
7. Accountability is a top priority.	Clear accounting of credit and blame — and underlying rationales for assigning each — has become important across the board.	<ul style="list-style-type: none"> • Tailor output and documentation for different recipients, with consideration for who they are holding accountable (e.g. asset managers, portfolio companies) and to whom they are accountable (e.g. investors, government entities, or the public). • Update the models with the latest market and emissions projections. • Ensure support for long term maintenance and development of all public facing features.
8. More data, please.	Everyone would like to see more technology models and more market and emissions data for more geographies — ideally in a standardized format and all in one place.	<ul style="list-style-type: none"> • Create a “library” feature that allows users to quickly find reliable sources of data and research across the different sectors. • Include indicators of quality of certain data sources based on new or established frameworks (e.g. Nesta Standards of Evidence) and/or machine learning modeling techniques. • Develop an API and provide supporting documentation.

Top 10 Takeaways

Takeaway	Summary	Upshot for CRANE
9. Modeling portfolio impact is messy.	It is generally agreed that allocation of credit for positive impacts should be fair and that double counting should be avoided, but there are no widely accepted practices for how to do either.	<ul style="list-style-type: none"> • Clarify design requirements and technical challenges with respect to a portfolio-level assessment tool and implement such a tool. • Apply a “drag and drop” philosophy to modeling the effects of new technology solutions on larger systems (e.g. markets and industries, corporate activities). <p><i>Users may be able to use the custom technology module to assemble a single model that represents an aggregate of their technologies.</i></p>
10. Net Zero 2.0 is here.	Net zero commitments are on the rise, but with few real plans for how to achieve them. Analysis of potential impacts can (and should) be used to set goal posts for measuring actual impact through time.	<ul style="list-style-type: none"> • Add a longitudinal analysis (i.e. tracking) module to document real progress on climate through an “emissions reduction realized” (ERR) or similar metric.

The following sections elaborate on each of these takeaways as they relate to the wider domain of measuring and managing climate impact, and they provide a quick summary (an “upshot”) of how CRANE is already addressing the challenges and/or how CRANE can be improved to better address them.

1. Starting lines are different.

Existing expertise and available resources for estimating potential GHG impact vary widely from organization to organization.

Respondents’ capabilities to perform in-depth carbon accounting exist along a spectrum. The relevance and application of carbon accounting depends on organizational goals, needs, resources, and level of expertise. Additionally, organizations have varying familiarity with different standards, frameworks and approaches, often without having a clear understanding of the fundamental principles (e.g. life cycle analysis, verification methods, forms and standards of evidence) that may connect each of these elements.

Figures 3(a-c) demonstrate the trends we saw from the survey in self-identified experience level with carbon accounting and, more specifically, forward-looking carbon accounting. Average values are displayed in parentheses in the legend. Generally speaking, Investors had the least experience with both carbon accounting and forward-looking carbon accounting and Enabling Organizations demonstrated the most. Investees were slightly more likely to have experience in forward-looking carbon accounting over carbon accounting, while the opposite was true for Investors and Enabling Organizations.

Figure 3a. Level of Carbon Accounting Experience

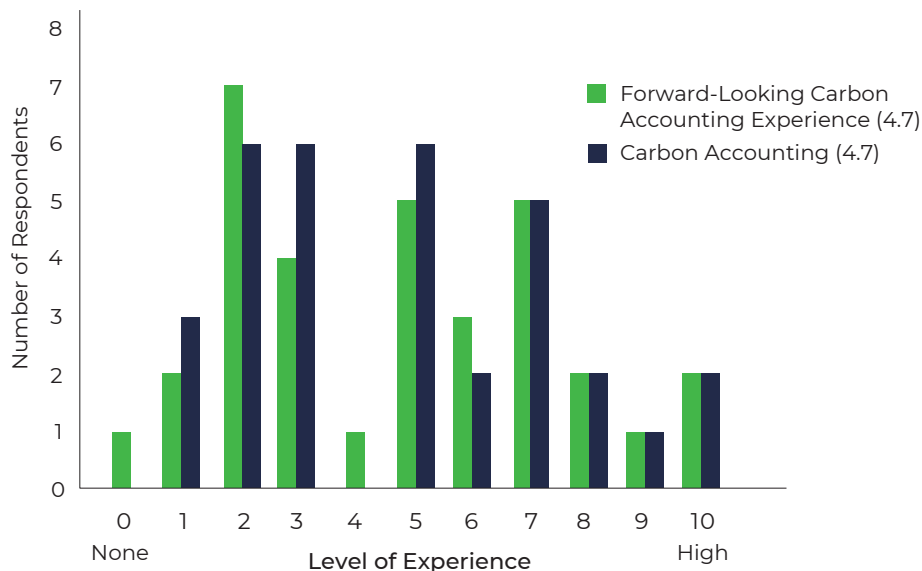


Figure 3a demonstrates the level of carbon accounting experience and, more specifically, forward-looking carbon accounting experience on a scale of 0 (“none”) to 10 (“high”). These values were self-reported by 33 total survey respondents. One of the challenges of CRANE has been designing a tool that is useful for both novices and experts, and this figure clearly illustrates the broad spectrum of carbon accounting expertise that users bring to CRANE.

Figure 3b. Level of Carbon Accounting Experience (by User Segment)

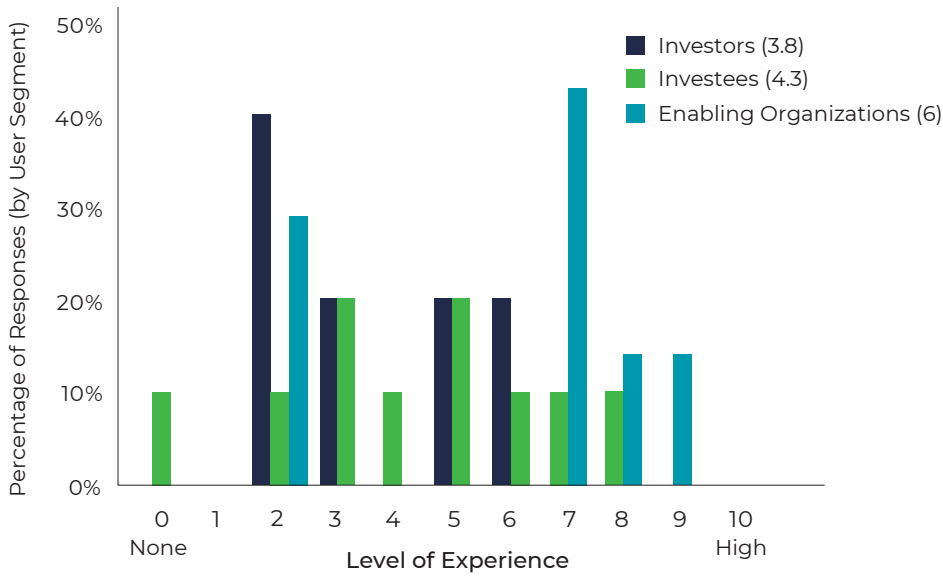


Figure 3b shows the level of carbon accounting experience on a scale of 0 (“none”) to 10 (“high”) broken down by user segment. Investors (10 respondents) reported the least experience in carbon accounting, with an average of 3.8; Investees (10 respondents) reported a very neutral average level of experience at 4.3; and Enabling Organizations (7 respondents) reported the highest level of expertise among the user types with an average of 6. The remainder of the respondents made up the “Other” user type and are not included in this figure. We expect that the level of experience in carbon accounting, as well as the differing use cases, for each user type influenced the differences that emerged in feedback between user types.

Figure 3c. Forward-Looking Carbon Accounting Experience (by User Segment)

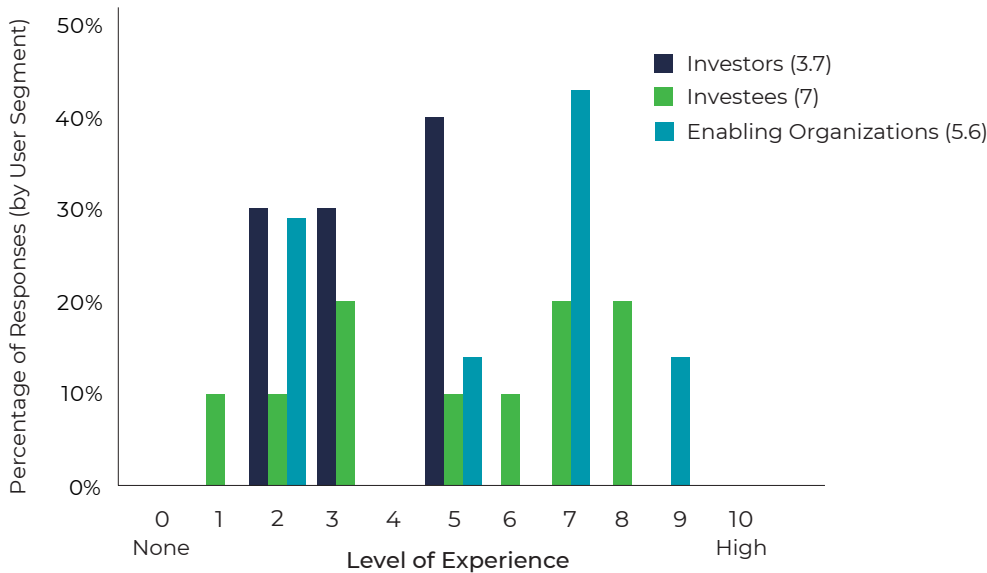


Figure 3c shows the level of forward-looking carbon accounting experience on a scale of 0 (“none”) to 10 (“high”) broken down by user segment. Investors (10 respondents) reported the least experience in carbon accounting, with an average of 3.8; Investees (10 respondents) reported a very neutral average level of experience at 4.3; and Enabling Organizations (7 respondents) reported the highest level of expertise among the user types with an average of 6. The remainder of the respondents made up the “Other” user type and are not included in this figure. We expect that the level of experience in carbon accounting, as well as the differing use cases, for each user type influenced the differences that emerged in feedback between user types.

Specifically for the Investor segment, there is wide variation in the number of companies in their pipeline, which can range anywhere from 10 to 1,000 annually. Likewise, fund sizes vary by several orders of magnitude, ranging from less than \$1 million to greater than \$1 billion. Figures 4(a,b) demonstrate the distribution of fund size and investor pipeline size for the Investor respondents.

The wide variability in user needs creates a barrier to using CRANE and other IMM tools. For CRANE specifically, the software can appear too advanced for individuals who are still building familiarity with carbon accounting. The units of measure are a constraint, and relying on the user to convert their units to those of the tool may be too cumbersome (e.g. converting vehicle sales projections to functional units such as “billion passenger vehicle miles traveled”).

Figure 4a. Fund Size (USD)

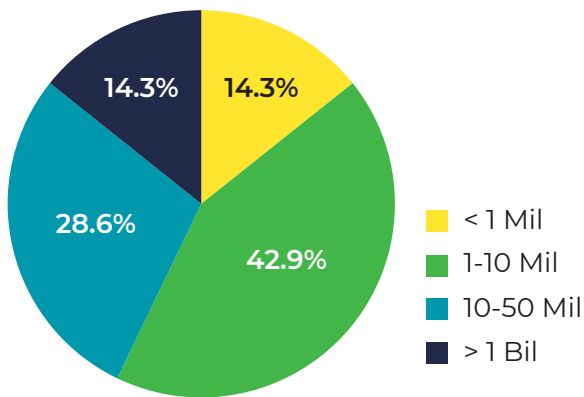


Figure 4a illustrates seven of the Investors' total assets under management for this calendar year. The distribution of fund size is very broad, ranging from less than \$1 million to over \$1 billion.

Figure 4b. Pipeline Size (Number of Companies)

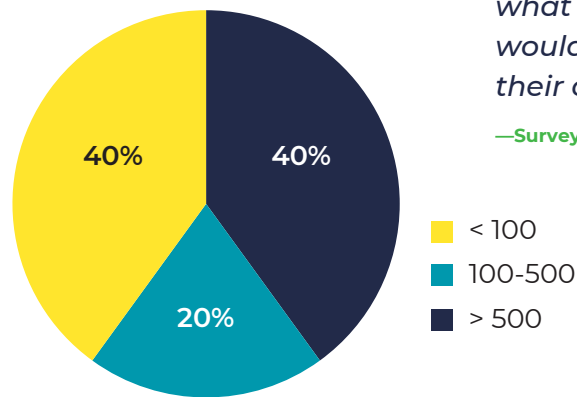


Figure 4b illustrates five of the Investors' total companies that sit at the start of their investment or grant pipeline. There is clearly a broad range of the number of companies that an investment firm will need to evaluate.

The terminology used in the tool may also be unfamiliar to the user. One survey respondent said, “I think it would be helpful to have a simple tool to coach users as to what information they should make sure to have available to get to an accurate result. Not just definitions of terms...but examples to give them a clear idea for what such a figure would look like in their case.”

For other individuals, CRANE is not advanced enough. These experts have already identified and used multiple approaches and tools to meet their specific and rigorous diligence requirements. Many are trying to understand the key drivers of uncertainty and find that the ability to interpret the sensitivity of the results to such uncertainty within the tool is lacking. For example, one interview respondent noted, “It’s super helpful to have the high level impact number but...you need the whole story of what’s building up to that number.” The tool also lacks the level of customization that more advanced users want, such as the ability to introduce additional intermediate variables and include limits or boundary conditions as needed.

A subset of users found that CRANE meets them at their level. These users commonly use CRANE as a validation tool by triangulating the results from CRANE with their own work or the work done by third-party consultants. They also utilize the underlying assumptions and references as a quick way to obtain current, reputable, and useful information as a starting point for their research or specific analysis.

“I think it would be helpful to have a simple tool to coach users as to what information they should make sure to have available to get to an accurate result. Not just definitions of terms... but examples to give them a clear idea for what such a figure would look like in their case.”

—Survey Respondent

“It’s super helpful to have the high level impact number but...you need the whole story of what’s building up to that number.”

—Interview Respondent

Upshot for CRANE

In its present form, and depending on the user's level of carbon accounting experience, CRANE is either sufficient, too complex, or too simplistic. In each case, the software provides a reference point for gauging the depth or quality of work done outside of the tool. For some, it's a resource for "catching up" or learning more about different technologies and keeping pace with developments in the impact investment and climate tech domains. For others, it's a starting point for more in-depth analysis. For both beginning and advanced users, CRANE's documentation provides useful reference material to trace calculation outputs to original sources.

Figure 5. Likelihood to Recommend CRANE by Carbon Accounting Experience

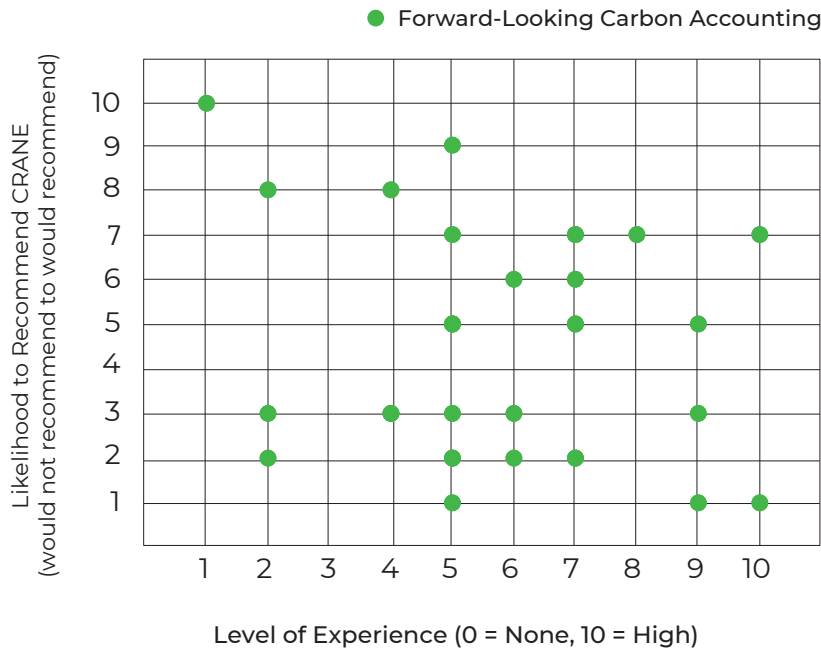


Figure 5 demonstrates the relationship between users' level of experience in forward-looking carbon accounting and how likely they are to recommend CRANE to a colleague or another organization. There is a very slight trend (correlation of 0.19) of more experienced users being less likely to recommend CRANE.

Future development of CRANE should take into account the varying abilities and needs of users. To that end, we could aim for different modes of interacting with the software that enable multiple levels of analysis (e.g. Simple, Classic, and Advanced modes) with multiple levels of inputs. Figure 5 demonstrates the likelihood of a user recommending CRANE to another organization or colleague based on their self-reported level of experience in forward-looking carbon accounting. There is a slight trend for users more experienced in carbon accounting to be less likely to recommend CRANE (-0.19 correlation), though this was not definitive.

Users may also find it beneficial for the tool to provide more guidance to inputs, including automated "sense checks" and quality assurance features. For example, when provided basic selections for units of measure and market, the tool could present reasonable ranges for numerical values. A more comprehensive FAQ, glossary of key and related terms, and detailed how-to guide are other ways we plan to assist users, no matter their level of experience.

2. Finish lines are different.

Despite an overarching aim of addressing climate change, every organization has its own specific objectives, workflows, and definitions of success. This means that the specific function of emissions-related research varies from firm to firm (as do expectations about the quality of the research).

As we have seen, when it comes to impact reporting, some organizations have detailed practices in place, while others are still defining their reporting metrics (see Takeaway 1). Figure 6 illustrates the type of impact reporting by the survey respondents. The majority of users perform some type of impact reporting (approximately three-quarters), but the majority of these are informal analyses, and only a small subset of organizations (19%) publish an impact report. One interview respondent noted that, when asking for impact documentation from multiple general partners with whom they work, “some people came back with... [a] three inch book, and offered to coach us on how to do this. Others [said] ‘no idea what you’re talking about, but it sounds interesting.’”

Compounding the inconsistencies in the quality and scope of research is the fact that each organization has different expectations around the depth, breadth, transparency, and rigor of the research they produce and/or use to make decisions. In other words, these inconsistencies are undoubtedly driven not only by what they are able to do, but by what they desire to do, based on the gravity and context of the decision being made. Since most impact and integrated reporting frameworks and standards are not explicitly and precisely aligned with others, formal adoption of any one of them can add to the confusion.

Figure 6. Tracking of Climate Impact by User Segment

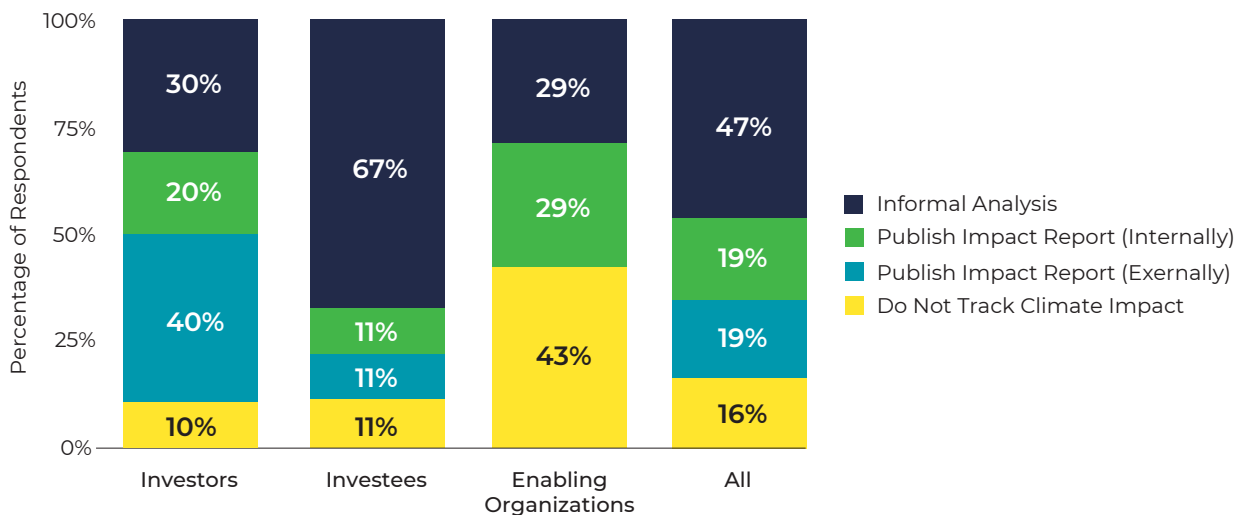


Figure 6 shows the percentage of organizations (by user type) that regularly track, audit, or otherwise assess its climate impact. Only a small percentage of the organizations do not track their climate impact at all (16%). Interestingly, Enabling Organizations demonstrated the least likelihood of tracking their impact. Of organizations that track their climate impact, only 22% of them publish the impact report publicly, and the majority only perform an informal analysis. Investors were the most likely to perform an impact analysis as well as publish that report publicly.

One interviewed Investee noted that they feel that life cycle assessments are not going away, so they are seeking to analyze the potential impact of their technology. However, in their experience, investors have not been asking for these impact analysis data points, and as such, they have not felt compelled to do a particularly rigorous analysis given the level of effort that it typically takes.

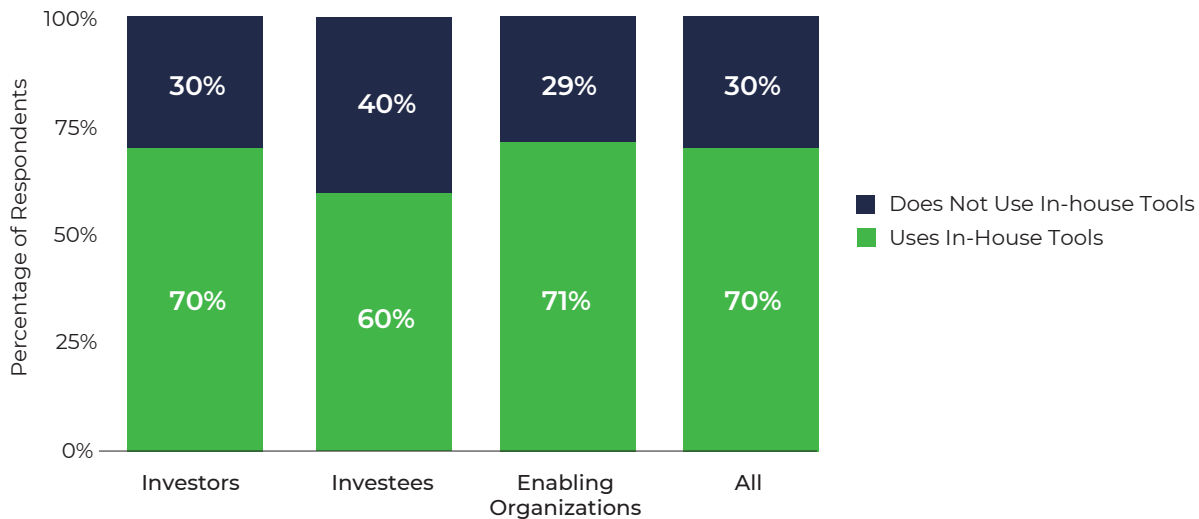
Figure 7. Type of Carbon Accounting Tools Used

Figure 7 depicts the type of carbon accounting tools used by each segment. The majority (70%) of the organizations use in-house carbon accounting tools in their carbon impact analysis. Whether or not an in-house tool is utilized in analysis is relatively consistent across user types, although investees were slightly less likely to use in-house tools.

By now, it should not be surprising that countless ad hoc approaches for climate impact tracking, carbon accounting, due diligence, and reporting have evolved. Almost three-quarters of the survey respondents reported that their organization had their own in-house carbon accounting tools that they use for impact measurement, particularly for Investors and Enabling Organizations (see Figure 7). There are active discussions at every level: from the esoteric questions about whether top-down versus bottom-up calculation approaches are best, to bigger questions about the value of estimating avoided emissions in the first place. The former is a case in point: the bottom-up calculation approach⁵ may better suit organizations evaluating a single technology, and who desire a ballpark estimate of their potential impact using familiar units (e.g. unit sales estimates).⁶ Other organizations, such as those within the Investors segment, look to identify whole sectors or “problem areas” that have potential to drive change, and that may include specific market or resource-related constraints. Either of these approaches may be valid, and 5-minute versus 5-hour versions of the same analysis each have an important role to play.

Upshot for CRANE

CRANE has become useful as a research tool that links to specific data and literature, and performs best when the intended use of the resulting analysis justifies at least a few hours of investigation. While it is generally not used directly for decision making, CRANE is being used to support knowledge building and reporting. It is most often used as a first or second step in evaluating the potential impact of a particular technology or cohort of technologies, or to produce preliminary estimates during due diligence processes (see Figure 8). Survey respondents have, for instance “[employed] CRANE for every investment in the impact due diligence” and to “[decide] who to put together for a Carbon X-Prize consortium.”

⁵ Summarized as $A \times B = C$, where A is the number of units of a product or service expected to be sold in the future, B is the impact per unit, and C is the total impact potential.

⁶ Clean Energy Ventures’ newly released [Simple Emissions Reduction Calculator \(SERC\)](#) does this well.

But some users have noted that the tool's outputs, while informative, are insufficient to carry them across the finish line. One survey respondent shared their experience, underscoring the depth of analysis they needed: "We used [CRANE] to estimate the impact of an energy saving window technology, but found that the [global] data it relied upon [was an inaccurate proxy for] certain regions of the world. The company we were evaluating created a bottom-up analysis from scratch in response." In another instance, a user noted that they were "hesitant to accept any tool, unless it's really transparent, and they can see all of the underlying data and assumptions ... that come into the results."

Figure 8. Current Uses of CRANE

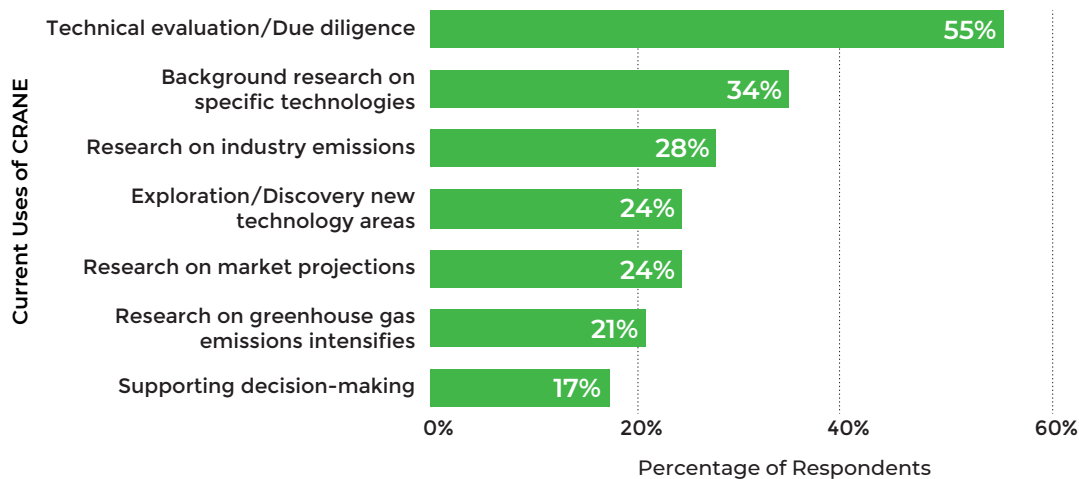


Figure 8 depicts how users have primarily employed the CRANE tool. Users were permitted to select up to three responses. While CRANE is typically not used to support decision making, it is often used (> 50%) in an organization's due diligence process in evaluating a technology or company.

The diversity of priorities, technical abilities, due diligence requirements, sector expertise, and success criteria means that, no matter what, a tremendous amount of work happens outside of CRANE. We should therefore focus research and software development on making CRANE more user friendly, especially in terms of how it integrates with existing workflows. For instance, we can make it simpler for users to investigate results and to share and export their data in familiar formats. In the same vein, we should endeavour to align with and communicate CRANE's relevance to well established standards, frameworks, metrics, guidance, and best practices, such as the GHG protocol, CDP, GRI, IIRC, the GIIN's IRIS+ catalogue of metrics, ISO 14000, SaSB, SBTi, the UN SDGs, TCFD, and others.⁷

"We used [CRANE] to estimate the impact of an energy saving window technology, but found that the [global] data it relied upon was [an inaccurate proxy for] certain regions of the world. The company we were evaluating created a bottom-up analysis from scratch in response."

—Survey Respondent

⁷ The GIIN's IRIS+ catalogue, in particular, seeks to centralize information on all standards and frameworks, and it is an enabling force for aligning decision making for investors and may be an enabling force in aligning decision making processes of other types of organizations.

3. Finding the right points of leverage is key.

The best impact models will illuminate where users can intervene based on their mission, expertise, time, and other resources.

It has already become a truism that all forward-looking impact estimates will be wrong, but the process of generating such estimates can still provide insight. It stands to reason that model mechanics and underlying assumptions are far easier to interrogate and validate than the projected outcomes themselves, and so it is unsurprising that many stakeholders are eager to quickly identify the key drivers of the results. Finding these drivers means that they can be tested for both accuracy and efficacy. In forward-looking impact estimation, such drivers could include the rate of technology adoption, choice of emissions scenario, anticipated performance of new technologies, changes in production cost, changes in policy,⁸ and supply chain innovations, among other considerations.

For example, while exploring CRANE, one respondent asks, “How is this curve getting generated? What specific strategies end up giving me [this result] ... I put a lot of time and thought into my [own research] assumptions and then justify them.” This exemplifies a trend in the feedback we have received: meaningful IMM, especially in the context of forward-looking analyses, requires a clear view into the background research and drivers of the final results, as well as the ability to plug into and toggle some of those drivers. These parameters may even sit outside the sphere of influence of the organization, which is itself an insight.

Besides evaluating the change in potential impact of key drivers, some organizations are also looking to drive additional change, in essence filling gaps in existing climate work — from the micro level of individual investments in otherwise overlooked technologies to the macro level of policies to spur investment in research and development programs addressing specific sectors. They also seek stable and formalized methods of understanding how second-order effects and “enabling” technologies should be evaluated.

CRANE

In practice

Finding the right points of leverage is a central element of the Catalyzed Emissions Reduction Framework (CERF) being developed by Breakthrough Energy and CDP. CERF uses CRANE’s ERP approach as one input to evaluate emissions avoided that are a consequence of early investment.

⁸Climate Interactive’s En-ROADS tool models global effects of policy changes and is an excellent place to learn about why the identification and incorporation of key drivers into climate impact modeling is so important.

Upshot for CRANE

CRANE highlights underlying assumptions that provide a range of results. It provides a high level overview of contributing drivers as well as illustrations on the sensitivity of the results to specific input variables, but could do more to demonstrate how and to what extent certain changes in the inputs affect the output. In other words, CRANE should provide advanced users with the ability to more quickly and clearly model interventions as well as the sensitivity of the results to those interventions.

While most users are satisfied with the level of documentation in CRANE, it is clear that many still feel there is room for improvement (as shown in Figure 9). CRANE provides a section in the results page with step-by-step documentation of the calculations to reach the final ERP for a single year of the analysis for users who desire a deeper understanding of the calculations. Further, as a part of the recently released Custom Technology module, CRANE now allows users to upload additional background notes to the technology model template. This gives users the ability to better document their underlying assumptions, data transformations, and references. CRANE provides examples and templates for these background notes as the first step toward streamlining and standardizing research and documentation methods.

Figure 9. Quality of CRANE's Documentation Standards

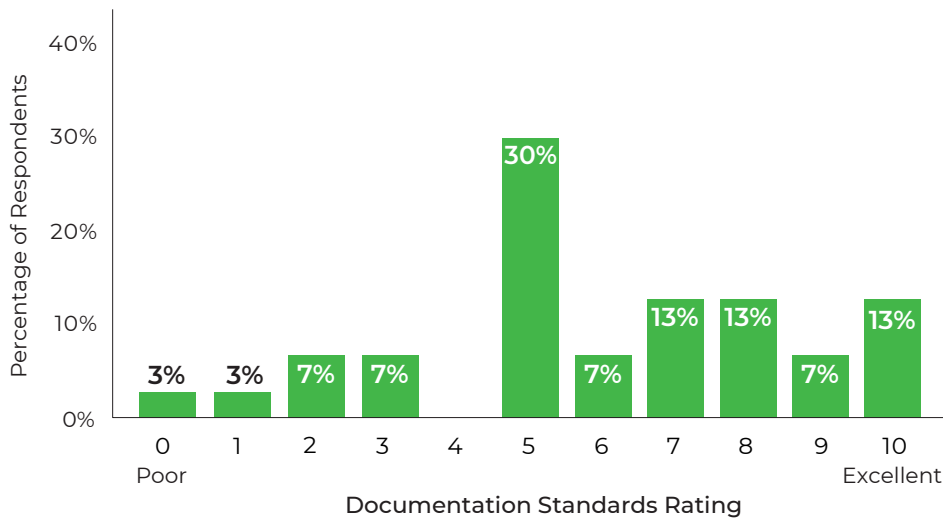


Figure 9 shows how users rate CRANE's documentation standards from poor (0) to excellent (10). CRANE's documentation was described to include reference/citation handling, calculation walkthrough, and line-of-site rules to original external data. The average rating of all respondents (6) was a little above average.

4. There is still no common language.

Multiple frameworks, metrics, standards, tools, requirements, and lexicons within and external to each organization present a major challenge.

Along with the variety of expertise and objectives, there exist multiple carbon accounting frameworks and in-house reporting requirements that all use unique terminology, particularly for forward-looking carbon accounting. In fact, the survey found that approximately three-quarters of respondents used their own in-house tools to assess forward-looking GHG impact potential (see Figure 7). One interviewee described, “[On the] Accelerator side of things - startups are doing their own analysis and they just receive those numbers - the accelerator doesn’t standardize reporting for portfolio companies.” One potential driver of this may be the fact that new funds are expected to last on the order of a decade, whereas many tools and standards may not last that long or are expected to lack backward compatibility. This is consistent with conversations we have had with other organizations that sought tools with standardizations around a methodology or analysis, but pursued an in-house method as a result of the sparsity of such tools. Figure 10 highlights the abundance of IMM lenses, and many of these approaches and standards have their own distinct taxonomy. This poses a challenge when sharing analyses to external entities and sharing lessons learned.

Figure 10. Commonly Used IMM Frameworks and Guidance

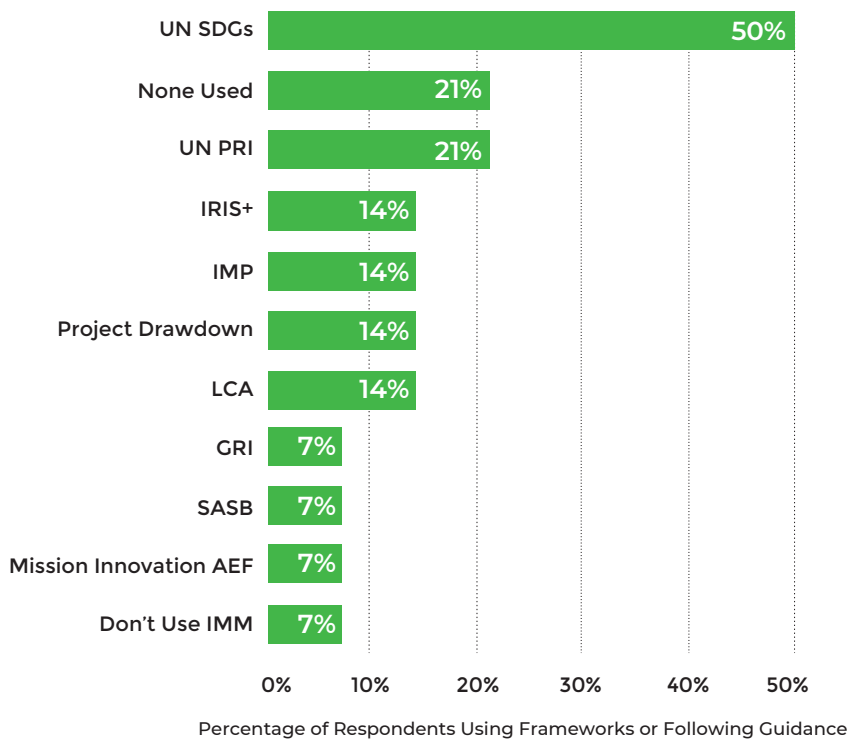


Figure 10 depicts the most common frameworks used and guidance followed. Each respondent was able to choose up to three tools. Approximately half of the respondents use the United Nations Sustainable Development Goals, but it is clear that there is a very broad spread of tools that are used. Acronyms: UN SDGs: [United Nations Sustainable Development Goals](#); UN PRI: [United Nations Principles for Responsible Investment](#); IRIS+: [IRIS Catalog of Metrics](#) or [IRIS+ Core Metrics Sets](#); IMP: [Impact Management Project](#); Project Drawdown: [Projection Drawdown Solutions Framework](#); LCA: [Life cycle assessment/analysis](#); GRI: [Global Reporting Initiative](#); SASB: [Sustainability Accounting Standards Board](#) (now the [Value Reporting Foundation](#)); Mission Innovation AEF: [Mission Innovation's Avoided Emissions Framework](#).

Upshot for CRANE

CRANE can help to establish a common language among different entities in the IMM space, especially as it applies to forward-looking carbon accounting. One of the specific goals of the CRANE glossary is to help rectify terminology differences so that the tool and analysis can be understood in the context of the broader field, and we are working with other organizations to help phase out some of the jargon. Where possible, CRANE will seek to demonstrate direct correspondence with other frameworks and standards. This may require additional certification work to validate across frameworks.

Furthermore, providing results using equivalencies (e.g. number of cars taken off the road, percentage of annual country or global carbon emissions) can help translate technical vocabulary into a more common vernacular and help many users gain perspective, provide needed context to aid with decision making, and better communicate results to less technical stakeholders. Lastly, we think a stronger presence of visuals and infographics instead of text will greatly enhance the user experience and utility of the tool at every stage of analysis.

5. We all have a lot to learn (and teach).

The outputs of any calculator aren't meaningful unless the inputs and intermediate computations are understood.

Given the variety of perspectives in the ESG and IMM spheres and adjacent communities, it is worth taking time to understand the many approaches to carbon accounting and impact measurement. There are major gaps in the existing professional educational resources, and an overall lack of fluency with respect to carbon accounting, the environmental effects of product life cycles, and catalogued landscapes of concepts, organizations and technologies.⁹ The learning curve is steep, the inconsistencies within taxonomies create confusion, and the lack of standardization of metrics, best practices, and even data formats creates genuine barriers to progress on climate change.

Upshot for CRANE

It is our goal that CRANE will exist not only as an analysis and research tool, but also as an educational tool to help bring individuals up to speed on understanding and performing emissions impact analysis. One survey respondent noted, "We are not a venture stage firm and so [we use CRANE] primarily for conceptual/learning purposes vs. as an investment decision input." We hope to continue improving this type of functionality within CRANE.

Figure 11. Incoming Message Requests

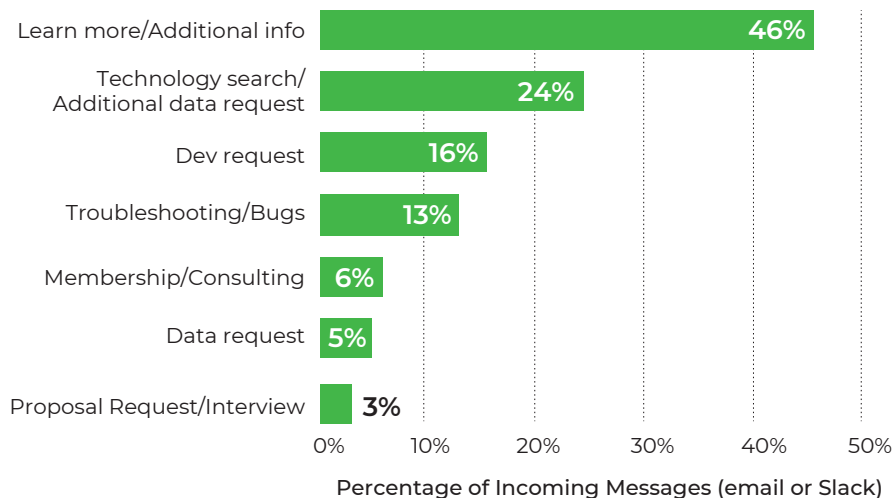


Figure 11 illustrates (as a percentage of the total) the general type of request of the incoming email or Slack messages. Messages were categorized as more than one type if applicable. Almost half of incoming messages requested additional information, typically as a demo or questions regarding how to get started using CRANE. The second most common inquiry was related to difficulties finding an appropriate technology template in CRANE or a request to build a new technology template for a specific technology.

The most frequent incoming messages we have received with respect to CRANE have been requests for additional information, demos, or learning materials, shown in Figure 11. Some users found the CRANE tool limiting because it was unclear where to start, and once they did, the analysis process and calculations were difficult to follow (see Figure 12). For example, one user, in an instance where they had hands-on support from the CRANE Fellows, noted that "it would be different if a venture were to go onto the [CRANE] site and do it themselves: [the ventures would] have a difficult time" with the analysis. Although CRANE currently provides tutorial videos and support documentation, it is clear that additional work is needed to communicate the analysis process and meet individuals where they sit.

⁹ Although there are exceptions, including The GIIN's [Navigating Impact](#) tool and [Climatescape](#).

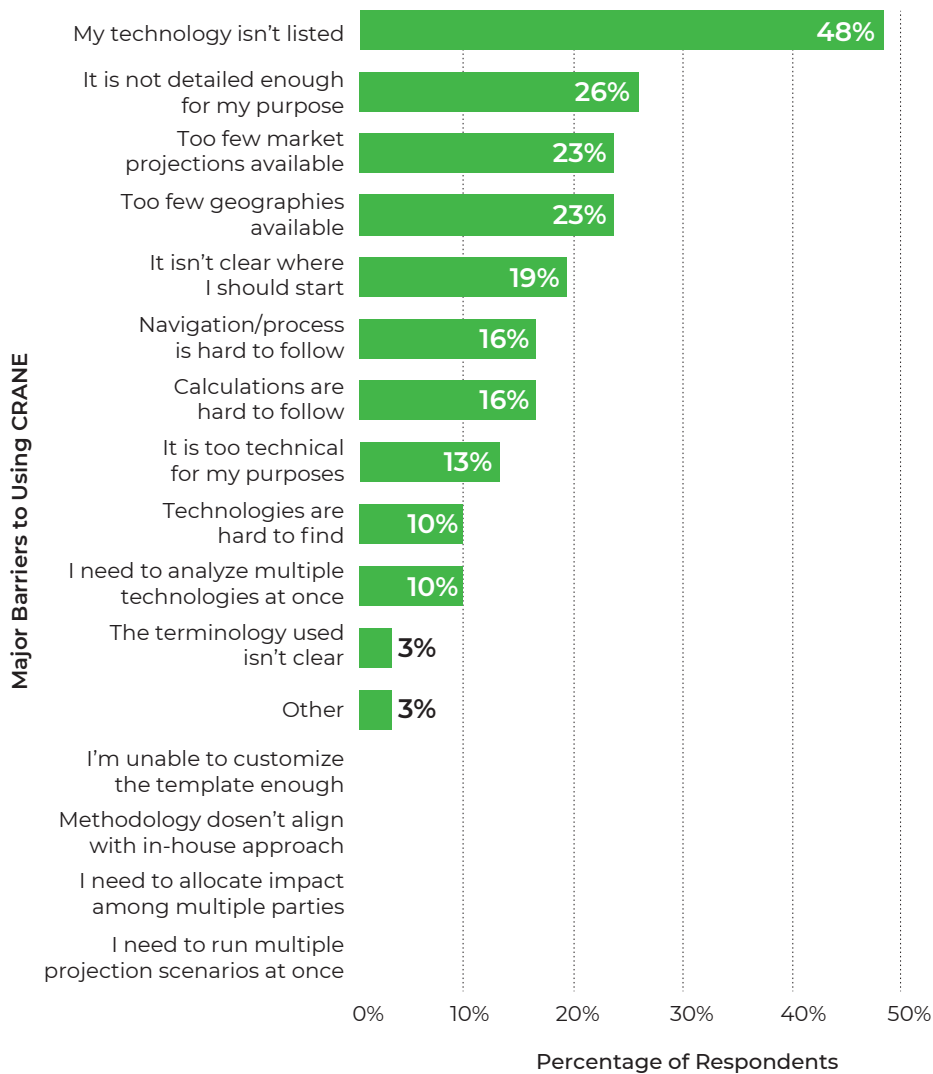
Figure 12. CRANE Limitations

Figure 12 depicts the most common challenges faced by users in order to use CRANE to create an impact analysis. Users could select up to three responses. The most commonly noted challenge (reported by 48% of the respondents) was not being able to find their technology in CRANE. Similarly, other common challenges included limitations of data such as too few geographies or market projections available. Another common challenge was difficulty in getting started using CRANE or difficulty following the methodology.

This user study is itself a way for CRANE to listen to and learn from our users and the wider community, and we hope that it will energize the dialogue we already see occurring. We have taken and will continue to take the lessons to heart, and they are already defining the direction of CRANE development. For instance, we have initiated monthly webinars to educate our users about the tool and better understand their needs. We will also look to develop the tool to meet users at varying levels of expertise by tailoring how much assistance and customization the tool allows. Lastly, in addition to expanding the glossary, we intend to provide more documentation around the methodology and code base.

6. Time is treasured.

Whether individuals expect to spend 40 minutes or 40 hours performing an ERP assessment, they are looking for tools that will save time and other resources without sacrificing quality.

Increasingly, countries are pledging to achieve net zero carbon emissions by 2050; however, many countries still lack the [roadmaps to get there](#). Organizations, meanwhile, are evaluating their own best course of action, and want to do so quickly. Whether initial assessments occur more quickly with a dedicated analyst or through CRANE depends, again, on the level of expertise available and the use case of the research itself. One estimate provided by a respondent was that CRANE is, in a sense, competing with an analyst who could provide investment insights within 90 minutes; other respondents say an initial estimate can take 20-40 person hours. In all cases, accessibility and clarity in the calculations as well as a user-friendly experience are essential.

Upshot for CRANE

Particularly for organizations that don't have an analytics team at their disposal, CRANE can help fill that role, i.e. providing content expertise in a digital space. One interview respondent said, "We're a small company ... I use it like I would use an analyst ... If we had an intern analyst on the team, I'd want them to be getting together all of the stuff that I [can now] get from the CRANE tool, because we can't afford an analyst." CRANE also helps to provide a standardized framework with consistent reporting formats and documentation.

Figure 13. User Activity

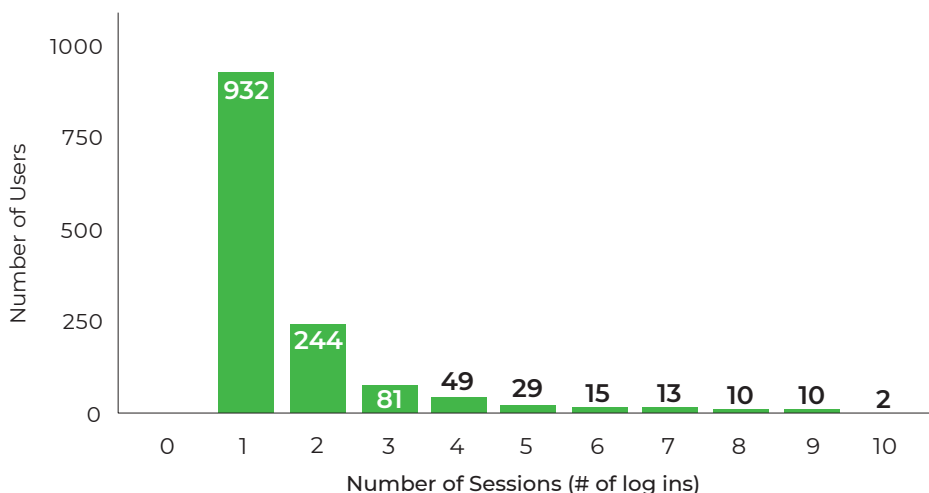


Figure 13 shows the number of times that each user has logged into the CRANE software (i.e. the number of sessions for each user). The majority of users have only logged into CRANE a single time, with an exponential decrease as the number of sessions increases. In some instances, a user may only need to use CRANE once to perform an analysis, but we expect these results are illustrative of users not returning to CRANE if their expectations and the tool are not aligned, whether as a result of understanding how to use the tool, not finding their sought after technology, etc.

CRANE

In practice

In support of the 2021 Mission from MaRS: Climate Impact Challenge, Rho AI worked with MaRS Discovery District to assess the emissions reduction potential of 36 Canada-based climate technology ventures. MaRS used the quantitative results of the ERP analyses as part of their scoring process and eventually selected a cohort of 10 Climate Champions, who collectively have the potential to mitigate, avoid, or remove 2.4 GtCO₂e by 2040, assuming 5% global market adoption.

"We're a small company...I use it like I would use an analyst...If we had an intern analyst on the team, I'd want them to be getting together all of the stuff that I [can now] get from the CRANE tool, because we can't afford an analyst."

—Interview Respondent

In an analysis of the average number of sessions per user (i.e. the average number of times a user logs into CRANE), it is apparent that over half of our users only attempt to use the tool on a single occasion (see Figure 13). In some instances, this may be all that is necessary to gather the necessary information, but we expect this is more reflective of users' inability to devote sufficient time to fully explore using the tool or overcome initial hurdles in the input process, such as identifying an appropriate technology model template. One user responded, "The customizations took more time than I had to give to it initially, [but] I hope to revisit soon." As discussed in previous sections, speaking the specific language of the user and meeting them at their starting point may improve these retention rates. Greater focus on user experience by gaining a deeper understanding of user abilities, workflows, time pressures, and intermediate goals, workflows, and desired outcomes will help to establish the CRANE software as a genuine time saver.

"The customizations took more time than I had to give to it initially, [but] I hope to revisit soon."

—Survey Respondent

7. Accountability is a top priority.

Clear accounting of credit and blame—and underlying rationales for assigning each—has become important across the board.

One of the more surprising takeaways from the feedback is that users now recognize accountability as the top priority, even over accuracy or clarity, in terms of guiding principles for the tool (see Figure 14). One of the main tenets of CRANE since its inception has been the desire to approach the challenges humbly, acknowledging that CRANE is not a crystal ball; the future is too uncertain. Instead, we describe the tool as an information resource and analytical aid to users who want to make better informed decisions despite uncertainty. Greenwashing and “greenwashing” are both real problems (Pucker, 2021), and should be prevented or otherwise phased out. We think that actionable insights into the decision making process itself (including documentation of data and core assumptions) can be a major driver of positive impact. It is encouraging that users demonstrate a similar understanding of the goals of forward-looking carbon accounting.

While the majority of survey respondents perform some degree of climate impact tracking, fewer than a quarter publish any public reports. One of the biggest barriers to publicly publishing these results is the potential for criticism if the forecasted emissions are in fact not achieved, along with a lack of reward for publicly asserting impact potential. We expect that continuing to emphasize accountability and transparency within the community will encourage more entities to measure and announce the impact potential of ventures as standardization around frameworks and assumptions continues to evolve.

Figure 14. Importance of CRANE Principles

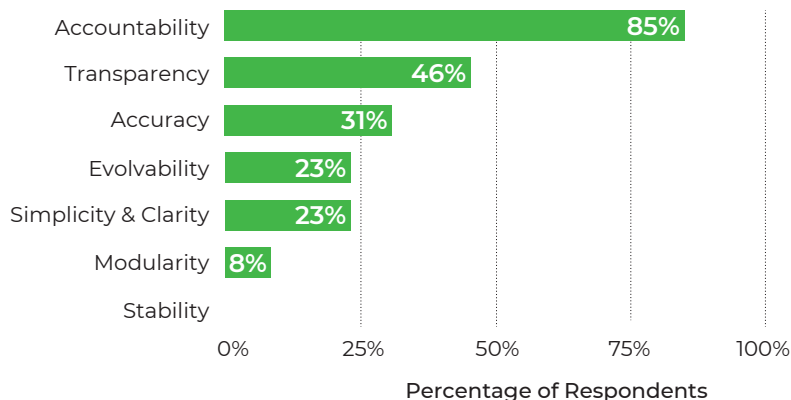


Figure 14 shows which driving principles of CRANE align most closely with their organization's driving principles. Users were permitted to make up to three selections. More than three-quarters of respondents identified with accountability as an important guiding principle. Interestingly, accountability and transparency were ranked as more important than accuracy.

Upshot for CRANE

CRANE strives to provide credibility to all of the results provided through a “line of sight” rule to all of the underlying data, i.e. ideally, users can trace results to the original references, including external studies and databases. It will be important going forward to continue to provide quality references for the underlying data. In conversations with our users, we have found that the citations to the underlying data, list of assumptions, and the step-by-step calculation references are consistently some of the most commended features of the CRANE tool. One user underscored its value, saying that “the data ... in the CRANE tool is always a useful starting point ... it’s always the first place I go.” This is consistent with the feedback received from the survey, shown in Figure 15.

Just as the software must be designed with each user segment in mind, the output must be tailored to different recipients, as organizations using CRANE may be accountable to a variety of external parties — government entities, investors, or the public.

As CRANE is still in its nascency, there exists some hesitation to adopt its use. Some of this reluctance may revolve around concerns for the longevity of the tool, and its ability to stay relevant and current. Updating the models with the latest market and emissions projections will be critical, as will securing long term support to ensure its ongoing maintenance and development of all public facing features.

As previously discussed, another area of improvement that we believe will support accountability and transparency is aligning CRANE with external standards, frameworks, and certifications. One survey respondent noted, “The board at my organization would have to approve [CRANE’s use] so finding ways to demonstrate [the tool’s] effectiveness [would be] helpful.”

CRANE

In practice

A former CRANE Research Fellow worked with the Chain Reaction Innovations program at the U.S. Department of Energy’s Argonne National Laboratory to evaluate the emissions reduction potential of several of their current and alumni startup companies. One challenge faced during the process was how to effectively demonstrate that CRANE’s ERP framework fit the Department of Energy’s own analytical and documentation standards for describing potential emissions reductions.

“The data..in the CRANE tool is always a useful starting point... it’s always the first place I go.”

—Interview Respondent

“The board at my organization would have to approve [CRANE’s use] so finding ways to demonstrate [the tool’s] effectiveness [would be] helpful.”

—Survey Respondent

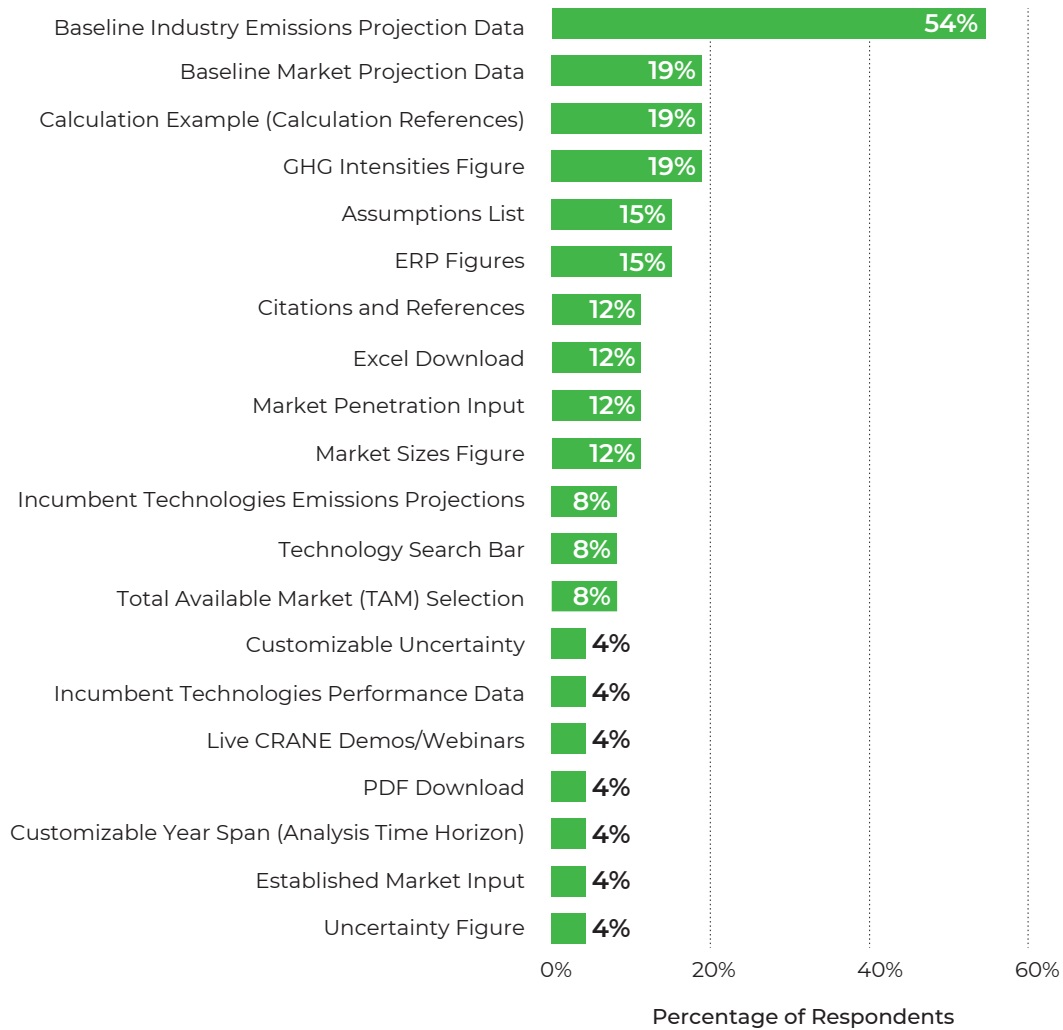
Figure 15. Most Valuable CRANE Features

Figure 15 depicts which CRANE features respondents found most valuable. Users were allowed to choose up to three features. Generally, data (including emissions and market projection data) were reported to be the most used features in CRANE. Illustrations or explanations of the calculation and results were also generally highly rated.

8. More data, please.

Everyone would like to see more technology models, more market and emissions data for more geographies — ideally in a standardized format and all in one place.

A typical forward-facing carbon impact assessment can require anywhere from ten to fifty unique data sources as well as data transformations, unit conversions, and intermediate calculations to create a cohesive and cogent analysis. Having access to more data, in a standardized format, with the right resolution, geographic scope, and clear units of measure, and which is instantly available for use within a compatible calculation framework, presents obvious advantages.

Figure 16. Most Requested Additional CRANE Features

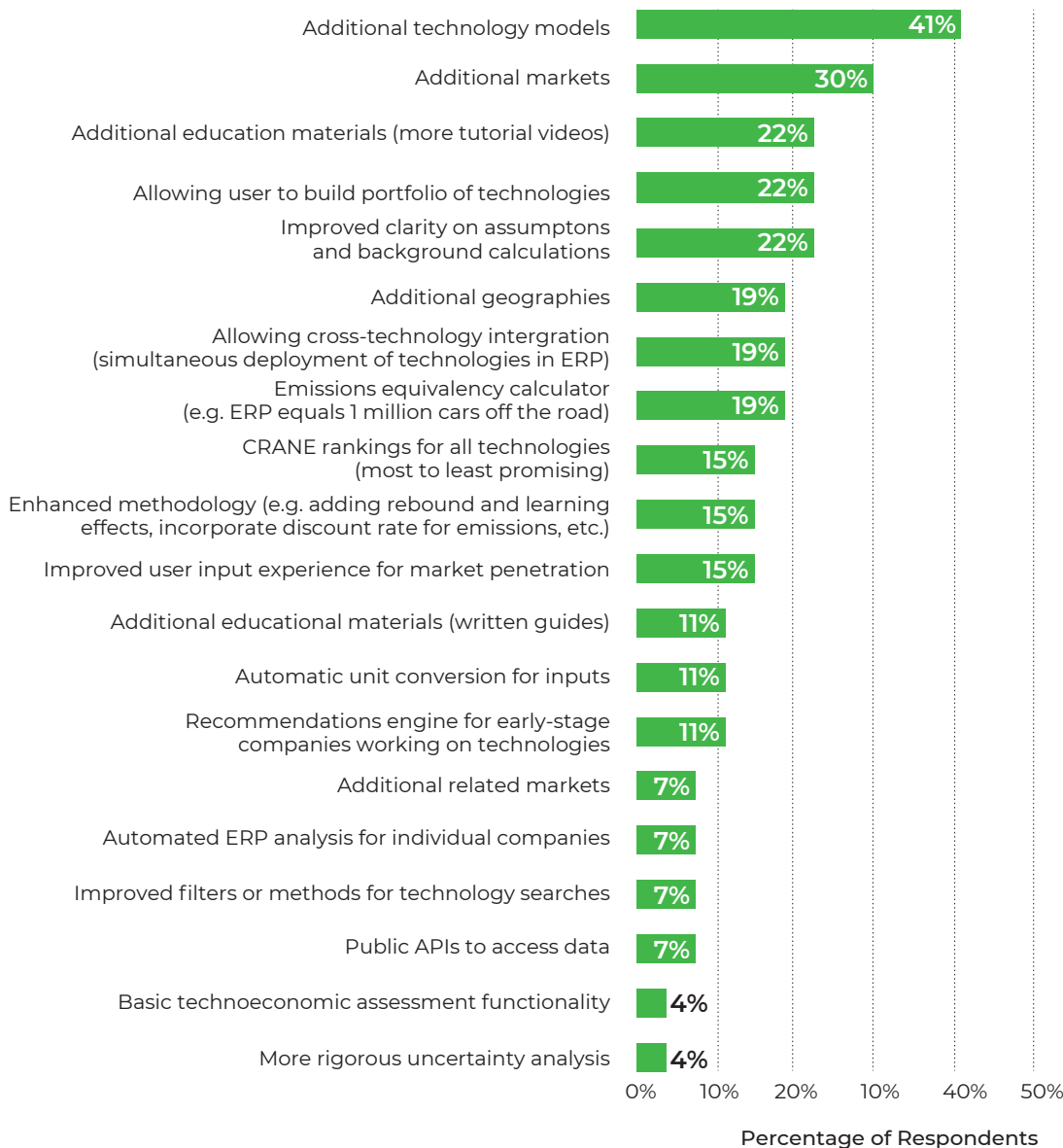


Figure 16 depicts which future CRANE features respondents would most like to see in the tool. Mirroring results from reported limitations of CRANE and common incoming requests, respondents requested additional data (in the form of technology models, additional markets, and additional geographies) as well as more education materials (e.g. additional tutorial videos and improved clarity on background calculations and assumptions) as most valuable.

Upshot for CRANE

Based on survey and interview responses, it is clear that CRANE users want more data available to support their analyses (see Figure 16). A common barrier to using CRANE is that a user “couldn’t specify closely enough in template form to our technology/geographic area.” Similarly, another survey respondent wrote that the CRANE “technology list was too restrictive to be useful to us.” Users are looking for more specific geographies, models that better reflect specific technologies they are working on, and more customizability. Ultimately, users are looking for ways to quickly integrate data into their own assessments. This includes data around geographies, market projections, and sector emissions scenarios, with users noting that “the geography, although it is an option ... [CRANE] usually doesn’t have specific data for different countries [or regions], like the ... EU and China.” Other users saw the missing technology as an opportunity, requesting to work with the Rho AI team to integrate their own technology into available modules.

The data available in CRANE only scratches the surface of what our users often need in order to generate forward-facing emissions estimates. However, CRANE has recently released the Custom Technology module, which allows users to create their own technology models to perform ERP analyses. This module guides the user on what data is required in order to perform an assessment, and the user can build off of existing models and data in the database. Users also have the ability to share their models publicly for the benefit of the community or keep them private if they contain proprietary data.

One request we have heard often in conversations with our users, but that was not included in the user survey, is a CRANE “library” of reliable sources of data across the different sectors that users can quickly reference. This is in line with the feedback from certain segments of users that they see CRANE primarily as an information resource and a stepping stone to a more in-depth impact analysis. This resource is a natural progression from the existing reference information that CRANE includes in each analysis. We have also begun investigating the feasibility of providing indicators of the quality of certain resources based on machine learning modeling techniques or existing quality standards. We hope these features will guide users toward “best-in-class” data quickly, even if that data is not currently available in existing CRANE models.

Survey responses also suggest that an API or open sourcing part or all of the development would facilitate integrating CRANE into other products. Conversely, CRANE could work with other entities to receive live data feeds where available. This would aid in the effort to keep CRANE’s data consistently up to date.

“couldn’t specify closely enough in template form to our technology/geographic area.”

—Survey Respondent

“technology list was too restrictive to be useful to us.”

—Survey Respondent

“the geography, although it is an option... [CRANE] usually doesn’t have specific data for different countries [or regions], like the...EU and China.”

—Interview Respondent

9. Modeling portfolio impact is messy.

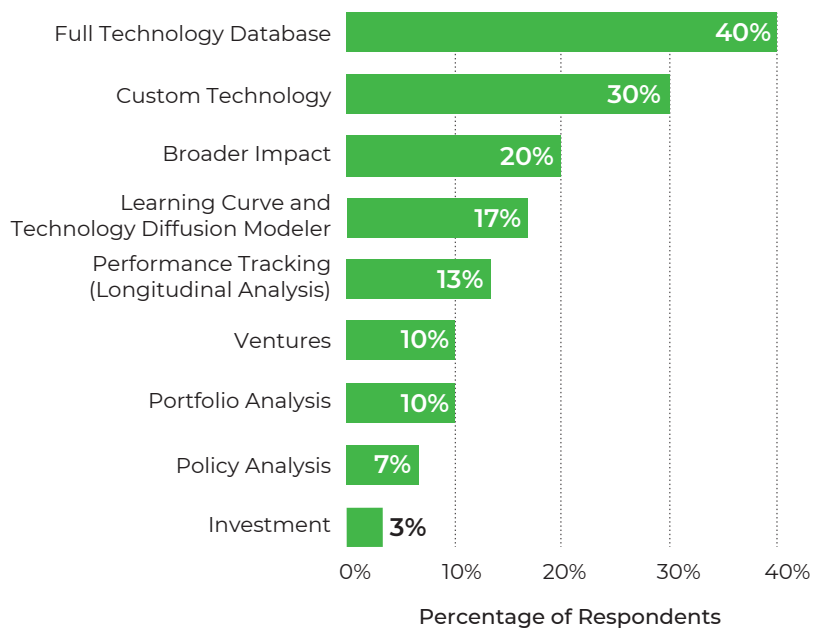
It is generally agreed that allocation of credit for positive impacts should be fair and that double counting should be avoided, but there are no widely accepted practices for how to do either.

Many of our users want the ability to assess emissions reduced as a result of concurrent deployment of multiple technologies, e.g. a portfolio of technologies. One respondent summed up this sentiment by saying that it would be great to “have some sort of portfolio analysis — theory of change and interrelation between technologies. First step would be this interrelation of technologies, and doing rough LCAs at the product level for startups they are assessing.” If we are to allocate credit for positive impacts (see Takeaway 7), such allocations should be fair, which implies that synergies between technologies should be identified and encouraged (e.g. clean power generation and better batteries) and double counting avoided. Cleanly demonstrating network effects and feedback loops in a quantitatively rigorous way becomes even more important (and challenging) when considering circular economy or cradle-to-cradle solutions.

Upshot for CRANE

One of the most requested modules for CRANE that we have heard in conversations with our users is Portfolio Analysis (although, interestingly, this was not reflected in the survey results, shown in Figure 17). Currently, users can assess a single technology at a time, and export the results to do more aggregate data analysis. This does not address issues for double counting across technologies and can be somewhat cumbersome. While we have consistently heard the request for a portfolio analysis tool that allows concurrent deployment of multiple technologies, a major challenge is that different users have different interpretations of what this would specifically entail and that they are not able to fully express the expectations for such a tool.

Figure 17. Most Requested Additional CRANE Modules



“It would be great to have some sort of portfolio analysis – theory of change and interrelation between technologies. First step would be this interrelation of technologies, and doing rough LCAs at the product level for startups they are assessing.”

—Interview Respondent

Figure 17 shows which CRANE modules users would like to see next. The majority of respondents requested a full technology database, reinforcing results from previous figures. A custom technology module was also highly requested, which was recently developed and released in CRANE (prior to the publication of this report, but following the user survey). Interestingly, a portfolio analysis module was not as highly requested, although in interviews and interactions with users, this has been one of the more commonly requested additions.

We have initiated preliminary concept design around a portfolio level tool, including assessing overlapping market displacement and allowing inputs and connections between technologies within the portfolio. Ultimately, we would like to enable a “drag and drop” approach to modeling the potential effects of new technologies on larger systems (e.g. markets and industries, corporate activities), so that portfolios more accurately reflect near term impacts and longer term potential impacts. Although the technical challenges are non-trivial, we speculate that multi-scenario modeling and “what-if” analyses for IMM would be far easier if such a thematic, visual language were developed and presented in interactive tools.

In the meantime, as we further assess the expectations around this development, users may be able to use the custom technology module to assemble a single model that represents an aggregate of their technologies

10. Net Zero 2.0 is here.

Net zero commitments are on the rise, but with few real plans for how to achieve them. Analysis of potential impacts can (and should) be used to set goal posts for measuring actual impact through time.

Impact planning is beginning to play a larger part in impact management and decision-making, and none too soon. In “The problem with zero carbon pledges,” the author quotes ClientEarth lawyer Daniel Wiseman, who sums it up in this way: “Unless [organizations’] targets are supported by strategies that are reasonable, transparent and include strong accountability mechanisms, there is a significant risk that stakeholders will be misled.” With respect to cutting or avoiding carbon emissions, Austin Whitman, CEO of Climate Neutral, succinctly provides the key questions we should all be asking: “how much, how soon, and how” (Vincent, 2020).

What this means is that, subsequent to understanding a technology’s potential at scale, many individuals seek to evaluate implications for their portfolio or company, and then desire to track their realized impact over time. In short, establishing an emissions projection for a technology is only one link in a much longer chain. The need for continuity between projection development and performance measurement exists whether the company has just received its first funding, or has already reached commercial scale.

Upshot for CRANE

While CRANE is not, at present, an impact management or direct decision making tool, its outputs can provide information that may influence user action. For analysts, CRANE outputs can be helpful in facilitating their day-to-day research to collate ERP intelligence. The ability to perform quick and standardized ERP assessments is valuable, but we also need to be able to compare present performance with projections and goals. One interview respondent commented that it would be great to have “functionality for portfolio companies to fill out and report back on their emissions realized – as each portfolio company grows, we don’t have as many people to support this increasing work.”

To better address the need for continuity and multiparty accountability through time, we plan to add a “tracking” feature to CRANE, i.e. longitudinal bookkeeping that enables a stable and cohesive cycle of improvement.

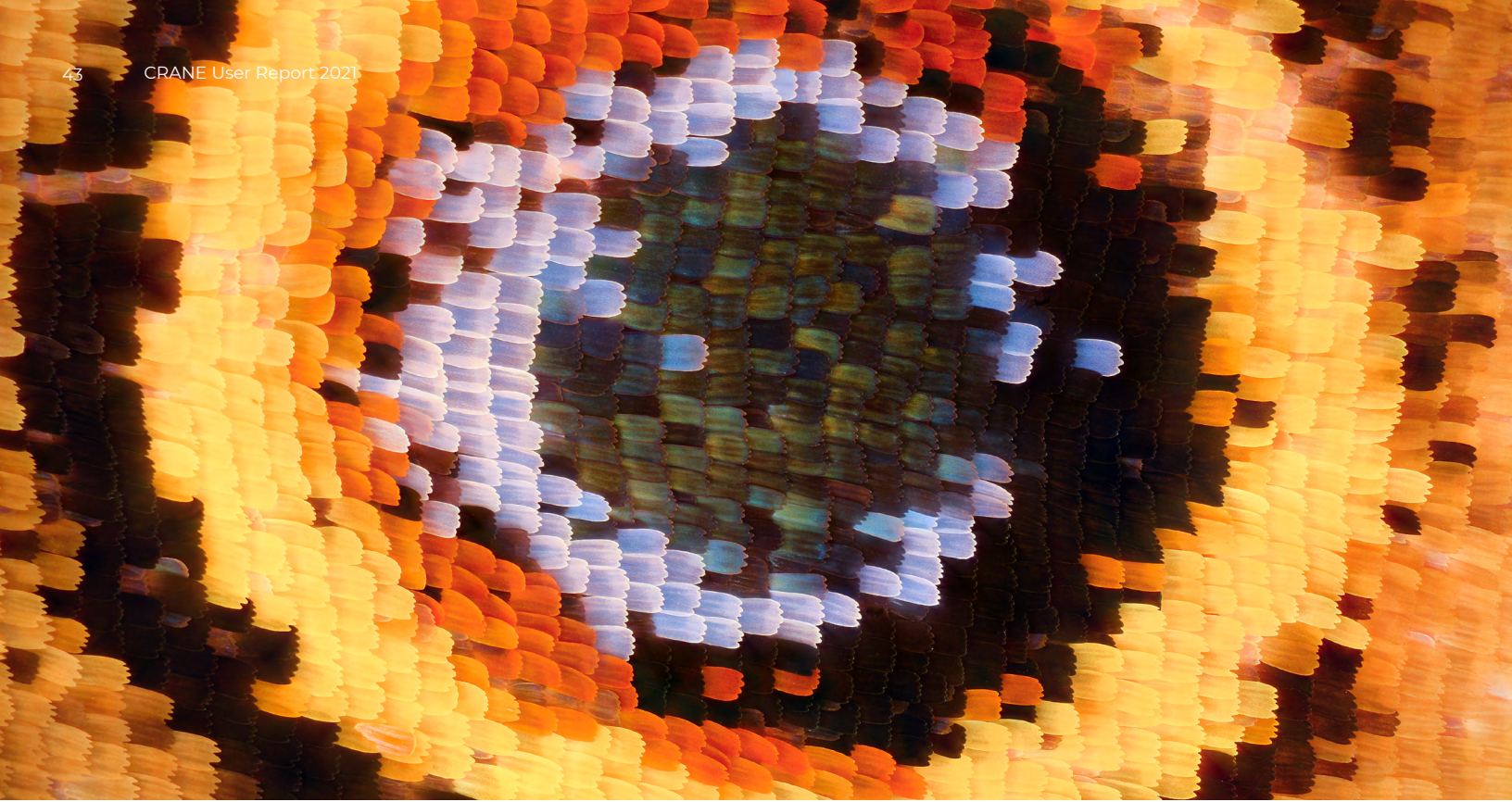
CRANE

In practice

Earlier this year, Prime Coalition released its inaugural impact audit (CEA, 2021), which offered a review of the organizations climate impact assessment tools and a proposed a methodology for future analysis. It suggests that CRANE should be used for more active management and decision making around IMM, and that there is a need to develop to a point where tracking of “emissions reductions realized” (ERR) is possible.

“It would be great to have functionality for portfolio companies to fill out and report back on their emissions realized – as each portfolio company grows, we don’t have as many people to support this increasing work.”

—Interview Respondent



Additional Insights

Diversity, Equity, and Inclusion (DEI)

Of the survey respondents, about a third (34%) came from women-led organizations (i.e. defined as having more than 50% of leadership roles occupied by women) and 6% are led by persons of color (i.e. defined as having more than 50% of leadership roles occupied by persons of color).

We also asked survey respondents if they would be willing to provide anonymous demographic data, either by providing open-ended, self-prioritized identity information, or by selecting from a predefined list of identity categories and responses. Figure 18 shows the percentages of respondents that were willing to provide this information. While there were too few responses to present significant DEI data, we have gathered at least two insights. First, since over half of the survey respondents were uninterested or unwilling to provide these data, we will consider moving this section to another place in the survey, or perhaps collect the information through a separate form entirely in order to mitigate the effects of survey fatigue. Second, we are encouraged by the fact that 18% of respondents were willing to provide their responses through an open-ended, self-prioritized format, which, in contrast to conventional demographics and DEI surveys, does not affirm predefined identities or response options. Future user studies will seek to make this section less onerous to complete, while continuing to respect the uniqueness and integrity of survey respondents as individuals.

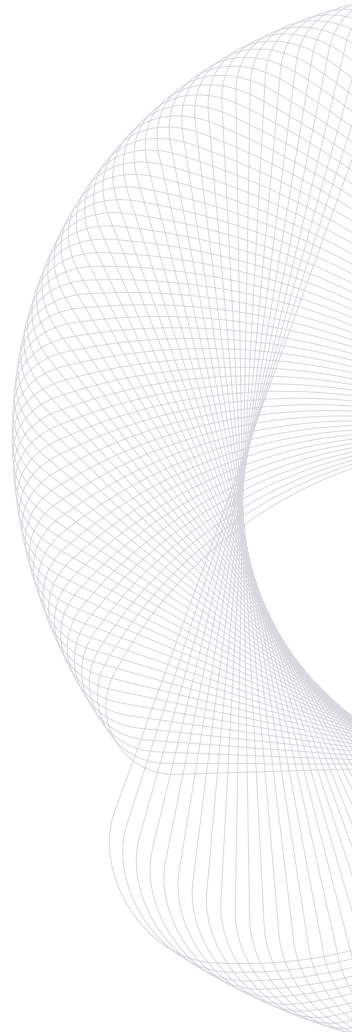


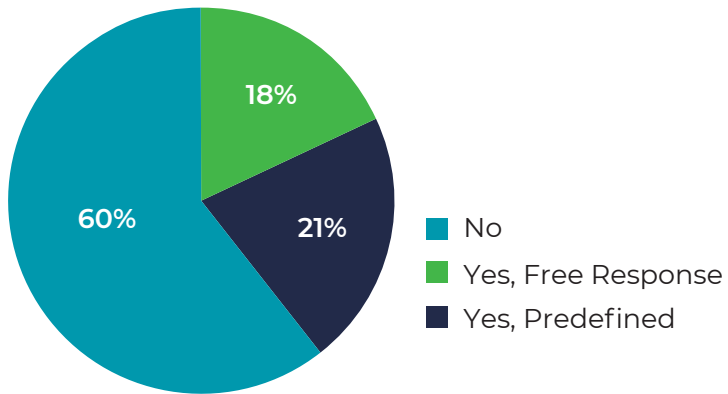
Figure 18. Response to Providing Demographic Information

Figure 18 depicts the percentage of respondents that were willing to provide anonymous demographic information. If users were willing to provide this information, they were given the options to select from categories or provide a free response. Specifically, the available responses were “Yes, I would like to provide some demographic data, and I do not need to refer to predetermined options,” “Yes, I would like to provide some demographic data, and I would like to be able to refer to predetermined options,” and “No, I prefer not to provide any demographic data.” The majority of respondents opted not to provide any demographic information, but it is unclear whether this is due to preference or a result of the length of the survey (as this was the final question). For respondents who were willing to provide this information, it was approximately evenly split between selecting from predefined categories versus providing an open-ended response.



Conclusion

In this inaugural CRANE User Report, we provide takeaways that have emerged from an analysis of survey data, a series of targeted interviews, and inbound messages and feedback we received from Investors, Investees, and individuals from a variety of Enabling Organizations. The overarching themes may be summarized as follows:

- **The set of challenges, needs, resources, and objectives are as varied as the set of stakeholders** (Takeaways 1-2).
- **Better data, enhanced analytics, and novel methodological approaches** are as sorely needed as ever (Takeaways 3, 8-9).
- **We should be encouraging a culture of collaboration, humility, urgency, and accountability** as we undertake impact innovation, investing, planning, measurement, and management (Takeaways 4-7).
- **Society is ready for a new kind of impact reporting** that focuses on positive and verifiable interventions and resulting outcomes rather than on paperwork (Takeaway 10).

Years after the CRANE project's start, we remain awestruck and humbled by the passion, dedication, creativity, and generosity of CRANE's users and supporters, and the wider impact community. And, fully cognizant of the enormity and diversity of challenges on the road ahead, we are encouraged by many of the trends we see in the impact space. For our part, we will continue to develop CRANE and related resources to help others build a better future.

References Cited

Burger, S., Systrom, N., & Kearney, S. (2017). Climate Impact Assessment for Early-Stage Ventures. PRIME Coalition. https://primecoalition.org/wp-content/uploads/2015/02/PRIME-NYSERDA-Climate-Impact-Assessment-Report_Final.pdf?x48191

CDP, CDSP, GRI, IIRC, SASB, Impact Management Project (IMP), World Economic Forum (WEF), & Deloitte. (2020). Statement of Intent to Work Together Towards Comprehensive Corporate Reporting. <https://29kjwb3armds2g3gi4lq2sx1-wpengine.netdna-ssl.com/wp-content/uploads/Statement-of-Intent-to-Work-Together-Towards-Comprehensive-Corporate-Reporting.pdf>

CEA, Dickie, A., Berger, M., & Roca Massana. (2021). Prime Coalition Inaugural Climate Impact Audit: A review of Prime Coalition's climate impact assessment tools and a methodology for future analysis. CEA Consulting. https://primecoalition.org/wp-content/uploads/2021/02/Prime-2020-Impact-Audit-long-report_final.pdf?x48191

Ceres. (2020, September 14). Climate Action 100+ calls for net-zero business strategies & sets out benchmark of largest corporate emitters. Ceres. <https://www.ceres.org/news-center/press-releases/climate-action-100-calls-net-zero-business-strategies-sets-out-benchmark>

Dewan, A. (2021, June 28). European Union enshrines net zero and emissions targets into law. CNN. <https://www.cnn.com/2021/06/28/europe/eu-climate-change-law-net-zero-intl/index.html>

Dinapoli, J. (2021, June 15). PwC planning to hire 100,000 over five years in major ESG push. Reuters. <https://www.reuters.com/business/sustainable-business/pwc-planning-hire-100000-over-five-years-major-esg-push-2021-06-15/>

European Council. (2021, June 28). Council adopts European climate law. <https://www.consilium.europa.eu/en/press/press-releases/2021/06/28/council-adopts-european-climate-law/>

Fancy, T. (2021, March 25). Opinion: BlackRock hired me to make sustainable investing mainstream. Now I realize it's a deadly distraction from the climate-change threat. <https://www.theglobeandmail.com/business/commentary/article-sustainable-investing-is-a-deadly-distraction-from-actually-averting/>

Foley, J. (2021, June 18). The World Needs Better Climate Pledges. Medium. <https://globalecoguy.org/the-world-needs-better-climate-pledges-4c3d969790d3>

Goldberg, J., Haya, B., Mitchell-Larson, E., Freeman, J., & Cullenward, D. (2021, January 5). RE: Comments on the Initial Recommendations of the Taskforce on Scaling Voluntary Carbon Markets (TSVCM). <http://bhaya.berkeley.edu/docs/CarbonDirect-CarbonPlan-BCTP-comments-on-TSVCM-draft-report.pdf>

Herren Lee, A. (2021, March 15). SEC.gov | Public Input Welcomed on Climate Change Disclosures. <https://www.sec.gov/news/public-statement/lee-climate-change-disclosures>

Holder, M. (2021, June 14). Carbon offset prices set to increase tenfold by 2030 | Greenbiz. <https://www.greenbiz.com/article/carbon-offset-prices-set-increase-tenfold-2030>

Makower, J. (2021, June 22). The net-zero backlash has arrived | Greenbiz. <https://www.greenbiz.com/article/net-zero-backlash-has-arrived>

Pucker, K. P. (2021, May 1). Overselling Sustainability Reporting. Harvard Business Review. <https://hbr.org/2021/05/overselling-sustainability-reporting>

Quinlivan, S. (2021, June 18). House Passes ESG Disclosure Simplification Act of 2021. JD Supra. <https://www.jdsupra.com/legalnews/house-passes-esg-disclosure-8479899/>

Rogelj, J., Shindell, D., Jiang, K., Fifita, S., Forster, P., Ginzburg, V., Handa, C., Kobayashi, S., Kriegler, E., Mundaca, L., Séférian, R., Vilariño, M. V., Calvin, K., Emmerling, J., Fuss, S., Gillett, N., He, C., Hertwich, E., Höglund-Isaksson, L., ... Schaeffer, R. (2018). Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. 82.

TSVCM, Adams, T., Winters, B., Nazareth, A., & Carney, M. (2021). Taskforce on Scaling Voluntary Carbon Markets: Final Report. https://www.iif.com/Portals/1/Files/TSVCM_Report.pdf

US SIF Foundation. (2020). Report on US Sustainable and Impact Investing Trends 2020. <https://www.ussif.org/files/Trends%20Report%202020%20Executive%20Summary.pdf>

ESG Disclosure Simplification Act, H. R. 1187, U.S. House of Representatives, 117th Congress, 1st Session (2021). <https://www.congress.gov/117/bills/hr1187/BILLS-117hr1187rh.xml>

Vincent, M. (2020, November 30). The problem with zero carbon pledges. Financial Times. <https://www.ft.com/content/83edfedd-77e7-4877-a016-b00b6b6d0307>



About PRIME

Prime Coalition (“Prime”) is a nonprofit organization focused on addressing the critical funding gap for transformative early-stage solutions to climate change. Prime’s unique model blends different forms of catalytic capital to support innovative technologies with potential to reduce or sequester greenhouse gas (“GHG”) emissions at the gigaton scale by 2050.

As of 2020, Prime employed staff at the nonprofit itself, as well as at Prime Management Company, a subsidiary that shares nonprofit status but focuses exclusively on investment of Prime Impact Fund (“PIF”). The nonprofit team focuses on running three nonprofit programs: 1) building and supporting Prime’s catalytic investments, 2) catalyzing climate investment broadly, and 3) sharing lessons learned about philanthropic investment. As part of Program 1, the Nonprofit Team is responsible for assessing climate impact and investment additionality for PIF during due diligence (pre-investment), while the Investment Team is responsible for driving portfolio companies toward climate impact (post-investment). As part of Program 2, nonprofit staff are responsible for welcoming investors outside Prime into the fold of climate impact measurement and management. Members of the Nonprofit Team and the Investment Team consider themselves part of one team, and although their functions and responsibilities are distinct, all drive toward mitigating climate change as the paramount end goal.

Since its inception in 2014, Prime has invested in 16 companies that, were it not for Prime, might not have been sufficiently funded to succeed at a scale necessary to contribute significantly to climate mitigation. Ten of these received investment through syndication from 2014 through 2018, and eight received investment through PIF, which closed at \$50 million in June 2020. Two companies received investments through both Prime’s syndication model and PIF. The companies cover a wide range of sectors including energy, cooling, transportation, industry, agriculture, and carbon capture.



About Rho AI

Rho AI’s mission is to harness the power of data science to propel projects with a positive world impact. Rho AI’s flagship venture is a real-time motorsports strategy software to predict competitor behavior and optimize decisions, known as PitRho. Their strategy tools have played a key role in key NASCAR wins and have shown the power of analytics in making real-time decisions. Rho AI has also been contracted to implement machine learning-based application and custom-built software in a broad range of industries including climate, energy, finance, healthcare, materials science, and more.

Rho AI is a growing company of data scientists, software engineers, and data analysts. They provide customizable products and services that allow companies and organizations to effectively obtain, organize, and utilize data, and have extensive experience developing and operating machine learning-based applications and custom-built software in production environments at scale.

ONE POINT FIVE

About One Point Five

OnePointFive (OPF) is a remote advisory firm working to democratize access to multidisciplinary sustainability experts with a focus on commercializing climate technologies, deploying climate finance, and providing bespoke sustainability services. Our vision is to accelerate solutions that enable businesses and the environment to coexist in harmony, ensuring global warming stays below OnePointFive degrees Celsius (1.5°C).

Since early 2020, OPF has been working to disrupt the traditional advisory model for accessing on-demand, cost-effective, and vetted sustainability experts. Covid has accelerated the future of work using remote technologies, and global business transitions to a “net-zero” and sustainable future will require increased access to sustainability talent. We provide customers with a centralized source of expert talent, expert insights, and productized services to meet their bespoke sustainability business needs.

Contact Us

Did we miss something? Please contact us!

We always appreciate feedback on CRANE, whether or not we’re conducting a user study. If you have additional thoughts, insights, or feedback for us, please don’t hesitate to contact us. You can reach the CRANE team by email at info@cranetool.org or through our Slack channel, which you can join on our landing page, www.cranetool.org. We also publish our backlog of technologies models [here](#). If you would like us to make additions, please let us know!

Appendix

Voices

Over 1,500 CRANE users were invited to participate in this study, including anyone who created an account for the CRANE tool, and who may or may not currently be using the tool. Of those invited, 33 respondents participated in a 45-minute interview, while 33 completed an online survey. The online survey included multiple choice and free response questions (see Table 3. User Survey Questionnaire). We further incorporated themes and insights from 63 incoming messages we received via our support email (info@cranetool.org), and additional messages received through our public Slack workspace.

Table A1 Counts from formal avenues of feedback for this report

Formal modes of feedback	Count
User interviews	33
User surveys	33
Incoming requests (via email and Slack)	63

Note: Other forms of feedback include software usage statistics and questions or comments emerging from live discussions with our users. The cumulative feedback used in this study came from roughly 120 distinct users (as there was some overlap between the incoming messages and the interview or survey responses), i.e. feedback from approximately 8% of CRANE's users (at the time the study was initiated) was included in the analysis.

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
1	No	32	All	What is your organization's name?	Free Response	
2	Yes	33	All	To what category would you say that you or your organization belong?	Multiple Choice	Investor Investee Enabling Organization Philanthropic investor/grant-maker Government investors/grant-maker Other
3	No	6	Investor	To what investor sub-category would you say that you or your organization belong?	Multiple Choice	Academic investment portfolio / University endowment Commercial Bank Corporations (as investor) Development Bank Early stage investor Growth / Late stage investor Investment Bank Investment manager Mid stage investor Multi-stage investor
4	No	9	Investee	To what investee sub-category would you say that you or your organization belong?	Multiple Choice	Corporation (as investee, e.g. R&D group) Entrepreneur Startup
5	No	7	Enabling Org	To what Enabling organization sub-category would you say that you or your organization belong?	Multiple Choice	Academic researcher/lab/institute Accelerator Advocacy group Climate impact research and reporting Government Incubator Insurance Management consulting Membership organization Reinsurance Think tank
6	Yes	32	All	In what country do you or your organization primarily operate?	Dropdown	
7	Yes	33	All	Is your organization led by women? (50% or more in leadership roles)	Yes / No	
8	Yes	33	All	Is your organization led by people of color? (50% or more black, indigenous or people of color in leadership roles)	Yes / No	
9	Yes	33	All	How much experience would you say that you or your organization has in terms of carbon accounting?	Opinion Scale	No Experience A Lot of Experience
10	Yes	33	All	...in terms of forward-looking carbon accounting?	Opinion Scale	No Experience A Lot of Experience
11	Yes	32	All	Does your organization regularly track, audit, or otherwise validate its climate impact (e.g. publishing a regular impact report)? If so, what form does this work take?	Multiple Choice	Publish impact report (publicly) Publish impact report (internally) Informal analysis
12	No	27	All	What is the cadence of your climate impact tracking?	Multiple Choice	Every year Every 1+ to 2 years Every 2+ to 5 years Every 5+ to 10 years

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
13	Yes	33	All	Does your organization use in-house tools (e.g. Excel-based calculators) to assess forward-looking GHG impact potential (aka. emissions reduction potential, avoided emissions)?	Yes / No	
14	No	8	Investees	Do you know what your technology's emissions reduction potential (ERP) is? If so, please provide the number in million metric tons CO ₂ e, as well as whether the value is annual or cumulative and the relevant analysis time horizon (e.g. 200 MMtCO ₂ e cumulative by 2040)	Free Response	
15	Yes	8	Investors, Philanthropic investors/grant-makers	What were your firm's total assets under management in (AUM) as of Jan 1 2021?	Multiple Choice	< USD 1 million USD 1 - 10 million USD 10 - 50 million USD 50 - 100 million USD 100 - 250 million USD 250 - 500 million USD 500 million - 1 billion > USD 1 billion
16	Yes	32	All	How likely are you to recommend CRANE to a colleague inside or outside your firm?	Opinion Scale	Would Not Recommend Would Recommend
17	Yes	32 (3 N/A)	All	How have you primarily been using CRANE? (Select up to 3)	Multiple Choice	Exploration / Discovering new technology areas Background research on specific technologies Research on market projections Research on industry emissions Research on greenhouse gas emissions intensities Technology evaluation / Due diligence Supporting decision making Other (Please specify)

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
18	Yes	32 (6 No Opinion)	All	What aspects of CRANE have you found to be most valuable? (Select up to 3)	Multiple Choice	Assumptions List Baseline Industry Emissions Projection Data Baseline Market Projection Data Calculation Example (Calculation References) Citations and References Customizable Uncertainty Customizable Year Span (Analysis Time Horizon) ERP Figures Established Market Input Excel Download GHG Intensities Figure Incumbent (Baseline, Conventional) Technologies Emissions Projections Incumbent (Baseline, Conventional) Technologies Performance Metric Data Live CRANE demos/webinars Market Penetration Input Market Sizes Figure PDF Download Performance Metrics (Figure of Merit) Input Save Solution Feature Secondary ERP (Related Market analysis) Sensitivity Figures Slack Community Target Market Selection Technology Descriptions Technology Filters Technology Search Bar Total Available Market (TAM) Selection Tutorial Videos Uncertainty Figure User Justification Input Other (Please specify)
19	Yes	32 (5 No Opinion)	All	What features or functionality in CRANE would you most like to see in the tool? (Select up to 5)	Multiple Choice	Additional educational materials (more tutorial videos) Additional educational materials (white paper or written guide) Additional geographies Additional language options Additional markets Additional related markets Additional technology models Allowing cross-technology integration (simultaneous deployment of technologies in ERP) Allowing users to build portfolio of technologies Automated ERP analysis for individual companies Automatic recommendation of CRANE technologies based on company information Automatic unit conversion for inputs Basic technoeconomic assessment functionality CRANE rankings for all technologies (most to least promising) Emissions equivalency calculator (e.g. ERP equals 1 million cars off the road) Enhanced application for additional platforms/locations (including mobile) Enhanced methodology (e.g. adding rebound and learning effects, incorporate discount rate for emissions, etc.) Improved clarity on assumptions and background calculations Improved filters or methods for technology searches Improved user input experience for market penetration Improved visualizations (PDF report, etc.) More rigorous uncertainty analysis Public API to access data Recommendation engine for early-stage companies working on technologies Refreshed/new data

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
20	Yes	32 (2 No Opinion)	All	What specific modules should we add next? Choose up to 2. (Note that the Custom Technology module will be released by early May 2021)	Multiple Choice	CRANE - Custom Technology Allow users to build a custom technology model and educate users on identifying appropriate data. CRANE - Ventures Streamline process of sourcing and evaluating new climate ventures, specific to individual companies/brands. CRANE - Full Technology Database Expand database into a comprehensive repository of impact information for emerging climate technologies. CRANE - Portfolio Analysis Build and assess entire portfolio of interacting technologies or companies. CRANE - Policy Analysis Assess impact of potential State and Country policies on emissions reductions. CRANE - Broader Impact Develop application for additional areas of impact (e.g. water, land, health) and integrate into systems-level analysis of impact in broader terms. CRANE - Longitudinal Analysis Allow users to track company progress on impact metrics over years and compare against projections CRANE – Investment Transparent analysis and allotment of credit for (or shares of) an emerging technology's ERP among investors based on scale and timing of investment CRANE – Learning Curve and Technology Diffusion Modeler Incorporating capacity, cost, diffusion coefficients, and other data to model market penetration (i.e. the s-curve) for a technology
21	No	32	All	Have there been any instances where CRANE was employed and influenced a key decision at your organization?	Yes/No	
22	No	4	All	In instances where CRANE has been used at your organization, to what extent would you say that it has influenced decision making?	Opinion Scale	None Significantly
23	No	27	All	Where in your typical workflow or decision making process do you find CRANE to be most useful?	Free Response	

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
24	No	2		Where in your typical workflow or decision making process do you find CRANE to be most useful? (Select up to 2)	Multiple Choice	Defining values Defining investing parameters Establishing risk tolerance Determining level of engagement Estimating level of return Establishing desire impact Deciding on investment approach Determining investment structure Building consensus with stakeholders Forming investment team Setting investment- and portfolio-level goals Establishing investment process Pre-investment impact evaluation Impact monitoring Impact auditing Other (Please specify)
25	No	28 (7 N/A)	All	Please describe how CRANE was employed and influenced a key decision at your organization.	Free Response	
26	No	30	All	To what extent would you say that CRANE and the ERP framework can help establish a cycle of improvement for the climate impact measurement and management (IMM) capabilities at your organization?	Opinion Scale	None Significantly
27	No	31	All	To what extent does CRANE allow your organization to make decisions that are fully optimized for GHG mitigation?	Opinion Scale	None Significantly
28	Yes	31	All	How would you rate CRANE's documentation standards (e.g. reference/citation handling, calculation walkthrough, line-of-site rules to original external data)	Opinion Scale	Poor Excellent
29	No	31	All	To what extent would you say that CRANE has enabled your firm to increase the pace of reducing global GHGs (either directly through your technology or indirectly through grants/investments)?	Opinion Scale	None Significantly

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
30	Yes	31	All	What are the major barriers you've identified in terms of being able to run CRANE analyses for your own purposes? (select up to 3)	Multiple Choice	It is too technical for my purposes My technology isn't listed Technologies are hard to find It is not detailed enough for my purposes Navigation/process is hard to follow Methodology doesn't align with our in-house approach Calculations are hard to follow I'm not able to customize the template enough to match my venture's situation Too few market projections available Too few geographies available It isn't clear where I should start The terminology used isn't clear I need to be able to analyze multiple technologies at once I need to be able to run multiple projection scenarios at once I need to be able to allocate impact among multiple parties, e.g. investors Other (Please specify)
31	No	26 (8 N/A)	All	Do you have suggestions to make CRANE more likely to be meaningful to your firm or otherwise more useful there?	Free Response	
32	No	25 (8 N/A)	All	What technologies should we add to our backlog?	Free Response	
33	No	32	All	Do you have time for additional questions?	Yes / No	
34	No	14	All	To what extent would you say that the CRANE assessment approach is intelligible and meaningful to multiple parties, including within your organization and with other organizations that you collaborate with?	Opinion Scale	Poor Excellent
35	Yes	14 (1 No Opinion)	All	Which of CRANE's driving principles would you describe as being most aligned with your organization's own driving principles? (Select up to 3)	Multiple Choice	Transparency Simplicity & Clarity Accountability Modularity Accuracy Stability Evolvability
36	No	14	All	What product or services does your organization primarily provide?	Multiple Choice	Construction Consulting Distribution and Supply Chain Financial Hardware Management Marketing Research Software Training Waste Management None Other: (specify)
37	Yes	5	Investors	Each year, how many companies sit at the start of your investment or grant pipeline?	Free Response	

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
38	No	5	Investors	How many investments or grants do you typically make per year?	Free Response	
39	No	3	Investees	How much funding has your organization received thus far? Feel free to round and please provide your answers in USD)	Free Response	
40	No	8	Investors, Philanthropic investors/grant-makers	At what point in your investment process do you see CRANE as being most helpful? (May select multiple.)	Multiple Choice	Market survey Early identification Selection Due diligence Negotiations Legal agreements Commitment Disbursements Monitoring & supervision Exit
41	No	14 (2 N/A)	All	What is the typical job title of the person or persons who work most directly and most regularly with CRANE at your organization? (select up to 2)	Multiple Choice	Administrator Advisor Asset Manager Assistant Professor Associate Associate Professor Board Member Consultant Contractor Coordinator Director Engineer Executive (CEO, CSO, President, Exec. Director) General Partner Intern Lecturer Limited Partner Manager Professor Research Assistant Researcher / Analyst Senior Researcher / Senior Analyst Specialist Technician Vice President Other (Please specify)
42	No	14 (2 N/A)	All	What is the typical job title of the person or persons who reviews the CRANE output report? (Select up to 2.)	Multiple Choice	Administrator Advisor Asset Manager Assistant Professor Associate Associate Professor Board Member Consultant Contractor Coordinator Director Engineer Executive (CEO, CSO, President, Exec. Director) General Partner Intern Lecturer Limited Partner Manager Professor Research Assistant Researcher / Analyst Senior Researcher / Senior Analyst Specialist Technician Vice President Other (Please specify)
43	No	1	Investors	Do you know the emissions reduction potential (ERP) for your entire portfolio of companies? If so, please provide the number in million metric tons CO ₂ e, as well as whether the value is annual or cumulative and the relevant analysis time horizon (e.g. 1,000 MMtCO ₂ e annually by 2050)	Free Response	

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
44	No	2	Investors	In 2020, what was the size of your typical investment or grant?	Free Response	
45	No	14	All	How many individuals at your organization use CRANE?	Free Response	
46	No	14 (3 N/A)	All	What impact measurement and management (IMM) tools does your organization use? (Please select up to 3)	Multiple Choice	N/A - No IMM frameworks or tools used United Nations Sustainable Development Goals (SDGs) IRIS Catalog of Metrics or IRIS+ Core Metrics Sets Impact Management Project (IMP) United Nations Principles for Responsible Investment (UNPRI) B Analytics / GIIRS Operating Principles for Impact Management Global Reporting Initiative Aeria CDFI rating system Sustainability Accounting Standards Board (SASB) Project Drawdown Solutions Framework Life cycle assessment / analysis (LCA) Mission Innovation's Avoided Emissions Framework Other (Please specify)
47	No	5 (1 N/A)		Where do these IMM frameworks and tools fit into your process? (Please select up to 3)	Multiple Choice	N/A - We don't use IMM Defining values Defining investing parameters Establishing risk tolerance Determining level of engagement Estimating level of return Establishing desired impact Deciding on investment approach Determining investment structure Building consensus with stakeholders Forming investment team Setting investment- and portfolio-level goals Establishing investment process Pre-investment impact evaluation Impact monitoring Impact auditing Other (Please specify)
48	No	8 (3 N/A)		Where do these IMM frameworks and tools fit into your process?	Free Response	
49	No	14	All	Have you joined the CRANE Slack community?	Yes / No	
50	Yes	33	All	Before you go, would you mind providing some optional, open-ended demographics data?	Multiple Choice	Yes, I would like to provide some demographic data, and I do not need to refer to predetermined options Yes, I would like to provide some demographic data, and I would like to be able to refer to predetermined options No, I prefer not to provide any demographic data

Table A2 User Survey Questionnaire

Question No.	Figure of Results	No. of Responses	User Segment	Question	Question Type	Available Responses
51	No	6	All	Either from among the following identity category examples or based on your own, please describe yourself. You may include as many or as few categories as you like. Descriptions may include as few or as many words as you like.	Free Response	Age, Race, Ethnicity, Gender, (Dis)ability, Level of education, Home geography, Military status, Employment status, Primary language, (Additional identity categories that you define)
52	No	7	All	Either from among the following identity category examples or based on your own, please describe yourself. You may include as few or as many categories as you like. Descriptions may include as few or as many words as you like.	Multiple Choice	Age Race -- Examples: American Indian, Alaskan Native, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Asian Race not elsewhere listed, Black, African American, Mexican, Mexican American, Chicano, Puerto Rican, Cuban, Native Hawaiian, Guamanian, Chamorro, Samoan, Pacific Islander not elsewhere listed, White, Race not elsewhere listed Ethnicity -- Examples: Hispanic or Latin(o/a/x), Not Hispanic or Latin(o/a/x) Gender -- Examples: Female (including transgender women), Male (including transgender men), Nonbinary, Genderqueer/genderfluid, Two Spirit, Gender not elsewhere listed (Dis)ability Level of education -- Examples: High School, Some college, College degree, Masters or equivalent, PhD or equivalent, Post doc, None apply Home geography Military status Employment status Primary language (Additional identity categories that you would like to share)
53	No	15 (1 Prefer not to answer)	All	Please indicate your annual household income in USD:	Multiple Choice	< \$10,000 per year \$10,000 to \$50,000 per year \$50,000 to \$100,000 per year \$100,000 to \$150,000 per year \$150,000 to \$250,000 per year \$250,000 to \$500,000 per year > \$500,000 per year Prefer not to answer

