Grant Agreement number: 101035716 – RACE – H2020-IBA-EIC-CLIMATE-2020

Project Number: 101035716
Project Acronym: RACE
Project title: Rapid Acceleration of Climate Entrepreneurs

MORSE:

REPORT ON THE GREENHOUSE GAS EMISSIONS REDUCTION POTENTIAL OF THE PILOT COHORT

Climate-KIC

Co-funded by the European Union

MORSE Report
Rapid Acceleration of Climate Entrepreneurs Programme

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The Rapid Acceleration of Climate Entrepreneurs, or RACE programme, was done in collaboration between EIT Climate-KIC and the European Innovation Council (EIC).

The purpose of RACE is to enhance Europe's innovation portfolios that support European Green Deal goals.

Please cite as:

Alvarez-Mendez, L., Van der Grinten, B., Lehtonen, S., Roehrer, C., Choueiri, Y. & Nikopoulos, A. (2023). MORSE: REPORT ON THE GREENHOUSE GAS EMISSIONS REDUCTION POTENTIAL OF THE PILOT COHORT. EIT Climate-KIC, The Netherlands.

Authors

Lia Montserrat Alvarez Mendez
Climate Impact Framework Lead, EIT Climate-KIC.

Bram van der Grinten
Director, Impact Forecast

Santeri Lehtonen
Climate Impact Expert, Lehtonen Sustainability Consulting

Editors

Christine Roehrer
EIC RACE Programme manager, EIT Climate-KIC

Alexandros Nikopoulos
Assistant manager, EIT Climate-KIC

Emily Amann
Project Manager, EIT Climate-KIC

Parisa Khoram
Project Manager, EIT Climate-KIC

MORSE stands for "Model of Regional Start-up Ecosystems"

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Introduction

In the current decade, impact investments assume a crucial role in facilitating the climate transition. An evaluation of the climate mitigation of innovations reveals that the potential for reducing greenhouse gas emissions in a single year may vary by a factor of 10 to 1000 among solutions. This begs the question: How can we consider the impact of start-ups on a longer time frame, in the interest of investment decisions, that maximise the positive climate mitigation of a portfolio of start-ups?

MORSE stands for Model of Regional Start-up Ecosystems and offers a way to model and visualise the climate mitigation of large numbers of impact innovations, to gain high-level impact insights to use in funding decisions, thematic focus or project goal setting. With validated climate impact forecastings, we can quantify the potential climate mitigation of a single innovation for one year. With MORSE, we aggregate these potential impacts for a group of innovations and project the impact into future years. The section below describes how this is done. The rest of this report draws insights from the MORSE results with the Rapid Acceleration of Climate Entrepreneurs (RACE) teams.

The goal of the MORSE tool is to investigate the potential future impact of a cohort of climate innovations, and how it depends on the impact of the solutions, the growth and the success or failure of their business. This report documents the outcomes of that process for the RACE cohort.

MORSE can help impact investors make better decisions.

In deciding where to invest, impact investors with a climate agenda select teams with technologies, business models and general solutions that reduce greenhouse gas (GHG) emissions. Most impact investors have a way to screen for the quality of climate mitigation. However, the problem often overlooked is that the reduction of GHG emissions is not a quality but a quantity. GHG emission reduction potential is not present or absent, but it is an amount that ranges from tonnes of CO2 equivalent to megatonnes (a million tonnes) of CO2 equivalent (CO_2eq).

In the context of economic return on investment, it may be evident that profitability is a quantity, not a quality. Return On Investment (ROI) is a metric used to evaluate potential investments to optimise the portfolio's return as a whole. The return would be suboptimal if ROI was a yes/no metric (is it profitable?).

The question answered by using the MORSE model is: What is the potential future impact of the RACE cohort of climate innovators, and what is the growth of their customer base and the success or failure of their business?

The MORSE tool was designed to consider the climate mitigation of start-ups in a 10-year time frame. These projections use the start-up's assessment of its future growth. That method is unsuitable for longer time frames and cohorts of start-ups because optimism bias is likely, the effect of small errors increases in a longer-projection time frame, and for both reasons, a zealous start-up could skew the results of the entire cohort. So instead of self-assessments, MORSE only uses validated results and generally applied (not start-up-specific) rules for growth and failure.

This design intends that programme managers and investors use MORSE to apply the growth and failure scenarios they deem likely, and discover the levers they have to maximise the climate mitigation impact of their portfolio. The levers are, in essence, the ability to select and support teams. By using MORSE, stakeholders can discover that selecting impactful start-ups in the portfolio is beneficial for the climate impact forecasting of the portfolio while selecting start-ups with almost no climate mitigation impact decreases the impact of the portfolio. In reality, those stakeholders prefer to outsource this discovery process. MORSE also demonstrates how a growing market share correlates with a growing climate impact, while the failure of a start-up implies that it cannot make an impact anymore. From this, we can deduce that start-ups with a high impact potential should be selected for the portfolio, and supported so they have a better chance to grow and succeed.

These conclusions might make intuitive sense, yet it is a notion that has yet to permeate throughout the impact investment landscape. MORSE is a way to make similar discoveries for other sets of start-ups, under different modelling regimes and with customisable assumptions about growth, failure, maturity and decline. Applying MORSE to the set of start-ups in RACE and comparing this to a 'best case' set of start-ups, we noticed that the programme could have had 20x more impact by selecting start-ups with demonstrable and significant climate impact. By comparing the investment made in these start-ups to alternative investments towards climate mitigation, we learned that the same funding could have resulted in much higher GHG emission reductions through less risky investments, e.g. in wind farms, or even Carbon Capture, Utilisation and Storage, which is one of the least cost-efficient ways to mitigate climate change.

MORSE report - reading guide

Set of start-ups describes the group of start-ups included in the dataset, how this group was assembled and which themes or subgroups they were divided into. This section also explains which impact data is used from the start-ups and how the climate impact data was sourced.

Invalid forecasts are self-assessments that a third-party impact expert found to be incomplete or containing insufficiently supported assumptions. In those cases, alternative (best and worst case) data is used from 150 recent, valid climate impact forecastings from outside of the RACE programme.

Growth and failure rate assumptions are used to project annual climate impact into future years. This section explains the growth rates and failure rates used in the projection, and how these were chosen.

Projected programme impact contains the MORSE results for the set of start-ups under these growth- and fail-rate assumptions. This gives a total projected climate impact for year N and a spread of simulation runs which gives a range of the total projected climate impact.

Climate Impacts per sector aggregates the climate mitigation impact per sector of the Climate Analysis Indicators Tool (CAIT) sector taxonomy. This shows the most impactful sectors, the start-ups active in these sectors and the gaps in project impact. The CAIT database is published by Climate Watch. 2022. Washington, DC: World Resources Institute. Available online at: https://www.climatewatchdata.org.

Scenarios of worst and best case replaces missing data with best-case and worst-case assumptions. This shows the sensitivity of the total impact of the group to the quality of impact forecasts per start-up.

Simulations of success and failure incorporate what-if scenarios on a start-up level showcasing how the overall climate impact of the project is sensitive to the success and failure of particular start-ups more than others.

Carbon abatement costs includes the investment assumptions, and combined with the climate impact range, calculates the carbon abatement cost per start-up. Carbon abatement costs can be used by start-ups that make the most climate mitigation impact with a given investment, and to compare climate impact innovation investments to conventional impact investments.

Actionable impact insights draw from the previous sections to conclude the ways to optimise the climate mitigation impact of projects.

Implementation of the Rapid Acceleration of Climate Entrepreneurship Programme

This programme, created by EIT Climate-KIC and the European Innovation Council, ran in four cohorts supporting **61 start-ups** to work with a Climate Impact Forecast Tool guided by expert support. The first cohort, or pilot, was delivered from **November 2021 to April 2022**, followed by two cohorts delivered from **February 2022 to April 2022**, and the final cohort delivered from March 2022 to May 2022. Each participant was offered a full-day workshop, individual coaching, a validation with climate impact projection and a certificate showcasing their climate mitigation impact.

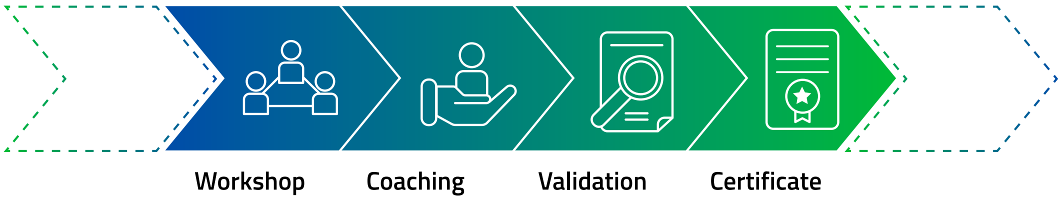

Figure 1: Implementation of RACE

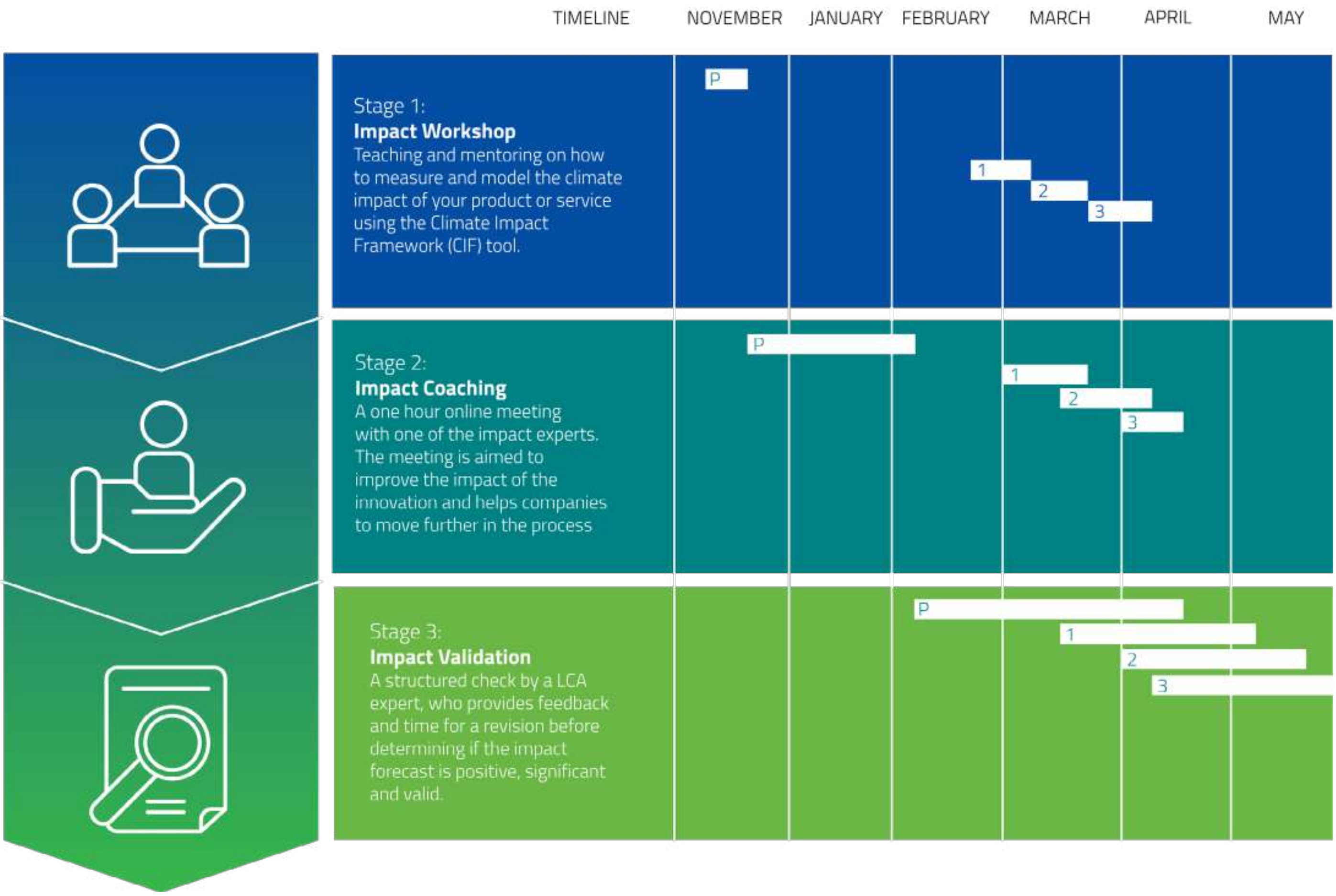

Figure 2: Implementation of RACE = planning

Set of Start-ups

This section describes the group of start-ups included in the dataset, how this group was assembled and which themes or subgroups they were divided into. This section also explains which climate impact data is used from the start-ups and how the climate impact data was sourced.

Of the 61 start-ups that participated in the programme, **46 completed the validation stage**.
They are listed in the table below and appear in alphabetical order.

Selected start-ups: maturity, sector and region

Table 1: Selected, maturity, sector and region

#	Select	Start-up name	Maturity	Sector	Region
1	✓	**Abura**	Scaling	Energy	Italy
2	✓	**Afzelia**	Scaling	Manufacturing/Construction	France
3	–	**Alder**	Scaling	Energy	Netherlands
4	✓	**Angelique**	Scaling	Manufacturing/Construction	Germany and Belgium
5	–	**Antiaris**	Scaling	not selected	not selected
6	–	**Aspen**	Scaling	Agriculture	World
7	–	**Azobé**	Scaling	not selected	not selected
8	✓	**Beech**	Scaling	Other Fuel Combustion	Denmark
9	✓	**Black poplar**	Scaling	Transportation	Netherlands
10	–	**Bosse clair**	Scaling	Transportation	Spain
11	–	**Carapa**	Scaling	not selected	not selected
12	✓	**Chestnut**	Scaling	Agriculture	United Kingdom
13	✓	**Coromandel Ebony**	Scaling	not selected	not selected
14	✓	**Dabema**	Scaling	Manufacturing/Construction	France
15	✓	**Elm**	Scaling	Energy	France, Switzerland and India
16	✓	**Guaiacum wood**	Scaling	Other Fuel Combustion	Germany
17	✓	**Hickory**	Scaling	not selected	not selected
18	✓	**Horse chestnut**	Scaling	Electricity/Heat	Sweden
19	✓	**Incense cedar**	Scaling	Agriculture	Ireland
20	–	**Kauri**	Scaling	not selected	not selected
21	✓	**Koto**	Scaling	Industrial Processes	Finland
22	✓	**Linde**	Scaling	Other Fuel Combustion	France
23	✓	**Mahogany**	Scaling	Agriculture	Netherlands
24	–	**Massaranduba**	Scaling	not selected	not selected
25	–	**Meranti**	Scaling	Industrial Processes	South Africa and Chile
26	✓	**Mersawa**	Scaling	not selected	not selected
27	–	**Mountain ash**	Scaling	not selected	not selected
28	–	**Mubura**	Scaling	not selected	not selected
29	–	**Niangon**	Scaling	Transportation	Portugal
30	–	**Okan**	Scaling	not selected	not selected

31	–	**Olon**	Scaling	not selected	not selected
32	–	**Oregon Pine**	Scaling	not selected	not selected
33	✓	**Palissander**	Scaling	Industrial Processes	France
34	–	**Parasolier**	Scaling	Industrial Processes	Israel
35	✓	**Pitch Pine**	Scaling	Electricity/Heat	France
36	✓	**Pockwood**	Scaling	not selected	not selected
37	✓	**Purpleheart**	Scaling	Industrial Processes	France
38	✓	**Red oak**	Scaling	not selected	not selected
39	–	**Sapelli**	Scaling	not selected	not selected
40	✓	**Scots pine**	Scaling	Building	Israel
41	✓	**Spruce**	Scaling	Industrial Processes	Spain
42	✓	**Sycamore**	Scaling	Industrial Processes	Italy
43	✓	**Tiama**	Scaling	Industrial Processes	Netherlands
44	✓	**Walnut**	Scaling	Manufacturing/Construction	France
45	✓	**Wengé**	Scaling	Industrial Processes	Sweden
46	–	**Yellow pine**	Scaling	Transportation	Spain

Selected start-ups: 28 out of 46 start-ups are selected within MORSE and contribute to the total impact of this group. The 18 start-ups that are not selected did **not deliver a valid Climate Impact Forecast**. This is an exceptionally high degree of invalid results, and an indication that not all teams took the time or received enough incentive to assess their climate impact.

Maturity: This metric can have the values **Ideation**, **Prototyping**, **Launched**, **Scaling** and **Established**. These shift the growth and failure rates that are used by 0, 1, 2, 3 or 5 years respectively. For scaling start-ups, the rates are shifted by three years, which means that their **Year 1 growth is calculated by taking the assumption of how much start-ups grow in year 3**. This feature was requested to account for start-ups that already survived the uncertain first years. Because all start-ups in this set have the same level of maturity on this scale, this shift affects the cumulative impact of all start-ups but not the relative impact of each start-up.

Sector: The majority of start-ups have indicated in which sector they are active. The CAIT sector division from the World Resources Institute is applied and provides the impact of the sector as an upper boundary of the start-up's climate impact at scale. An upper boundary is an amount to which another variable is limited. Limiting the climate impact of a start-up to the impact of their sector means that this start-up cannot reduce more GHG emissions than the GHG emissions produced by their sector.

Region: The majority of start-ups indicated the region where they are active through the CAIT sectors, from which the climate impact of a sector is provided for each country.

Upper and lower boundaries of climate impact

In the table below the lower and upper boundaries of the impact of the selected start-ups are listed. The lower boundary is the Avoided Emission Potential (AEP) from year 1. The upper boundary can be set to the sector's impact, or the addressable part of this sector. The latter is chosen out of these two options.

In this context, the "upper boundary" refers to the maximum impact a start-up can have on climate mitigation. The two options for setting this upper boundary are:

- Setting the upper boundary equal to the total impact of the sector, which includes all of the impacts that the sector has, whether or not they are addressable by the start-up.
- Setting the upper boundary equal to the addressable part of the sector's impact, which includes only those impacts that can be addressed or mitigated through targeted interventions or actions.

The second option is preferred because it allows for a lower boundary which is closer to what is attainable by the start-up.

Table 2: Total addressable climate impact per sector

#	Start-up name	AEP Year 1 in t CO_2 eq	Sector and impact share data availability	Impact of sector	Addressable share	Impact share	Addressable impact
1	**Abura**	**-117**	Sector from start-up, share from start-up	329 130 000	1%	1%	32 913
2	**Afzelia**	**-7 600**	Sector from start-up, share from start-up	40 080 000	100%	5%	2 004 000
3	**Alder**	**-70**	Sector from start-up, share from start-up	153 680 000	10%	85%	13 062 800

4	**Angelique**	**-1 000**	Sector from start-up, share assumed	118 550 000	1%	1%	11 855
5	**Antiaris**	**-62**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
6	**Aspen**	**-21 000**	Sector from start-up, share from start-up	5 817 650 000	100%	100%	5 817 650 000
7	**Azobé**	**-0,74**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
8	**Beech**	**-469**	Sector assumed, share assumed	20 60 000	1%	1%	206
9	**Black poplar**	**-551 000**	Sector assumed, share assumed	30 830 000	1%	1%	3 083
10	**Bosse clair**	**-3 500**	Sector from start-up, share assumed	9 2310 000	1%	1%	9 231
11	**Carapa**	**-42**	Sector assumed, share assumed	2 5930 000	1%	1,00%	2 593
12	**Chestnut**	**-5,4**	Sector from start-up, share assumed	50 700 000	1%	1%	5 070
13	**Coromandel Ebony**	**-18**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
14	**Dabema**	**-1 700**	Sector from start-up, share from start-up	40 080 000	50%	100%	20 040 000
15	**Elm**	**-8 500**	Sector from start-up, share from start-up	2 771 220 000	15%	100%	415 683 000
16	**Guaiacum wood**	**-15 000**	Sector assumed, share assumed	17 520 000	1%	1%	1 752
17	**Hickory**	**-0,31**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
18	**Horse chestnut**	**-75 000**	Sector assumed, share assumed	8 610 000	1%	1 %	861
19	**Incense cedar**	**-2 600**	Sector from start-up, share from start-up	25 350 000	20%	80%	4 056 000
20	**Kauri**	**-9 100**	Sector assumed, share assumed	25 930 000	1%	1 %	2 593
21	**Koto**	**-121**	Sector from start-up, share from start-up	2 070 000	5%	70 %	72 450
22	**Linde**	**-94 000**	Sector assumed, share assumed	17 400 000	1%	1%	1 740
23	**Mahogany**	**-113**	Sector from start-up, share assumed	18 570 000	1%	1%	1 857
24	**Massaranduba**	**-24 000**	Sector assumed, share assumed	25 930 000	1%	1 %	2 593
25	**Meranti**	**-2 300**	Sector from start-up, share from start-up	26 510 000	20%	3%	159 060
26	**Mersawa**	**-8,5**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
27	**Mountain ash**	**-18 000**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
28	**Mubura**	**-526**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
29	**Niangon**	**-1 300 000**	Sector from start-up, share assumed	16 820 000	1%	1 %	1 682
30	**Okan**	**-455 000**	Sector assumed, share assumed	25 930 000	1%	1%	2 593

31	**Olon**	**-4 800**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
32	**Oregon Pine**	**-4 000 000**	Sector assumed, share from start-up	25 930 000	100%	70 %	18 151 000
33	**Palissander**	**-746**	Sector from start-up, share assumed	24 350 000	1%	1%	2 435
34	**Parasolier**	**-3 200**	Sector from start-up, share from start-up	14 640 000	20%	10 %	292 800
35	**Pitch Pine**	**-5 600**	Sector assumed, share assumed	61 750 000	1%	1%	6 175
36	**Pockwood**	**-0,000003**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
37	**Purpleheart**	**-75**	Sector assumed, share assumed	24 350 000	1%	1%	2 435
38	**Red oak**	**-6 500**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
39	**Sapelli**	**-10**	Sector assumed, share assumed	25 930 000	1%	1%	2 593
40	**Scots pine**	**-859**	Sector from start-up, share from start-up	670 000	15%	30%	30 150
41	**Spruce**	**-29**	Sector assumed, share assumed	18 450 000	1%	1%	1 845
42	**Sycamore**	**-4 600**	Sector from start-up, share from start-up	21 510 000	11%	60%	1 419 660
43	**Tiama**	**-89**	Sector assumed, share assumed	3 500 000	1%	1%	350
44	**Walnut**	**-4 300**	Sector assumed, share assumed	40 080 000	1%	1%	4 008
45	**Wengé**	**-50**	Sector from start-up, share assumed	2 480 000	1%	1%	248
46	**Yellow pine**	**-4,4**	Sector from start-up, share from start-up	92 310 000	70%	100%	64 617 000

AEP: Avoided Emission Potential or climate impact in tCO_2 eq at the current scale of each start-up.

Sector and impact share data availability: When the sector is not selected by the start-up, or there is no impact share provided, the upper boundary is made using conservative assumptions instead.

Impact of sector: The climate impact in tCO_2 eq of the sector and country that the start-up is active in.

Addressable share: The market share of the start-up relative to the selected sector. If no addressable share is provided, one per cent is assumed.

Addressable impact: The climate impact of the sector multipled by the addressable and impact share.

Impact share: The share of the impact in the addressable share of the selected sector that the start-up can reduce at scale. If no impact share is provided, one per cent is assumed.

"Addressable share" refers to the portion of the total market a particular start-up can realistically target or capture with its products or services. It is the start-up's maximum market share within a specific sector or industry.

When conducting an analysis or assessment of a start-up's climate impact, it is important to consider its addressable share to understand its relative impact within the larger sector.

If an addressable share is not provided or available, a default value of one per cent is assumed as a conservative estimate of the start-up's impact. This default value is used as a way of ensuring that the start-up's impact is not underestimated in the absence of specific information. Still, it is small enough not to overestimate it as well. A one per cent market share represents a relevant player in that market without assuming they are a dominating force in their market.

It is worth noting that this default value is a rough estimate and may not accurately reflect the true impact of a particular start-up. To get a more accurate picture of a start-up's impact, the start-ups were requested to provide their assessment of this variable. One per cent is used if the start-up did not fulfil that request.

Remarkable start-ups in the set

Black poplar stands out for having the highest validated AEP in year 1. They offer an Ethereum-based materials tracing system to help actors in the plastics supply chain increase their levels of recycling. In the forecast, they assume that they reach ten supply chain actors (plastic producers and recyclers) per year who recycle ten per cent % more than they do now -these are conservative assumptions. Black poplar owes their large climate impact to the fact that one plastic manufacturer or recycler processes hundreds of tonnes of plastic per year and that the climate impact of recycled plastics can be much lower than the same plastic from a virgin source. In the example of nylon, a widely used and easily recyclable plastic used in the forecast, the difference between virgin and recycled material emissions is around 3kg of CO_2 eq for a single kilogram of plastic.

Start-ups Linde and Horse chestnut **reported remarkably high impacts** and are defined in the RACE impact report as the "Impact Unicorns" in this set, along with Black poplar.

> Black poplar enables supply chain actors to trace materials and thereby increase recyclability with the help of a proprietary blockchain-based solution which maintains the chain of custody of material transactions and enables sharing of confidential information in a secure manner.
>
> Circular economy requires an unprecedented level of collaboration, trust and transparency among all industry players. An open standardised protocol for supply chain transparency is the foundation that start-ups need to build trust and move away from linear production to a circular one. Black poplar enables traceability and transparency in supply chains which leads to closing of material loops and hence reducing primary material production and waste. Our platform allows information exchange between participants in value chains while retaining the ability to fine-tune the amount of information disclosed.
>
> Linde makes hydrogen transportable through 'Hydrosil', a Liquid Hydrogen carrier replacing compressed Hydrogen.
>
> Transforming Hydrogen to Hydrosil requires 40 kWh/kgH2, while compressing Hydrogen requires around 2 kWh/kgH2. However the majority of the difference in climate impact is made by avoided transport. The impact of avoided transport of compressed gas is taken from the ADEME database at about 11 kgCO2eq reduced per ton kilometer.

Abura and Elm **stand out for addressing the most impactful sector: energy**. The energy sector is an important one to decarbonise because burning fossil fuels is the main driver of global warming. Elm is operating in more than one country, and international presence is guaranteed to increase any start-up's climate impact potential. Abura has the highest addressable impact share, because their addressable per centages are well above those of Elm.

On the other end of the scale, Pockwood and Chestnut **stand out for having the lowest impact potential** in the valid set. Chestnut makes fertiliser from nitrous oxide, which holds a significant impact potential asenormous amounts of fertilisers are used globally. But their total impact is calculated for seven tonnes of wheat- a small amount for a large industry. Chesnut demonstrates that the assumptions on the business scale also greatly influence the resulting climate impact forecasting.

Projection frame of 10 years

The projections in this report span up to Year 10. Year 1 is 2022, and Year 10 is 2032. For readability, years 6 to 9 are cropped out from tables.

Growth and failure rate assumptions

The assumptions are used to project annual climate impact into the impact of future years. This section explains the growth rates and failure rates used in the projection and how these were chosen.

Growth rates and limits

To calculate the climate impact of each start-up, their Avoided Emissions Potential in Year 1 is multiplied by a growth rate that can be different each year. Because of these European Union (EU)-based start-ups, growth rates from EU start-ups can be found in "Table 3: Impact × growth rate: Using Start-up growth rates EU maturity based, limited to addressable climate impact". The EU growth rates were extracted from IETP investors, pioneering impact investment group entirely dedicated to financing and supporting small and medium-sized enterprises (SMEs) and start-ups in Sub-Saharan Africa.

Settings for growth rates and limits

Rates: Start-up growth rates EU
Modify: Apply later growth rates to mature start-ups
Limits: Limit to addressable impact

Table 3: Growth rates

Year	1	2	3	4	5	6	7	8	9	10
Growth rate	20%	30%	60%	35%	30%	35%	35%	35%	35%	35%

This formula is used to calculate the impact of a start-up in any given year:

$$Scaled\ impact_{year\ N} = Scaled\ impact_{year\ N-1} \times (1 + Growth\ rate_{year\ N\ +\ Maturity\ modifier})$$

This formula represents a way to calculate the "scaled impact year" of a start-up in a given year N based on its previous year's scaled impact year (year N-1), along with the growth rate and maturity modifier for the current year.

Here is a breakdown of the components of the formula:

- **Scaled impact year N-1:** This represents the scaled impact year of the entity in the previous year (N-1). This is a measure of the entity's impact.
- **Growth rate year N:** This is the per centage increase in the entity's impact or success from the previous year to the current year (N-1 to N). A growth rate of 30 per cet means that the start-up grows by 30 per cent.
- **Maturity modifier:** This factor accounts for the entity's maturity or stage of development. As an entity matures, its growth rate may slow down, and its impact may become more stable or plateau. The maturity modifier adjusts for this by reducing the impact of the growth rate as the entity becomes more mature.
- **Scaled impact year N:** This is the final calculated value of the entity's scaled impact year in the current year N, based on the formula. This value reflects the entity's impact in the current year, considering its previous year's impact, growth rate, and maturity modifier.

Overall, the formula is a way to model the growth and maturity of an entity's climate impact over time and can be used to track the relative success of different entities in a given industry or market.

Which gives us the following results (Years 6 to 9 cropped).

Impact × growth rate

Using Start-up growth rates EU maturity based, limited to addressable climate impact

Table 4: Impact × growth rate: Using Start-up growth rates EU maturity based, limited to addressable climate impact

	Year	1	2	3	4	5	10
#	Total	-48 074	-65 588	-81 397	-99 691	-127 044	-483 077
1	Abura	-117	-187	-253	-329	-444	-1 989
2	Afzelia	-7 600	-12 160	-16 416	-21 341	-28 810	-129 185
4	Angelique	-1 000	-1 600	-2 160	-2 808	-3 791	-11 855
8	Beech	-206	-206	-206	-206	-206	-206

9	Black poplar	-3 083	-3 083	-3 083	-3 083	-3 083	-3 083
12	Chestnut	-5	-9	-12	-15	-20	-92
13	Coromandel Ebony	-18	-29	-39	-51	-68	-306
14	Dabema	-1 700	-2 720	-3 672	-4 774	-6 444	-28 897
15	Elm	-8 500	-13 600	-18 360	-23 868	-32 222	-144 484
16	Guaiacum wood	-1 752	-1 752	-1 752	-1752	-1 752	-1 752
17	Hickory	0	0	-1	-1	-1	-5
18	Horse chestnut	-861	-861	-861	-861	-861	-861
19	Incense cedar	-2 600	-4 160	-5 616	-7 301	-9 856	-44195
21	Koto	-121	-194	-261	-340	-459	-2 057
22	Linde	-1 740	-1 740	-1 740	-1 740	-1 740	-1 740
23	Mahogany	-113	-181	-244	-317	-428	-1 857
26	Mersawa	-9	-14	-18	-24	-32	-144
33	Palissander	-746	-1 194	-1 611	-2 095	-2 435	-2 435
35	Pitch Pine	-5 600	-6 175	-6 175	-6 175	-6 175	-6 175
36	Pockwood	0	0	0	0	0	0
37	Purpleheart	-75	-120	-162	-211	-284	-1 275
38	Red oak	-2 593	-2 593	-2 593	-2 593	-2 593	-2 593
40	Scots pine	-859	-1 374	-1 855	-2 412	-3 256	-14 601
41	Spruce	-29	-46	-63	-81	-110	-493
42	Sycamore	-4 600	-7 360	-9 936	-12 917	-17 438	-7 8191
43	Tiama	-89	-142	-192	-250	-337	-350
44	Walnut	-4 008	-4 008	-4 008	-4 008	-4 008	-4 008
45	Wengé	-50	-80	-108	-140	-190	-248

Failure rates and method

The impact times growth rate provides the climate impact for each year, only restrained by the addressable market share selected by the start-up. In reality, the climate impact is also restrained by the success of the start-up, which we can calculate by assuming a failure rate. One way to do this is in a probabilistic model which, given a 50% probability of failure, fails in half of the cases and succeeds in the other half. This method does not permit fractional failure; start-ups fail or succeed, and they cannot partially fail, which is why this is a discrete approach. The downside of a discrete, probabilistic approach is that the results depend on chance.Running the model gives a different result each time.

The average of many cases generated from a probabilistic model will have the same results since the approach does not permit for fractional failure. The divisible method uses the failure rate to calculate which fraction of an infinite set of start-ups has succeeded up to that year. In other words, we can calculate the average result from infinite probabilistic model runs, by briefly assuming that a single start-up is an infinitely divisible group of start-ups. This is the model chosen here.

The start-up failure EU rates (Table 5) have been provided by IETP investors.

Settings for failure rates and method

Method: Divisible: applying the maturity based failure rate to the scale of the start-up as if it were an infinitely divisible group
Rates: Start-up failure rates EU

Table 5: Failure rates

Year	1	2	3	4	5	6	7	8	9	10
Failure rate	50%	25%	15%	10%	5%	5%	5%	5%	5%	5%

This formula is used in the divisible method to convert the failure rate into a survival factor:

$$Survival_{year\ N} = Survival_{year\ N-1} \times (1 - Failure\ rate_{year\ N+Maturity\ modifier})$$

The divisible method is a statistical method (also used in reliability engineering) to estimate the probability of an item or system surviving over a certain period of time. Survival, in reality, is a binary property; yes/no, which is based on chance. The divisible method generates the average survival of all possible scenarios of chance. A survival of 0.8 means there is an 80 per cent probability that a start-up survived up to that point.

Here is a breakdown of the components of the formula:

- **Survival year N-1:** This represents the survival factor of the item or system in the previous year (N-1). The survival factor is the probability that the item or system will still be operational or functional at a given point in time.
- **Failure rate year N:** This is the probability that the item or system will fail in the current year N. The failure rate can be expressed as a per centage or a decimal.
- **Maturity modifier:** This is a factor that accounts for the entity's maturity or stage of development. As an entity matures, its rate of growth may slow down, and its impact may become more stable or plateau. The maturity modifier adjusts for this by reducing the climate impact of growth rate as the entity becomes more mature.
- **Survival year N:** This is the final calculated value of the survival factor in the current year N, based on the formula. This value reflects the probability that the start-up will still be operational or functional at a given point in time, taking into account its previous year's survival factor and maturity modifier.

Overall, the formula is a way to model the reliability and survival of a start-up over time,and can be used to estimate the probability of failure or the expected lifespan of the start-up.

Pass/ failure schedule

Applying Start-up failure rates EU using the maturity based divisible method

Table 6: Pass/ failure schedule: Applying Start-up failure rates EU using the maturity based divisible method

	Year	1	2	3	4	5	10
#	Average	1	0,9	0,85	0,8	0,76	0,57
1	Abura	1	0,9	0,85	0,8	0,76	0,57
2	Afzelia	1	0,9	0,85	0,8	0,76	0,57
4	Angelique	1	0,9	0,85	0,8	0,76	0,57
8	Beech	1	0,9	0,85	0,8	0,76	0,57
9	Black poplar	1	0,9	0,85	0,8	0,76	0,57
12	Chestnut	1	0,9	0,85	0,8	0,76	0,57
13	Coromandel Ebony	1	0,9	0,85	0,8	0,76	0,57
14	Dabema	1	0,9	0,85	0,8	0,76	0,57
15	Elm	1	0,9	0,85	0,8	0,76	0,57
16	Guaiacum wood	1	0,9	0,85	0,8	0,76	0,57
17	Hickory	1	0,9	0,85	0,8	0,76	0,57
18	Horse chestnut	1	0,9	0,85	0,8	0,76	0,57
19	Incense cedar	1	0,9	0,85	0,8	0,76	0,57
21	Koto	1	0,9	0,85	0,8	0,76	0,57
22	Linde	1	0,9	0,85	0,8	0,76	0,57
23	Mahogany	1	0,9	0,85	0,8	0,76	0,57
26	Mersawa	1	0,9	0,85	0,8	0,76	0,57
33	Palissander	1	0,9	0,85	0,8	0,76	0,57
35	Pitch Pine	1	0,9	0,85	0,8	0,76	0,57
36	Pockwood	1	0,9	0,85	0,8	0,76	0,57

37	**Purpleheart**	1	0,9	0,85	0,8	0,76	0,57
38	**Red oak**	1	0,9	0,85	0,8	0,76	0,57
40	**Scots pine**	1	0,9	0,85	0,8	0,76	0,57
41	**Spruce**	1	0,9	0,85	0,8	0,76	0,57
42	**Sycamore**	1	0,9	0,85	0,8	0,76	0,57
43	**Tiama**	1	0,9	0,85	0,8	0,76	0,57
44	**Walnut**	1	0,9	0,85	0,8	0,76	0,57
45	**Wengé**	1	0,9	0,85	0,8	0,76	0,57

Projected Programme Impact

Contains the MORSE results for the set of start-ups under these growths and fail rate assumptions. This gives a total projected climate impact for year N and a spread of simulation runs which gives a range to the total projected climate impact of the start-ups in the RACE programme.

Impact projected per start-up

Accounted in the year of production

When projecting climate impact, it is possible to account for most impact innovations needing some time to realise their GHG emission reductions. For example, a solar panel that displaces grid electricity uses a ~10-year life span to realise its GHG emission reductions. On the other hand, a brick with lower emissions than those on the market has already made its reductions when it it produced. In Life Cycle Assessment, it is uncommon to look at how impacts are distributed over time; the goal is to get the environmental impact of a product over its entire life. This lifetime impact (reduction) can be attributed to the start-up each time they make a product, even when the product takes a while to amass this impact. Because of this convention, impacts are accounted for in the year of production here. There is also no impact onset (period without impact preceding the product's use life). life).

Settings for impact projected per start-up

Impact period: Accounted in the year of production
Impact onset: None

The impact of a start-up in any given year can now be calculated with:

$$Projected\ impact_{year\ N} = Scaled\ impact_{year\ N} \times Survival_{year\ N}$$

This formula is used to calculate the projected impact of a start-up in a given year, taking into account its growth, maturity, and failure rates. This is how its outcome is calculated, using the two formulas we previously defined:

1) First, we calculate the scaled impact in year N using the formula:

- **Scaled impact in year N** = Scaled impact in year N-1 x (1 + Growth rate in year (N + Maturity modifier))

2) Next, we calculate the survival in Year N using the formula:

- **Survival in year N** = Survival in year N-1 x (1 - Failure rate in year (N + Maturity modifier))

3) Finally, we calculate the projected impact in year N by multiplying the scaled impact and survival factors:

- **Projected impact in year N** = Scaled impact in year N x Survival in year N

In summary, the formula "Projected impact in year N = Scaled impact in year N x Survival in year N" is a way to estimate the expected impact of an item, system, or start-up in a given year, by combining its growth, maturity, and failure rates.

Which gives us the following results (Years 6 to 9 cropped).

Projected impact, tCO_2eq

Accounted in the year of production

Table 7: Projected impact, tCO_2eq: Accounted in the year of production

	Year	1	2	3	4	5	10
#	**Total**	**-48 074**	**-59 029**	**-69 188**	**-79 753**	**-96 553**	**-275 354**
1	**Abura**	-117	-168	-215	-263	-337	-1 134
2	**Afzelia**	-7 600	-10 944	-13 954	-17 073	-21 896	-73 636
4	**Angelique**	-1 000	-1 440	-1 836	-2 246	-2 881	-6 757
8	**Beech**	-206	-185	-175	-165	-157	-117
9	**Black poplar**	-3 083	-2 775	-2 621	-2 466	-2 343	-1 757

12	Chestnut	-5	-8	-10	-12	-16	-52
13	Coromandel Ebony	-18	-26	-33	-40	-52	-174
14	Dabema	-17 00	-2 448	-3 121	-3 819	-4 898	-16 471
15	Elm	-8 500	-12 240	-15 606	-19 094	-24 489	-82 356
16	Guaiacum wood	-1 752	-1 577	-1 489	-1 402	-1 332	-999
17	Hickory	0	0	-1	-1	-1	-3
18	Horse chestnut	-861	-775	-732	-689	-654	-491
19	Incense cedar	-2 600	-3 744	-4 774	-5 841	-7 491	-25 191
21	Koto	-121	-174	-222	-272	-349	-1 172
22	Linde	-1 740	-1 566	-1 479	-1 392	-1 322	-992
23	Mahogany	-113	-163	-207	-254	-326	-1 058
26	Mersawa	-9	-12	-16	-19	-24	-82
33	Palissander	-746	-1 074	-1 370	-1 676	-1 851	-1 388
35	Pitch Pine	-5 600	-5 558	-5 249	-4 940	-4 693	-3 520
36	Pockwood	0	0	0	0	0	0
37	Purpleheart	-75	-108	-138	-168	-216	-727
38	Red oak	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
40	Scots pine	-859	-1 237	-1 577	-1 930	-2 475	-8 323
41	Spruce	-29	-42	-53	-65	-84	-281
42	Sycamore	-4 600	-6 624	-8 446	-10 333	-13 253	-44 569
43	Tiama	-89	-128	-163	-200	-256	-200
44	Walnut	-4 008	-3 607	-3 407	-3 206	-3 046	-2 285
45	Wengé	-50	-72	-92	-112	-144	-141

The total projected climate impact in Year 10 is -275 ktCO_2eq.

This is a GHG reduction potential similar in magnitude to 74 wind turbines running or the amount of carbon sequestered by 131,600 hectares of forest in a year. The cumulative total climate impact projected by year 10 is roughly 5.9 times higher at -1,62 MtCO_2eq.

Projection of the climate impact of 28 start-ups in tCO_2eq

Using start-up growth rates (EU maturity based) to their selected addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by start-up.

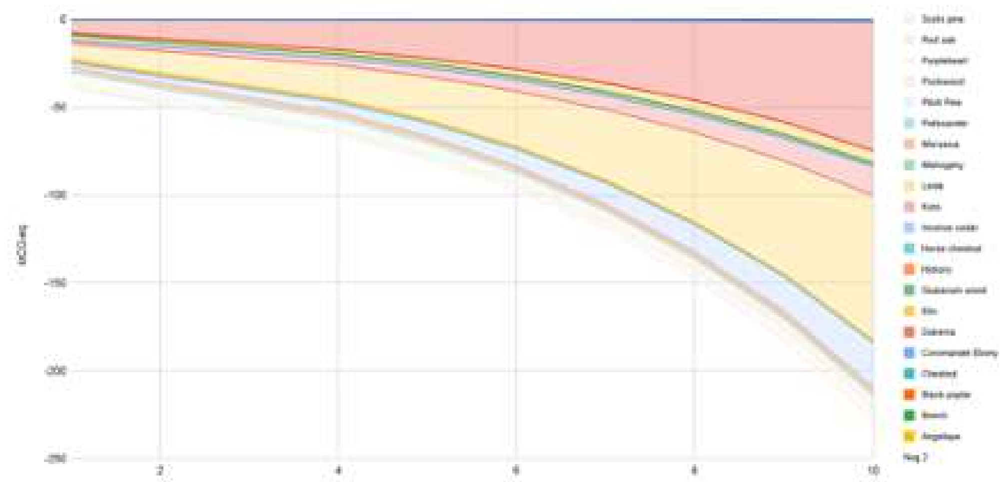

Figure 3: Projection of the climate impact of 28 start-ups in tCO_2eq Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by start-up.

Cumulative climate impact of 28 start-ups in tCO_2eq

Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by start-up, cumulative.

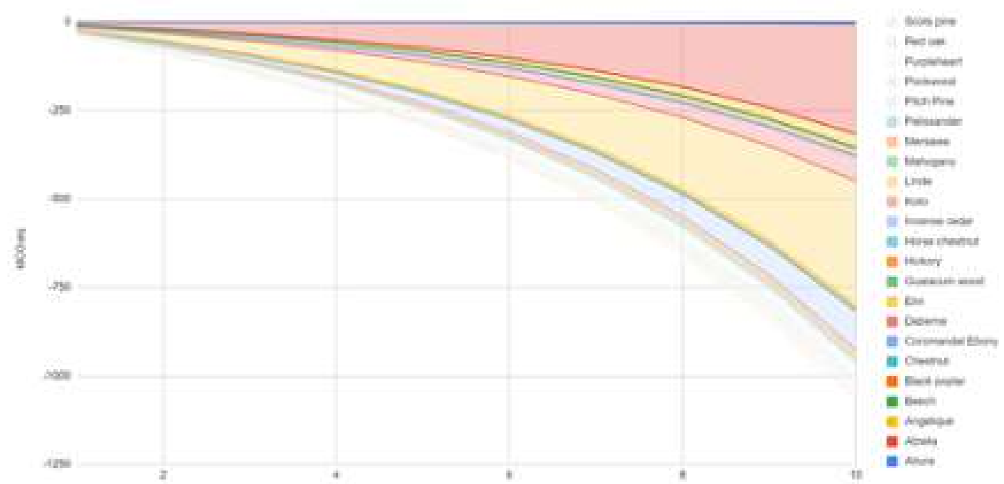

Figure 4: Projection of the climate impact of 28 start-ups in tCO_2eq. Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by start-up, cumulative.

Climate impact per sector

Aggregates the climate impact per sector of the CAIT sector taxonomy. This shows the most impactful sectors, the start-ups active in these sectors and the gaps in project impact.

Sectors from CAIT database with percentage of sector impact in total GHG emissions (inc LUCF)

Energy **73%**	**Energy sub-sectors**
Industrial Processes **6%**	Electricity/Heat **32%**
Agriculture **13%**	Manufacturing/ Construction **14%**
Waste **3%**	Transportation **13%**
Land-Use Change and Forestry **5%**	Other Fuel Combustion **9%**
Bunker Fuels **2%**	Fugitive Emissions **5%**

The CAIT database reports GHG emissions for 11 sectors and sub-sectors. Twelve start-ups are in the Energy sector, with a diversity of sub-sectors, mainly in Manufacturing/Construction and replacing Other Fuel Combustion. Seven teams are in Industrial Processes, four of which self-selected this sector and four were allocated it. Overall, 12 out of the 28 start-ups selected their own sector, and 11 did not make a selection and were allocated a sector based on information disclosed by the company previously. The sector could not be determined for five start-ups, and an average limit for addressable impact was used. The table in the “Set of Start-ups” section of this document shows these selections.

The projection of impacts per sector show that most of the climate impact is made in the other fuel combustion sector (44 per cent of climate impact in Year 10), followed by Energy with 24 per cent of climate impact by Year 10. However, other fuel combustion is a sub-sector of Energy, and in total Energy represents 99 per cent of the Year 10 company sectors, which aligns where the majority of emissions are (CAIT: 73 per cent of emissions in Energy).

CAIT: Country Greenhouse Gas Emissions Data | World Resources Institute (wri.org)

Projection of the climate impact of 28 start-ups in tCO_2eq

Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by sector.

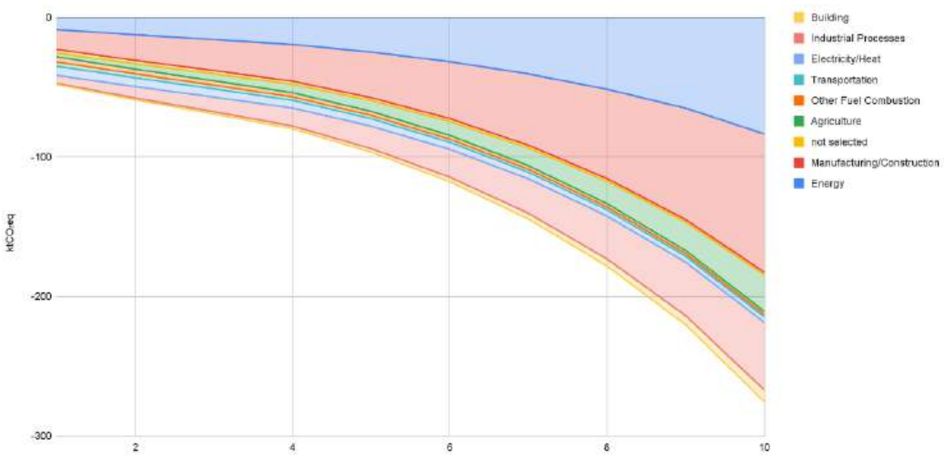

Figure 5: Projection of the climate impact of 28 start-ups in tCO_2 eq Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by sector.

Simulations of Success and Failure

Incorporate what-if scenarios on a company level, to simulate the effect of the uncertain faith of the start-ups.

In the base case, we used the divisible method which gives an average of all possible success and failure pathways of start-ups, but the downside is that the sensitivity of the total impact to the individual success of start-ups is removed. With the discrete method, start-ups either fail or succeed year on year, given the assumed failure rates:

$$Survival_{year\ N} = (Random_{0..1} < Failure\ rate_{year\ N+Maturity\ modifier}) \rightarrow 1 \wedge 0$$

This formula is a way to simulate the probability of an item, system, or company surviving in a given year based on its failure rate and maturity level. The sign ⟶ means 'then' and ^ denotes 'else', these are logic operators. ^ should not be confused with the similar sign ˄ which means 'to the power of'.

This is how this formula works:

- First, we calculate the sum of the failure rate in year N using the maturity modifier. This represents the probability that the company will fail in the given year.
- We then generate a random number between 0 and 1 using the "Random 0..1" function. This represents the element of chance in whether the company will survive or fail in the given year.
- If the random number is less than the calculated probability of failure, then the company is assumed to have failed in the given year, and its survival factor is set to 0.
- If the random number is greater than or equal to the calculated probability of failure, then the company is assumed to have survived in the given year, and its survival factor is set to 1.
- The formula uses the "1^0" expression at the end to ensure that the output is always either 0 or 1, representing whether the company has failed or survived in the given year.

In summary, this formula simulates the success or failure of a company in a given year based on its failure rate and maturity level, taking into account the element of chance through the use of a random number generator.

To see how pass/failure schedules can vary, here are two examples (cropped to 10 start-ups):

Pass/ failure schedule examples

Applying Start-up failure rates EU using the maturity based discrete method with $^1/_3$ decline period

Table 8: Pass/ failure schedule examples: Applying start-up failure rates EU using the maturity based discrete method with $^1/_3$ decline period, example 1

	Year	1	2	3	4	5	10
#	Average	1	0,95	0,9	0,9	0,9	0,74
1	Abura	1	1	1	1	1	1
2	Afzelia	1	1	1	1	1	1
4	Angelique	1	1	1	1	1	1
8	Beech	1	0,5				
9	Black poplar	1	1	1	1	1	1
12	Chestnut	1	1	1	1	1	1
13	Coromandel Ebony	1	1	1	1	1	1
14	Dabema	1	0,5				
15	Elm	1	1	1	0,67	0,34	
16	Guaiacum wood	1	1	1	1	1	

Table 9: Pass/ failure schedule examples: Applying start-up failure rates EU using the maturity based discrete method with $^1/_3$ decline period, example 2

	Year	1	2	3	4	5	10
#	Average	1	0,9	0,9	0,85	0,8	0,725
1	Abura	1	1	1	1	1	0,25
2	Afzelia	1	1	1	1	1	1
4	Angelique	1	1	1	1	1	1
8	Beech	1	1	1	1	1	1
9	Black poplar	1					
12	Chestnut	1	1	1	1	1	0,25
13	Coromandel Ebony	1	1	1	1	1	0,6
14	Dabema	1	1	1	1	1	1
15	Elm	1	1	1	1	1	1
16	Guaiacum wood	1	1	1	1	1	0,25

To be precise we are using the discrete method with a maturity modification, which means that all scaling start-ups are using the failure rates from three years ahead, and with a one-third decline period which means that in the last third of the company's life, its scale linearly declines to zero:

$$Survival_{year\ N,decline} = (N \leq Lifetime \times (1 - Period)) \rightarrow 1 \wedge Survival_{year\ N-1} - \frac{1}{1 + Lifetime \times Period}$$

This formula is used to calculate the survival rate of a company in a given year N, taking into account a decline period. Where:

- N is the year for which we are calculating the survival rate.
- Lifetime is the expected lifetime of the company.
- Period is the fraction of the lifetime over which the company is in decline.

Overall, the formula provides a way to estimate the fractional survival of a company in a given year, taking into account a decline period. This is how the calculation works:

- Start with the survival rate of the company in year N, denoted as "Survival year N", calculated for all years, e.g. with the discrete method. In the discrete method this value can be either 0 or 1, and this step ensures that a perished company (survival year N = 0) cannot be in decline anymore. From this survival for all years N, conclude the company Lifetime.
- Check if the current year N is in the decline period, which is calculated as "Lifetime x (1 - Period)"
- If the current year is below the decline period, then the result is 1, which indicates that the company is assumed to be in its growth phase and not subject to decline.
- If the current year is within the decline period, the second part of the formula (Survival year N-1/(1 + LifetimePeriod)) calculates the survival of year N based on the survival from the previous year, adjusted for the decline in performance.

From these 30 simulations a few observations can be made:

- The base case, green dotted line, follows from an average of scenarios that can be more optimistic, as well as much more pessimistic.
- Since there are several start-ups creating significant impact (relative to the average of the set), the end results depend not on the success of one start-up especially, but on the overall success of the (high performers in) the group.
- There are 17 optimistic cases mostly ending up around -300 to -445 ktCO_2eq (similar to the positive climate impact of >100 2MW wind turbines).
- There are 13 pessimistic scenarios that project lower GHG emission reductions than the base case, mostly spread between -27 and -300 ktCO_2eq.
- Trying out different survival scenarios illustrates how sensitive the total impact of accelerated start-ups depends on their commercial success.

Projection of the climate impact of 28 start-ups in tCO_2eq

Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based discrete method with a one-third decline period, accounted in the year of production, grouped by sector.

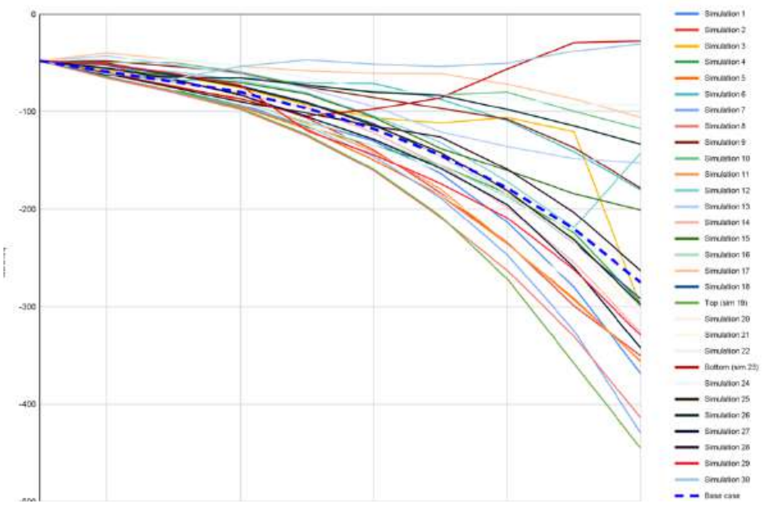

Figure 6: Projection of the climate impact of 28 start-ups in tCO_2eq. Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based discrete method with a one-third decline period, accounted in the year of production, grouped by sector.

Scenarios of Worst and Best Case

Replace missing data with best-case and worst-case assumptions. This shows the sensitivity of the total impact of the group to the quality of impact forecasts per company.

Half of the start-ups did not reach a valid forecast and their data was left out of the projection. What if they were best cases or worst cases in their climate impact?

Best case

In this first investigation we are assuming that the missing 18 start-ups have the kind of impacts that we see in the top half of all validated projects. To calculate these best cases without using case data, we take an increasing per centile from the top range of valid forecasts with one outlier removed. These 18 most-likely impacts range from -511 kt to -231 tCO_2eq. The same sectors and limits are used for the start-ups with the invalid data that is replaced. This gives the following results:

Projected impact, tCO_2eq:

Accounted in the year of production, years 6 to 9 cropped.

Table 10: Projected impact, tCO_2eq: Accounted in the year of production, Years 6 to 9 cropped.

	Year	1	2	3	4	5	10
#	Total	-617 471	-863 734	-1 086 540	-1 317 538	-1 675 784	-5 515 921
1	Abura	-117	-168	-215	-263	-337	-1 134
2	Afzelia	-7 600	-10 944	-13 954	-17 073	-21 896	-73 636
3	BEST CASE	-510 684	-735 385	-937 616	-1 147 201	-1 471 285	-4 947 967
4	Angelique	-1 000	-1 440	-1 836	-2 246	-2 881	-6 757
5	BEST CASE	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
6	BEST CASE	-22 500	-32 400	-41 310	-50 544	-64 823	-218 000
7	BEST CASE	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
8	Beech	-206	-185	-175	-165	-157	-117
9	Black poplar	-3 083	-2 775	-2 621	-2 466	-2 343	-1 757
10	BEST CASE	-9 231	-8 308	-7 846	-7 385	-7 016	-5 262
11	BEST CASE	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
12	Chestnut	-5	-8	-10	-12	-16	-52
13	Coromandel Ebony	-18	-26	-33	-40	-52	-174
14	Dabema	-1 700	-2 448	-3 121	-3 819	-4 898	-16 471
15	Elm	-8 500	-12 240	-15 606	-19 094	-24 489	-82 356
16	Guaiacum wood	-1 752	-1 577	-1 489	-1 402	-1 332	-999
17	Hickory	0	0	-1	-1	-1	-3
18	Horse chestnut	-861	-775	-732	-689	-654	-491
19	Incense cedar	-2 600	-3 744	-4 774	-5 841	-7 491	-25 191
20	BEST CASE	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
21	Koto	-121	-174	-222	-272	-349	-1 172

22	**Linde**	-1 740	-1 566	-1 479	-1 392	-1 322	-992
23	**Mahogany**	-113	-163	-207	-254	-326	-1 058
24	**BEST CASE**	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
25	**BEST CASE**	-4 150	-5 976	-7 619	-9 323	-11 956	-40 209
26	**Mersawa**	-9	-12	-16	-19	-24	-82
27	**BEST CASE**	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
28	**BEST CASE**	-2 550	-2 334	-2 204	-2 074	-1 971	-1 478
29	**BEST CASE**	-1 400	-1 514	-1 430	-1 346	-1 278	-959
30	**BEST CASE**	-857	-1 234	-1 573	-1 925	-1 971	-1 478
31	**BEST CASE**	-682	-982	-1 252	-1 532	-1 965	-1 478
32	**BEST CASE**	-613	-883	-1 125	-1 377	-1 766	-5 939
33	**Palissander**	-746	-1 074	-1 370	-1 676	-1 851	-1 388
34	**BEST CASE**	-538	-775	-988	-1 209	-1 550	-5 213
35	**Pitch Pine**	-5 600	-5 558	-5 249	-4 940	-4 693	-3 520
36	**Pockwood**	0	0	0	0	0	0
37	**Purpleheart**	-75	-108	-138	-168	-216	-727
38	**Red oak**	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
39	**BEST CASE**	-403	-580	-740	-905	-1 161	-1 478
40	**Scots pine**	-859	-1 237	-1 577	-1 930	-2 475	-8 323
41	**Spruce**	-29	-42	-53	-65	-84	-281
42	**Sycamore**	-4 600	-6 624	-8 446	-10 333	-13 253	-44 569
43	**Tiama**	-89	-128	-163	-200	-256	-200
44	**Walnut**	-4 008	-3 607	-3 407	-3 206	-3 046	-2 285
45	**Wengé**	-50	-72	-92	-112	-144	-141
46	**BEST CASE**	-231	-333	-424	-519	-666	-2 238

When the same growth and failure methods and rates are used, we can generate the total projected impact in Year 10 to benchmark the original value of -275 ktCO_2eq. against this best case of -5516 ktCO_2eq.

The BEST CASE total projected climate impact in Year 10 is -5516 ktCO_2eq

This is 20 times the climate impact of the base case, and a GHG reduction potential similar in magnitude to >1000 wind turbines running, or the carbon sequestered by 1.9 million hectares of forest in a year. The impact is mostly driven by a single best-case company under favourable and optimistic addressable market assumptions.

Projection of the climate impact of 46 best case start-ups

Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by company.

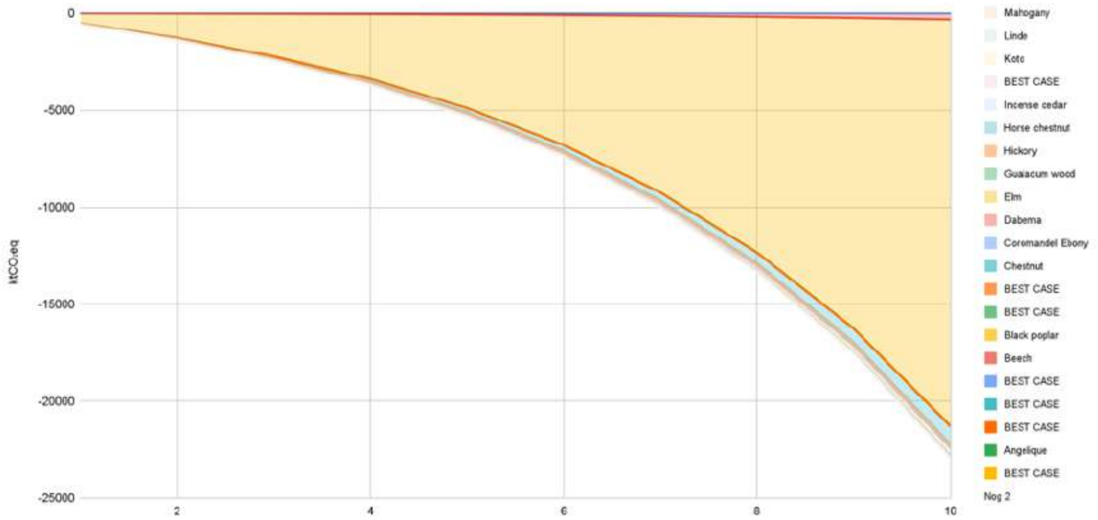

Figure 7: Projection of the climate impact of 46 best case start-ups. Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by company.

Worst case

In this second investigation, we are assuming that the missing half of start-ups have the kind of impacts that we see in the bottom half of all validated projects. To calculate these worst cases without using case data, we take an increasing per centile from the top range of valid forecasts (with one outlier removed). These 18 remaining most likely impacts range from -231 t to +2 tCO_2eq. The same sectors and limits are used for the start-ups with invalid data. Which looks like this:

The WORST CASE total projected climate impact in Year 10 is -287 $ktCO_2eq$.

This per year impact is ~12 ktCO2eq more than the base case (275 ktCO2eq), and 5229 ktCO2eq less than the "Best case" scenario of -5516 ktCO2eq. The base scenario can hardly be used as a comparison however due to the fact that 18 more start-ups were considered for the worst case scenario. It is relevant to note however that because the bottom 18 of all validated projects (the worst case cohort selected for this scenario) are selected, the impact grows only 12 ktCO2e which is dwarfed by the impact of the best performing two start-ups. The graph below shows how the additional emissions from worst case start-ups do not counteract the positive impact, mostly driven by two start-ups: Elm and Afzelia. The difference between the best- and worst-case scenarios for the "missing" 18 start-ups of 5229 ktCO2eq is equivalent to taking ~1400 wind turbines (of 1,82 MW capacity) offline for a single year.

Projected impact, tCO_2eq:

Accounted in the year of production, years 6 to 9 cropped

Table 11: Projected impact, tCO_2eq: Accounted in the year of production, years 6 to 9 cropped.

	Year	1	2	3	4	5	10
#	Group	-49 316	-60 818	-71 468	-82 543	-100 132	-286 899
1	Abura	-117	-168	-215	-263	-337	-1134
2	Afzelia	-7 600	-10 944	-13 954	-17 073	-21 896	-73 636
3	WORST CASE	-231	-333	-424	-519	-666	-2 238
4	Angelique	-1 000	-1 440	-1 836	-2 246	-2 881	-6 757
5	WORST CASE	-203	-292	-373	-456	-585	-1 478
6	WORST CASE	-160	-230	-294	-359	-461	-1 550
7	WORST CASE	-141	-203	-259	-317	-406	-1 366
8	Beech	-206	-185	-175	-165	-157	-117
9	Black poplar	-3 083	-2 775	-2 621	-2 466	-2 343	-1 757
10	WORST CASE	-118	-170	-217	-265	-340	-1 143
11	WORST CASE	-110	-158	-202	-247	-317	-1 066
12	Chestnut	-5	-8	-10	-12	-16	-52
13	Coromandel Ebony	-18	-26	-33	-40	-52	-174
14	Dabema	-1 700	-2 448	-3 121	-3 819	-4 898	-16 471
15	Elm	-8 500	-12 240	-15 606	-19 094	-24 489	-82 356
16	Guaiacum wood	-1 752	-1 577	-1 489	-1 402	-1 332	-999
17	Hickory	0	0	-1	-1	-1	-3
18	Horse chestnut	-861	-775	-732	-689	-654	-491
19	Incense cedar	-2 600	-3 744	-4 774	-5 841	-7 491	-25 191
20	WORST CASE	-85	-122	-156	-191	-245	-824
21	Koto	-121	-174	-222	-272	-349	-1 172
22	Linde	-1 740	-1 566	-1 479	-1 392	-1 322	-992

23	Mahogany	-113	-163	-207	-254	-326	-1 058
24	WORST CASE	-57	-82	-105	-128	-164	-552
25	WORST CASE	-45	-65	-83	-101	-130	-436
26	Mersawa	-9	-12	-16	-19	-24	-82
27	WORST CASE	-30	-43	-55	-67	-86	-291
28	WORST CASE	-18	-26	-33	-40	-52	-174
29	WORST CASE	-14	-20	-26	-31	-40	-136
30	WORST CASE	-11	-16	-20	-25	-32	-107
31	WORST CASE	-9	-13	-17	-20	-26	-87
32	WORST CASE	-7	-10	-13	-16	-20	-68
33	Palissander	-746	-1 074	-1 370	-1 676	-1 851	-1 388
34	WORST CASE	-5	-7	-9	-11	-14	-48
35	Pitch Pine	-5 600	-5 558	-5 249	-4 940	-4 693	-3 520
36	Pockwood	0	0	0	0	0	0
37	Purpleheart	-75	-108	-138	-168	-216	-727
38	Red oak	-2 593	-2 334	-2 204	-2 074	-1 971	-1 478
39	WORST CASE	0	0	0	0	0	0
40	Scots pine	-859	-1 237	-1 577	-1 930	-2 475	-8 323
41	Spruce	-29	-42	-53	-65	-84	
42	Sycamore	-4 600	-6 624	-8 446	-10 333	-13 253	-44 569
43	Tiama	-89	-128	-163	-200	-256	-200
44	Walnut	-4 008	-3 607	-3 407	-3 206	-3 046	-2 285
45	Wengé	-50	-72	-92	-112	-144	-141
46	WORST CASE	2	3	4	4	6	19

Projection of the climate impact of 46 worst case start-ups

Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by company.

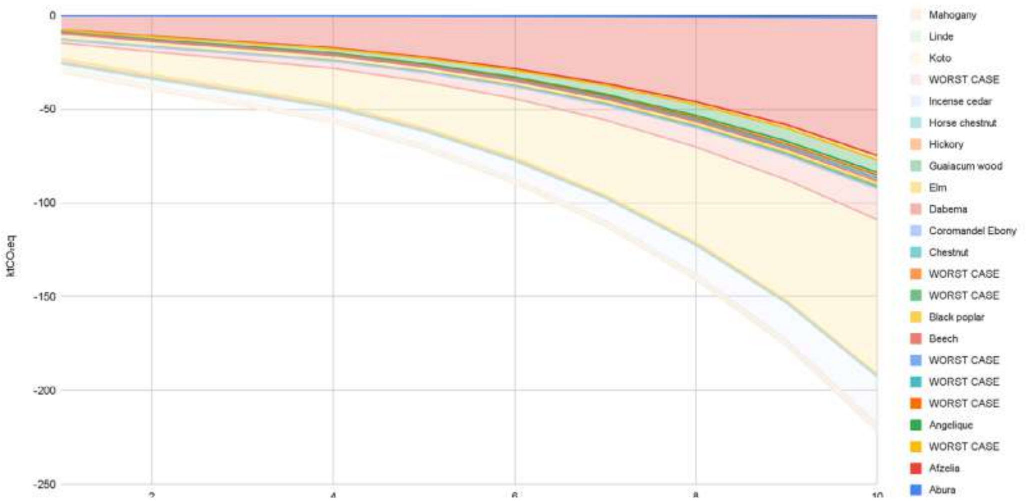

Figure 8: Projection of the climate impact of 46 worst case start-ups. Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by company.

Comparing the base case, worst case and best case

The best case has 20 times more climate mitigation potential by Year 10 than the base case. But the base case is only half as many start-ups as the best and worst case. From a close-up (cropped graph) of the worst and base cases, it is clear that 18 start-ups (with impacts seen in the bottom 50 per cent of valid projects) adds very little to the total impact (around 4 per cent).

Comparison of the climate impact of cases in tCO_2eq

Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by company.

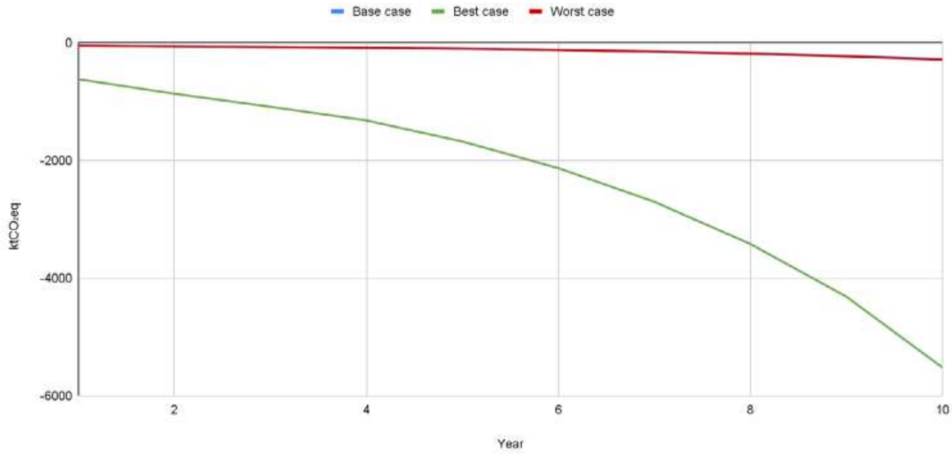

Figure 9: Comparison of the climate impact of cases in tCO_2eq. Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by company.

Cropped to -500ktCO_2eq:

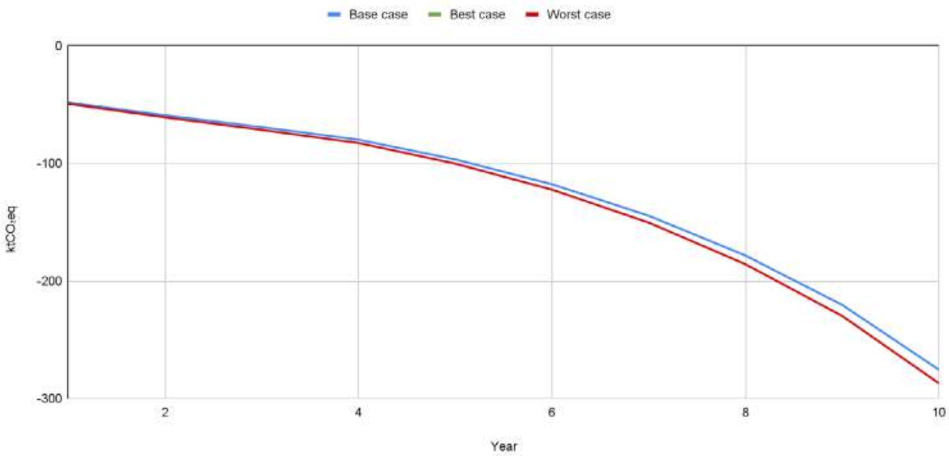

Figure 10: Comparison of the climate impact of cases in tCO_2eq. Using start-up growth rates EU maturity based, limited to addressable impact. Applying start-up failure rates EU using the maturity based divisible method, accounted in the year of production, grouped by company. Cropped to -300ktCO_2eq.

Carbon Abatement Costs

Includes the investment assumptions, and combined with the impact range, calculates the carbon abatement cost per company. Carbon abatement costs can be used by the start-ups that make the most impact with a given investment, and to compare impact innovation investments to conventional impact investments.

$$\textit{Carbon Abatement Costs} = (\textit{Lifetime Cost} - \textit{Lifetime Savings}) / \textit{Cumulative GHG Emissions}$$

This formula calculates the carbon abatement costs of a technology or company, where:

- Lifetime Cost is the total financial cost of implementing and maintaining the technology or measure over its entire lifetime.
- Lifetime Savings is the total financial savings generated by the technology or measure over its entire lifetime compared to a baseline scenario.
- Cumulative GHG Emissions is the total greenhouse gas emissions associated with the technology or measure over its entire lifetime.

By dividing the net lifetime cost of the technology by its cumulative GHG emissions, we get a measure of its carbon abatement costs. A lower carbon abatement cost value indicates that the technology is more cost-effective in reducing greenhouse gas emissions.

Carbon abatement costs are the costs (or savings) associated with reducing one tonne of CO_2eq in GHG emissions. It is the lifetime cost of the technology or measure and the lifetime savings accruing as compared to a baseline divided by the cumulative GHG emissions of that technology. This metric can be used to determine whether investments made are a cheap or expensive way to reduce GHG emissions, relative to other solutions.

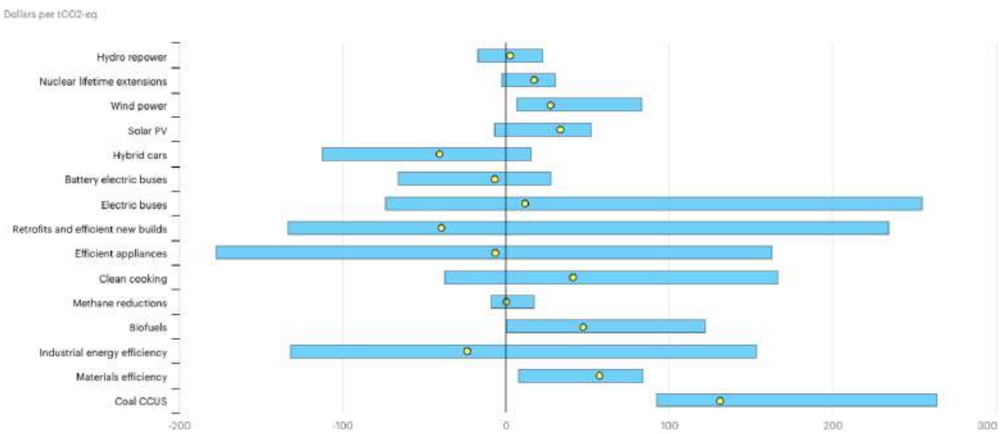

Figure 11: Carbon abatement costs [IEA, GHG abatement costs for selected measures of the Sustainable Recovery Plan, Paris, https://www.iea.org/data-and-statistics/charts/ghg-abatement -costs-for-selected-measures-of-the-sustainable-recovery-plan, IEA (International Energy Agency) Licence: CC BY 4.0]

Investment and attribution factor

The average investment in a 46 RACE portfolio company was €1.49 million (1 490 438), with €1.51 million on average invested per one of the 28 selected start-ups for the base case, and €1.46million per a non-selected company.

The start-ups in the RACE cohort in this report have already found a product-market fit, and developed their product to the point where they can scale its production. This means that any investment made in these start-ups can increase their positive climate impact, but without investment they could make a positive climate impact as well. By comparing the investment made to the preceding and future investments into these start-ups, we can find an attribution value which can be used to determine the share of the projected impact that can be attributed to the in-kind investment of the programme. These investments are done by the European Innovation Council or EIC. “The EIC is Europe’s flagship innovation programme to identify, develop and scale up breakthrough technologies and game changing innovations” [About EIC]

For example, if all the combined investment of a company in Year 10 was €100 million, then the average attribution factor would be ~1.49 per cent. However, for the calculation shown in the table below an attribution factor of 100 per cent has been used to show the abatement cost of all the forecasted impact made in Year 10. Based on the below formula, EIC will have invested €7 233 on average for every tonne of CO2 equivalent mitigated, with one outlier (Pockwood) removed. If another clear outlier (Hickory; significantly lower-than-average impact performance) were removed, the average cost of abatement would come to €551.

$$Carbon\ abatement\ costs = \frac{Investment}{Attribution\ factor \times Cumulative\ projected\ impact_{year\ 10}}$$

In the context of impact investment, carbon abatement costs can also be expressed as the investment divided by the impact (accumulated over a given period in years) that can be attributed to the investment, where:

- Investment is the funding provided to the company with the specific intent to fund climate impact innovations.
- Attribution factor is a measure of the proportion of greenhouse gas emissions that can be attributed to the investment.
- Cumulative projected impact Year 10 is the sum of the annual climate impacts projected for all years up to and including 10.

This formula calculates the carbon abatement costs by dividing the total investment required for the company by the cumulative projected impact of the company, where the attribution factor is used to account for the share of greenhouse gas emissions that can be attributed to the investment.

A 100 per cent attribution factor implies that none of the impact would have been possible without this investment. Which is optimistic since there are other sources of funding and the start-ups are already operating at some level before the investment. Lower attribution factors imply attributing a lesser part of the impact to the investment, and result in higher abatement costs.

A lower carbon abatement cost value indicates that the company is more cost-effective in reducing greenhouse gas emissions. By understanding the carbon abatement costs, decision-makers can make informed decisions about which technologies or start-ups to fund to achieve their greenhouse gas emissions reduction targets. And through abatement costs, investments in impact innovation, with high possible impact return, can be compared to other investments that meet the same reduction targets with lower risk, such as wind farms or solar PV.

Comparing the cost to the Global GHG abatement potentials and costs of different technologies showcased in the figure above, a group of 13 of the start-ups are cheaper than the costliest technology of "Coal CCUS" (~50 per cent of the total 28 start-ups), although the average price of €7 233 is still higher than the average ton mitigated via CCS (~€120/tCO2e). CCUS stands for Carbon Capture Utilization and Storage, and is based on the premise coal power plants can be retrofitted or built with technology that could capture the carbon emissions on the plant-level and store (or utilise) the CO2 in long-term effective storage.
The variance in the Avoided Emissions Potential and therefore the Carbon Abatement Cost of the RACE start-ups is high (as is the case for many other solutions as seen in the figure 11 above). With the abatement cost of €1/tCO2eq. Pitch Pine and Scotch Pine are on par with hydro repower and electric buses, while Coromandel Ebony would end up being more that nine times more expensive than the most expensive Coal CCUS scenario.

To become better in predicting which types of start-ups, in which sectors and setups end up mitigating the most carbon dioxide emissions, models like MORSE need higher quantity and quality of company activity and impact data. This can be shown by looking at the BEST CASE scenario carbon abatement costs, which drops to €4 366 per tCO2 equivalent (or €353 without Hickory). It is important to remember that negative carbon abatement costs can be achieved only if return on investments and/ or saved costs are calculated in. For example, better insulation saves on heating and therefore has a negative carbon abatement cost. In this exercise, monetary returns or cost savings for EIC or society at large could not be computed and are therefore not possible.

Table 12: Carbon abatement costs for validated impact.

ID	Select	Name	EIC investment	Cumulative AEP Y10	Abatement costs (€/ tCO2e)	13 are better than CCS
Average			1 490 438	-28 010	7 233	-
1	✓	Abura	496 250	-4 797	103	✓
2	✓	Afzelia	1 888 285	-31 1591	6	✓
4	✓	Angelique	803 507	-37 625	21	✓
8	✓	Beech	2 380 644	-1 549	1 537	-
9	✓	Black poplar	1 502 331	-23 184	65	✓
12	✓	Chestnut	50 000	-221	226	-
13	✓	Coromandel Ebony	1 659 356	-738	2 249	-
14	✓	Dabema	1 249 500	-69 698	18	✓
15	✓	Elm	1 480 000	-348 489	4	✓

16	✓	**Guaiacum wood**	2 485 000	-13 175	189	-
17	✓	**Hickory**	2 300 000	-13	180 965	-
18	✓	**Horse chestnut**	1 634 472	-6 475	252	-
19	✓	**Incense cedar**	2 478 231	-106 597	23	✓
21	✓	**Koto**	2 137 625	-4 961	431	-
22	✓	**Linde**	1185 013	-13 085	91	✓
23	✓	**Mahogany**	50 000	-4 597	11	✓
26	✓	**Mersawa**	1 517 863	-348	4 356	-
33	✓	**Palissander**	2 481 500	-14 533	171	-
35	✓	**Pitch Pine**	50 000	-45 861	1	✓
36	✓	**Pockwood**	1 053 258	0	N/A	-
37	✓	**Purpleheart**	1 633 275	-3 075	531	-
38	✓	**Red oak**	1 981 875	-19 499	102	-
40	✓	**Scots pine**	50 000	-35 218	1	✓
41	✓	**Spruce**	1 572 156	-1 189	1 322	-
42	✓	**Sycamore**	2 091 639	-188 594	11	✓
43	✓	**Tiama**	1 885 130	-1 960	962	-
44	✓	**Walnut**	2 272 044	-30 140	75	✓
45	✓	**Wengé**	1 994 039	-1 266	1 575	-

Actionable impact insights

Draws from the previous sections to conclude the ways to optimise the positive climate mitigation impact of projects.

AEP Year 1: bigger is better

The impact projections start from the per-year Avoided Emissions Potential in the first year. From the 28 valid forecasts, Black Poplar has the highest first-year impact. The per year impact is capped at the addressable impact assuming 1 per cent and 1 per cent in lack of start-up data. In the best-case scenario, assuming start-ups with typical top 50 per cent values for AEP Year 1, the GHG reduction potential in Year 1 is two times greater than it is currently, which means that by selecting for impactful start-ups, the GHG reduction potential of the project can be more than doubled.

Addressable impact: reached by 13 start-ups within the 10 year timeframe

Thirteen of 28 start-ups hit their addressable climate impact, including seven in Year 1. Other start-ups reach their addressable impact in Years 2, 5, 6, or 9, after which time their projected impact is capped (and dropping because of the failure rate). The impact of the sector is furthermore limited in all start-ups because their markets are mostly national; two start-ups indicated two countries. Therefore, to increase the climate impact potential of this group, the start-ups could be supported with international expansion.

Maturity: scaling start-ups that have a reduced risk of failure

All start-ups in this group are at the point of scaling, which results in a maturity factor that shifts the growth and failure rates by three years. With a lower maturity, e.g. prototyping, the total projected climate impact would decrease. With a higher maturity, such as the five-year shift used for established start-ups, the impact would not increase drastically, because the selected EU growth and failure rates level off between Years 3 and 5.

Growth rates: room for improvement

The growth rate for most years in the selected set of EU company rates is 35 per cent. A more rapid growth of scaling start-ups can easily be imagined, and the RACE platform can provide means to accelerate the growth of a company. In the RACE-MORSE mode,l it is possible to experiment with custom growth rates and to see their effect on the outcomes in Year 10.

Sectors: 13% of GHG emissions addressed

The start-ups in this group are active in the other fuel combustion and industrial processes sectors, which together determine 13 per cent of global GHG emissions. The impact of the group might be improved by including start-ups that are active in the most impactful sectors, for example electricity/ heat (32 per cent) and transport (13 per cent). Secondly, many of the start-ups were allocated into the other fuel consumption subsector, and their addressable impact could be higher as they operate in the energy sector. Being able to break into the electricity/heat (32 per cent) and manufacturing (14 per cent) subsectors could increase their total Avoided Emissions Potential.

Simulations: nurture impactful start-ups

The simulations show that there is a significant range of possible outcomes, around the base case. This range is made up of individual stories of growth and failure, governed by pure chance in this model. Reality similarly has elements of chance determining the success of start-ups, while there are also levers to push the results in favourable ways. Investment and support are important in improving the chances of start-ups succeeding, hence their ability to make impact.

Best and worst case: data gaps increase uncertainty

For two start-ups, no valid forecast data was available, and therefore, best- and worst-case assumptions were made, which had a drastic effect on the total projected impact. Impact assessments can reduce the risk of a negative climate impact and prevent missing out on positive impact unicorns.

Glossary

Rapid Acceleration of Climate Entrepreneurs	An impact programme offered to the Rapid Acceleration of Climate Entrepreneurs participants selected with the help of EIT Climate-KIC. The programme includes client support in the selection phase, a climate impact forecasting (CIF) workshop, a coaching session and validation. These services were offered to 61 selected teams, 46 of which completed the programme.
Impact Forecast	This company helps start-ups know, grow and show the climate impact of their innovations, with a scalable approach based on Life Cycle Assessment (LCA), leveraging online software and on-demand impact expertise.
Start-ups	Start-ups in this context are enrolled in Rapid Acceleration of Climate Entrepreneurs and supported by Impact Forecast to make a CIF and get validation.
CIF or	It is not quite valid as we could not verify all assumptions. At most one input has raised a concern with the validator, and it is not a key input, or otherwise not a priority to resolve the concern.
Climate impact forecast	A Climate Impact Forecasting or CIF is an LCA-based calculation of the GHG reduction or climate adaptation potential of a project. Using our CIF tool, the project team found the net climate impact of the key differences between business-as-usual and their innovative solution.
LCA or Life Cycle Assessment	Life Cycle Assessment is the science that studies the impacts on the environment associated with a product, process or service. Every part of a product's life cycle – from extraction of materials, the production of the product, the use phase and the End-of-Life phase – can have an impact on the environment. LCAs require extensive amounts of time and expertise that make them unavailable and unsuitable for most entrepreneurs.
CIF coaching	Coaching is a 1-hour, 1-on-1 video call with an impact expert around an impact forecast file.
CIF workshop	The Climate Impact Forecast (CIF) workshop takes between 6-8 hours and includes an introduction to the science of impact assessment, examples of impactful start-ups and their best practices, a CIF demo and a 2-hour breakout session with individual support from our trainers.
$tCO_2eq.$ / year	Metric tonnes of carbon dioxide equivalent per year. A measure of global warming potential or greenhouse gas emission reduction potential.
Pos : Neg	The ratio of positive to negative impact in the forecasts. Flagged when 100 per cent which indicates not all key differences are included, and below 55 per cent which indicates the impact is very sensitive to assumptions.
Climate Impact data	The Climate Impact data in this report, and in CIF in general, is calculated with information from the project team and from the CIF tool. Technical details, amounts, and assumptions in the calculation are provided by the project team. Impact factors (LCA data), impact equivalents and the calculation itself are provided by the CIF tool.
CIF validation	CIF Validation is a review process performed by an impartial impact expert to determine if a CIF is Valid, Positive and Significant. The validation process is initiated by the request of a company and includes one round of feedback and revision.

CO_2eq	Amount of greenhouse gas effect equivalent to the emission of an amount of CO_2
kg	Kilogram, a unit from the International System of Units (SI). Equal to 1000 gram.
t	Metric tonne, equal to 1000 kg.
kt	Kilotonne, equal to 1000 t.
Mt	Megatonne, equal to 1000 kt.

Glossary

Glossary - possible validation results

Valid	A CIF is valid if it is representative of the project, using appropriate data and well-justified assumptions. Therefore, the CIF and its results are representative of the potential for the project to mitigate, enable or adapt to climate change.
Positive	A CIF is positive when it shows that the project has a lower climate impact than business as usual, or improved climate resilience in the case of adaptation. A positive mitigation or enabler CIF shows the avoided GHG emissions in -tCO_2eq.
Significant **Marginal**	A CIF is significant when the project has a climate impact (positive or negative) greater than 5 tonnes of carbon dioxide equivalent (CO_2eq) per year. This is roughly the global average annual carbon dioxide (CO_2) emissions per person. Below this amount we consider the impact to be marginal.
Plausible	It is not quite valid as we could not verify all assumptions. At most one input has raised a concern with the validator, and it is not a key input, or otherwise not a priority to resolve the concern.
Improbable	It is not quite plausible. At least one key input has raised a concern or rejection with the validator; the uncertainty may be too high, there may be a calculation error or lack of evidence, or there is contrary evidence.
Invalid	Not valid. At least one input does not meet requirements and is rejected. (e.g. an assumption without clarification, data without source, overly optimistic, wrongly scoped, or another error).
Positive within limits	Lesser than positive but not negative. The positive impact is possible within limits for energy consumption, material use or adoption rates.
Unclear	Insufficient information, unsupported assumptions, lack of referencing or other gaps, of such magnitude that they make it impossible to say if the impact is positive or negative.
Sensitive	Positive impact, but with considerable risk of negative impact in a worst case.
Negative	The forecast shows that the innovation creates additional CO_2 impact (e.g. +1 kilogram CO_2eq).

Overview of Equations

The projected impact is calculated in MORSE as follows

$$Projected\ impact_{year\ N} = \sum_{t=0}^{Time\ to\ impact-1} \square \left[\frac{Scaled\ impact_{year\ N-t} \times Survival_{year\ N-t}}{Time\ to\ impact}\right]$$

When accounting in the year of production, Time to impact = 1 and the formula simplifies to

$$Projected\ impact_{year\ N} = Scaled\ impact_{year\ N} \times Survival_{year\ N}$$

Where

$$Scaled\ impact_{year\ N} = Scaled\ impact_{year\ N-1} \times (1 + Growth\ rate_{year\ N})$$

$$Survival_{year\ N,divisible} = Survival_{year\ N-1} \times (1 - Failure\ rate_{year\ N+Maturity\ modifier})$$

$$Survival_{year\ N,discrete} = (Random_{0..1} < Failure\ rate_{year\ N+Maturity\ modifier}) \rightarrow 1 \wedge 0$$

$$Survival_{year\ N,decline} = (N \leq Lifetime \times (1 - Period)) \rightarrow 1 \wedge Survival_{year\ N-1} - \frac{1}{1 + Lifetime \times Period}$$

And

$Scaled\ impact_{year\ 1}$	= AEP year 1
$Growth\ rate_{year\ N}$	= Selected / custom
$Failure\ rate_{year\ N}$	= Selected / survival schedule
$Maturity\ modifier$	= 0, 1, 3 or 5 based on selection
$Lifetime$	= result from the discrete model
$Period$	= fraction of the lifetime in decline

This report is written as part of the Rapid Acceleration of Climate Entrepreneurs programme commissioned by EIT ClimateKIC. For more information please contact the programme managers or reach out to Impact Forecast directly.

Impact Forecast B.V.
The Netherlands
info@impact-forecast.com

Co-funded by the European Union

HISTORY OF CHANGES		
Version	**Publication date**	**Change**
1.0	28.02.2023	▪ Initial version