



**MISSION
INNOVATION**

NET-ZERO COMPATIBLE
INNOVATIONS
INITIATIVE



**Swedish
Energy Agency**



Gigatonnes of Climate Innovations from Sweden



**Towards
>60 Gigatonnes
of potential CO₂
reductions**

Introducing Sweden as an “**Innovation+** Country” with a first round of innovative solutions providers with >1 Gigatonne of GHG reduction potential.

This paper presents a strategic group of innovative start-ups from Sweden that has been supported by the Swedish Energy Agency. Together these start-ups have the potential to deliver more than a billion tonnes of avoided emissions annually by 2030.

The Swedish Energy Agency (SEA) and Mission Innovation’s Net-Zero Compatible Innovations Initiative (NCI) are collaborating to identify and support a new generation of solution providers. As the first step, 10 start-ups have been selected for initial estimations. In addition, earlier estimations of start-ups have been integrated using the Avoided Emissions Framework.

The goal of the collaboration is to present investment-ready innovations with a global potential to avoid more than 2 Gigatonne at Mission Innovation’s fifth ministerial meeting in 2020. The SEA and the NCI, together with investors and cities, will also present a strategy for accelerated uptake of Net-Zero compatible innovations.

Innovation+



Innovation+ is an approach developed by Mission Innovation’s Net-Zero Compatible Innovations Initiative (NCI) to support a shift in society from only considering reductions from polluters, to also always including their solution providers.

Currently companies, cities and countries are primarily viewed as polluters/problems where the best they can do is reduce their emissions to zero. To view companies, cities and countries as sources of emissions and only ask them to reduce their emissions is however only half of the equation.

With the fourth industrial revolution and new business models it is becoming increasingly counter-productive to only ask companies, countries and cities for reductions,

as this can undermine many disruptive innovations and ignore solution providers.

The Net-Zero Innovations Initiative provides the opportunity for stakeholders to identify solutions and assess the GHG reduction potential of these solutions.

The **Innovation+** approach allows leading companies, investors, cities and countries to develop strategies and collaborate for accelerated uptake of net-zero innovations.

To emphasise the importance of solutions the first generation of Innovation+ stakeholders must have solutions with a potential for reductions in society that are higher than their country’s/ city’s/ company’s own emissions.

The initiative is part of Sweden's concerted effort to be at the forefront of climate change mitigation by delivering transformative solutions from a new generation of start-ups, as well as established companies. These companies capitalise on opportunities provided in the current fourth industrial revolution and recognise the need for transformative system solutions to deliver what is needed for a net-zero emission future. Many of the start-ups are purpose driven and have been created in response to the global sustainability challenges of today.

Identification and assessment of innovations

In 2018, the Swedish Energy Agency (SEA) initiated a collaboration with Mission Innovation's Net-Zero Compatible Innovations Initiative (NCI) to explore how the uptake of clean energy innovation can be supported.

The collaboration builds on the urgent need for curating and supporting solutions in response to the global challenge, and the ability to unleash creative energy, in combination with responsibility for present and future generations.

After an initial vetting process, assessment of the avoided emission potential was conducted on nine clean energy technology start-ups being incubated by the Swedish Energy Agency.

Further, keeping in view the international development agenda, particularly the eradication of poverty coupled with its commitment to following the low carbon path to progress, the links to relevant Sustainable Development Goals (SDGs) will also be assessed.

In order to provide a comprehensive assessment of solutions to ensure that they are future compatible, these solutions will, in addition to the quantification of potential avoided emissions, also be assessed in relation to their 1.5 °C pathway compatibility, how they can support net-zero acceleration and avoid high-carbon lock-in, and an innovation matrix will be used to assess how transformative the solution is.

IPCC 1.5 °C Special Report

IPCC's Special Report on Global Warming of 1.5 °C, released in October 2018 found that limiting global warming to 1.5 °C will require 'rapid and far-reaching' transitions in land, energy, industry, buildings, transport and cities.

Further, it stated that global net human-caused emissions of carbon dioxide (CO₂) would need to fall by about 45 percent from 2010 levels by 2030, reaching 'net zero' around 2050. These radical reductions require a focus on new innovative solutions that can scale fast.

Sweden overarching commitment can be seen in the following paragraph from Sweden's Export Strategy:

"The Government's ambition is for Sweden to have the world's most ambitious environment and climate policy. The transition to a green economy through the streamlining of resources and a circular economy, sustainable consumption and production, environmental technologies and innovations presents opportunities for businesses to develop at the same time as the impact on the environment and climate is reduced."

Calculating Avoided Emissions

The overall concept of avoided emissions is that a solution (product or service) enables the same function to be performed with significantly less GHG emissions.

The method of measuring avoided emissions is to compare a baseline scenario without the enabling solution with a scenario using the enabling solution, where the baseline represents the 'business as usual' (BAU) scenario. This involves calculating the emissions in the following categories:

BAU system

The emissions from the BAU baseline, without the introduction of the enabling solution.

Enabling Effects

The avoided emissions due to the activities avoided as a result of using the solution. These are further subdivided into primary (or immediate) enabling effects and secondary (or longer-term) enabling effects.

Direct Solution Emissions

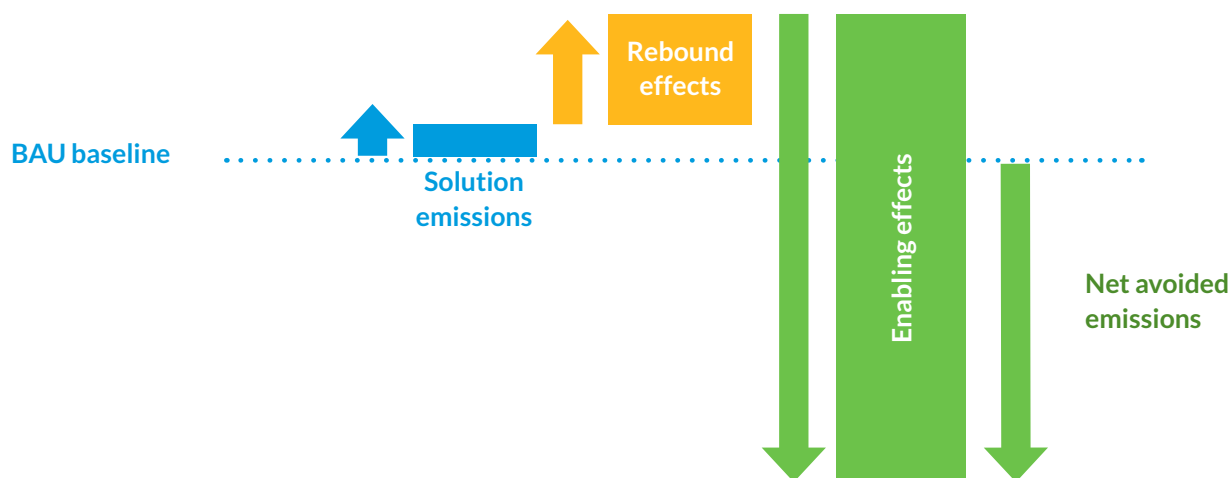
The life cycle emissions of the solution that is causing the enabling effect.

Rebound Effects

The increase in BAU emissions occurring as a result of the enabling solution implementation. Rebound effects may be caused by related consequential effects or by unrelated (and sometimes unintended) effects and are often related to human behavioural changes in demand for carbon-intensive goods or activities. These effects are further subdivided into immediate rebound effects and longer-term rebound effects. Because of the nature of rebound effects, they are extremely hard to quantify and predict, and assessing them is inherently uncertain as it is difficult to accurately estimate the effects.

The net avoided emissions are then calculated as follows:

$$\text{Net avoided emissions} = \text{Enabling avoided emissions} - \text{Direct solution emissions} - \text{Rebound emissions}$$



Depending on need, four levels of assessments can be conducted

AEF Level 1 assessment: A fast guesstimate of magnitude (1/10/100/1000 Mt), including what market this is relevant for (mobility, buildings, food, etc) and a short description of the solution, how it might be similar to other solutions or areas where it covers known gaps in potential.

AEF Level 2 assessment: For potentials below 50 Mt. Uses standardised calculation template. Relies on some data from the solution provider. To include some sensitivity analysis but not as extensive as Level 3.

AEF Level 3 assessment: Does not rely on any data from the solution provider (but compares with their data), uses only independent third-party verified data and compares different data sources. Level 3 is 'obligatory' when Level 2 identifies solutions >50 Mt, or when we require greater confidence.

AEF Level 4 AEF assessment: Similar to a AEF Level 3 assessment, but for a new kind of solution where new information (formulas) or deeper research are needed, or an external stakeholder wants a more thorough assessment.

Assessment of 1.5 °C Low-Energy Demand (LED) compatibility, dynamic feedback and relation to SDGs

To deliver the dramatic emissions reductions that are needed, especially if we want to ensure delivery on the other sustainable development goals, will require more than a business-as-usual approach where countries, cities and companies only focus on reducing their existing emissions. It will require new approaches delivering innovative and disruptive solutions that will bring about significant changes in societal behaviour and overall reductions in emissions. It is therefore important to make sure that we can deliver the necessary reductions through a low energy demand scenario with disruptive innovation.







Many of the most significant emissions reductions today have been made possible by stakeholders delivering solutions for nutrition, mobility, buildings in different

parts of society, not simply reducing their own emissions. Examples such as renewable energy, electric cars, dematerialisation, virtual meetings, etc. have been driven by a focus on providing solutions rather than by reducing emissions from existing systems.

The Fourth Industrial Revolution (connectivity, new materials, and new business models) provides ample examples of opportunities that could radically reduce the emissions by delivering much smarter solutions for mobility (including virtual mobility), building/spaces (including virtual spaces) and nutrition (especially when linked to health and wellbeing).

In order to assess different innovations compatibility with disruptive paths and relation to different aspects relevant for delivering on global sustainability and transformative system change the NCI use a six category assessment.

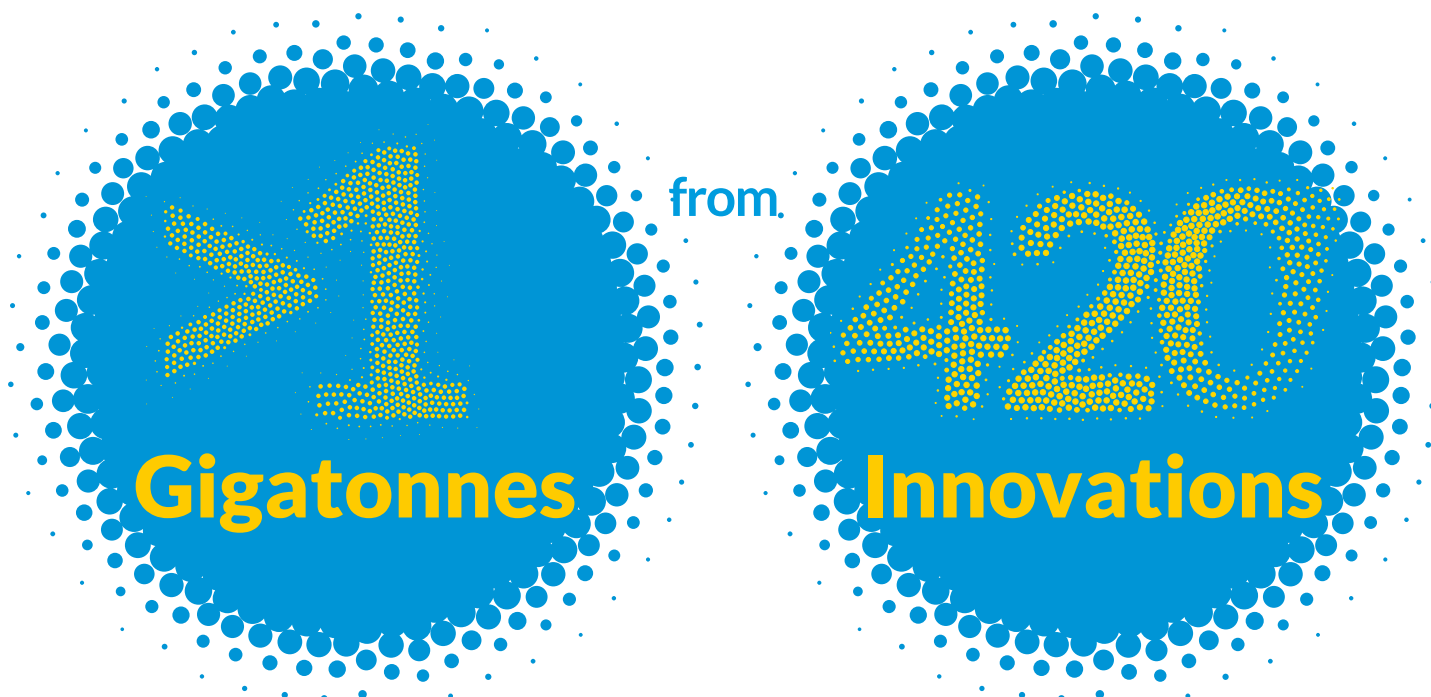


| | | | | | |
|---|-------------------------------------|--|---|--|---|
|  | Impact on market | Incremental, disruptive or transformative impact on the existing global market |  | 1.5 °C compatibility pathfinder | Alignment with pathways in the 1.5 °C compatibility pathfinder framework |
|  | Impact on technology | Incremental, disruptive or transformative impact on existing technology |  | LED acceleration | Whether the innovation makes it easier for an uptake of other Low Energy Demand solutions |
|  | Shift to renewable resources | How much the innovation contributes to implementing the usage of renewable resources |  | Probability of avoiding lock-in | Indicates risk of lock-in to resource-intensive systems. |

Examples of innovative solutions from Sweden

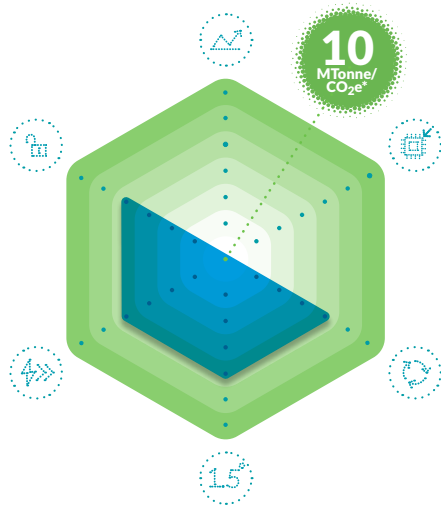
| Name | Description | Avoided emissions in 2030 |
|-----------------------------|---|-----------------------------|
| Greater Than AB | Greater Than's platform can reduce fuel consumption and increase driver awareness through driving data analysis. | 80 |
| Meva Energy AB | Meva Energy provides modularized and pre-manufactured turn-key gasification systems to generate renewable industrial gas or power based on small fraction fuels. | 76 |
| Bzbt AB | Bzbt Taxi Pods provides an app-based taxi service in urban areas through the use of small electrically powered 3-wheel taxis at the price point of public transport and with zero local emissions. | 64 |
| Climeon AB | Climeon AB has developed a solution to convert waste heat with temperatures between 70 and 120 °C into electricity through a vacuum process. | 47 |
| Altered Stockholm AB | Altered:Nozzle 'atomizes' the water from taps, breaking it up into a high-speed dense mist made out of millions of individual drops so the user gets in contact with, and uses, every single drop of water coming out of the tap. | 26 |
| Orbital Systems | Orbital Systems developed a real-time water purification technology, implemented in its recirculating shower, where the water from the drain is collected, purified re-used, enabling water and energy savings. | 21 |
| Other companies | The above are only a selection of companies, for information of all the following solutions providers please see https://www.misolutionframework.net | 704 |
| TOTAL | | 1018 million tonnes* |

* The estimated avoided emissions are estimations subject to change during improvements in data sources and methodology development

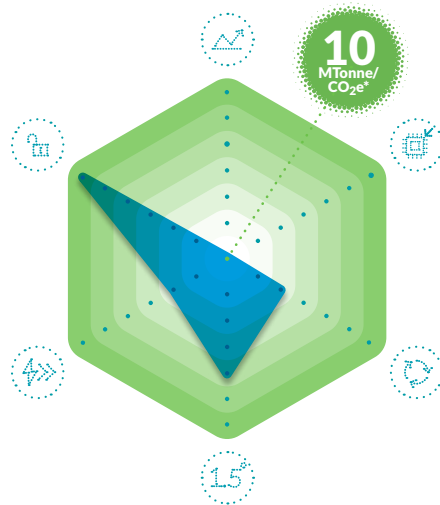


Strategic Solution Providers

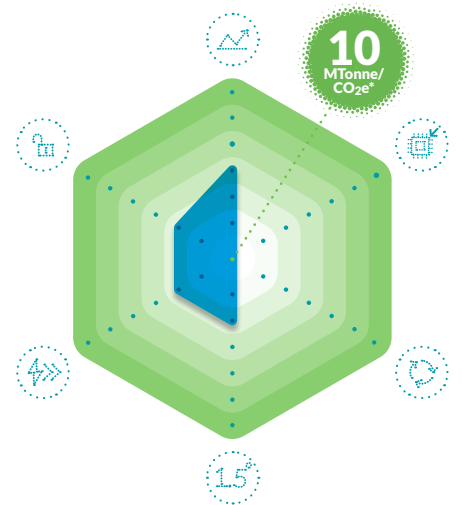
Azelio AB



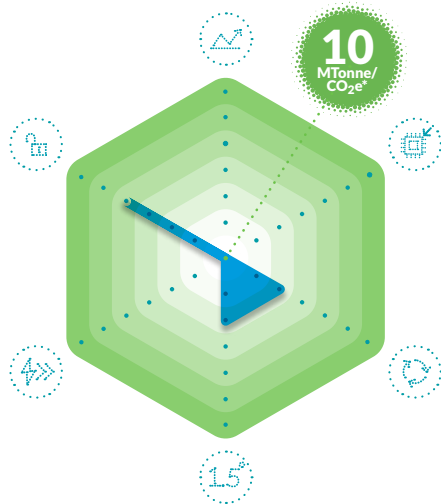
CarbonCloud AB



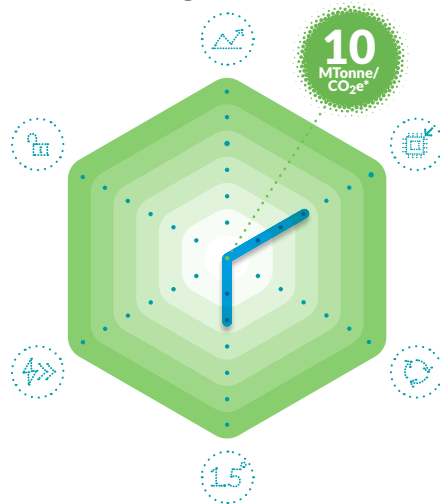
CargoSpace24



I-Tech AB



Kasi Technologies AB



Spotscale AB



Spowdi AB



W4P Waves4Power



Velove Bikes AB



Impact on market



Impact on technology



Shift to renewable resources



1.5 °C compatibility pathfinder



LED acceleration



Probability of avoiding lock-in

* Estimates of the magnitude of avoided emissions potential pending a more detailed assessment

A four-step approach for accelerated uptake

The Swedish Energy Agency (SEA) collaboration with Mission Innovation's Net-Zero Compatible Innovations Initiative (NCI) has four key elements:



Improved identification of potential solution providers

The collaboration will develop selection criteria for emission reduction/avoidance potential of start-ups to identify the most impactful solutions and enterprises. This includes both early filtering and active targeting of entrepreneurs with solutions that have a significant potential to deliver important contributions in society.



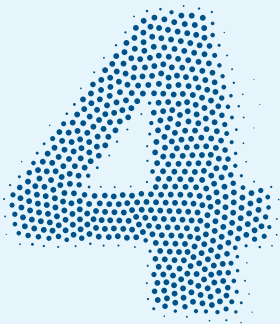
Support in early impact articulation

It has been noticed that early stage entrepreneurs struggle to articulate their impact narratives, especially with respect to their environmental contributions. The SEA and NCI will work together to support early stage entrepreneurs in identifying, quantifying and articulating potential impacts in a structured and credible manner.



Cluster encouragement

The collaboration will work to identify potential collaborating partners that can allow the solutions provided by the entrepreneur to deliver more significant results, increase the probability of success, increase market shares for the new offering, accelerate speed of innovation, etc. Collaborating in clusters increase the possibility of allowing the solutions to move beyond incremental changes in existing system to become part of a necessary transformative system change.



Strengthened links to investors and markets

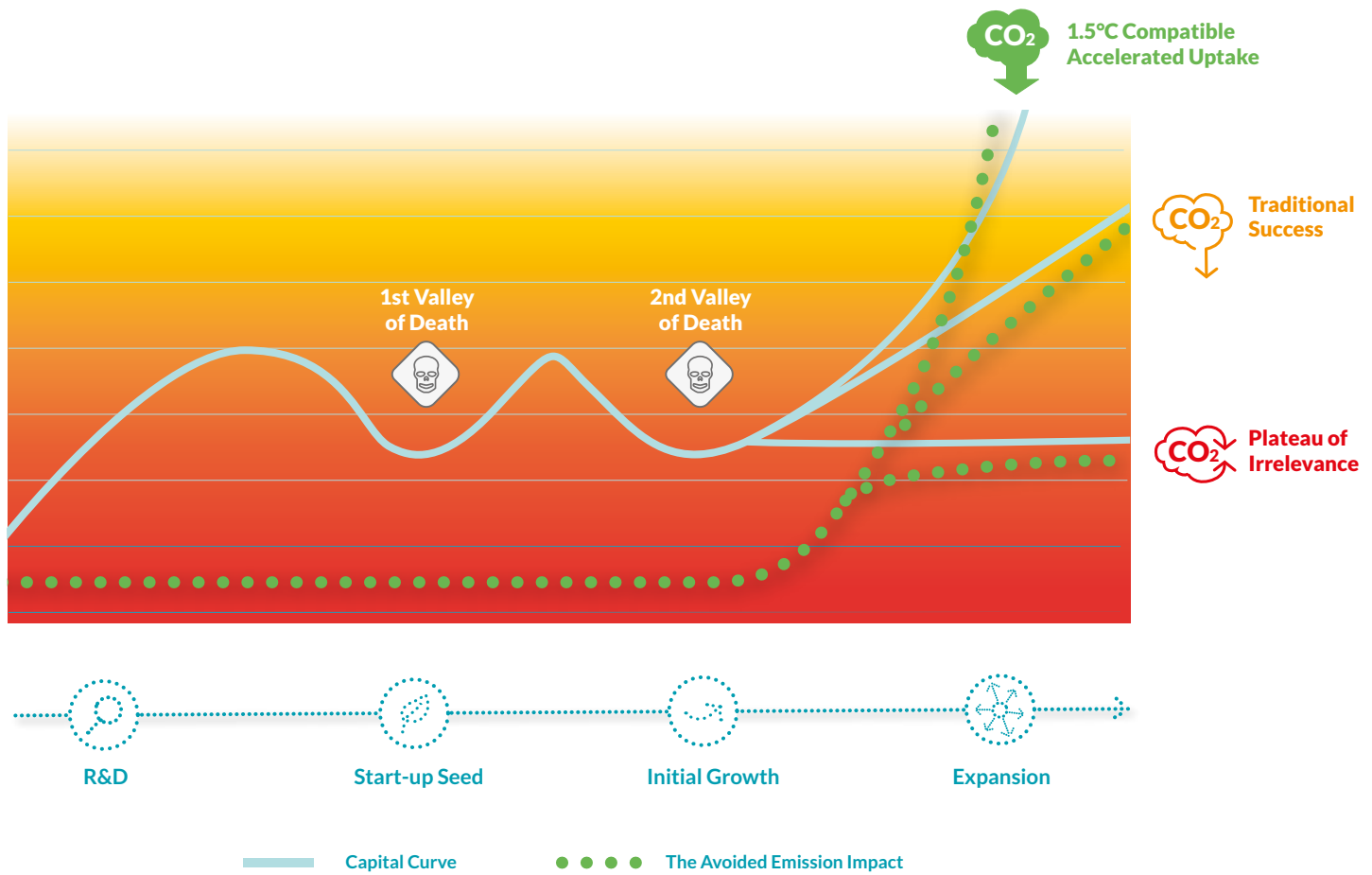
The collaboration will also explore how to best establish links between the entrepreneurs and both investors and markets. This will include the quantified assessments of the potential for avoided emissions in society and 1.5 °C compatibility assessment with SDG synergies, based on transparent assumptions and credible methodology; and connecting them to like-minded investors with an alignment of vision for emission reduction.

Next steps

The start-ups assessed so far are only a small part of Sweden's start-up ecosystem and in the next phase the collaboration hopes to engage a broader ecosystem, including leading international incubators and accelerators, to gather a new generation of solution providers with a combined potential for emissions reduction above 60 gigatonne of CO₂e.

This symbolic number has been selected as it is higher than the current total global emissions. By supporting Mission Innovation in gathering the largest and most significant group of solutions providers the collaboration hopes to contribute to a shift in the global climate discussions where solution providers are included in all relevant processes and initiatives.

Capital Curve and Climate Impact for accelerated uptake of Innovations



Innovation and 1.5 °C relevance curves for climate innovations

Ensuring capital and markets for net-zero compatible innovations require strategic approaches. In addition to traditional initiatives to avoid the valley of death, incentives are also needed to support accelerated uptake beyond what is traditionally seen as financially successful. Transformative system change will also require new tools to support clusters of innovations capable of delivering transformative system change. The required exponential growth of such innovations will in many cases also require low-probability high-impact investments.

Mission Innovation (MI) is a global initiative of 24 countries and the European Commission (on behalf of the European Union) working to reinvigorate and accelerate global clean energy innovation with the objective to make clean energy widely affordable. MI was announced at COP21 on November 30, 2015, as world leaders came together in Paris to commit to ambitious efforts to combat climate change.

Mission Innovation's Net-Zero Compatible Innovations Initiative (NCI) was created to help accelerate the uptake of clean energy innovations. The Initiative builds on the findings in IPCC's 1.5 °C special report, and especially the Low-Energy Demand (LED) pathway. One of the main objectives is to shift the focus from only reductions of emissions by existing big emitters, to also include support for solutions providers with the potential to deliver the solutions society needs to stay below 1.5 °C.

The Swedish Energy Agency (SEA), is leading the energy transition into a modern and sustainable, fossil free welfare society – applying our credibility, a comprehensive approach and courage. SEA contribute with facts, knowledge, and analysis of supply and use of energy in the society. Research on new and renewable energy technologies, smart grids, as well as vehicles and transport fuels of the future receives funding from us. SEA also support business development that allows commercialisation of energy related innovations, and ensure that promising cleantech solutions can be exported.

This collaborative work builds on important work by other stakeholders, including:

1. Criteria for 1.5 °C compatible solutions (e.g. by IPCC)
2. Identified innovation gaps (e.g. by IEA)
3. Solutions with significant reduction potential (e.g. by Project drawdown)
4. Current market preferences (e.g. by cities and investors)
5. SDG synergies and status (e.g. UNDP)

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Core team and partners

