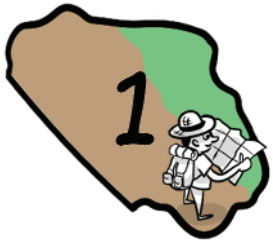
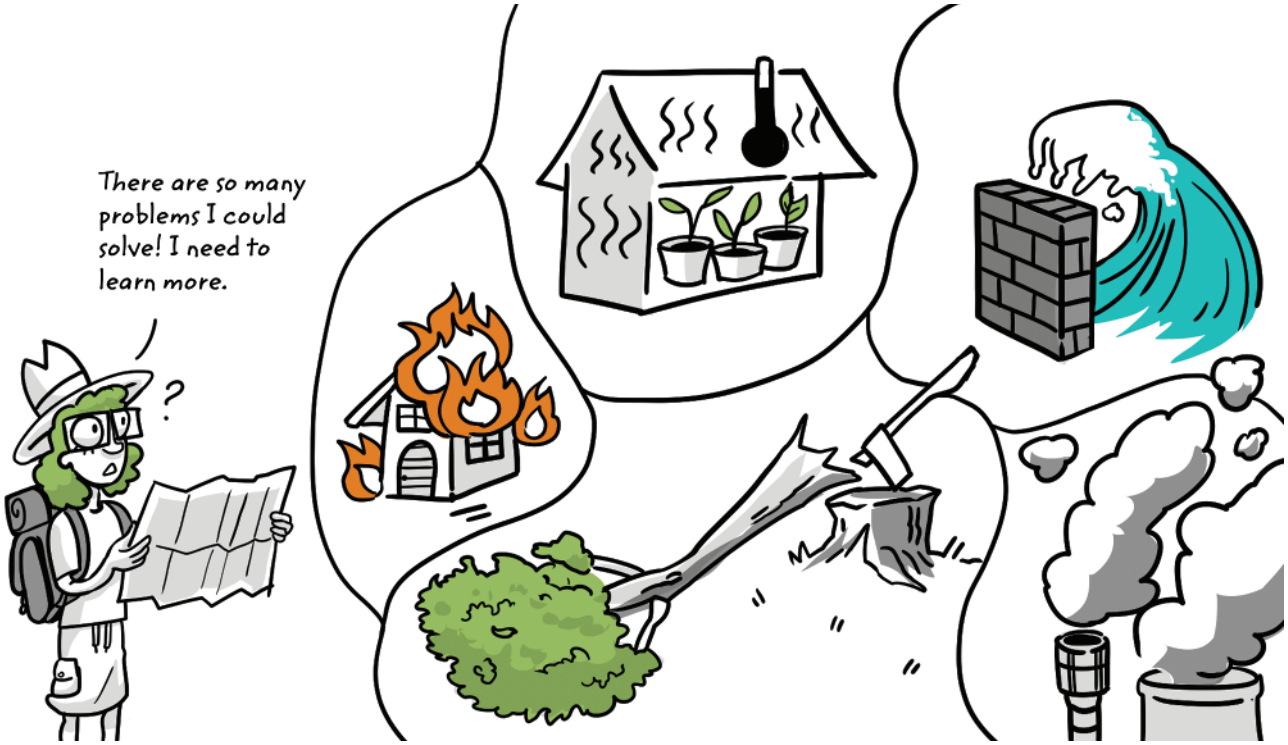


STEP 1

Explore the Problem Landscape

In This Step, You Will

- Get a primer on the climate and energy challenges facing the world today.
- Develop a tool kit to dig deeper into these problems.
- Ultimately narrow this down to a problem that can be concretely solved through entrepreneurship.



Why This Step, and Why Now?

DISCIPLINED ENTREPRENEURSHIP

REFER TO STEP

0

GETTING STARTED

The first step of your journey as an entrepreneur in climate and energy is to find your place in the universe of potential problems. We could write books and books about the problem of climate change and its drivers, but for now, we will simply give you a high-level overview of these issues as a jumping-off point for your own exploration process. We will also share a structured process of breaking down big global problems into smaller individual problems that you can potentially address through your climate and energy venture.

Climate Change 101

The basic mechanics of climate change are well known at this point. Greenhouse gases enter the atmosphere, largely due to people burning fossil fuels, and they warm the planet, which leads to a wide variety of changes to our climate (see Figure 1.1).

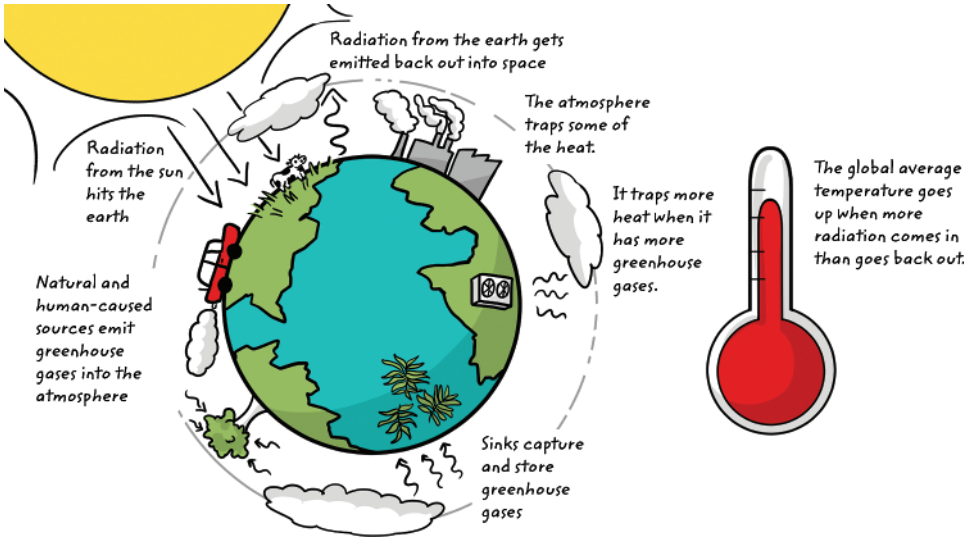


Figure 1.1: An overview of the greenhouse effect.

Earth's systems are dynamic, so some years are a bit warmer and others a bit cooler, but by looking at the trend, it's clear that we have now raised Earth's atmospheric temperature by well over 1°C since preindustrial times. Twelve thousand years ago, Earth's climate stabilized and entered a geological era called the Holocene. This led to humans settling, establishing communities, and creating governments and our current economy. Now, that stable climate is gone, so we need to build a new economy based on our new reality. This is a multi-trillion-dollar transition and a tremendous opportunity for entrepreneurs.

Climate and Energy Verticals

The scale of climate and energy problems is so massive that they can be overwhelming. It is helpful to break them down into smaller categories or verticals to narrow the potential universe of

problems you could choose to solve. Here, we lay out 13 verticals that encompass most but certainly not all the problems you might consider in this space (see Figure 1.2). Note that some verticals might overlap—they're not mutually exclusive!

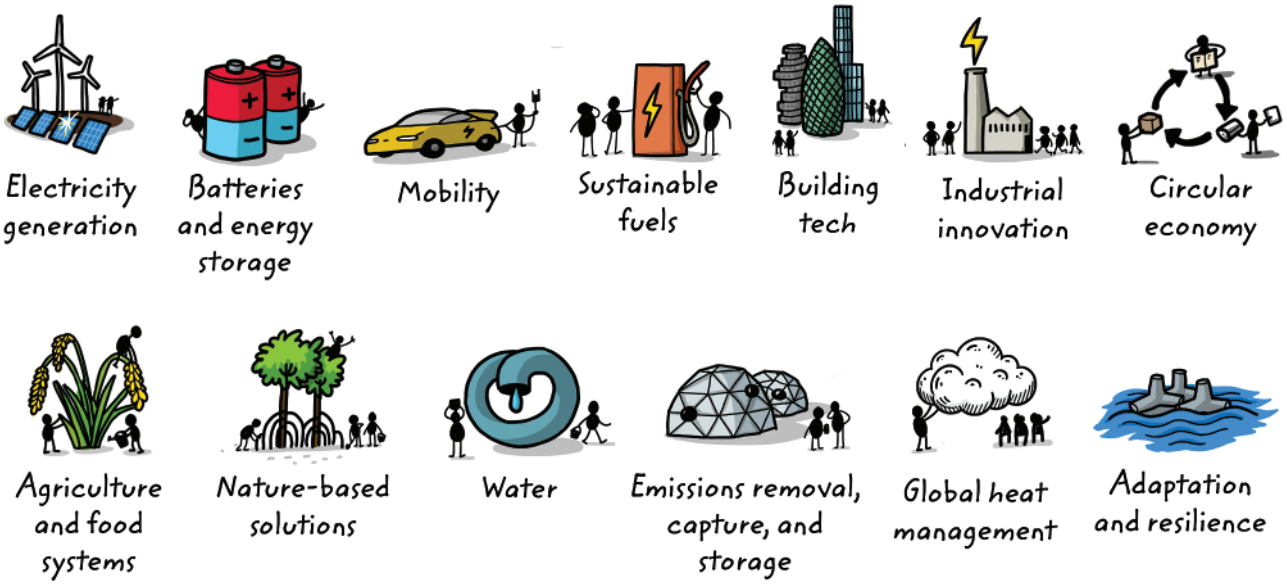


Figure 1.2: Climate and energy verticals.

- **Electricity generation.** Expanding the production of clean, low-emissions power.
- **Batteries and energy storage.** Finding ways to store energy for later use, enabling grid stability, integration of clean energy and electrification of transportation and industry.
- **Mobility.** Decarbonizing transportation by road, rail, air, or sea.
- **Sustainable fuels.** Introducing low-carbon alternatives to fossil fuels.
- **Building tech.** Reducing emissions from heating, cooling, and powering buildings.
- **Industrial innovation.** Seeking breakthroughs in manufacturing and heavy industry to reduce emissions, especially low-carbon cement, steel, and chemical production.
- **Circular economy.** Minimizing waste and maximizing resource efficiency by reusing, recycling, and redesigning materials and products across industries.
- **Agriculture and food systems.** Advancing practices and technologies that reduce emissions from farming, improve soil health, and create sustainable food production.

These verticals focus on reducing greenhouse gas emissions. This is currently the most common area of climate and energy innovation. Emissions from fossil fuels have been the primary driver climate change, so it makes sense that the world has focused on this problem. However, reducing emissions is no longer sufficient to avoid the worst climate impacts, so entrepreneurs must consider additional verticals as well:

- **Nature-based solutions.** Leveraging ecosystems to address climate challenges, including both mitigation of emissions and adaptation to climate impacts.
- **Water.** Ensuring reliable access to clean water for agricultural, industrial, and domestic use.
- **Emissions removal, capture, and storage.** Removing greenhouse gases from the atmosphere or capturing them at the source, and then either storing them permanently or repurposing them.
- **Global heat management.** Adjusting the earth's energy imbalance (put simply, this is the energy the earth receives from the sun minus the energy that it radiates back). We should not have to do this. It is and should be controversial, but highly credible organizations have been assessing options like releasing reflective particles into the atmosphere, adjusting global cloud cover, putting solar shades in space, and other ideas. We think this vertical will become more mainstream, just like emissions removal, which used to be a fringe concept.
- **Adaptation and resilience.** Helping people, economies, and ecosystems to withstand the impacts of climate change. The assumption of a stable climate is embedded in almost every aspect of civilization. As local climates shift, every community faces new risks, some acute (e.g., wildfires, storms) and some chronic (e.g., drought, changes in seasonal patterns). Climate adaptation is the process of responding to current hazards as well as preparing for future risks.

See Figure 1.3 for a visual representation of the role each of these verticals can play in addressing climate impacts.

Problem Segmentation

As you explore problems within climate and energy, we recommend a process called *Problem Segmentation*. This process can be used to explore problems in many other areas as well. The goal is to start with a public problem experienced at a high level across large swaths of society and break it down into a private problem faced by individuals or businesses who would be willing to pay to solve it. This framework comes from Jason Jay, director of the MIT Sloan Sustainability Initiative. Figure 1.4 shows in more detail what constitutes a public problem and what constitutes a private problem.

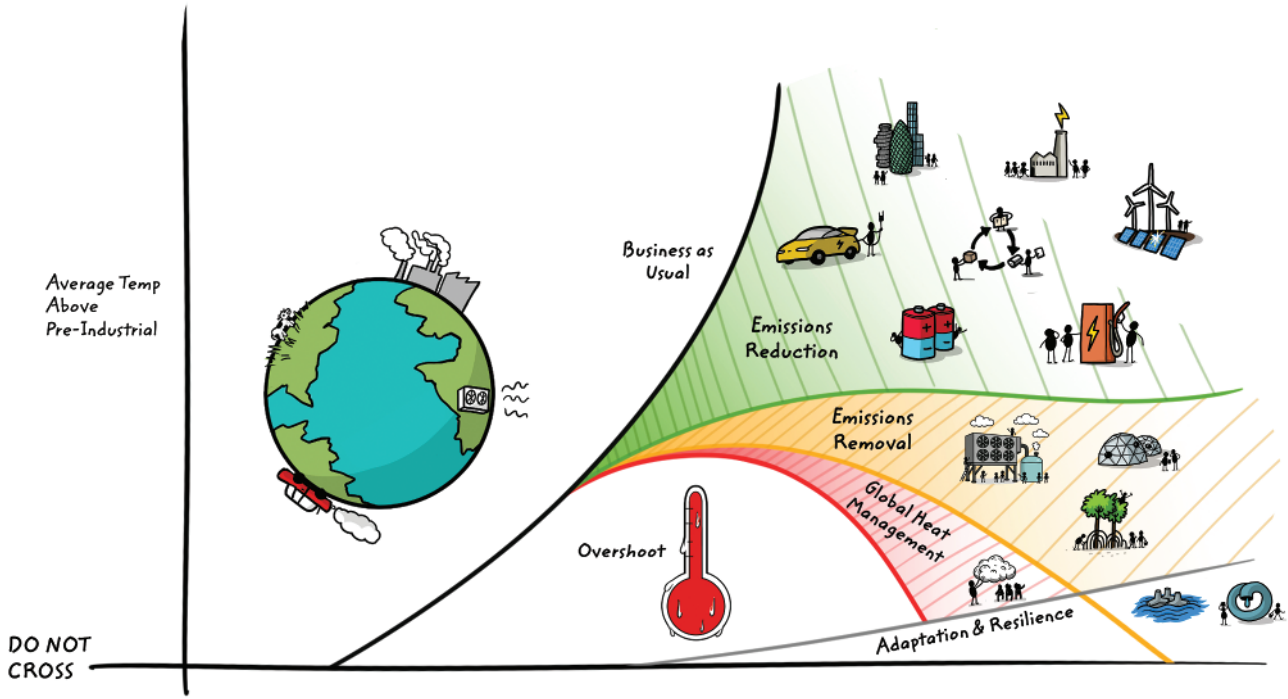


Figure 1.3: The big picture of climate and energy verticals. Adapted from the book After Geoengineering by Holly Jean Buck..

Public Problems	Private Problems
Concerned with properties of the whole "system" (economy, society, environment)	Concerned with issues as experienced by specific individuals and organizations
Considered among other public policy objectives and directions	Affected individuals and groups seek direct solutions
Debated in public conversations, mass media	Expressed relationally or in social media
Can scope down to private problems with specific beneficiaries	Can reveal infrastructure needs that are lurking public problems

Figure 1.4: Public problems and private problems, based on a framework developed by Jason Jay of the MIT Sloan Sustainability Initiative, who teaches it in his class "Innovating for Impact."

To do a Problem Segmentation, start by picking one of the climate verticals we mentioned. Then, articulate a public problem within that category. For climate and energy ventures, that problem will most likely be in terms of emissions or climate impacts. Other aspects might include social and financial considerations.

Once you have stated the public problem, list the relevant stakeholders:

- Who experiences the problem?
- Who does not experience the problem?
- Who contributes to the problem?
- Who has been excluded?

For each stakeholder, begin brainstorming subproblems. These are more specific questions about their relationship with the problem:

- How do they experience the problem?
- How do they contribute?

Keep drilling down into subproblems as much as you can. A great question to ask here is why? As you examine a problem's deeper layers, keep asking why? to get to its root cause.

When you complete this exercise, it should look something like Figure 1.5.

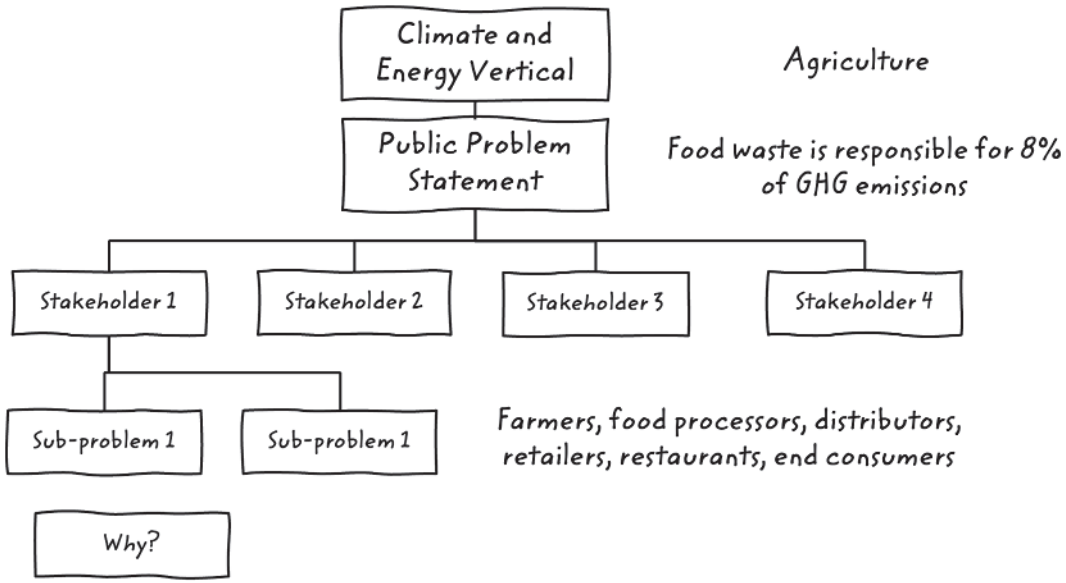


Figure 1.5: An example Problem Segmentation Tree.

At this point, we are brainstorming and learning. You can do this using only secondary market research (e.g., sources like market reports and articles). Generative AI can also be a useful tool to supercharge your process. However, directly interacting with people involved in your area of interest will be essential to fully understand the situation and possibilities. (We will discuss primary market research in Step 3.)

Estimate the Climate TAM for Each Segment

A key metric for each of your problem segments is what we have dubbed the Climate Total Addressable Market (Climate TAM). Whereas a traditional TAM analysis focuses on the private problem and its financial opportunity (see Step 10), your Climate TAM focuses on the public problem—what is the largest possible impact you could have on the climate?

A Climate TAM is a rough estimate of the opportunity before you have a specific solution in mind. If you are working on emissions reduction, a simple estimate is the relative share of emissions attributed to the problem you are trying to solve. You could also estimate your Climate TAM in terms of other metrics, such as emissions removed, warming avoided, lives saved, or economic losses prevented.

Your Climate TAM is not the only factor you should consider when deciding which opportunity to pursue, but it is an important one to think about early. It's not about getting precision; it's about understanding the order of magnitude of potential impact so you can feel confident that you are spending your time and effort in the right place. Before you build a climate and energy venture, you should ask yourself, "If I create this solution, and it becomes as big and successful as it could possibly be, would it have a meaningful impact on both people and the planet?" If the answer to that question is no, or in the more likely case, if you are unsure, then your Climate TAM is probably not big enough, and you should revisit your Problem Segmentation.

Output for This Step

After you have spent some time exploring the Problem Landscape, compile 5–10 of the most interesting and meaningful problems you've identified into a matrix like the one in Table 1.1.

Table 1.1: *Problem Landscape Matrix*.

Subproblem	Briefly describe a specific problem within the larger Problem Landscape you are exploring.
Stakeholders	Who experiences the problem? Who does not experience the problem? Who contributes to the problem? Who has been excluded?
Why?	Why does this problem exist? What contributing factors can you identify?
Climate TAM	What is the largest possible climate impact of solving this problem in terms of emissions reduced, emissions removed, warming avoided, lives saved, or economic losses prevented?

EXAMPLES

Spoiler Alert

Ricky Ashenfelter and Emily Malina began their entrepreneurial journey with a single statistic: up to 40% of food in the United States gets wasted.[1] Food waste is a major contributor to climate change. It is also a missed opportunity to feed people and for businesses to improve their bottom lines.

They knew that waste in the food industry was an important public problem, but they wanted to find a more specific private problem that they could tackle. Farms seemed too far away from the end consumer, and grocery stores and restaurants seemed too close. Eventually, they focused on food service distributors, who serve the restaurant industry and deal with some of the largest volumes of food and waste. What if those distributors had an easier way to donate excess food instead of throwing it away?

They launched a company called Spoiler Alert and landed the biggest food service distributor in the country as their first customer. However, there was not broad, replicable interest across the industry because most distributors are in the business of selling inventory, not giving it away. While they had found a pressing public problem, the private problem they had picked was not big enough to support a high-growth venture.

Ultimately, they pivoted and began working with large food brands to better manage excess and aging inventory. Their pivot reveals something important about exploring the Problem Landscape. While it may be the first step in the process, it never truly ends. Climate and energy entrepreneurs are constantly learning about problems, even many years into working on a solution.

MEER

As Ye Tao began researching problems in climate and energy, he realized that too little attention was being paid to the problem of heat. He left his former career running a lab at Harvard focused on high-resolution microscopes, and he founded a nonprofit called MEER (Mirrors for Earth's Energy Rebalancing). MEER applies reflective and infrared emissive materials to rooftops in areas at risk of extreme heat events, with initial projects in India, Sierra Leone, and California. This solution can reduce the internal temperature of a home by more than 6°C, which improves the quality of life in normal conditions and could be a literal lifesaver in a lethal heat wave.

In addition to the local cooling effect, there is also a global cooling effect. If people around the world adopt reflective rooftops, they will reflect enough energy back into space to meaningfully reduce Earth's temperature. For now, MEER's efforts are still small in scale, but they are researching and piloting solutions for freshwater reservoirs, coastal cooling, and agricultural water-saving that they or others can potentially implement at a larger scale in the future.

Ye's story highlights the importance of exploring the Problem Landscape as the first step in the journey of climate and energy entrepreneurship. By identifying an overlooked challenge like extreme heat, he was able to pivot his expertise toward a solution with both local and global impact.

Google

Many people within Google are looking to use the company's vast data and resources to make a dent in climate and energy problems. Juliet Rothenberg, product director of Google's Climate AI initiative, is one of those people. She aims to tackle big problems that are going to move the needle, so it might seem surprising that she worked on a partnership with American Airlines and Breakthrough Energy not to address the greenhouse gases emitted when planes burn fuel but rather to tackle contrails, the long skinny clouds that airplanes make during certain conditions.

Contrails trap heat in the atmosphere and surprisingly account for 35.3% of the airline industry's climate impact.[2] Lots of companies are working on the fuel problem—more efficient engines, sustainable aviation fuel, electrification, alternative transportation methods, and so on—but those solutions will take many years or decades, and new hardware and infrastructure, to bring to fruition. However, the team at Google realized that nobody was working to reduce contrails, and there was a relatively low-effort way to do so with software and procedure changes.

Google engineers spent thousands of hours poring over images to manually identify contrails, and they trained an AI model to do the same. The AI model could then determine parts of the atmosphere where contrails would likely form. Google shared that information with American

Airlines so their pilots could avoid those areas while in flight, reducing their impact at a very low cost. The changes are not even noticeable for passengers.

This example shows the importance of thinking beyond the climate and energy problems that we are aware of in our daily lives. Before you start developing a solution that may take decades to bring to market, you might just find a simpler solution lurking behind a different problem.

ADDITIONAL RESOURCES

There are additional resources for this step at www.de4cev.com/step1, including the following:

- Problem Segmentation Worksheet
- Spoiler Alert Case Study
- MEER Case Study
- Google Case Study
- Links to a multitude of informational resources on climate change, including Project Drawdown, Woodwell Climate Research Center, Probable Futures, the Intergovernmental Panel on Climate Change, and Open Minds.

Additional resources will be added as new and updated examples and information become available.

Notes

1. Dana Gunders, "Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill." *Natural Resources Defense Council*, August 16, 2017. https://www.nrdc.org/resources/wasted-how-america-losing-40-percent-its-food-farm-fork-landfill.
2. https://sites.research.google/contrails/.