
THE CLIMATE KIDS

Billions to Save Trillions...

Docudrama Film Manuscript

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Summary

A brilliant M.I.T. freshman and her classmates discover the world's leaders are catastrophically wrong about climate change. National policies focus on reducing carbon dioxide emissions (“decarbonization”). However, harm comes from global warming—and warming is primarily caused by 150 years of *past* carbon dioxide emissions, methane emissions, melting sea ice, etc.

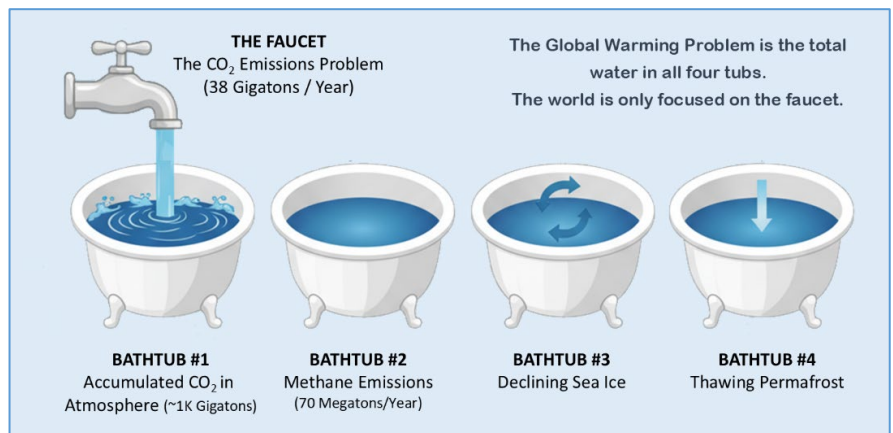
In other words, national leaders are trying to solve the wrong problem.

The freshmen respond by launching a campus-wide quest to design a “climate moonshot”: a massive R&D program aimed at solving the whole problem before it is too late.

Synopsis

NANCY, a petite Asian-American with a bouncy, irrepressible energy enters M.I.T. hoping to prove she belongs. Within days, she discovers a problem so large that belonging is no longer enough; she needs to lead.

The first lecture that she attends is riveting. The charismatic climate professor shatters the students' worldview with a simple metaphor: the climate problem is like a faucet with several bathtubs. The faucet, he explains, represents annual carbon emissions—40 billion tons of carbon dioxide per year. The first bathtub represents warming from a trillion tons of carbon dioxide accumulated in the atmosphere over 150 years. The water in the other tubs is due to other warming sources, such as methane emissions. Ultimately, multiple sources of warming combine and increase the planet's temperature.



He reveals a terrifying truth: global policy, media, and activism are all obsessed with slightly turning down the faucet, while completely ignoring the fact that the water already in the tubs is what's causing catastrophic global warming. In other words, the planet is heading toward disaster, and the people responsible for fixing it are focusing on the wrong problem.

Over lunch the freshmen consider the following question: What is more likely to solve the climate problem, a million confused adults or several caffeinated M.I.T. freshmen? They conclude the freshmen. Yet how might they get started? An upperclassman suggests they seek out former US Secretary of Energy, Professor Anthony Stone.

They find Stone sitting on a park bench feeding pigeons.

NANCY: Is it possible for a few freshmen to solve the climate problem, and if so, how?

STONE: You have more power than you know.

NANCY: Tell us about our secret power?

STONE: Billions to save trillions.

NANCY: Explain.

STONE: Billions of additional dollars for R&D, to save trillions of dollars in climate-related costs.

NANCY: But what might be developed that is not already being worked on?

STONE: This is for you to identify.

NANCY: But how?

STONE: Your second secret power.

NANCY: Which is?

STONE: Your campus.

NANCY: We ask professors what they would do with billions of dollars for additional R&D?

STONE: That's it.

NANCY: And we record the responses, feed them to AI, and generate a summary document?

STONE: Now you're thinking.

NANCY: What might we call this document?

STONE: A plan to save the planet.

Unsettled and fascinated, Nancy and her classmates canvass the campus in search of professors and former leaders in climate science, aerospace engineering, atmospheric research, business management, and economics. Each expert gives them one piece of a larger answer.

They conclude the world's current approach is destined to fail for two primary reasons:

- (a) The current plan is to transition to a green economy, at a greater cost. However, no one benefits by reducing their own carbon dioxide emissions. They are too small. Instead, each person wants the other 8 billion people on the planet to collectively reduce theirs. In other words, the world's current plan requires people to do things they will not do. Nancy and her friends conclude the only solution is to do R&D, to the extent required, to reduce the cost of green energy, to below that of fossil fuel.
- (b) The current climate plan distributes responsibility downward — from nations, to regions, to agencies, to individuals — until no one is responsible for solving the whole problem. Nancy and her friends reach a radical conclusion: the world needs a new kind of laboratory; one explicitly tasked with solving climate change end-to-end. Not managing it. Not slowing it. Solving it. But what would such a lab actually do? A summary of their interviews becomes the business plan for a new Climate Moonshot laboratory.

Is it possible for a few freshmen to solve the climate problem?

They're about to find out.

Principal Characters

- **NANCY:** A petite 18yo Asian-American M.I.T. freshman; brilliant, energetic, impatient with vague answers, and driven by a need to do something real.
- **SAM (NERVOUS):** The nervous student. Smart and anxious; asks the fearful questions the audience is thinking.
- **LEO (COMIC):** The comical student. A skateboarder with a fast mouth and a surprisingly sharp grasp of systems failure. LEO often wears a baseball cap backwards.
- **MAYA (BUSINESS):** The practical student. Focuses on money, feasibility, incentives, and what people will actually do.
- **ETHAN (ENGINEER):** The engineering student. Thinks in systems, lists, machines, and flows of material.
- **ASHA:** Pacino’s graduate teaching assistant. Sharp, fast, and comfortable with models, slides, and climate data.
- **REA:** Residential advisor for NANCY’S dormitory (“den mother”). A 25yo graduate student in chemistry, with a grasp of how things work both at M.I.T. and the state of Massachusetts.
- **PROFESSOR ROBERT PACINO:** Climate science professor. Charismatic, blunt, and theatrical.
- **PROFESSOR ANTHONY STONE:** Former U.S. Secretary of Energy and professor. A park-bench philosopher with an expansive knowledge of energy.
- **PROFESSOR SUNLIGHT:** An expert in sunlight reflection and stratospheric aerosol concepts.
- **PROFESSOR AEROSPACE:** An aircraft and operations expert who understands how reflectivity systems could be built and tested.
- **PROFESSOR ATMOSPHERE:** A climate-model and field-experiment expert.
- **PROFESSOR BUSINESS:** A gruff former CEO who understands organization structure, money flow, and large technical teams.
- **PROFESSOR ECONOMICS:** A systems-minded economist who explains why society remains confused about climate.
- **UN CLIMATE STAFFER:** A senior staffer who sees the students’ materials and asks for a concise proposal.

ACT I - THE CLIMATE PROBLEM

SCENE 1 - TITLE CARD: THE QUESTION

Black screen.

NARRATOR: What would it take to solve the *entire* climate problem?

Not slow it.

Not talk about it.

Just solve it.

NARRATOR: Could a surge of research and development do what politics has failed to do?

And if so—
what would be developed,
who would develop it,
and how much would it cost?

On screen, words appear slowly, with a small planet Earth in the background surrounded by stars.

WHAT WOULD IT TAKE
TO SOLVE THE ENTIRE
CLIMATE PROBLEM?

Cut to a morning aerial shot of M.I.T. The Charles River glints. Students hurry across campus. A bicycle bell rings. A skateboard clatters on stone.

On screen:

THE CLIMATE KIDS

SCENE 2 - INT. NANCY ARRIVES AT MIT TO BEGIN HER FRESHMAN YEAR

NANCY arrives at M.I.T. to begin her freshman year. A car pulls up in front of a dorm. Out pops Nancy, her mother, her father, her younger sister, and younger brother.

NANCY'S FATHER: You're going to do great. We have confidence in you!

NANCY'S MOTHER: Just remember to study!

NANCY: I will.

Hey, I would not be here if it was not for you two.

You are the best parents ever!

NANCY'S MOTHER, FATHER, SISTER, and BROTHER: We love you!!!

NANCY: Hey, I love you too.

Tears begin to flow from Nancy's parents, due to a profound sense of pride.

Nancy tears up herself as she gives them a big hug, turns around, and walks toward her dorm.

SCENE 3 - INT. NANCY CHECKS INTO DORMITORY

NANCY finds REA in front of a counter in the dormitory lobby. REA is a 25yo graduate student in chemistry and is the dorm's residential advisor ("den mother").

NANCY: Hi. My name is Nancy Chen.

REA: I'm REA, and I'm the residential advisor for the dorm.

Welcome to M.I.T.

NANCY: Thank you so much. I'm looking forward to college.

REA: Hey, if you run into any problem, with anything, just put it on my shoulders and let me handle it.

NANCY: Wow. That's great.

REA: Here, let me introduce you to several incoming freshman.

REA walks over to a couch and several chairs where several freshmen are chatting.

REA: This is LEO, he grew up on a farm in Montana,
and he has a quick wit.

LEO (COMIC): Hey there.

NANCY: Hi.

REA: This is SAM. He grew up in New York City,
and attended the Bronx High School of Science.

SAM (NERVOUS): It is a pleasure to meet you.

NANCY: Hi there.

REA: This is MAYA. She grew up in Connecticut and is interested in business.

MAYA (BUSINESS): Hi there.

NANCY: Hey.

REA: And this is ETHAN. He's from California and he's interested in engineering.

ETHAN (ENGINEER): Hi.

NANCY: Hey.

I'm looking forward to learning about science and engineering.

MAYA (BUSINESS): Maybe we'll end up doing something big in our careers?

LEO (COMIC): Maybe *you'll* end up doing something big.

I think I'll end up scooping ice cream somewhere.

The kids laugh.

NANCY: Hey. Ice cream is important.

The kids nod.

SCENE 4 - EXT. MIT CAMPUS WALKWAY - LATER

CLIMATE PROFESSOR ROBERT PACINO, late sixties, charismatic and fast-moving, walks toward the lecture hall with a leather folder tucked under one arm. Students recognize him the way other people recognize actors.

SAM passes on a bicycle, brakes too hard, and nearly tips over.

SAM (NERVOUS): Hello, Professor!

PACINO: Hey there.

LEO rolls by on a skateboard, backward, reckless but controlled.

LEO (COMIC): How's the planet doing?

PACINO: Don't get me started.

LEO (COMIC): Jeez.

Nancy hurries past them. She sees the course title on the door: CLIMATE 100.

She takes a breath, squares her shoulders, and walks in.

SCENE 5 - INT. CLIMATE CLASS – PROF PACINO

The room is semicircular, part seminar room, part theater. Twelve students sit around a large table. On the wall: a blank white screen. Pacino stands at the front, letting the silence settle.

PACINO: Welcome to Climate 100.

Nancy leans forward. Sam opens a notebook and writes every word. Leo balances a pencil under his nose.

PACINO: I don't want to make anyone nervous,
but the issues that we will discuss are of profound importance.

The room tightens. Everyone knows the topic. Nobody knows where he is going.

PACINO: I will begin by asking for a favor.

I request that you forget what you've previously learned about climate change.

Just put it out of your mind.

Pacino is known as a grumpy curmudgeon.

Much of it is probably wrong in some way.

Instead, I would like you to mentally start with a blank piece of paper.

And on this paper, build an understanding of climate,
based on basic principles of science, engineering and economics.

First, we need the physics. Asha?

ASHA, a graduate teaching assistant, steps to the screen. A slide appears: GLOBAL WARMING.

Global Warming

ASHA: Hi. My name is Asha, and I'm going to summarize global warming in 100-seconds.

We are going to move fast, so hold onto your seats.

A simple periodic table appears and Carbon is highlighted.

ASHA: Carbon is an element on the periodic table.

A slide appears with pictures of coal, oil and natural gas.

ASHA: It is contained in coal, oil, and natural gas.

A slide appears with pictures of smoke and graphics showing molecules.

ASHA: When these fuels are burned, carbon atoms mix with oxygen from the air to produce carbon dioxide gas.

Sam scribbles with intense focus.

ASHA: That gas is emitted into the atmosphere, and much of it stays there for hundreds of years.

A slide appears with a cloud of smoke and the text, "1 trillion tons of CO₂"

ASHA: Over the last 150 years, roughly one trillion tons of additional carbon dioxide has built up in the atmosphere.

Leo winces as if physically hit by the number.

A slide appears showing rays of sunlight hitting the earth.

ASHA: Sunlight passes through this additional carbon dioxide and warms the planet's surface. The planet then emits heat radiation back toward outer space.

A slide appears showing rays of heat going out and being absorbed by CO₂ in atmosphere.

Also, the additional carbon dioxide absorbs the outgoing radiation more than the incoming light; and this causes the planet to heat up.

Camera focuses on Asha as she moves her hands.

ASHA: There are other processes that also cause the planet to heat up, such as methane emissions and declining sea ice.

These processes add together to yield total warming.

A slide appears with a temperature vs. time graph. The title "Global Warming" appears at the top. The text "0.3 degrees-per-decade" appears next to a line in the graph.

ASHA: Today the average temperature of the planet is increasing at roughly three-tenths of a degree Celsius every ten years.

Camera switches to Asha with a concerned look.

ASHA: This is commonly known as global warming.

Asha winces.

ASHA: And it is bad.

ASHA: Ok. Any questions?

The Carbon Tax Question

MAYA (BUSINESS): If it is bad, why don't we just levy a tax on carbon dioxide emissions?

PACINO: That will not fix the warming problem.

MAYA (BUSINESS): Why not?

PACINO: To answer that question, we need to quantify the impact of *your* proposed policy.

MAYA (BUSINESS): Mine?

PACINO: Yes. *Yours.*

To do this, we need software, an example of which is called En-ROADS.

This was developed by people at M.I.T.,
and can be accessed for free with a web browser.

Asha pulls up an En-ROADS-style graph on her computer.

PACINO: Let's ask EN-ROADS what would happen if we doubled the cost of fossil fuel worldwide with taxes.

Leo quietly raises both hands in fake prayer

SAM (NERVOUS): I don't think that's politically feasible.

PACINO: It's not. Yet let's ignore that for a moment, and see what this would do to the temperature of the planet.

ASHA: This graph estimates future global temperatures both with and without your massive tax.

MAYA winces. She's feeling nervous.

MAYA (BUSINESS): Mine?

ASHA: Yes, yours.

MAYA (BUSINESS): Ok.

ASHA: The displayed temperatures are relative to where we were about 150 years ago. As you can see, we get runaway climate change both with and without *your* tax.

SAM (NERVOUS): I think the main point here is, a tax that is prohibitively expensive will not fix this.

ASHA: That's right.

MAYA puts a hand over her mouth and whispers.

MAYA (BUSINESS): Damn it.

Nancy looks up from her notes, and exhales. The familiar climate-policy picture is beginning to crack.

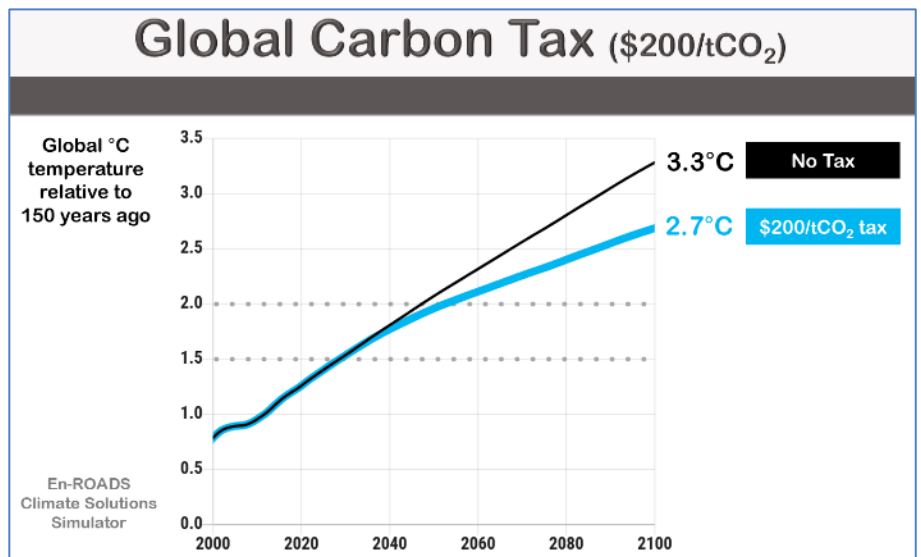
NANCY: Wait. If a massive carbon tax does not fix the warming curve, then what exactly are we all arguing about?

PACINO: That's a very good question.

What Actually Causes Warming?

NANCY: Professor, excuse me.

I thought carbon dioxide emissions cause global warming, and switching to green energy will solve the problem.



PACINO: That's only slightly correct.

ASHA: Very slightly.

PACINO: As I noted previously,
much of what you've been taught is probably wrong in some way.

SAM (NERVOUS): Yikes.

ETHAN (ENGINEER): I think we're hitting the question of, "What causes global warming?"

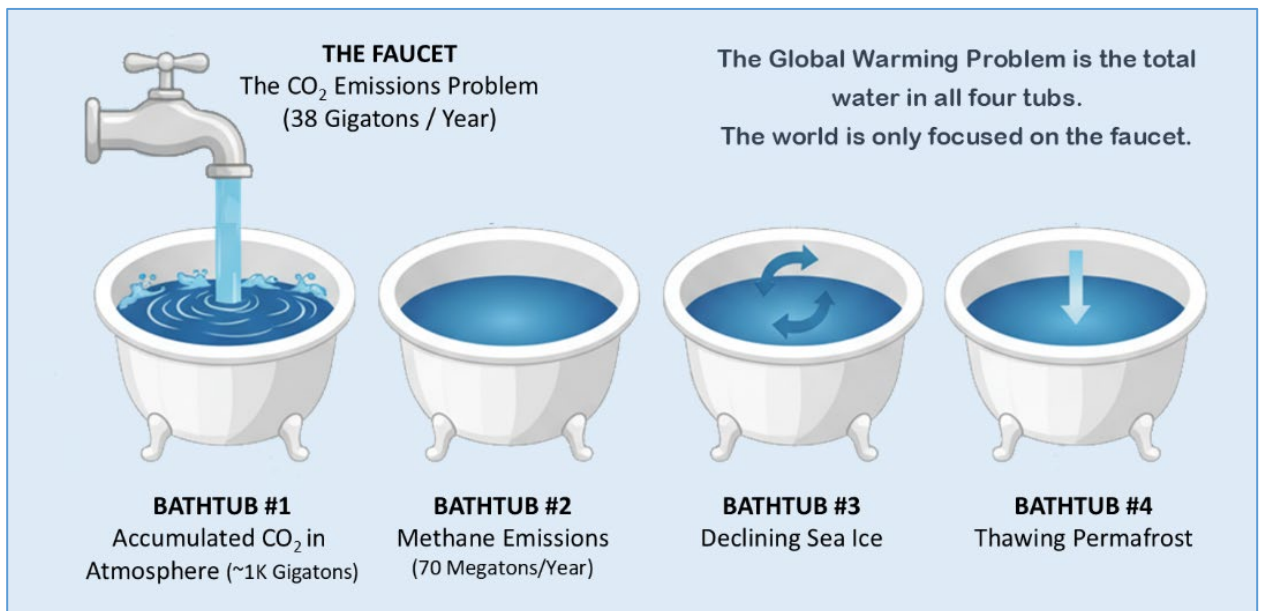
PACINO: That's correct.

And to understand that, we need to understand climate change.

Asha, please give us a 100-second summary of how this works.

Climate Change (faucet and bathtubs)

The screen changes. Four old-fashioned bathtubs appear under a faucet.



ASHA: Climate change is like a faucet with several bathtubs.

PACINO: I like to boil things down to 100-second summaries.

This helps us focus on the big ideas.

Details just clutter the mind.

Asha, please continue.

Asha taps the faucet with a pointer.

ASHA: The faucet represents carbon dioxide emissions,

Asha circles the tubs with a pointer.

ASHA: while the combined water in the tubs represents global warming.

Asha taps the faucet with a pointer.

ASHA: The flow of water at the faucet is proportional to the amount of carbon dioxide emitted into the atmosphere each year.

Asha circles all tubs with a pointer.

ASHA: And the combined water in the tubs is proportional to the increase in Earth's temperature each year.

Asha taps first tub with a pointer.

ASHA: The water in the first tub is due to 150 years of past carbon dioxide emissions, not one year's emissions.

Asha circles all tubs with a pointer.

While the water in the other tubs is due to other warming sources such as methane emissions, declining sea ice, etc.

Focus on Asha

ASHA: Ultimately, multiple sources of warming combine to increase the planet's temperature.

SAM (NERVOUS): So, turning down the faucet helps a bit, yet does not remove water already in the tubs.

ASHA: That's right.

Government Emissions Policy

NANCY: Excuse me professor. Is it possible to fix the climate problem with a government policy that reduces carbon dioxide emissions?

PACINO: No.

Nancy winces.

PACINO: Global policy, media, and activism are all obsessed with slightly turning down the faucet, while completely ignoring the fact that water already in the tubs is what's causing catastrophic global warming.

LEO (COMIC): So, while the planet heads towards disaster, the people responsible for fixing it, are trying to solve the wrong problem?

PACINO: Yes.

LEO winces as he writes in his notebook "Adults are crazy". When finishes, he underlines the words.

The World's Climate Plan is not Realistic.

ETHAN (ENGINEER): I think we're hitting the question of, "What is a plan that fixes this?"

PACINO: That's correct.

MAYA (BUSINESS): Didn't the United Nations hire thousands of scientists to drum up a climate plan?

PACINO: Yes. That group is called the Intergovernmental Panel on Climate Change, or IPCC. They publish thousands of pages of reports, and those reports contain a so-called climate plan. However, their plan has problems.

MAYA (BUSINESS): What kind of problems?

PACINO: For one, it is based on the idea that people will spend money when they do not benefit.

And, according to basic principles of economics, that is not how the world works.

ETHAN (ENGINEER): Explain.

PACINO: If one consumer pays money to reduce their own carbon dioxide emissions, that consumer will not benefit. Their emissions are too small. They only benefit if the other eight billion people on the planet act collectively.

MAYA (BUSINESS): So, the incentive for each individual is to minimize their climate costs and hope others will act.

PACINO: That's correct. Economists refer to this as the Prisoner's Dilemma problem.

MAYA (BUSINESS): Who are we talking about? Consumers? Companies? Governments?

PACINO: All of them.

LEO (COMIC): So, you're saying the world's climate plan is bad?

PACINO: I prefer the term "realistic." The world's climate plan is not realistic.

MAYA (BUSINESS): So, it's not going to work.

PACINO: That's right.

NANCY: Ok. So, what's an example of a plan that *will* work?

PACINO: You mean one that prevents runaway global warming, while not requiring people to do things they will not do?

NANCY: Yes, please.

PACINO: I've never seen a climate plan I like.

A First Glimpse of the Moonshot

ETHAN (ENGINEER): What about this?

What if we split the climate problem into two primary parts and do R&D, to the extent required, to resolve each?

PACINO: Go on.

ETHAN (ENGINEER): The faucet is one part, while the water in the tubs is the other.

PACINO: And how would you do R&D to resolve each?

MAYA (BUSINESS): For the faucet problem, we need green energy to cost less than fossil fuel-based energy.

Consumers and companies would switch over to save money.

NANCY: And for the warming problem, we need to figure out how to reflect sunlight back into outer space, to offset warming, with cooling.

MAYA (BUSINESS): You mean at a reasonable cost, and without harm.

NANCY: That's right.

PACINO: A surge of R&D aimed at solving the whole climate problem is sometimes referred to as a "climate moonshot."

An intense look appears on NANCY's face.

PACINO: This idea has been suggested.

However, no one has clearly defined where the money comes from, where it goes, what it does, or who manages it.

He looks around the room and lets the challenge hang.

PACINO: If you can figure those things out, you can potentially save the planet from climate change.

The bell rings. Nobody moves.

PACINO: Ok. Class dismissed.

ACT II - THE CLIMATE SOLUTION

SCENE 6 - INT. DINING HALL - LUNCH

Several students gather at a long table. Trays, laptops, half-finished drinks, and notebooks pile up. Nancy is still thinking about the bathtubs.

SAM (NERVOUS): This climate thing is a big mess.

SAM (NERVOUS): Yeah. The adults are crazy for creating it.

LEO (COMIC): Oh, I agree.

NANCY: I think they're doing their best.

SAM (NERVOUS): Hey. Who is crazier, the adults that deny the problem exists, or the adults that are trying to fix it without a plan?

MAYA (BUSINESS): Sam, that's a very good question.

LEO (COMIC): I think all adults are crazy.

NANCY: Perhaps students can fix this?

MAYA (BUSINESS): Fix what?

NANCY: The climate problem.

ETHAN (ENGINEER): What part of it?

NANCY: The whole thing.

MAYA (BUSINESS): The entire climate problem?

NANCY: Yeah.

SAM (NERVOUS): How?

NANCY: No idea.

LEO (COMIC): Damn it.

REA is at the end of the lunch table where she is reading a book. NANCY looks toward REA.

NANCY: Hey Rea.

REA: Hi there.

NANCY: I have a question. This might sound a little crazy.

REA: Hey, crazy is fun. Hit me.

NANCY: Ok. Here it is. I

is it possible for a few caffeinated M.I.T. freshmen to solve the entire climate problem, and if so, how?

REA: That does sound a little crazy. Also, I must admit, it's a good question.

Ok. You need to talk to the person who knows the most about this.

SAM (NERVOUS): Right. So, who's that?

REA: Probably Professor Stone. He used to be the United States Secretary of Energy.

ETHAN (ENGINEER): You mean his boss was the President of the United States?

REA: That's right. Stone is now retired, but he has open office hours every day at 5pm. Appointment not needed.

MAYA (BUSINESS): Wow. That's awesome.

NANCY: Where's his office?

REA: It's a bench in the park across the river. He chats with students while feeding pigeons.

NANCY does a thumb's up motion, and the other students follow. NANCY says to REA:

LEO (COMIC): I like this guy.

NANCY: We're on it.

SCENE 7 - EXT. STUDENTS DANCE ON SUBWAY TRAIN – Sundown

NANCY, LEO, MAYA, and ETHAN dance to disco beat music while on a subway train that crosses the Longfellow bridge at sundown with Boston and the Charles River in the background. The lighting is warm due to the setting sun. Their mood is not casual happiness. It is the strange euphoria of young people who have just convinced themselves that an

impossible problem might have a path forward. This causes them to smile while dancing, as they embark on a potentially historic journey. There is no dialog in this scene.

NOTE: Being wired with energy is typical for 18-year-olds; however, the energy level experienced by “the climate kids” is extreme due to the importance of their mission.

SCENE 8 - EXT. PROF STONE ON BENCH FEEDING PIGEONS

Professor ANTHONY STONE sits on a bench at sundown with a paper bag of birdseed. Pigeons orbit him like a tiny bureaucracy. Nancy approaches with Sam, Maya, Ethan, and Leo.

NANCY: Professor Stone I presume.

STONE: Depends on who’s asking.

NANCY: I’m Nancy. This is Leo, Maya and Ethan; and we’re M.I.T. freshman.

STONE: It is a pleasure to meet you.

NANCY: We have a not-so-simple question.

STONE smiles.

STONE: I like a good challenge.

NANCY: Ok, here it is.

Is it possible for a few freshmen to solve the climate problem, and if so, how?

STONE: Hm. I see where this is headed.

STONE pauses as he thinks.

Ok.

STONE pauses some more as he thinks about his response.

You have more power than you know.

LEO (COMIC): Ok. So, tell us about our secret power.

STONE: Billions to save trillions.

MAYA (BUSINESS): Explain.

STONE: Billions of additional dollars for R&D,
to save trillions of dollars in climate-related costs.

MAYA (BUSINESS): You mean the world can justify a billion-dollar R&D surge for climate.

STONE: That’s right.

ETHAN (ENGINEER): But what would be developed that is not already being worked on?

STONE: That’s for you to figure out.

NANCY: Ok. But how might we do that?

STONE: Your second secret power.

MAYA (BUSINESS): Which is?

STONE: Your campus.

NANCY: Oh, I see.

We ask professors what they would do with billions of dollars for additional R&D?

STONE: That's right.

ETHAN (ENGINEER): We could record the responses, feed them to AI, and have AI generate a summary document.

STONE: Now you're thinking.

MAYA (BUSINESS): But, what might we call that document?

STONE: A plan to save the planet.

LEO (COMIC): Hey, could we get credit for this?

STONE: Probably not.

LEO (COMIC): Damn it.

MAYA (BUSINESS): The world is focusing on reducing future carbon dioxide emissions. However, global warming is caused by past emissions and other things. It seems the people responsible for climate are confused.

STONE: They are.

LEO (COMIC): What is more likely to succeed,
a million confused adults or several clear-minded freshmen?

STONE: I would put my money on the freshman.

Sam breaths in. The weight of the world's problems is making him feeling nervous.

SAM (NERVOUS): Ok then.

MAYA (BUSINESS): Who do we talk to first?

STONE: I suggest you reach out to Professor Sunlight, and ask him about his sulfur trick.

Students nod.

NANCY: Ok.

SCENE 9 - INT. SUNLIGHT PROFESSOR

Professor Sunlight's office is full of sky photographs, aerosol diagrams, and a model airplane hanging from the ceiling. Nancy places her phone on the table to record. We are indoors, during the day, while sunny.

MAYA (BUSINESS): Professor, thank you for meeting with us.

PROFESSOR SUNLIGHT: How might I help you today?

NANCY: We want to learn more about reflecting sunlight.

PROFESSOR SUNLIGHT: I see. You want to offset global warming, with cooling, to prevent runaway climate change.

SAM (NERVOUS): Yes, please.

The Sulfur Trick

PROFESSOR SUNLIGHT: Ok. In theory, airplanes could spray sulfur-based gases into the upper atmosphere, to reflect a small fraction of sunlight back into outer space.

ETHAN (ENGINEER): Why sulfur?

PROFESSOR SUNLIGHT: Sulfur is already present in coal and oil and is therefore released when these are burned.

Also, sunlight reflects off sulfur in atmosphere.

In principle, sulfur could be harvested from fuel before combustion, transferred to aircraft, and emitted at high altitude, instead of at ground level.

MAYA (BUSINESS): You're talking about changing the emissions site, and not increasing total sulfur emissions.

PROFESSOR SUNLIGHT: That's right. We're looking at moving sulfur, not increasing it.

MAYA (BUSINESS): Why does moving it reduce the planet's temperature?

PROFESSOR SUNLIGHT: Sulfur emitted at a high-altitude stays aloft for one to two years; while ground-level sulfur typically stays aloft for hours to days. Therefore, changing the emissions site increases the amount of sunlight reflected without increasing total sulfur emissions.

NANCY: And this reduces the planet's temperature?

PROFESSOR SUNLIGHT: Yes.

SAM (NERVOUS): Isn't sulfur harmful to living things?

PROFESSOR SUNLIGHT: Yes, and that's why we would rather not increase total sulfur emissions. However, moving it from ground level to a high altitude should be okay.

Mitigation Costs vs. Adaption Costs

MAYA (BUSINESS): How much might this cost?

PROFESSOR SUNLIGHT: Some studies suggest this could cost tens of billions of dollars per year.

ETHAN (ENGINEER): To solve the global warming problem?

PROFESSOR SUNLIGHT: Yes.

If done enough, this would cause the average temperature of the planet to peak, and then drop back down.

SAM (NERVOUS): I think they call that "bending the global warming curve."

PROFESSOR SUNLIGHT: That's right.

MAYA (BUSINESS): How much might it cost, if we *don't* bend this curve?

PROFESSOR SUNLIGHT: Preventing global warming is called *Mitigation*; while not preventing it is called *Adaptation*.

MAYA (BUSINESS): Ok. So, how much might *Adaptation* cost?

PROFESSOR SUNLIGHT: The world's gross domestic product is about 120 trillion dollars a year. If climate change caused it to decrease 10%, for example, that would cost 12 trillion dollars each annually.

SAM (NERVOUS): So, from a purely financial perspective, *Mitigation* might cost tens of billions of dollars, while *Adaptation* costs 12 trillion.

PROFESSOR SUNLIGHT: Yes. However, all of these numbers are gross estimates.

Reflectivity Motivation

SAM (NERVOUS): When might we see multi-trillion-dollar-per-year *Adaptation* costs?

PROFESSOR SUNLIGHT: Perhaps 10 to 25 years from now.

NANCY: What might we see first?

PROFESSOR SUNLIGHT: Ocean currents in the Atlantic carry warm water from the equator to Europe, and if these weaken, the climate in Europe would look more like that of Southern Canada.

And this would result in less food production in Europe, and other problems.

SAM (NERVOUS): I see.

So, if Europeans see ocean currents weaken,
interest in reflecting sunlight would increase.

PROFESSOR SUNLIGHT: That's right.

LEO (COMIC): What about the Chinese? What would pique their interest?

PROFESSOR SUNLIGHT: Their farms need water from rivers,
and their rivers need water from snow.

If food production declines, their interest in reflecting would increase too.

Reflectivity Plan

ETHAN (ENGINEER): How much sunlight needs to be reflected and when?

PROFESSOR SUNLIGHT: Something like 1% of sunlight by the year 2040.

However, this is a rough estimate.

NANCY: If we did this, what needs to be done between now and then?

PROFESSOR SUNLIGHT: You're talking about a reflectivity plan.

NANCY: That's right.

PROFESSOR SUNLIGHT: Professor Aerospace knows the most about this.

He used to be the CEO of a company that maintained hundreds of large airplanes.
So, he knows how to build fleets of planes to do stuff.

MAYA (BUSINESS): Wow, that's great. Hey, we want to thank you for helping us.

PROFESSOR SUNLIGHT: It is admirable that students like yourselves are not afraid to think big.

NANCY: Excuse me professor.

We want to do more than think big.

We want to save the planet from climate change.

PROFESSOR SUNLIGHT: For real?

SAM (NERVOUS): Oh yes.

PROFESSOR SUNLIGHT: Well, in that case, I wish you godspeed.

SCENE 10 - INT. AEROSPACE PROFESSOR

A large room with aircraft components, drones, wing sections, and safety signs. Professor Aerospace walks them past a mock-up of a fuel system. We are indoors, during the day, while sunny.

MAYA (BUSINESS): Thank you for meeting with us.

PROFESSOR AEROSPACE: I enjoy chatting with students

ETHAN (ENGINEER): We're looking for a Reflectivity Plan that solves the global warming problem.

Reflectivity Plan

PROFESSOR AEROSPACE: I see. I think a Reflectivity Plan would entail 3 phases.

Phase I is R&D.

Phase II is experimental operations.

Phase III is construction.

And then you have full-scale operations.

Phase I - R&D

NANCY: Ok. Tell us about Phase I.

PROFESSOR AEROSPACE: There are two parts to Phase I.

One part involves conducting experiments;
while the other part involves developing large-scale sulfur handling equipment.

ETHAN (ENGINEER): Alright. What kind of experiments?

PROFESSOR AEROSPACE: There are primarily two types of experiments.

One type involves airplanes that sprays a sulfur-based mist,
while the other type is similar yet sprays a gas instead of a mist.

And the mist would be monitored for several hours,
while the gas is monitored for several weeks.

ETHAN (ENGINEER): What are we looking for?

PROFESSOR AEROSPACE: We want to measure how much sunlight is reflected,
and how the material changes over time.

And, we want to look for harm of some kind.

MAYA (BUSINESS): Is it easy to do these experiments?

PROFESSOR AEROSPACE: Not really.

The spray and monitoring equipment would need to be developed,
and this takes time and money.

ETHAN (ENGINEER): So, we're talking about hiring engineers.

PROFESSOR AEROSPACE: Yes. Lots of engineers.

NANCY: You mentioned Reflectivity Plan Phase I involves experiments and also involves
developing large-scale sulfur handling equipment. Tell us about the sulfur equipment.

PROFESSOR AEROSPACE: During full-scale operations, we would need large aircraft that
moves something like one hundred tons of sulfur gas into the upper atmosphere, every
several hours.

And, to do this at reasonable cost, we probably need to automate flying, refueling, and
reloading.

And, we might need one-hundred to two-hundred aircraft.

LEO (COMIC): Wow. That's a lot of stuff.

PROFESSOR AEROSPACE: Oh yes.

And, before we build hundreds of planes, we need to build one.

MAYA (BUSINESS): Let me guess. Developing that first plane is part of Reflectivity Phase I?

PROFESSOR AEROSPACE: That's right.

We're looking at modifying a Boeing triple-seven airplane, which is quite large.

ETHAN (ENGINEER): What kind of modifications?

PROFESSOR AEROSPACE: We need to put a tank of sulfur gas in the belly,
and route a pipe from the tank to behind the plane.

ETHAN (ENGINEER): So, you spray the gas behind the plane, not in front?

PROFESSOR AEROSPACE: That's right.

NANCY: How much might Phase I cost?

PROFESSOR AEROSPACE: This could be one billion dollars for experiments, and one billion dollars to develop the sulfur handling equipment.

NANCY: Spent over one year?

PROFESSOR AEROSPACE: No. This would be spread out over something like 5 years.

Past Funding vs. Needed Funding

MAYA (BUSINESS): How much money has been spent previously on sulfur-based reflectivity research?

PROFESSOR AEROSPACE: Several million dollars, depending on what you count.

LEO (COMIC): So, we're looking at increasing this a thousand-fold?

PROFESSOR AEROSPACE: Yes, from several million, to several billion.

LEO (COMIC): Wow.

PROFESSOR AEROSPACE: Yeah.

Phase II - Experimental Operations

MAYA (BUSINESS): Ok. Tell us about Reflectivity Plan Phase II.

PROFESSOR AEROSPACE: This is where we start to reflect sunlight with sulfur, yet at a low level.

MAYA (BUSINESS): We look for harm?

PROFESSOR AEROSPACE: Yes, we look for harm, side-effects, and impact.

ETHAN (ENGINEER): Are we increasing scale during Phase II?

PROFESSOR AEROSPACE: Yes.

In the first year of Phase II, we might operate at one-one thousandth of full-scale, while in the last year of Phase II, we might operate one-tenth of full-scale operations.

ETHAN (ENGINEER): At full-scale, we're looking at reflecting approximately one percent of sunlight?

PROFESSOR AEROSPACE: Yes, that's correct.

NANCY: At full-scale, what percent of ground-level sulfur would be moved to a high altitude with airplanes?

PROFESSOR AEROSPACE: Approximately ten percent.

LEO (COMIC): In summary, we're looking at moving ten percent (10%) of sulfur, to reflect one percent (1%) of sunlight, to solve the global warming problem?

PROFESSOR AEROSPACE: That's a good one-sentence summary.

Phase III - Construction

MAYA (BUSINESS): What does Phase III entail?

PROFESSOR AEROSPACE: We need to build lots of stuff.

This includes airplanes, airport infrastructure, sulfur processing equipment, storage systems, monitoring networks, etc.

Also, during Phase III, we would ramp up from ten percent (10%) of full-scale to full-scale.

NANCY: How long for Phases I, II, and III?

PROFESSOR AEROSPACE: Something like five years each, or fifteen years total.

SAM (NERVOUS): Ok. And after that, how long would we operate at full-scale?

PROFESSOR AEROSPACE: This would run until the people who are doing it want to stop.

People with Power

LEO (COMIC): Who are these people?

PROFESSOR AEROSPACE: This would be people with power.

MAYA (BUSINESS): You mean large governments?

PROFESSOR AEROSPACE: Yes.

MAYA (BUSINESS): So, we're talking about the US, European and Chinese governments?

PROFESSOR AEROSPACE: Yes.

They control the large budgets, the regulators, and the militaries that would protect reflectivity operations.

SAM (NERVOUS): Would they work together, or might they fight in some way?

PROFESSOR AEROSPACE: To be determined.

MAYA (BUSINESS): Correct me if I'm wrong,
but they would compare reflecting,
with not reflecting?

PROFESSOR AEROSPACE: That's right.

MAYA (BUSINESS): And they would compare harms associated with reflecting,
if there are any,
with harms associated with not reflecting.

PROFESSOR AEROSPACE: Correct.

Risk of Harm

SAM (NERVOUS): What kind of harms are we talking about?

PROFESSOR AEROSPACE: So far, according to our calculations, we don't see much harm,
relative to everything else that is happening.

However, moving sulfur in this way has never been done before.

Therefore, our calculations need to be verified with experiments.

NANCY: How might we look for harm?

PROFESSOR AEROSPACE: Instruments on land and on satellites would monitor the atmosphere.

Machines on airplanes would analyze samples of air.

And, optical telescopes on airplanes would make observations.

MAYA (BUSINESS): And if we see harm?

PROFESSOR AEROSPACE: We would need to deal with it in some way.

Termination

NANCY: Might we stop reflecting?

PROFESSOR AEROSPACE: Yes.

SAM (NERVOUS): If that occurs, will much damage have been done to the planet due to our activity?

PROFESSOR AEROSPACE: Very little. The planet is too big.

Mount Pinatubo put 20 million tons of sulfur dioxide into the upper atmosphere in 1991, and we barely noticed.

Also, we are currently emitting 70 million tons of sulfur dioxide, and 40 billion tons of carbon dioxide annually due to fossil fuel combustion.

Reflecting Phases I and II are tiny compared to these other activities.

Also, we are not increasing total sulfur emissions, only changing where we emit a small amount relative to total.

ETHAN (ENGINEER): What happens if full-scale operations run for ten years and then stop?

PROFESSOR AEROSPACE: The planet is currently warming at a rate of three-tenths of a degree Celsius per decade.

If reflecting canceled this to zero, for example, then the average global temperature would stay the same during those 10 years.

Then, if we stopped reflecting, the three-tenths of a degree per decade warming would resume.

SAM (NERVOUS): Oh. And eventually we would bump into large Adaptation costs.

PROFESSOR AEROSPACE: Yes, eventually.

Risk of Conflict

LEO (COMIC): Some nations might want to reflect, while others do not want to reflect.

Might they argue?

PROFESSOR AEROSPACE: Yes, they might argue.

MAYA (BUSINESS): Might they be more aligned if monitoring data was shared freely?

PROFESSOR AEROSPACE: I believe so.

Furthermore, I favor sharing all atmospheric data with the public.

Reflectivity Risks (Harm, Conflict, Timing)

MAYA (BUSINESS): What are the big risks associated with reflecting?

PROFESSOR AEROSPACE: There are three primary risks.

These are Harm, Conflict, and Timing.

Harm refers to the possibility that we detect harm and need to stop.

Conflict refers to the possibility that nations fight over this.

And Timing refers to the possibility that we do not complete Phases I, II, and III in the needed time.

Public Support

SAM (NERVOUS): It seems the public is nervous about reflecting.

PROFESSOR AEROSPACE: They are.

Also, they are beginning to realize, the current climate strategy, is not working.

And, this is causing interest, in reflecting, to increase.

SAM (NERVOUS): Are they realizing fast enough?

PROFESSOR AEROSPACE: Nope.

NANCY: I see. So, we're bumping into the Timing risk you referred to.

PROFESSOR AEROSPACE: Yes. Timing is a big problem and we're falling behind.

LEO (COMIC): Yikes.

Improving Global Climate Models

NANCY: You mentioned we've calculated we need to reflect by the year 2040.

But, this is a gross estimate.

How do we improve the accuracy of this calculation?

PROFESSOR AEROSPACE: The software that does this is called a global climate model, or GCM for short.

And, to improve accuracy,
we need to conduct experiments.

And, the person that knows the most about this is,
Professor Atmosphere.

NANCY: Ok, we'll reach out to him.

OTHERS: Thank you professor.

PROFESSOR AEROSPACE: It's my pleasure.

SCENE 11 - INT. ATMOSPHERE PROFESSOR

Screens show cloud fields, satellite data, model grids, and radiative forcing diagrams. Professor Atmosphere speaks quickly, then slows down when Sam looks panicked. We are indoors, during the day, while sunny.

NANCY: Thank you for meeting with us.

PROFESSOR ATMOSPHERE: Thank you for reaching out.

NANCY: We're interested in Global Climate Models.

SAM (NERVOUS): Let's cut the chase. Do you consider them accurate?

Improving Climate Models

PROFESSOR ATMOSPHERE: Unfortunately, they are not accurate.

We know this because the planet is much warmer than that predicted by the models.

SAM (NERVOUS): Ouch.

PROFESSOR ATMOSPHERE: This is a big problem, since it means we are not sure when very bad things will happen.

NANCY: How do we improve these models?

PROFESSOR ATMOSPHERE: Well, we do not fully understand clouds, and we do not fully understand how much sunlight reflects off air pollution.

So, to improve models, we need to conduct atmospheric experiments.

ETHAN (ENGINEER): What's an example experiment?

PROFESSOR ATMOSPHERE: We need to spray stuff into the atmosphere with an airplane, and then measure things.

ETHAN (ENGINEER): How long would it take to develop the spray and monitoring equipment?

PROFESSOR ATMOSPHERE: This could take several years.

NANCY: We're back to, "we need engineers."

LEO (Comic): Lots of engineers.

PROFESSOR ATMOSPHERE: Improving climate models could cost a billion dollars, spread out over 5 years.

AI Support

SAM (NERVOUS): Can AI help?

PROFESSOR ATMOSPHERE: AI can suggest experiments.

And for each experiment,
it can provide a list of needed equipment,
and a budget.

However, the information it generates is only a rough estimate.

MAYA (BUSINESS): How might we do better?

Expert Panels

PROFESSOR ATMOSPHERE: For perhaps a hundred thousand dollars,
you can assemble a panel of top climate scientists,
and ask them to suggest experiments.

For several million more,
you can develop software that calculates what might happen in each experiment.

NANCY: How does this software help us?

PROFESSOR ATMOSPHERE: It can help you to decide what to measure,
where to measure, how to measure, etc.

MAYA (BUSINESS): Ultimately, money can improve the climate models.

NANCY: And the money goes to scientists and engineers.

PROFESSOR ATMOSPHERE: That's right. You start with an assignment, such as "conduct experiments that significantly improve accuracy of global climate models."

And then a panel of scientists drums up a list of experiments.

And then scientists write software that describes each experiment.

And then scientists write proposals.

And then proposals are funded.

ETHAN (ENGINEER): In summary, we need assignment, money, scientists and engineers.

PROFESSOR ATMOSPHERE: You got it!

Climate R&D Plan

PROFESSOR ATMOSPHERE: If you do not mind my asking, what is your overall objective?

LEO (COMIC): We want to save the planet from climate change.

PROFESSOR ATMOSPHERE: Are you serious?

LEO (COMIC): Yep.

PROFESSOR ATMOSPHERE: Well, that's nice.

Ok. So, tell me, what's your approach?

ETHAN (ENGINEER): We're assembling a list of things, that if developed, solve the problem.

PROFESSOR ATMOSPHERE: Alright.

So, you want to publish a climate plan,
based on an R&D surge.

NANCY: Yes.

PROFESSOR ATMOSPHERE: Ok. After you have your R&D plan, what do you do next?

LEO (COMIC): Absolutely no idea.

Raising Money

PROFESSOR ATMOSPHERE: You're going to need a system for moving money from funding sources to scientists and engineers.

MAYA (BUSINESS): What are they looking for?

PROFESSOR ATMOSPHERE: They want to maximize climate benefit per dollar spent.

LEO (COMIC): You mean they don't want to waste time or money.

PROFESSOR ATMOSPHERE: That's correct.

Also, they are likely to spend small money before medium money,
and medium money before big money.

MAYA (BUSINESS): So, they spend small money first,
and advance if reasonable.

PROFESSOR ATMOSPHERE: That's correct.

LEO (COMIC): Who on campus knows the most about not wasting money?

PROFESSOR ATMOSPHERE: I suggest you reach out to Professor {Business} at the business school.

He used to be the CEO of a large company.

He's your guy.

NANCY: We're on it!

SCENE 12 - INT. BUSINESS PROFESSOR

Professor Business is a gruff, outspoken man in his sixties, who previously led a large company. He enters the M.I.T Business School conference room with coffee and no small talk. We are indoors, during the day, while sunny.

MAYA (BUSINESS): Thank you for meeting with us.

PROFESSOR BUSINESS: Thank you for reaching out.

I hear from the grapevine you're exploring how to do R&D,
to the extent required,
to solve the climate problem.

NANCY: That's right.

PROFESSOR BUSINESS: Ok. Have you figured out your organization structure?

LEO (COMIC): Nope.

MAYA (BUSINESS): Also, we don't know where money might come from,
where it might go,
and who might manage it.

SAM (NERVOUS): And, we don't know how to get it started.

Leo considers this, then writes it down.

PROFESSOR BUSINESS: OK. Fair enough.

You should be able to produce a list of things to develop,
by asking the right people,
the right questions.

And, as far as the other issues are concerned,
I can offer several comments,
in no particular order.

LEO (COMIC): Shoot.

Money, Management, and Workers

PROFESSOR BUSINESS: Ok.

An R&D surge would involve 3 groups: Money, Management, and Workers.
And you need to figure out how these fit together.

SAM (NERVOUS): Tell us more.

PROFESSOR BUSINESS: Money refers to funding sources.

These include high-net-worth individuals, foundations, and governments.
And some of them want to use their money to solve the climate problem.

LEO (COMIC): Perhaps we can help them?

PROFESSOR BUSINESS: Maybe so.

Management refers to organizations that receive money from funding sources,
and then gives it to Workers,
in return for work.

LEO (COMIC): You mean you pay scientists and engineers to do stuff.

PROFESSOR BUSINESS: That's right.

Scientists and engineers receive purchase orders specifying what must be done,
and how much they are paid.

MAYA (BUSINESS): Ok. So, we're talking about a system that moves money from one place
to another.

PROFESSOR BUSINESS: That's right.

And it needs to meet the satisfaction of the funding sources.

LEO (COMIC): Otherwise, they'd run like hell.

PROFESSOR BUSINESS: Something like that.

Seven Thousand Workers

MAYA (BUSINESS): Suppose ten billion dollars is spent over five years,
and each technical person costs a third of a million dollars per year.

PROFESSOR BUSINESS: Ok.

MAYA (BUSINESS): And this works out to seven thousand scientists and engineers.

PROFESSOR BUSINESS: Ok.

MAYA (BUSINESS): This would go beyond what one university can handle.

PROFESSOR BUSINESS: Right.

MAYA (BUSINESS): But here's the question.

How would a management organization handle all of these people without getting confused?

Multiple Research Areas

PROFESSOR BUSINESS: They would need to divide your initiative into different research areas.

ETHAN (ENGINEER): I see. Like different departments in a university,
or different divisions in a company?

PROFESSOR BUSINESS: That's right.

For example,
one division might focus on aircraft development,
while another division focuses on atmospheric experiments.

ETHAN (ENGINEER): And the aircraft division would be led by aircraft engineers,
while the atmosphere division is led by climate scientists.

PROFESSOR BUSINESS: Correct.

To spend wisely, you need the right people, in the right places.

Managing Organizations

NANCY: I understand money flows from Funding Sources,
to a Managing Organization,
and then onto Scientists and Engineers.

Does this mean you could have multiple Managing Organizations?

PROFESSOR BUSINESS: Sure.

There is lots to be done;
therefore, many organizations can manage money.

MAYA (BUSINESS): Who are possible candidates?

PROFESSOR BUSINESS: You are looking for places that are already trusted by funding sources,
and have experience managing money.

MAYA (BUSINESS): Such as?

PROFESSOR BUSINESS: The Gates Foundation,
and the Bezos Earth Foundation are potential candidates.

NANCY: I see.

They already receive money from wealthy people,
and they are interested in climate.

PROFESSOR BUSINESS: That's right.

And for those reasons, they might be inclined to get involved.

Getting Started

MAYA (BUSINESS): How might a managing organization get started?

PROFESSOR BUSINESS: They would need to hire managers to issue purchase orders,
and then announce they are willing to receive money.

MAYA (BUSINESS): Funding sources have many things they can do with their money.

What would encourage them to send money in this direction?

PROFESSOR BUSINESS: Your program would be more attractive if overhead costs were zero.

MAYA (BUSINESS): I see.

You mean Bill Gates or Jeff Bezos could use their money to pay the salaries of the managers
at their own organizations.

PROFESSOR BUSINESS: That's correct.

If they did that, then 100% of funding source money could go to scientists and engineers.

MAYA (BUSINESS): And the funding sources would find that attractive.

PROFESSOR BUSINESS: Very much so.

Directed Donations

MAYA (BUSINESS): How might funding sources direct their money?

PROFESSOR BUSINESS: In theory, they could direct it to an organization,
to a division within an organization,
to a specific manager,

to a specific proposal,
or to a specific purchase order.

Climate Money vs. Investment Money

NANCY: Are these financial investors?

PROFESSOR BUSINESS:

No, this is Climate Money, which differs from investment money.

Climate Money is looking to maximize climate benefit per dollar spent,
while Investment Money is looking to maximize a return on investment.

These are two very different activities.

Getting Started

ETHAN (ENGINEER): How might one get an R&D surge started?

PROFESSOR BUSINESS: If your surge cost ten billion dollars over 5 years, for example, then you could get started with anywhere from ten million to hundred million dollars.

This would support rough designs of machines, designing experiments, developing proposals, etc.

MAYA (BUSINESS): So, where could this startup money come from?

PROFESSOR BUSINESS: To get started, you just need is one wealthy person or one foundation.

NANCY: Terrific. But, how might we get their attention?

PROFESSOR BUSINESS: You could set up a conference.

NANCY: What kind of conference?

PROFESSOR BUSINESS: It could focus on the following question:

Is it possible to solve the climate problem with a surge of R&D in key areas; and if so, what are those areas and how much might a “climate moonshot” cost?

NANCY: I see.

PROFESSOR BUSINESS: Speakers could explain how they would solve a specific problem, given billions in funding.

ETHAN (ENGINEER): So, how might we get a conference started?

PROFESSOR BUSINESS: Summarize the conference in 2-pages,
and share this with people on campus.

LEO (COMIC): This could help raise money for research.

PROFESSOR BUSINESS: Yep.

Agreements and Open-Source Outputs

MAYA (BUSINESS): What else might we consider?

PROFESSOR BUSINESS: You need to figure out, the agreement between Funding Sources and Managing Organizations, and the agreement between Managing Organizations and researchers.

MAYA (BUSINESS): I see. Funding sources might want to approve each purchase order.

PROFESSOR BUSINESS: They might.

Also, Managing Organizations might want to receive money, before issuing a purchase order.

ETHAN (ENGINEER): Funding Sources might want developed technology placed on the internet, and marked open-source so others could use it freely.

MAYA (BUSINESS): Yes. Open-source could reduce false claims.

NANCY: And maximizes climate benefit per dollar spent.

PROFESSOR BUSINESS: That's right.

One more thing.

I suggest you reach out to Professor Economics and ask her why the world is confused about climate.

She knows a lot about that.

NANCY: Fantastic. We'll do that.

PROFESSOR BUSINESS: I wish you all luck.

SCENE 13 - INT. ECONOMICS PROFESSOR

Professor Economics is calm, precise, and almost cheerful about human irrationality. The students sit around a seminar table in a seminar room. Nancy turns on the recorder. We are indoors, during the day, while sunny.

NANCY: Thank you for meeting with us.

PROFESSOR ECONOMICS: It is my pleasure. How can I help?

SAM (NERVOUS): It seems our society is confused about climate, and we want to understand why.

PROFESSOR ECONOMICS: It is true.

We are confused.

And this is due to several factors which we can review.

Climate Journalism

LEO (COMIC): If people are confused, then climate reporting must also be confused.

Does that make sense?

PROFESSOR ECONOMICS: It does.

Let's look broadly at what climate journalist do,
and what they don't do.

First, what do they do?

MAYA (BUSINESS): Ok. They cover existing climate initiatives.

NANCY: They cover published papers.

LEO (COMIC): And they report on weather-related incidents.

PROFESSOR ECONOMICS: All of this is correct.

Now, what *don't* they do?

NANCY: They ignore the bathtub and faucet physics taught by Professor Climate.

ETHAN (ENGINEER): They ignore the En-ROADS climate software.

LEO (COMIC): And they rarely talk about what it takes to solve the entire climate problem.

PROFESSOR ECONOMICS: You are all correct.

NANCY: And the incomplete reporting causes the public to end up with a distorted view.

PROFESSOR ECONOMICS: Yes.

The Prisoner's Dilemma Problem

MAYA (BUSINESS): What about consumers.

Are they confused, and if so, why?

PROFESSOR ECONOMICS: Let's look at this from their perspective.

Imagine a consumer has 3 options:

- (a) Do nothing,
- (b) Pay \$100 dollars to reduce the average global temperature by 1 nanodegree or,
- (c) Pay \$100 dollars to reduce the average global temperature by 10 nanodegrees.

ETHAN (ENGINEER): A nanodegree is a billionth of a degree.

PROFESSOR ECONOMICS: That's right.

Now, what happens and why?

MAYA (BUSINESS): If someone reduces the planet's temperature by a billionth of a degree, they don't benefit since that's a small amount.

PROFESSOR ECONOMICS: Correct.

Instead, they only benefit if the other 8 billion people on the planet act collectively.

NANCY: I see. So, for this reason, most people favor option A, and do nothing.

PROFESSOR ECONOMICS: That's what happens.

Economist refer to this as "The Prisoner's Dilemma Problem."

Climate Consumers

PROFESSOR ECONOMICS: Now why would someone select the costly option, which is B or C?

SAM (NERVOUS): Some people feel good by doing the right thing.

LEO (COMIC): Yeah, they pay to feel virtuous.

PROFESSOR ECONOMICS: Both are correct.

Now, do they select Option B, or Option C?

In other words, do they maximize carbon dioxide reduction per dollar spent?

LEO (COMIC): They don't see that data, so they don't know the difference between B and C.

PROFESSOR ECONOMICS: That's right.

MAYA (BUSINESS): Also, sellers maximize profit.

LEO (COMIC): And people lie to make money.

PROFESSOR ECONOMICS: Both are correct.

ETHAN (ENGINEER): I see.

Ultimately, there's no mechanism that causes us to decarbonize at the lowest cost.

NANCY: And no one talks about this, which is interesting.

PROFESSOR ECONOMICS: Very interesting.

ETHAN (ENGINEER): This calls into question, "Who's in charge?"

PROFESSOR ECONOMICS: It does, and we'll talk about that in a moment.

Climate Show

LEO (COMIC): In some cases, people pay to feel virtuous.

While in about cases, people pay to *appear* virtuous.

PROFESSOR ECONOMICS: Do you have examples?

LEO (COMIC): Well, a company may claim they are reducing emissions, to improve their image.

SAM (NERVOUS): Or, a lawmaker may put solar panels on the roof of the public library, to look concerned.

PROFESSOR ECONOMICS: In these cases, what happens and why?

LEO (COMIC): Well, it is in their best *financial* interests to put on a show, while minimizing costs.

MAYA (BUSINESS): And they'll hide cost and emissions reduction data, since those numbers might make them look bad.

SAM (NERVOUS): And with data hidden, we have no way of knowing if their acts are meaningful or symbolic.

PROFESSOR ECONOMICS: All of this is correct.

MAYA (BUSINESS): Ultimately, people sell climate to make money, and people put on a show to look good.

PROFESSOR ECONOMICS: True.

The Ownership Problem

ETHAN (ENGINEER): It seems like we're bumping into the following question.

Ethan walks to the dry board and writes:

WHO IS RESPONSIBLE FOR SOLVING THE ENTIRE CLIMATE PROBLEM?

ETHAN (ENGINEER): Who is responsible for solving the entire climate problem?

PROFESSOR ECONOMICS: That's a good question.

Professor Economics writes on board:

NO ONE and circles it.

The answer is, no one.

NANCY: No one?

PROFESSOR ECONOMICS: No one owns the whole problem.

If someone owned it, they would quantify the impact of proposed initiatives, and develop a plan that solves the entire problem at the lowest cost.

Distributed Responsibility

ETHAN (ENGINEER): Instead, we distribute responsibility across nations, regions, companies, and individuals.

PROFESSOR ECONOMICS: Yes.

And we push on them to reduce their own emissions, while no one feels responsible for total.

NANCY: Ok. So, what would you do if you were responsible for total emissions?

PROFESSOR ECONOMICS: Give me a topic, and I will tell you what I would do.

Solar Panels on Houses

SAM (NERVOUS): Solar panels on houses.

PROFESSOR ECONOMICS: Electricity generated by solar panels on houses cost much more than electricity generated by solar farms.

This is because each house is a unique construction project with lots of overhead costs.

This includes design, permitting, installation, inspection, billing, etc.

Solar farms avoid these costs.

Therefore, if your goal is lowest-cost decarbonization,
you don't need to touch houses,
and you can let the power company handle solar on farms.

SAM (NERVOUS): This is never talked about.

Where are the journalists?

PROFESSOR ECONOMICS: There is a field of study called "energy economics."

It gets into cost numbers, emission numbers, consumer behavior, and energy-related markets.

And very few people know this is a thing.

SAM (NERVOUS): Are you an energy economist?

PROFESSOR ECONOMICS: Yup.

United Nations Decarbonization Programs

LEO (COMIC): What about government money that passes through international programs?

PROFESSOR ECONOMICS: If one dollar goes from the U.S. Treasury to build a solar farm in Africa, then almost all of that money will go to NGO and government people.

SAM (NERVOUS): And little will go to the solar farm?

PROFESSOR ECONOMICS: That's right.

So, this is an inefficient use of money.

Carbon Taxes

MAYA (BUSINESS): What about carbon taxes?

PROFESSOR ECONOMICS: Almost all of that money goes to things other than lowest cost decarbonization.

MAYA (BUSINESS): So, you don't like passing money through government?

PROFESSOR ECONOMICS: We can do much better.

Electrical Power Decarbonization Requirements

LEO (COMIC): How?

ETHAN (ENGINEER): Government can require power companies, to decarbonize electrical power generation at a specific rate, and pass additional costs, or savings, onto consumers.

LEO (COMIC): And they'll get this done at the lowest cost?

PROFESSOR ECONOMICS: Yes.

That's what power companies do.

They generate electrical power at the lowest cost.

So, pushing on them to decarbonize is one of the few things that is reasonable.

Brute Force Decarbonization vs. R&D

LEO (COMIC): What would you do about carbon dioxide emissions?

PROFESSOR ECONOMICS: There are two broad paths.

One is brute force decarbonization, while the other is R&D.

Brute force often involves paying more for green products.

While R&D involves developing green technologies until they cost less than fossil fuel.

The second path costs less, and does not require people to spend money when they do not benefit.

MAYA (BUSINESS): So, the second option is better.

PROFESSOR ECONOMICS: Yes.

ETHAN (ENGINEER): What kind of R&D?

PROFESSOR ECONOMICS: We need to focus on known technologies, with favorable cost models.

ETHAN (ENGINEER): Who knows the most about this?

PROFESSOR ECONOMICS: See Professor {...} for Fission, Professor {...} for Fusion, and Professor {...} for Geothermal.

The Global Warming Problem

NANCY: What do we do about the global warming problem?

PROFESSOR ECONOMICS: Crank up the R&D budgets for sunlight-reflection, atmospheric experiments, and carbon removal.

And focus on techniques that are affordable and not harmful.

Climate is a Confusion Problem

LEO (COMIC): Here's a question.

If our society was less confused, could we fix the climate problem?

PROFESSOR ECONOMICS: I think so.

*Professor Economics walks to the dry board and writes:
CLIMATE IS A CONFUSION PROBLEM.*

One can argue climate is a confusion problem.

The Climate Kids

Nancy walks over to the whiteboard. The words “NO ONE” (owns climate problem) seem larger than everything else.

NANCY: What if we tell ourselves we own the problem?

What happens next?

PROFESSOR ECONOMICS: Well, your lives might become more interesting.

NANCY: But what might we do?

PROFESSOR ECONOMICS: You could focus on the following question:

*Professor Economics walks to the dry board and writes:
WHAT IS A PLAN THAT SOLVES THE CLIMATE PROBLEM,
AT THE LOWEST COST,
WITHOUT REQUIRING PEOPLE TO DO THINGS THEY WILL NOT DO?*

What is a plan that solves the climate problem,
at the lowest cost,
without requiring people to do things they will not do?

NANCY: Wow.

PROFESSOR ECONOMICS: Hey, is this your destiny?

NANCY: Maybe so.

SCENE ... - INT. FISSION PROFESSOR

Conversation with Professor Fission...

SCENE ... - INT. FUSION PROFESSOR

Conversation with Professor Fusion...

SCENE ... - INT. GEOTHERMAL PROFESSOR

Conversation with Professor Geothermal...

ACT III – INITIATING A MOONSHOT

SCENE ... - ...

During Act III the students initiate a climate moonshot.

Yet how might they get it started?

- *Climate Moonshot Conference ...*
- *Climate Moonshot Film ...*
- *Climate Moonshot Videos ...*