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DAVID HSU: My name is David Hsu. I'm a professor of urban studies and planning at MIT. And this is another lecture in the urban energy systems class at MIT.

Today we're going to talk about the role of the built environment, and land use, and decarbonization in cities. This is our fourth lecture, hopefully convincing you about the importance of cities in achieving decarbonization, and why we should look at cities of particular scale of interest.

The materials for today are on the syllabus. We're going to talk about Ontario's Greenbelt. We're going to talk about a crusader for clean power in the Tea Party. We're going to talk about local politics and their role in perhaps helping and perhaps rewarding decarbonization. We're going to talk about a particular case study in Copake, New York. And finally, we'll talk a little bit about what permitting reform might mean for decarbonization.

So let's just-- I'm going to structure our talk today with three key questions about land use and decarbonization. First, let's ask, simply, should cities continue to expand? I think I showed you a few weeks ago or a few lectures ago the statistics from the UN urbanization prospects, showing every major region of the world continuing to urbanize-- some faster than others, but every region of the world is going to be a majority urban population in the coming years, over the next 30 years.

So there's a fundamental question. Should cities continue to expand or not? Should they expand in terms of area? Do they expand in terms of their proportion of the population? These are things that we have to plan for going forward.

Another key question we'll talk about today is, what is the role of land use planning in shaping the energy use and climate impact of the built environment? In other words, if we shape land use, how does that shape subsequent development and subsequent energy use and climate impact?

Finally, another key question we'll talk about in this lecture, and also talk about in our discussion is, who and how should land uses be decided? What's the correct framing? We talked about climate justice last time. We talked about rhetorical framing of justice concerns that everyone has, but different populations may react to different framings or rhetorics differently. But if we're going to talk about how land use should be governed or land use should be decided, what framing should we use? And that's something we'll probably talk about mostly in class.

So to start with the Tomalty report, this is a report about Ontario's Greenbelt around the city of Toronto, one of the largest greenbelts in the world. And it has a number of notable features. It has this like 300-kilometer, I think, long corridor. It has a lot of agricultural land inside the Greenbelt itself.

And just to show you examples of other greenbelts, this is London's greenbelt. This is a greenbelt that, I think, has existed for almost 100 years, designed to govern the expansion of London. London has been expanding for maybe 250 years since the beginning of the Industrial Revolution. And the greenbelt was put in place to try to govern development and try to limit the extent of London, which is an increasing portion of the entire country. Of course, London, as we know, is a dynamic urban environment. In some cases, development has leapfrogged the greenbelt, and some people commute in across the greenbelt every day to London.

And of course, there is some development in the greenbelt. This is from the London Greenbelt Council. They've put together this map of development projects, which means that they're proposals to build on protected greenbelt sites. So greenbelts are a policy that can be used to constrain development or shape development, but also they have to be maintained, protected, or perhaps modified over time. Another city that famously has a greenbelt is Seoul, Korea.

So let's just talk about the implications of the greenbelt and land use planning for urban expansion and for the shape of the city itself. Here's a few greenbelt facts from the Toronto Greenbelt Report. It's close to 750,000 hectares-- 1.8 million acres, the largest greenbelt in the world. It's an integrated band of mostly green countryside, allowing for more complete ecosystem habitats and continuous migration routes. It allows for more complete habitats and migration routes than do isolated parks.

One thing that ecologists tend to look at for species or for fauna is how large the patch size is. How large is the size of the ecosystem so it can develop more complexity and develop more species and more freedom of movement for animals and other species?

The Greenbelt in Toronto has 217,000 hectares or 535,000 acres of lakes, wetlands, river valleys, and forests, providing habitat for over one third of Ontario's species at risk. It preserves space for locally accessible tourism, recreation, and outdoor activities. It has over 7,000 farms in the Greenbelt. Agriculture is the predominant land use in the Greenbelt, generating $1.5 billion in gross farm receipts annually.

And here's the key point that we want to take home and discuss from this Greenbelt report. In terms of carbon storage, the Greenbelt stores about 1.4-- sorry-- 147 million tons of carbon dioxide equivalent. And to put this in perspective and kind of highlight reasoning, we want to put this quantity of carbon in perspective, this amounts to more than twice the total CO2 released each year in Ontario transportation, the province's largest source of emissions.

And I highlighted this in blue because I want to discuss this carbon storage in a number of ways. The Greenbelt is continuously uptaking carbon from the atmosphere and continually growing vegetation, but it may not actually continue to grow in the way that our greenhouse gas emissions are. This is why we have a fundamental problem with climate change. We continue to emit greenhouse gases into the atmosphere. Even though the total amount of greenhouse gases are relatively small compared to natural processes, what we're doing is upsetting the balance.

And so I think in some ways it's worth discussing. This carbon storage is a fixed quantity. It represents twice the CO2 from transportation, the province's largest source of emissions, but it may not be continually uptaking twice the amount of CO2 per year as transportation.

In other words, this is to say that it's good that we have the carbon storage. We have lots of other ecological benefits from the Greenbelt. Having said that, there's a considerable amount of debate among ecologists about how this quantity of carbon storage is going to change over time. Is it possible to continue to uptake more carbon? Is it going to expand any more in the future, depending on how we manage this land? But it's not going to continue to expand in the way that we are emitting greenhouse gases from all of our activities.

And so this brings me to the idea of nature-based climate solutions. This is an incredibly popular idea among the general public, and scientists, and some activists. And this fairly distinguished group of scientists published in *Proceedings of the National Academy of Sciences* an article, "Natural Climate Solutions." And in this article, they basically argue that there's climate mitigation potential from a number of natural ecosystem solutions.

On the left-hand side, you can see 20 or so natural pathways. It involves reforesting lands. And forests also, you can avoid further forest conversion. You could do better management of natural forests. You can improve plantation management of forests. You could avoid trying to use wood fuels. And you could do fire management. And those would all improve the climate mitigation potential of forests.

In terms of agriculture and grasslands, you could try to develop biochar. It's a form of carbon storage in charcoal. You could try to put more trees in croplands. You could do a better job of managing nutrients. You could increase the grazing or feed-- improve grazing or feed. You could do conservation agriculture, and you can improve varieties of rice, and so on, and so on, and so on. And wetlands are important to note, you can do coastal restoration, peat restoration, and avoid peat impacts.

And what these bars on the graph show you are the total climate mitigation potential. There's a few things I want to highlight about this. First, the scientists in this article are arguing for nature-based carbon climate solutions, and they actually found a fairly large climate mitigation potential. If you'll keep in mind the number we discussed in the first class of greenhouse gas emissions, ranging from, let's say, 25 to about 30 or 40 gigatons per year, depending on your data source and what you count, then this climate mitigation potential in 2030 actually looks fairly significant.

It looks like we have roughly-- this bar graph is composed of how much it might cost. And you can see that the bar is almost as big as 10 petagrams of CO_2 per year. That's the same thing as a gigaton, if you remember our powers of 10.

The other thing to note about this is the tremendously large error bars on reforestation. Reforestation could get us up to 10 petagrams. But that's relatively expensive. That's the maximum of safeguards. The low cost portion of that climate mitigation potential is 3 petagrams of CO_2 equivalent per year. But the error bars range from less than 3 to more than 10.

We actually don't know the order of magnitude of reforestation potential. This is not to say we shouldn't do it. We just have to start trying this and studying this to understand how to do it best. And then we'll see. It's also worth noting that some of these nature-based climate solutions or climate mitigation potential is not the same thing as all the other benefits I mentioned of the Greenbelt itself.

Because see this bar here? This legend of these little bars indicate other benefits, like air quality benefits, biodiversity benefits, water benefits, and soil benefits. Those are all really important environmental problems, too. So it's a question of how do we balance the mitigation potential of these nature-based climate solutions with other benefits, but also, how do we reduce the uncertainties of this climate mitigation potential?

Just to give you a kind of a side note, I should have talked about earlier, but it's also in the MacKay book. We have the *Powers of Ten,* the name of a famous 1977 film by Charles and Ray Eames.

But this is to say that petagrams of carbon dioxide equivalent may not necessarily be a unit that we're familiar with. It's 10 to the 15 grams, but actually, it turns out a ton is 10 to the 6 grams. So 10 to the 9 gigatons-- a gigaton, which is 10 to the 9 tons, times 10 to the 6 gives you the exact same unit as a petagram. And that's just worth keeping in mind. As we continue to look at different numbers, we want to convert them, convert the units, and also convert their orders of magnitude properly.

Many of these same scientists in the first paper who wrote an article about nature-based solutions for the world also write a nature-based climate solution paper for the US. And they find in this paper-- this is in *Science Advances* or *Science*-- we find a maximum potential of 1.2, 0.9 to 1.6 petagrams CO2 per year, the equivalent of 21% of current net annual emissions in the United States. At current carbon market prices, which are relatively low, at $10 per megagram-- sorry-- yeah, megagram of CO2 equivalent, this could be achieved, or rather, nature-based solutions could provide air and water filtration, flood control, soil health, wildlife habitat, and climate resilience benefits.

And so to look at the potential for the United States, you can see, of course, the x-axis is much smaller, but they look at many of the same kinds of nature-based climate solutions. In this case, they look at 21 or so. And you can see that, again, the uncertainties are fairly high. The bars are composed of low, medium, and high-cost benefits.

So this is worth talking about. We have a total potential climate mitigation potential, but only a small amount of reforestation can be achieved for $10 USD per megagram or ton of carbon dioxide equivalent. It'll be $50 a ton to achieve the most potential. And for reforestation, there's a relatively small potential that could be achieved at a very high cost of $100 per ton.

Of course, again, the uncertainties are very high. That doesn't say we shouldn't do it. That says we should start thinking very carefully and studying how to do it properly before we try to go to scale.

And so this brings me to some of the conversations I've been having with ecologists for the last few years, in some cases longer, about the importance of land use and land cover. Now, if I had to summarize those conversations and that kind of literature in just, I guess, a few key bullet points that I want you to take home for our discussion on land use, first, the total sequestration potential of land use and land cover is currently quite uncertain. Dynamics of sequestration are also quite uncertain.

For example, one of our new faculty at MIT has written a number of papers on how if we increase trying to do carbon sequestration in trees by ostensibly sucking carbon dioxide out of the atmosphere, we may actually be taking carbon dioxide out of the soil that's currently stored in the soil. So we have to understand the dynamics of sequestration and how that's going to work going forward if we want to pursue these nature-based climate solutions.

Now, one thing that comes through the ecological literature quite consistently is that natural or existing ecosystems that are perhaps better preserved than other ecosystems-- you have many ecosystems that have been modified in North America by Indigenous peoples, and subsequent-- continuous waves of human settlement. But those ecosystems that are existing are much more efficient than if we tried to do ecological restoration or management.

Those ecosystems tend to be more complex. They tend to sequester more carbon. We tend to do things-- like in natural ecosystems, we will let old logs lie. Those old logs not only preserve the carbon in the forest as opposed to us taking them out for timber products, but those old logs also provide the basis for other carbon sequestering activities, like the growth of ecosystems on old logs. And they provide nutrients for the forest to actually continue to become more complex and to sequester more carbon.

Finally, it's worth pointing out for the last 20 or so climate solutions I showed, the policy mechanisms may be wildly different to preserve different ecosystems. For example, farm preservation is a very different kind of policy mechanism than biodiversity protections. Actually, significant United States, actually, is preserved for conservation through biodiversity and through other laws. But it's worth pointing out that all of these laws are really different. So we have to think about different ecosystems or, let's say, different land uses in different ways.

And so if we want to add carbon storage as an objective of all of our different policies, we may have to fit this into different policy mechanisms. For example, if we have a policy mechanism for protecting biodiversity, that may protect that natural or existing ecosystem. But if you want to do coastal restoration or coastal preservation, that's going to be quite different than agricultural preservation, and quite different than forestry management.

Finally, we're going to talk in this class more about what does this all imply for urban planning of cities. We may have to look at carbon storage as the additional objective, but also managing our different lands, different agricultural lands at the outskirts of cities, brownfield sites within cities, industrial lands. These are all things that we'll have to consider in terms of carbon storage and climate solutions.

And so one answer to what does this imply for the urban planning of cities is that controlling the spatial expansion of cities is going to be crucial, as the Toronto Greenbelt example shows us. Toronto is a vibrant urban city. It's got a very expensive housing market. We have to think carefully about how to control the spatial expansion of cities.

Portland, Oregon has very famously an urban growth boundary. And the urban growth boundary expands over time. So house prices are also high in Portland, but the city is continuing to build high density housing. So it's not uncontrolled growth.

So just to give you a sense of what the relative breakdown of land uses are in the United States, you can see on the left-hand side the land use in the United States, and on the right-hand side, the comparison for the land use required for 1,000 gigawatts of renewables. This is from the *Rewiring America* report, which argues that, yes, we can rewire America in a renewable way.

Land use is going to be one of our main challenges. If you look on the left-hand side, much of the United States is used for cropland, forest use land, and grassland. That would be great to try to site renewables on those. But we just said that we actually need to preserve a lot of this land for climate solutions, and perhaps other benefits, like air quality, water, biodiversity, and food.

So if we start to look at the existing uses, you can see that we've already allocated a large part of the US for rural parks and wildlife. There's miscellaneous other uses, which is mysterious and large. But if we look at the things that are relevant to us, we have urban areas around 69 million acres. We have rural transportation, roads, farm roads, idle crop land. Those all seem pretty big. But that is worth putting for a moment in perspective with what it will require to get 1,000 gigawatts of renewables.

The 1,000 gigawatts of wind will require 56 million acres, which is roughly as much area as we need for all the urban areas in the US. We need 1,000 gigawatts of solar, which will require much less because solar has higher density of energy. We'll talk about that more. But that's also like saying we need to basically take all the farmsteads and all the farm roads in the US and convert them to solar.

We obviously aren't going to focus on that certain category. It's just to give you a sense of the magnitude of the problem. Farm roads, not always well maintained, or regular highways, not always particularly well maintained. Now to think about how to actually locate as much uses. And if we don't maintain existing roads well, we're not going to do silly things like putting solar on top of roads, or anything like that, which has sometimes been suggested.

So this is just to say that many aspects of decarbonization depend on land use. Let's just focus on a few of the ways that decarbonization will depend on land use in the electricity sector. Solar and wind, as I've said, are different energy densities, but in both cases, they're less energy dense than fossil fuels. They're going to require much more land area.

Nuclear power plants are relatively energy dense, but, of course, we have concerns about siting the power plant, plus handling the radioactive fuel for the next 10,000 years. Hydropower in North America is an energy resource that is relatively clean now that we've been exploiting it for over 100 years. But we've also tapped most of the hydropower potential in the US. There's discussion of maybe using hydropower in smaller rivers and streams, revamping the hydropower that we have, but most estimates don't have a vast increase in hydropower as much as maintaining the hydropower potential we already have.

And of course, in order for solar, wind, and nuclear, and hydropower to work better, especially the first two categories of solar and wind, we're going to need much more transmission lines. We're going to need to site the transmission lines, and we're going to need to provide interconnection so solar and wind projects can connect to the grid.

In terms of buildings, I've already talked about how we need to change our heating and cooling systems. That also means we have to, in a lot of cases, get rid of the pipes going into our houses, the pipes that carry natural gas and oil, in some cases, the oil tanks in houses. And we're going to need to replace that with wires. That's actually going to be a really big challenge.

And of course, location, location, location-- that matters for real estate. And the buildings may have to be in different places if you want to try to achieve lower carbon transit or transportation. And of course, we're going to have to offset that with all of our challenges in how the buildings are used, what the value of the buildings are, historic preservation, and occupancy.

One thing I probably should have added is that we know we have an affordable housing crisis in many cities in the US. So we have to balance our buildings, rebuilding our buildings, and frankly, building much more housing so everyone can afford a reasonably priced place to live.

In terms of transportation, transportation and mobility is going to make this all possible. Not only do we need to have better roads and bridges, which are currently in a poor state of repair, we're trying to add charging stations so people can electrify their vehicles. And so, frankly, people can drive electric vehicles and have some assurance they'll be able to charge them at work or on long distance trips.

Again, transportation dictates the locations of where things happen. It dictates urban expansion. It dictates real estate value in many cases. And of course, on top of that, we need to think about transit, freight, air, and shipping. Everything in our houses, everything that we use gets shipped to us in various ways. These large transportation systems require decarbonization. Sectors like freight and air and shipping actually have very large climate impacts, which is why we want to think about managing our demand or consumption also.

And finally, where do we make all this stuff? Currently, we have a lot of manufacturing around the world. As we know, this year supply chains have been stressed out. And in some cases, companies have looked at moving manufacturing closer to consumption, like back to United States. And of course, we have a new industrial policy that is very focused on bringing factories and manufacturing back to the United States.

The implication for decarbonization is that if we want to try to achieve decarbonization with new fuel sources, like hydrogen, like renewable energy, we're going to have to change how manufacturing works. In many cases, factories are located near energy infrastructure. Many times factories have their own energy sources. We need to convert all of that industrial supply chain to new energy sources.

And of course, we know it's very important in politics to think about the job implications. Part of the reason why we have polarization in this country is by income and by education. A lot of manufacturing and industrial jobs used to be open to people who had a high school education and didn't have a college education. Now we know we need increasing levels of training for populations who might be left behind in that energy transition. And of course, as we rebuild all of our electricity, all of our building, all our transportation, and all of our industry, we're going have to think about where the jobs are provided and which groups have jobs, are going to be assured to have jobs, whether or not they had jobs in the past.

And so this is what brings me to the importance of land use and energy. In the US, almost all decisions about land use are made at the local level. Just to give you a few examples of what is decided at the local level, land and property taxes, zoning, our favorite tool as planners. Building codes, I would say, sometimes are not a very sexy topic, but I think they're really important because that's how we shape how all the buildings we've built are retrofitted in the future, including energy codes, fire codes, inspection, enforcement, and frankly, other policy mechanisms you want to use to affect buildings.

We also can do urban-- use other urban planning tools, like visioning, like community engagement. We can basically develop a plan that can bring along both or align both the interests of the public and private sector. I think we don't talk about visioning and using graphic tools to get a kind of common vision, arriving to a common vision together enough. I think that's one of the key tools that planners have also.

And finally, infrastructure financing-- the US is unusual in that we have flourishing capital markets at the subnational level. In other words, cities and states do the majority of borrowing for infrastructure in the US. And also, local governments and state governments tend to own most of the fixed assets and infrastructure in the US. That's including the private sector, including the Defense Department. All of our schools, all our water systems, all of our roads added up together are worth more than what we think of as the private sector. And that's worth noting because that's the control that local and state governments have over infrastructure.

If we look at federal jurisdiction over land use and energy, the key thing that we'll be discussing this semester and in politics is the National Environmental Policy Act of 1970. This act simply says that you have to review the impacts of the environment for any projects that federal agencies allow. And of course, that is the heart of the permitting reform debate that we're likely to have in Congress this fall.

And of course, there are other kinds of federal land protections. The US government and state governments simply outright a large-- simply outright own a large part of the US. About 40% of the US is actually just outright owned by federal and state governments. And so they actually have jurisdiction. They actually have to manage these lands in a certain way, sometimes for uses like oil and gas leasing, or sometimes for timber management, but also some of the federal agencies have to manage lands for other uses, like recreation, but also conservation and biodiversity.

And of course, the states may have what's called little NEPAs, their own state environment policy acts that require further review. And this is part of the burden on development. And that takes a long time to build in the US. At the same time, we can have a debate or discussion in class about whether or not we need these protections to protect communities or protect the kind of development we want around local areas.

So we have at the state level, as I said, some states have regional growth plans. Oregon, most famously. We also have public utility commissions. Our energy system is essentially divided into 50 energy systems, where utilities are regulated at the state level. So we actually have 50 or so commissions that regulate the energy system. We'll talk more in this class about how that-- what implications that has for the development of the energy system.

And finally, we have state level legislation and constitutions. Sometimes states can preempt local towns or local governments from making decisions about cities. One example I've said to you a couple of times in this class is that for many years, the state of Massachusetts has not been allowing local governments to pass natural gas bans.

You see a number of states now, predominantly through the Southeast and Southwest, mostly Republican states, passing state level legislation that doesn't allow local governments for cities to pass natural gas bans because cities, in places like Texas, tend to be much more liberal than their state government because the federal system of government allows the federal government to preempt states, and states to preempt local government. But the point of this slide is to say that local governments still have a lot of jurisdiction and a lot of capacity to actually think about how to shape energy use at the local level.

So this brings me to one more theme I want to talk about, which is the idea of local fragmentation. Mancur Olson was a scholar who wrote this book way back when in 1965 called *The Logic of Collective Action.* It's a pretty interesting book, actually, because a lot of books that preceded this were concerned with, let's say, the tyranny of the majority over the minority. How do you protect the rights of the minority?

And Mancur Olson actually writes this interesting book. It's really about the difficulty of achieving collective action. And he argues that collective action is difficult to achieve because of a free rider problem. For example, things that would probably benefit many people, let's say, the majority, may be opposed by a concentrated minority.

One example might be it might be better and generally popular to try to pursue climate policy. But if you're the concentrated minority that had a die hard interest in, let's say, continuing our current energy system, like the fossil fuel industry, they may be much more highly motivated to do something about climate policy than the vast majority of people. And so if the many people are not sufficiently motivated, then the few people can win. So Mancur Olson's book is kind of interesting. It argues that collective action is actually hard to achieve because concentrated minorities may oppose broadly what the majority wants to do.

And so kind of as a rebuttal to Mancur Olson's book, but also to Garrett Hardin's famous essay "The Tragedy of the Commons," Elinor Ostrom in 1990 writes this book called *Governing the Commons.* And she argues in this book that common pool resources can be preserved by collective action and goals. And the mechanisms may be particular institutions. There may be norms or cultures of behavior that govern common pool resources. And there may be enforcement mechanisms. Those enforcement mechanisms can be formal or informal.

But her argument generally is that it's possible to achieve collective action in things like managing common pool resources, like a fishery, or, let's say, natural benefits. But she starts to look at-- she really kicks off a lot of the study of institutions, and norms, and enforcement mechanisms.

And this also leads in the 1990s to a big level of big growth in interest in governance, this idea of how is governance achieved. Governance is not only achieved through formal governance. It may be through other informal institutions, or non-governmental organizations, or community groups, or norms or other means. But you also may need enforcement mechanisms to achieve a broad interest that is not represented by, let's say, a concentrated minority.

And so this brings me to the Jonathan Chait column that I suggested from earlier this year. It actually says one of the more depressing lead sentences I've ever read in a news story published on January 11. "A temporary moratorium on developing large scale ground-mounted solar projects is winning support from residents." Of course, this is the article that highlights in the national media the moratorium in my hometown of Amherst, Massachusetts. I also, as I've said to you before in class, find this really depressing that an otherwise liberal progressive town that everyone ostensibly believes in climate change actually considered passing moratoriums to avoid solar.

This brings me to this kind of case study story that in Copake, New York-- and it talked about a solar farm essentially dividing the town until it didn't divide the town, until the two groups came together and achieved common ground. Of course, it is worth looking at the story carefully when you read it this week, because it talks partly about the relationships between the people and how different opposing groups came to achieve a compromise. And it also talks about some of the New York State legislation that essentially forced some of these groups to compromise when they didn't necessarily want to compromise before.

One other reason-- I think I mentioned the Debbie Booley article for this week-- it's a very different area. It's about solar subsidies and connections to the grid. But I would argue that a lot of the interest in Debbie Dooley as a solar activist in Florida is because she has a really fundamentally different take and a different opinion or a different view about the relationships between individuals, government, and technology.

And so there have been many national reporters who have written many positive articles about her effectiveness because she's a really unusual activist for solar power. She has fundamentally different motivations. She is opposed to government intervention, and frankly, utilities restraining people from putting solar on their rooftops.

And so the key questions I want to ask about permitting reform as we go through the semester are-- or rather, the key questions you should ask as we talk about different ideas on permitting reform, are we actually talking about specific legislative language? We don't have any drafts of what a permitting reform deal might look like. So there's a lot of heat and not so much light so far about what specific legislation might look like.

We should ask ourselves if we do permitting reform, is this going to change the speed of current permitting? Is there sufficient administrative capacity to govern the permitting? Are changes in permitting going to result in more or less litigation?

Will our permitting reform change the amount of public participation that's currently allowed in the process? Do we need to change the level of public participation in the process? Do we need to change who shows up in the process?

We know that lots of urban planning processes that solicit public participation are quite often dominated by, frankly, people who are older and whiter than the residents of places that may be looking at development. They may be represented by people who already live there, not the people who want to live there. So how do we need to change public participation to truly reflect community desires, but also try to achieve building the things that also communities desire? Everybody wants better roads, bridges, infrastructure. Everybody, probably most people, want a cleaner energy system. So how are we going to achieve that? We have to not lose sight of those goals.

And of course, we should ask ourselves, both in terms of permitting reform, but our existing permitting regime, are these permitting systems leading to the desired outcomes we want? And are we going to need permitting reform to build renewable resources? Are we going to need to build things like affordable housing?

And are we going to need permitting to stay as it is to build or block fossil fuel resources? Some people argue that environmental groups are really good at using litigation to block fossil fuel development. But we've also built a lot of fossil fuel infrastructure in the last 20 or 30 years. It's not like we haven't built a lot of other pipelines, even if we've stopped some pipelines. So we should ask ourselves, is the permitting system we have enabling us to achieve the outcomes we want?

And finally, if we have permitting reform, can it get the necessary votes in the House or Senate? 45 or 50 House Democrats have already signed a letter saying that they oppose any permitting reform. If we ask if the Senate, it's going to need 10 Republican votes. The previous climate bill was done through reconciliation. So it can be done with 51 Democratic votes, or 50 Democratic votes plus the vice president. But if you want to do something non-financial or non-budget-related, it has to go through the filibuster. And filibuster requires at least 10 Republican votes.

So we talk about permitting reform. There's been a lot of discussion of what the perfect permitting system might be. The perfect should not be the enemy of the good. We need a possible level of permitting reform that 50 House Democrats and 10 Senate Republicans can agree on. We do not know if any legislative language currently exists or any reform exists that's going to satisfy these two different extremes on the political spectrum.

So we're going to do a class discussion on Tuesday. I want you to be prepared to discuss your p-set answers at length. We're going to discuss it quite actively in Tuesday's class. The questions I had in the p-set are all on the slide. I encourage you to think very carefully about your answers and be prepared to talk about them with your classmates. Thank you very much, and have a good one.