Energy Justice Intervenor 2024

Session 3: Foundations of Energy Equity Cont. & Threats to the Energy System

Future of Gas
The first emerging issue we are going to talk about is the future of gas. You might have heard this term in the states you work in as more regulatory commissions examine how much gas should play a role in our energy future.
—NEXT SLIDE

Why Now?
That's because of a lot of changes, especially in climate science, over the last decade or so. What was once regarded as a bridge fuel is now understood to have a lot more negative impacts than we previously understood. Bridge fuel is a commonly used term for a fuel that will provide power with the least environmental cost while we deploy non-polluting, renewable energy.
Natural gas advocates characterize it as a bridge fuel, with the implication that we will use it now to achieve short-term greenhouse gas reductions by replacing coal-fired power, then reduce or end reliance on natural gas over some time period to lock in long-term greenhouse gas reductions.
Today, we know that methane, the largest component of natural gas, is actually 86 times more potent a global warming agent than carbon over a 20-year period. RMI put out a study that calculated gas's global life-cycle emissions (extraction to end-use) and compared it to coal's global life-cycle emissions. They found that 2% methane release puts gas's climate risk on par with coal. However, when considering the net emissions from all natural gas and coal greenhouse gases (including CO_2, methane, and sulfur dioxide), the climate risk for natural gas and coal can be on par at just 0.2% methane leakage. And we know from aerial surveys that methane leaks are much more frequent and intense than was originally assumed so we are definitely past that threshold in our current operations.
—NEXT SLIDE

Key Questions
So, how long is the natural gas bridge? When should we stop developing new natural gas infrastructure? How do we make our use of natural gas beneficial without turning it into a long-term problem? These are some of the questions central to the future of the gas problem.
—NEXT SLIDE

Facts and Considerations
Some of the considerations that play a part in this issue include the fact that we have spent a lot of money building up gas infrastructure to deliver natural gas to people across great distances. I live in Chicago, and some of our gas pipes here are thought to be around 100 years old. So, our current system is very seriously tied to decisions made generations ago.
There's been a lot of investment in gas, so we have to think about a really intentional managed transition to decommission as many of the gas assets as we can. But a lot of those costs associated with gas are considered sunk.
If these assets are assumed to have a useful life of 70 years, they're paid off over several decades, so multiple generations of customers may all be paying for the same piece of pipe because it's so expensive,

under the assumption that it will be used for that long. Well, if you abandon that pipe or you stop using it during that time, it becomes a stranded asset, and that means that there are still costs associated with it that haven't been paid off, and that adds tension and complexity to this issue. What happens to those assets?

We talked about the impacts of methane already, but to add some context to that, the Inflation Reduction Act has really accelerated federal action on methane leaks. In December of last year, the EPA released a rule that will sharply reduce emissions of methane and other harmful air pollution from oil and natural gas operations by imposing new industry standards and earlier this year announced a proposed rule to impose and collect an annual charge on methane emissions that exceed specified waste emission thresholds. So, this increased scrutiny and regulation also increases costs associated with natural gas.

Again, the fact that it is a price-volatile resource also plays a role; it is a finite resource, it is not renewable. Gas distribution can also be quite expensive, especially as we face aging infrastructure and the need for pipe replacement in some areas.

There's the feasibility of electrification. The way that the grid is built today to accommodate the current peaks on the system is going to have to change in order to accommodate the electrification of home heating. And electrifying other sectors that have relied on gas as well.

There's also the issue of some gas utilities targeting lower-income areas that have not had gas in the past. Instead, they were reliant on propane and, in some areas, using wood-burning furnaces. Because gas companies are seeing the writing on the wall and are seeing that strategic decommissioning is on the horizon, they're trying to expand their gas systems to areas like Pembroke, Illinois, a historically Black farming community that was primarily reliant on propane and coming as something of a savior, and saying, we're going to give you the gas that you have been asking for decades now. This is not entirely reflective of their motivation, which includes having new pipes they can continue making money from for generations to come.

Now, we can discuss threats to our energy system, including powerful lobbies that are pushing for the future of gas because they have a vested interest in it and how it appeals to people.

—NEXT SLIDE

The Players

Here are some of the big players when it comes to utility power and influence. This is by no means a comprehensive list, but it includes some names you can expect to encounter in the field.

The American Gas Association (AGA) has done a great job of convincing many decision-makers that gas isn't going anywhere and that it's in the best interest of many people to keep gas in our energy mix. The AGA has become really adept at lobbying and marketing to amp up public messages of support for gas and all of the ways that we have historically interacted with gas appliances, whether that's your furnace or your gas stove.

Next is the Edison Electric Institute. According to their website, “EEI engages on behalf of utilities with federal and state legislators, regulators, and other policymakers through lobbying, advocacy, and regulatory proceedings, with the goal of providing customers affordable, reliable, and resilient clean energy.” We know from their track record that they continue to push for the persistence of fossil fuels in our system and that they are extremely powerful and well-funded.

The Koch brothers have an empire of companies. But they generate a lot of their wealth from oil drilling, refineries, fracking, tar sands, and oil processing. Really, they can be found playing a part across the entire supply chain of oil, and because of their vast wealth, they play a large role in funding oil and gas propaganda as well as lobbying

—NEXT SLIDE

Spending

Let’s talk about some numbers around utility and big oil’s influence.

- The world’s four biggest climate-polluting companies made a combined $32.6 billion in profit in just Q1 of 2023 (BP is missing from the chart on the right)
    - Which, just to put it to scale, would solve world hunger for an entire year, according to some estimates
- Lobbyist spending has increased dramatically since the 1970s
- Exxon, Chevron, Shell, BP, and the American Petroleum Institute spent a combined $452.6 million lobbying the federal government since 2011
- BP, Shell, Chevron, and Exxon, in total, spend around $750 million annually on climate-focused communications

—NEXT SLIDE

The Media
Media is a huge tool for advancing utility goals
We see some of the following messages amplified

- Amplified Messages:
    - We need oil and gas
    - It would be dangerous to rely only on renewables
    - Climate action is too expensive
    - Energy freedom and independence
    - Now we’re cooking with gas
    - You can only control your cooking temp with a gas stove and flame
    - Food tastes better cooked on a gas range
    - Cost shift: Wealthy people have solar, and the cost of that on the grid will fall on low-income communities
- We also see the practice of Omission: Most news outlets are not connecting climate impacts we are seeing today to climate change or fossil fuels and the companies behind them.
- TV, social media, radio, papers, etc are all fair game for utilities to promote their brand and mislead the public

—NEXT SLIDE

Politics and Charitable Giving
We also see how these interests show up in politics and the philanthropy world. This includes direct donations to political leaders when they are running for office or for their affiliated causes like foundations. We also see this tactic of directly giving to local organizations. According to the Energy and Policy Institute, from 2013 to 2017, 10 of the country’s largest utilities gave about $1 billion in donations. Those contributions often went to groups representing minority communities, and many of the recipients promoted the interests of utilities in front of government regulators.
Those interests are promoted through op-eds, through direct testimony, and public comments. There are lots of ways that local community members, unfortunately, fall into the trap of advancing utility interests. It’s been documented that utilities will intentionally wait to step up with donations when there is an active fundraising effort underway, usually for some critical community programs or resources. And they are of course, often taking advantage of a lack of knowledge around some of these issues.
All of this giving in turn, helps their public image because then they can also talk about their giving in press releases and the media as well. I’m gonna read out an example of this that came from one of the energy justice intervenors from our previous cohort, Gregory Norris:

“In 2020, Ameren gave out $100 gift cards to NAACP branch members to offset electric bills around Christmas. The result of these donations is that the organizations, individual members, and residents are less likely to speak out against Ameren and their high electric bills. In my opinion, Ameren uses funding in a legal and strategical, but potentially unethical, manner to mute the voices of organizations like these so there are fewer voices advocating for big, fundamental change in how the energy system works. It makes me mad to watch this happen over and over and to see organizations step back as a result of what is relatively little given on Ameren’s part but can be quite impactful to grassroots organizations that are just trying to get the system to be equitable.”
Something that I heard in a video that I’ll link in the resources that was really eye-opening for me was that utilities don’t need to advertise at all. Because utilities are natural monopolies, you are pretty much locked into who will service your energy needs. The excess amount of advertising is very strategic in its goal to position a utility positively in order to advance a profit agenda.
Another pattern we see is that utility directors of regulatory or external affairs often hold executive or board positions on the utilities’ separate 501(c)(3) charitable organizations. For example, in 2019, Katharine Bond, the Executive Director of the Dominion Energy Charitable Foundation, also served as Senior Policy Director for Dominion Energy and as a registered lobbyist for the company.
Kim Despeaux, the President of the Entergy Foundation, previously served as Senior Vice President for Federal Policy, Regulatory, and governmental Affairs for Entergy. EPI also found many cases where utilities’ executives and lobbyists hold board positions on a host of civil society organizations, many of which end up supporting the utilities’ position on political matters.
We also see that because of their connections to community-based organizations and other community leaders, they are able to infiltrate environmental and social justice spaces more and more. We’ve seen it at COP, and just recently, there was coverage coming out of a national civil rights convention hosted by National Action Network where 4 individuals with ties to the oil and gas industry were on a panel called Affordable Energy is a Civil Rights Issue, and they warned attendees of how wealthy individuals were pushing for net zero emissions and how that would affect energy bills without disclosing their financial ties to the industry or offering counter perspectives.
—NEXT SLIDE

Corporate Greenwashing
We see all of this play out as corporate greenwashing or the act of painting a company’s operations as more environmentally friendly than they actually are.

- Big Oil utilities and API have expressed a commitment to the Paris Agreement, but their actions have not lined up with those commitments
- The Paris Agreement, often referred to as the Paris Accords or the Paris Climate Accords, is an international treaty on climate change. Its overarching goal is to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels” and pursue efforts “to limit the temperature increase to 1.5°C above pre-industrial levels.”
- However, in recent years, world leaders have stressed the need to limit global warming to 1.5°C by the end of this century to avoid some of the most catastrophic effects of climate change.

Some examples of actions not matching up are:

    - ExxonMobil invested only 0.22% of its capital expenditures in low-carbon projects between 2010 and 2018
        - In 2018, the company announced a seven-year, $210 billion investment plan that would increase oil and gas production and would result in the company’s yearly CO_2 emissions *increasing* 17% by 2025.

    - Shell’s 2020 emissions were nearly twice that of the entire nation of Canada, and the company plans to increase natural gas extraction by 20%
- We see that most corporate lobbying spending goes toward policies that are oppositional to clean energy progress and the Paris Agreement
- And we are also seeing Misleading Claims abound in utility comms projects
    - Washington Gas was sued for claims made on customer bills: “Natural gas is clean, efficient, and reliable energy”
    - And there’s further confusion being created as utilities move away from saying “oil” and “gas” on their websites to more broad terms like “integrated energy” that makes it harder for the everyday consumer to discern what we’re actually talking about

To put a finer point on this, here are some of the policies that are impacting the future of gas.
—NEXT SLIDE

Policies Shaping the Future of Gas
More cities and states are considering electrifying buildings or using geothermal heat instead of gas for new buildings, as well as retrofitting existing buildings.
Clean heat standards and clean heat plans are also a really hot topic right now. There are only 2 states in the country that have passed clean heat standards via legislation: Colorado and Vermont passed those in 2023. Massachusetts and Maryland are considering a regulation Clean Heat Standard. When a state passes a clean heat standard, gas utilities are required to achieve a certain level of emissions reductions by a target date. They must also file and get approval for a clean heat plan intended to achieve that goal. On its face, it’s a great measure, but it’s important to review those plans because utilities will try to meet those requirements; sometimes, what’s proposed is worse and more expensive than electrification.
Future of gas dockets are emerging or underway in several states, essentially making plans for decommissioning.
Another policy is line extension allowances where gas utilities are able to socialize amongst all customers the cost of a certain amount of pipe to reach new customers. So, for example, when a new apartment complex is developed, the gas utility isn't just charging those new customers in that apartment complex for that pipeline. They're charging all customers for it, and the rationale has been that the more gas they’re selling, the more customers they’re spreading their costs among, so it’s better for everyone. And you can see in the image here what costs can be socialized amongst customers. But given how much we know now about the gas and all of the risks embedded in its use and the costs associated with those risks, there are efforts to end these extension subsidies.
Some municipalities are passing outright gas bans and saying you cannot in new construction build in the infrastructure for natural gas use, while other jurisdictions are passing laws to prohibit gas bans. So, there is a push and pull happening here in real-time.
—NEXT SLIDE

Transmission
Okay, the next issue we are going to talk about is transmission.
—NEXT SLIDE

Infrastructure Needed to Support Electrification
The decarbonization of the energy system will require a massive buildout of clean energy infrastructure. New renewable generation and storage resources are needed to replace fossil resources and meet electrification needs. And because of the scale of resources needed to electrify our system, those resources will likely be sited in rural areas and not as close to actual load centers in dense residential areas.

So electric transmission, which takes the energy long distances, will need to be built out. The ability of a new project to interconnect to the system and then build the transmission that's needed to get it from one place to another has really slowed down a lot of projects.
In the best conditions, large-scale renewable generator construction often takes two or more years, while the development of major transmission lines takes five or more years. However, under current conditions, some renewable developers are being told they won’t even be able to start construction until after 2030, and transmission lines may take ten or more years if they’re not simply canceled.
Developers are dropping out of interconnection queues for a lot of different reasons and it just doesn't work from a business standpoint to be sitting around waiting for approvals for that long, especially with all of the studies that are required to bring a project online and the fact that every regional transmission organization (RTO) and Independent System Operator (ISO) in the US has a significant backlog in its generator interconnection queue.
So, we need generator interconnection rules that will accelerate clean energy deployment through increased transparency, reduced costs, stricter deadlines, and improved study processes. We also need transmission planning processes and cost allocation rules that will require planners to identify the investments that will cost-effectively meet the needs of a decarbonizing grid and create a process for selecting and funding those projects.
FERC has been working on addressing some of these rules to advance approvals and ensure we have the capacity resources we need, but a lot of work still needs to be done on this front to improve the process.
—NEXT SLIDE

Electrification
Okay, we started to talk about electrification before, but just to go specifically into some of the considerations and factors affecting electrification here.
—NEXT SLIDE

Considerations with Electrification
There are a lot of different factors at play here, including how much electrification the grid is currently built to handle, the impact of electrification on renters who may not be able to choose to electrify their appliances or may not be able to choose to install a charging infrastructure for their cars.
Additionally, electrification is premised on the idea that you're drawing from renewable energy, but is it any better if your region is being powered primarily by fossil fuels? If a coal plant is powering the grid where you are, is that any cleaner, and did electrification really help advance climate goals?
Obviously, there are a ton of costs to consider. Who pays what? How much? There are differences between residential customers and industrial customers and their electrification costs and needs. There are some hard-to-electrify industrial sectors, and the organization Industrious Labs is one that I would point to that is working on those sectors, including steel and aluminum production.
Also, considering transportation electrification, I think many people might think of individual car owners who have passenger vehicles as necessary adopters of EVs, which is true, but the majority of emissions come from medium—and heavy-duty vehicles, particularly diesel vehicles, and much of the policy debate right now is focused on these vehicles.
Some states are passing requirements that only zero-emission vehicles may be sold in their state after a certain date, and they're providing rebates or other incentives for people to use electric vehicles and or to purchase electric appliances.
We already talked a little bit about managed charging last session when we talked about third party energy managers.
Make ready buildings refers to making buildings ready for electric vehicle charging or electrification ready.

Fuel switching is what the name implies: moving from one energy source to electrification and this can be mandated in some cases.
And lastly, rate design will need to adapt for a cleaner electric grid. The Maine Public Utility Commission approved two pilot rate proposals for residential households with electric vehicles (EVs) or heat pumps served by the state's two regulated electric utilities.
One pilot introduces a seasonal rate that lowers the volumetric delivery charge (which is based on electricity use) during the winter to encourage heat pump usage. To compensate for the reduced revenue collected from this portion of the bill, the pilot increases the fixed monthly charge (that does not vary with electricity consumption) for households opting into the seasonal rate.
The second pilot, called the "Electric Technology Rate" is designed for households using both heat pumps and EVs. The pilot offers the same monthly fixed charge as the seasonal rate pilot and offers reduced volumetric delivery charges year-round. Since fuel oil is a common home heating source in Maine, both rate pilots encourage electrification through heat pumps, delivering energy savings, carbon reductions, and health benefits for communities.
So, this is very much a hot issue, with experiments and pilots in the works as we adapt to life with more renewable resources powering our lives.
—NEXT SLIDE

Rate Design
Please listen to the recording for this part of the presentation led by Curt Stokes. The example walkthroughs are especially helpful in understanding rate design.

Aligning Performance with Rates
An early goal for utilities and regulators was to build the electricity system while providing access to customers across a large geographic area. Traditional cost-of-service (COS) regulation rewarded utilities and delivered financial returns to shareholders based on the utility's investment in the capital infrastructure necessary to reach as many customers as possible in their territory.
Today, the way utilities define performance is evolving. In addition to ensuring safety and reliability, regulators often task utilities with achieving goals related to EVs, integration of renewables and DERs, and even customer satisfaction and equity.
To incorporate new performance metrics into the way utilities are regulated and compensated, we use performance-based rate making, or PBR which is often enabled through legislation. The chart on the right comes from Rocky Mountain Institute. They wanted to better understand the policy motivations driving interest in PBR, so they looked at PBR legislation enacted in seven states since 2018. Their review found that states cite as many as 17 different policy goals for PBR, with reliability, emissions reductions, and cost control among the most commonly cited goals. This would make sense given that these states have set zero or net-zero emissions targets for the electricity sector, they have experienced a lot of extreme weather that has led to blackouts, and that utility bills have come under greater scrutiny post-2020 when COVID impacted many people financially. So, states are setting aggressive timelines to define and adopt these performance metrics and incentives.
—NEXT SLIDE

PBR Approaches
There are four primary approaches to PBR:

- **Revenue Decoupling:** First is revenue decoupling which we touched on a bit in our first session but this is the most widely used mechanism for removing the incentive for utilities to increase sales in order to increase earnings. In doing so, utility revenue no longer depends on consumption, making utilities more open to pursuing other incentives. At least 33 states and

Washington, D.C., have adopted decoupling policies; 17 of those states adopted policies for both electric and natural gas utilities.

Next is,

- **Performance Metrics and Incentive Mechanisms:** These are clear and measurable metrics—including some linked to targets and incentives—used to monitor and incentivize performance in priority areas. The regulatory approach here typically includes tracking performance metrics, establishing performance targets, and designing clear financial incentives for utilities to strengthen performance in certain areas. Some metrics may be tracked without incentives to provide tracking insight for regulators, customers, and policymakers. While PIMs have been effectively applied in many scenarios, they are still only as effective as their design and implementation. Careful consideration is required to ensure that rewards and penalties are proportionate, in the public interest, and not able to be gamed or manipulated. They can also add to the cost of regulation by requiring onerous tracking and oversight for utilities and regulators.

Next is,

- **Multiyear Rate Plans:** These are intended to streamline the regulatory process, strengthen cost-containment incentives, and provide utilities with greater operational flexibility. These plans combine a multiyear rate case moratorium (3 to 5 years) with a mechanism that automatically adjusts utility rates between rate cases to account for drivers of financial attrition without being tied to actual costs. This gives the utility an allowance for cost growth as opposed to the traditional reimbursement for actual cost growth. So, basically, under an MYRP, regulators approve a multiyear plan that establishes a revenue requirement necessary to cover the anticipated cost of providing service over that timeframe.

Last is,

- **Incentives for Underused Practices:** This is more of an umbrella term for cost-trackers and other financial incentives used to encourage utilities to pursue solutions that may be innovative but beyond the utility's normal appetite for risk. Shared savings mechanisms (SSMs) are one example of a regulatory incentive to support energy efficiency and other programs that result in reduced consumption. SSMs assess the savings resulting from these programs and share the savings between the utility and customers. Other things that would be incentivized are things like the rate design pilot from Maine I mentioned or to work on emerging issues in some way like peak load management or managing a lot of distributed energy resources.

—NEXT SLIDE

PIM State Examples
This is a snapshot of some PIMS aimed at addressing distributive equity. An upside-only incentive means that a utility will only receive financial incentives based on their performance toward a target whereas a symmetrical incentive means that a utility can be either rewarded or penalized for their performance. Basis points, known as BPS, are a common unit of measurement for changes in financial percentages. A 0.01% change is equal to one basis point so 1% = 100 basis points of equity
—NEXT SLIDE

Climate and Equitable Jobs Act (IL,2021)

In IL, the Climate and Equitable Jobs Act was passed, in 2021 and amongst many things, it established 6 performance metric areas listed here for development with the commission able to establish up to 8 metrics for utilities, and it also puts utilities on new 4-year multi-year rate plans.
And you can see the additional considerations tied to these metrics below:

- They must be within utility control.
- They shall encourage cost-effective, equitable achievement of the above outcomes on the slide.
- There's a requirement of at least one year of tracking data for performance metrics
- Performance metrics shall achieve incremental improvements over baseline values over 4-10 years.

—NEXT SLIDE

Climate Resilience and Cumulative Impacts
And just to touch on the issue of resilience and cumulative impacts here, because we see that some of the PIMs are working to address these impacts, it's becoming more common for policies to integrate a cumulative impacts analysis of communities by requirement as we have more tools and data at our disposal, like the EPA's EJScreen tool and others at the state level. There are also cumulative impact bills popping up across the country.
In 2022,, New Jersey passed the Environmental Justice Law, which set a formal definition for overburdened communities, required Environmental Justice Impact Statements for certain types of facilities (e.g., incinerators, smelters, sewage treatment plants) proposed in overburdened communities, and set public participation requirements for permit proceedings impacting overburdened communities, among other things.
Tools are also being developed that measure resilience across a number of metrics. With these tools, we can make the case for why a measure would or would not benefit a community that is already environmentally overburdened.
We can also look at disparities in service and reliability; we can compare where utility investments are going across a state. Where are we seeing more system hardening? Where are energy burdens higher? Where is air quality low?
We are fully experiencing the impacts of climate change, and so we need to be mindful of building toward the future without perpetuating more inequities.
—NEXT SLIDE

Alternative Fuels and New Technologies
Okay let's talk about alternative fuels and new tech affecting energy policy
—NEXT SLIDE

Alternative Fuel: Hydrogen
Let's start off by talking about hydrogen. Hydrogen is being evaluated as a tool to decarbonize the energy system because it emits no greenhouse gases at its point of use. When used to produce energy in fuel cells, hydrogen only produces water. If hydrogen is burned for energy instead, it produces water vapor and air pollutants, mainly nitrogen oxides.
Carbon-free hydrogen is part of the U.S. Department of Energy's strategy to achieve Biden's net-zero by 2050 target. The bipartisan infrastructure law earmarked $8 billion for regional clean hydrogen hubs, while natural gas and electric utilities in more than a dozen states are proposing hydrogen-blending for use in buildings and natural gas plants.
It is a versatile fuel able to power vehicles, heat homes, and even generate electricity.
It can be helpful for renewable energy storage with excess solar or wind energy converted to hydrogen for later use, addressing the challenge of storing renewable energy.

Hydrogen is classified by its production method, so as you can see here, the “color of hydrogen” indicates how it was produced. The holy grail is green hydrogen, which is hydrogen produced from water using dedicated new solar and wind power plants or renewable energy that would otherwise be curtailed. Curtailed refers to excess renewable electricity production that would normally go unused or be turned off when supply exceeds demand. Instead of curtailing it, this surplus renewable energy is diverted to power electrolysis for green hydrogen production.
There’s also interest in hydrogen blending, the practice of injecting or mixing hydrogen gas into existing natural gas pipeline networks. Blending hydrogen into natural gas reduces the overall carbon footprint of the gas supply. Rather than building entirely new dedicated hydrogen pipelines, blending allows the existing vast natural gas pipeline networks to transport and distribute a mixture containing hydrogen. There are technical limits on blending percentages, typically ranging from 5-20% hydrogen by volume, depending on the pipeline material, end-use equipment, and regulations. Higher percentages require adjustments to infrastructure and appliances. Blending provides a means to scale up the low-carbon hydrogen supply in the near term while leveraging the established natural gas network as a delivery mechanism for the hydrogen-natural gas blend but a lot of work has to go into designing the optimal mix and there’s a lot of skepticism around its application.
—NEXT SLIDE

Alternative Fuel: Hydrogen Concerns
Hydrogen production is very water-intensive. Some or all of the hydrogen comes from its content in water; half in the case of production from natural gas, and all when electrolysis is used to split water. Using thermo-electric generation (e.g. nuclear or fossil-based power) to supply the energy increases water use dramatically because of water requirements when cooling plants with freshwater. Such immense water use has serious implications for siting, especially in water-stressed areas.
Skepticism surrounds the prospect of blending because it could be used to prolong the life of natural gas and would not reduce emissions overall.
Hydrogen leaks also have an indirect warming impact; if not minimized, they could negate much or all of the climate benefits of using hydrogen.
Blue hydrogen—made from natural gas with Carbon Capture Storage—does not meet the DOE “clean hydrogen” guidance. When replacing fossil fuels Btu-for-Btu, blue hydrogen increases net atmospheric methane pollution unless hydrogen leaks are kept very low and methane leaks are reduced by about two-thirds.
Diverting carbon-free electricity from existing loads to produce hydrogen results in a net CO_2 emissions increase since fossil-fuelled electricity will generally be needed to replace a portion of the diverted electricity. In most cases, the resulting net emissions/unit of hydrogen production are higher than emissions from fossil-fuel-based hydrogen production, including grey hydrogen. There are also safety concerns because of the combustibility of hydrogen as well as risks associated with the various production methods.
—NEXT SLIDE

CCS: Carbon Capture and Storage/ Carbon Capture and Sequestration
Carbon capture and storage (CCS), also known as carbon capture and sequestration, refers to a set of technologies and techniques used to capture carbon dioxide (CO_2) emissions from sources like power plants or industrial facilities before the CO_2 enters the atmosphere, and then store it underground to prevent its contribution to global warming.
The CCS process involves three main steps:

1. Capture: CO_2 is separated and captured, usually from the gases of fossil fuel power plants, cement manufacturing plants, or other large industrial emission sources. Capture techniques include absorption, adsorption, membrane separation, and others.
2. Transport: The captured CO_2 is compressed and transported, usually via pipelines, to a suitable storage site.
3. Storage/Sequestration: The CO_2 is injected deep underground into geological formations such as depleted oil and gas reservoirs, deep saline aquifers, or unmineralizable coal seams preventing the CO_2 from entering the atmosphere.

In theory, the CO_2 can remain trapped for millions of years by an impermeable, non-porous rock layer or "cap rock" above the storage formation that acts as a seal.

—NEXT SLIDE

CCS: Carbon Capture and Storage/ Carbon Capture and Sequestration Concerns
There are a lot of challenges that remain around cost, scaling up deployment, and long-term monitoring of storage sites. There are also a lot of really valid environmental justice concerns:
1. Perpetuating fossil fuel extraction and use: Critics argue that CCS prolongs the life of fossil fuel power plants and extraction activities, which disproportionately impacts low-income communities and communities of color located near these facilities through air/water pollution, health impacts, and disruption of lands.
2. Burdening disadvantaged communities: There are concerns that the geological CO_2 storage sites will be located in disadvantaged communities that already bear a heavy burden of industrial activity and pollution. These communities may face risks of leaks, induced seismicity, and potential contamination of groundwater aquifers. Concerns exist about the lack of meaningful participation, consultation, and consent from fenceline communities and indigenous groups regarding the siting and risks of CCS infrastructure.
3. Opportunity costs and Lock-in of Emissions: Some environmental justice advocates argue that investments in CCS divert resources away from prioritizing a more rapid transition to renewable energy sources that could provide cleaner air, green jobs, and economic opportunities for disadvantaged communities, and the continued burning of fossil fuels is, in effect locking in greenhouse gas emissions from these sources for decades instead of driving urgent decarbonization.
4. Monitoring and liability issues: There are doubts about the capacity for long-term monitoring of CO_2 storage sites and liability frameworks in case of leakage events impacting local communities.

Overall, while CCS is viewed as a potential emissions reduction tool, environmental justice advocates emphasize prioritizing a just transition to renewable energy while ensuring frontline communities have a voice in CCS developments that may impact them.
—NEXT SLIDE

Biogas and Biomethane
Biogas is a mixture of methane, CO_2, and small quantities of other gases produced by anaerobic digestion of organic matter in an oxygen-free environment. The composition of biogas depends on the type of feedstock and the production pathway; these include the following main technologies:

- **Biodigesters**: These are airtight systems (e.g., containers or tanks) in which organic material, diluted in water, is broken down by naturally occurring micro-organisms. Contaminants and moisture are usually removed prior to the use of the biogas.

- **Landfill gas recovery systems**: The decomposition of municipal solid waste (MSW) under anaerobic conditions at landfill sites produces biogas. This can be captured using pipes and extraction wells along with compressors to induce flow to a central collection point.
- **Wastewater treatment plants:** These plants can be equipped to recover organic matter, solids, and nutrients such as nitrogen and phosphorus from sewage sludge. With further treatment, the sewage sludge can be used as an input to produce biogas in an anaerobic digester.

Biogas can be used directly to produce electricity and heat or as an energy source for cooking. Biomethane (also known as “renewable natural gas”) is a near-pure source of methane produced either by “upgrading” biogas (a process that removes any CO2 and other contaminants present in the biogas) or through the gasification of solid biomass followed by methanation.
Upgrading biogas to biomethane allows for wider applications and integration into existing natural gas networks and infrastructure. It can be injected into natural gas pipelines, used as vehicle fuel, or for any application requiring conventional natural gas
—NEXT SLIDE

Biogas and Biomethane Concerns
There are several environmental justice concerns associated with biogas and biomethane production:

1. **Facility Siting and Local Impacts:** Biogas facilities like anaerobic digesters, and upgrading plants are often located in low-income communities and communities of color already burdened by industrial activity and pollution sources.
    - If the organic feedstocks (e.g., manure, and food waste) for biogas production are transported over long distances, this can increase diesel truck traffic, noise, and air pollution in surrounding neighborhoods. Communities near large animal operations may also face impacts from manure management practices, such as increased odors and ammonia and nitrate air and water pollution.
2. **Land Use and Property Values Concerns** exist about the siting of large biogas facilities in rural and agricultural areas, as well as impacts on property values for nearby homes and communities due to perceived nuisances like odors and visual impacts.
    - Relatedly, if you are growing crops solely for the production of biogas, that can require a lot of land as well as industrial agriculture practices such as the application of fertilizer, which involves fossil fuels. This is not as common in the US as it is in Europe; here in the US, it is more common to use residues of certain crops, but still something to keep in mind because connecting our food supply to biogas can, in a way, lock us into industrial agriculture practices that we know are negatively affecting the planet and our health.
3. **Worker Health and Safety** within biogas facilities is another concern, as there are risks of exposure to hazardous gases like hydrogen sulfide. It is really important to consider whether the people working in these facilities are coming from nearby communities that are typically overburdened.
4. **End Use Impacts:** If the purified biomethane is used for power production or as vehicle fuel, it can contribute to localized air pollution hotspots impacting nearby communities when combusted, despite being a renewable fuel.

—NEXT SLIDE

New Technologies
Okay, some other new technology

- **Batteries:** Energy storage batteries are devices that store electrical energy from any source and provide that energy later on demand. Energy storage batteries allow storing electrical energy from intermittent renewable sources like solar and wind when the supply is high but demand is low. This stored energy can then be dispatched onto the grid or used locally on-demand when needed later.
- **Geothermal:** A renewable energy source that harnesses the heat contained within the Earth's subsurface to generate electricity or provide direct heating and cooling. There are a few different types of geothermal and you can see a ground source heat pump pictured here.

—NEXT SLIDE

New Technologies
A virtual power plant (VPP) is a cloud-based distributed power system that aggregates and optimizes a network of distributed energy resources (DERs) to function as a single, unified power plant. The key components of a virtual power plant include:

1. Distributed Energy Resources, so those are things like
    - renewable sources (solar PV, wind)
    - energy storage systems (batteries)
    - flexible loads (HVAC systems, electric vehicles)
    - backup generators
    - combined heat and power plants

You also need a

2. Smart Software Platform: Using artificial intelligence, internet of things, and advanced controls, the VPP software aggregates, monitors, and remotely optimizes the operations of the distributed resources.
3. Bidding and Trading: The aggregated capacity from the distributed resources can be offered into electricity markets and grid service markets as supply or demand response.

There are more examples of these virtual power plants being established, including:

- In California, the utility Pacific Gas & Electric is working with Sunrun, a solar and battery storage company, to enroll 7,500 customers to be part of a virtual power plant with capacity of up to 30 megawatts.
- In Vermont, the utility Green Mountain Power has a virtual power plant with more than 4,000 batteries in customers' homes and businesses and is in the process of expanding the program.

Utilities will generally offer rebates or credits on bills for customer participation in these programs.
We are in the early stages of realizing the potential of virtual power plants. Batteries are just one of several resources that can be turned into networks, and RMI sketched out what this might look like, showing the potential for 61.9 gigawatts of capacity in the United States in 2030 to be connected.