Top-Down Approach to Influencing Carbon Capture and Sequestration Policy: Why the Bottom-Up Approach Will Fail in Generating Effective Policy for CCS Technologies

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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If elected officials can kill Aramis, what should you do? Make them change their minds, or get other ones elected. You don't think you have the power? Then don't expect that Aramis will –

Latour, 1996 pg. 292

Fundamental Problems to the Development of CCS Policy

For the purposes of this study, it is assumed that preventing climate change is inherently good; using this assumption as a base, we conclude that preventive steps need to be taken to mitigate climate change and uphold the well-being of the general environment. Exxon Mobil's published 20-year energy forecast shows that many long-term, sustainable energy sources are still several decades away from being viable and able to support current energy demands (Crane 2020, n.p.). This time period is sufficiently long that the environment cannot afford to wait for their arrival. It requires action to happen now (Crane 2020, np.). To meet today's energy and environmental needs, bridging technologies will need to be utilized ("Status of the Ratification of the Convention.", 2018 n.p.). A bridging technology is a temporary, technical construct that helps to ease the transition from an established technology to a new, and still undeveloped technology. One prominent solution that offers both large scale energy outputs, and environmentally friendly exhaust is a natural gas burning power plant that incorporates carbon capture and sequestration (CCS) technologies. The helps by providing a method of power generation using existing technologies while also negating all of the CO_2 emissions that are typically associated with the technology.

While this CCS power plant provides solutions to a well-known problem, the plant suffers from some sociotechnical flaws. The first being that because the plant is a bridging technology, there is very little public awareness of what the technology does, and how it will affect stakeholders in local communities. Furthermore, since these plants do not yet exist there is

little to no evidence of how to build community support for this type of power plant. It is vital to the successful implementation of the power plant that it gets the necessary policy and local support. Without a sound social base to back it up, the technology will fail in the same fashion that the Aramis technology failed in France (Latour, 1996 pg. 219).

People will lose interest and defund the necessary infrastructure that keeps the project running (Latour, 1996 pg. 15). It is vital that the implantation of this kind of power plant reaches completion. Without it, the global average temperature may rise over 2 ^{o}C from pre-industrial averages ("Status of the Ratification of the Convention.", 2018 n.p.). The Paris agreement cites this number specifically as a line that cannot be overstepped without severe consequences to most ecosystems across the globe. With the earth already being up 1 ^{o}C from pre-industrial averages, it is of the utmost importance that action be taken immediately ("Status of the Ratification of the Convention.", 2018 n.p.).

"As climate change mitigation technologies emerge, there is an increased need to understand public support for the technology and the policies that will shaper or thwart its evolution. Of particular importance are the communities directly impacted" (Moon, 2019 pg. 1). In this paper, I argue that support for a CCS power plant must be developed using a top-down approach as opposed to a more traditional bottom-up approach that most climate change technologies are using right now. In this case, a "top-down" approach entails using high-level policy, such as international, to help motivate and trickle down to smaller, local policy making units. To prove this theory, a combination of case studies done by Won-Ki Moon and Bart Terwel will be examined through a framework provided by Frank Geels. Between these two studies and the framework provided by Frank Geels, it will be made apparent how and why a

top-down approach to policy making will be effective in gathering local support for this kind of power plant.

The Climate Demands Urgent Action from Policy Makers

The best way to combat this rise in global emissions is "Reaching and sustaining net zero global anthropogenic CO_2 emissions and declining net non-CO_2 radiative forcing would halt anthropogenic global warming on multi-decadal times scales" ("Status of the Ratification of the Convention.", 2018 n.p.). This is exactly what CCS technology accomplishes. It allows for power generation while capturing the emitted CO_2 and sequestering before it can dissipate into the atmosphere. Rodney Allam has developed a method to use CCS technology in combination with natural gas burning power plants and has already built a pilot plant to demonstrate its effectiveness. It has thus far been a technologically sound power plant that is capable of being scaled to commercial levels (Allam 2013, pg. 2).

However, if CCS was a perfect solution to the problem it would already be implemented. As mentioned earlier, the technology suffers from several non-technical flaws. These are just as important to address as any technical solutions. Latour's conclusions in his study on the Aramis technology shows that technologies, especially new and emerging technologies, require community support to make them viable. They can be technically sound but without the proper organization and social support, they will fail none the less (Latour 1996, pg. 292). Because CCS is a bridging technology, this is particularly important and relevant. Terwel agrees with Latour's conclusion by saying "The increased interest in [CCS] is hardly surprising considering that most professionals recognize that—in addition to economic, regulatory, and technical

aspects—the viability of CCS is likely to depend on whether or not the general public accepts CCS as a climate change mitigation strategy" (Terwel 2011, pg. 1).

The aspect of being a bridging technology has several interesting and important problems that normal technologies do not. First of all, convincing people to implement the solution will be much harder because it is not a permanent solution. In addition to all of the work that it will take to make this technology a success, more work will have to be done to develop a permanent solution. Furthermore, there is a sense of urgency in implementing this technology that is not normally associated with new technologies (IEAGHG 2012, n.p.). Furthermore, as seen in Figure 1, provided by Rob Crane, electricity generation is only projected to grow its carbon dioxide output by billions of tons over the next 20 years.

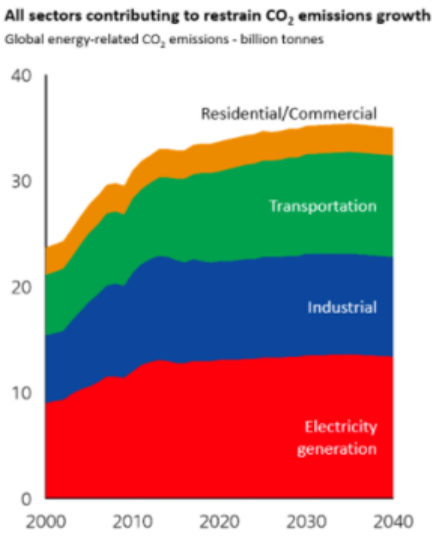

Figure 1: Timeline of Global CO_2 emissions broken down by sector

In order to save the globe from irreversible damage there needs to be action now, not in several decades. "Future climate-related risks depend on the rate, peak and duration of warming. In the aggregate, they are larger if global warming exceeds 1.5 ^{o}C before returning to that level by 2100 than if global warming gradually stabilizes at 1.5 ^{o}C, especially if the peak temperature in high (e.g., about 2 ^{o}C). Some impacts may be long-lasting or irreversible, such as the loss of some ecosystems" ("Status of the Ratification of the Convention.", 2018 n.p.). This sense of urgency to prevent climate change almost demands that a well thought out method for finding

community support is discovered. This is particularly important for this type of CCS implementation because it allows for the elimination of large-scale carbon dioxide pollution.

The problem with developing a method to build community support is that there is as of yet, no existing power plant that uses this technology (Allam, 2013 pg. 2). Because of this, there is a lack of understanding as to how exactly community support can be built to the point where one of these plants can be successfully implemented. However, there is not a complete lack of knowledge on the subject. Merrill and Sintov have written a paper that suggests "pathways", or several factors that occur in series, that lead to support for environmental energy policies. They cite both social and psychological phenomena that lead to this support. Interestingly, one of the social phenomena that is cited is an individual's relationship to the community, or their social capital (Merrill 2016, pg. 88). "The researchers found that people who feel connected to their community are generally aware of community norms and are more likely to support policies that generate shared benefits" (Moon 2020, pg. 2). There are two things that are not well understood. The first is there is no clear understanding of how to start the conversation of looking at CCS technologies on an environmental level. The second is what type of approach would work best to start a large-scale conversation about CCS technologies across many local communities at once? The latter question is the focus of this study.

This research will attempt to fill the gap in knowledge of how CCS community support can be developed. In particular, this will be done by analyzing how can what is already known about the climate change landscape best be applied to the two problem listed above. For example, if there is already international support for policy shaping climate change, what led to that support and why is it not showing itself at local levels? Furthermore, what networks need to utilize their social capital to have a positive impact on the climate change landscape? The

answers to these questions will help to paint a picture of what needs to be done to get a power plant that incorporates CCS technology working at a scale that fits the needs of whole communities. Unfortunately, there simply is not enough time for straightforward, large scale study to be done that can answers these questions more directly. These questions demand a rapid answer that can be answered using the insights developed in this project.

Both Terwel and Moon establish in their research that communities with more awareness of the cost and consequences of climate change are more likely to support new mitigation technologies (Terwel 2011, pg. 2). Furthermore, Moon also makes the conclusion that a higher climate change awareness at both the individual and community levels were strong predictors in the measured support for CCS technologies (Moon 2020, pg. 6). Moon makes several other conclusions that are both fascinating and of importance to this study. First, he found that the correlation between CCS support and climate change awareness was significantly stronger on an individual level than on a community level (Moon 2020, pg. 6). Next, he found that social capital was correlated positively with the perceived community level support for CCS technologies, but not an individual's support (Moon 2020, pg. 6). In other words, people with more social capital, who had a greater understanding of climate change, felt that their communities had stronger support for CCS technologies, while their own opinion was unaffected. This might seem like a troubling conclusion, but because of the structure of American politics, that is the use of representative democracy, it works in the favor of this study quite well.

Methods: The Facts Behind Current Pushes to Support CCS Policy and Their Flaws

The research used to develop this argument stems from two major sources already cited in this paper. The first is an article done by Bart Terwel which analyzes how community trust in

stakeholders affects public acceptance of CCS. This paper was chosen because of its relevance to how a community might react to the introduction of CCS. More importantly, it can serve as a basis to establish to what extent and how community stakeholders are responsible for generating support for the technology. Terwel establishes early on that CCS support cannot be directly measured by normal surveying techniques. "Traditional public opinion surveys are not very suited to examine public opinions about CCS…. Such opinions are very unstable and hardly usable for the purpose of policyaking" (Terwel 2011, pg 2). Elizabeth Malone agrees with Terwel and says the reason why individual opinions cannot be trusted for policymaking is because the general population has so little knowledge of CCS. Instead of trying to get information to stakeholders and having them absorb it, Malone concludes that it would be better to try and get stakeholders actively involved.

Without an accurate way to directly measure public opinion and the need to know the public's opinion immediately, Terwel concludes that an indirect method of measuring the public opinion is needed (Terwel 2011, pg 2). He decides that the best way to do this is measure the level of trust that the public has in professional CCS stakeholders. Once the level of trust has been measured, it can be used to extrapolate how likely the public is willing to support the actions of CCS stakeholders.

Terwel conducted a series of experiments that tested the public's competence-based trust, integrity-based trust, current trust, and methods of instigating trust. Terwel found that the perceived competence of stakeholders affected people's reliance on the positions that those stake holders held. The higher the trust, the more people thought that they would give accurate information which led to an overall increase in positive feelings about CCS (Terwel 2011, pg. 6). The public's perception of the stakeholders' integrity only impacted their feelings about CCS if

the public had thought that the stakeholder exhibited low levels of integrity. When this was the case, people actually developed opinions that were the opposite of the stakeholders' which resulted in much lower support overall (Terwel 2011, pg. 6). Currently, the public trusts representatives from non-profit organizations much more than representatives from industrial companies. The study also found that the public supported CCS policy decisions if the policy was sponsored by a trusted political authority. If said political authority was transparent about how the policy decisions were made, there was higher levels of trust and support found (Terwel 2011, pg. 7). All of these conclusions are extremely relevant to this research because it establishes what kind of stakeholders are likely to be able to influence communities and have an impact on policymaking. Not only does the research accomplish this, it can be used in combination with Malone's conclusion about how to garner community support to show what kinds of networks will be able to call community stakeholders to action.

The second major source is a paper written by Won-ki Moon that studies the social psychological factors that affect support for CCS. Moon agrees with Terwel that direct surveys of the public's opinion on CCS is not usable data for policy makers. Instead, observations about a community's support for CCS can be made by looking at their psychological relationship to stakeholders. Moon studies how trust in stakeholders varies with the stakeholder's social capital, and the expected influence of stakeholders with various levels of social capital. Moon reaches several important conclusions. The first being that individual support and the perceived community support are independent of each other and one cannot be used to predict the other (Moon 2020, pg. 8). Furthermore, perceived level of social capital that a stake holder had in relation to their influence on policy making was extremely important in gauging both an individual's support of CCS and that individual's perceived community support of CCS (Moon

2020, pg. 8). Stakeholders with large amounts of social capital had much more influence on policy making than would be expected from stakeholders with low social capital. Social capital also affected several other aspects of a stake holder and their impacts on policy making. For example, the more social capital a stakeholder had, the more the public needed to trust them to reflect positive feelings towards CCS at the community level (Moon 2020, pg. 7).

In a similar manner Moon showed that when individuals have a more positive relationship with their community, they tend to think that CCS is a worthwhile investment to help protect the other members of their community. These findings lead to the conclusion that increasing social capital amongst the members of a community will lead to an increase in the participation of developing community level climate change policy (Moon 2020, pg. 7). Increasing participation in climate change policy for an entire community can only be good for CCS development because it means that there will be a more educated population on the risks associated with climate change, which Moon proved earlier in his paper is associate with higher levels of CCS support (Malone 2009, pg. 420). Evan Fraser further demonstrates in his paper that community involvement is of the utmost importance in determining if government environmental policies will fail or succeed. Figure 2 further explains how standard decision-making process of government policies towards climate change work (Fraser 2006, pg. 117). In the case of CCS there are fatal flaws in this design at stage 1 and 4. There is no clear way to find and organize community actors that

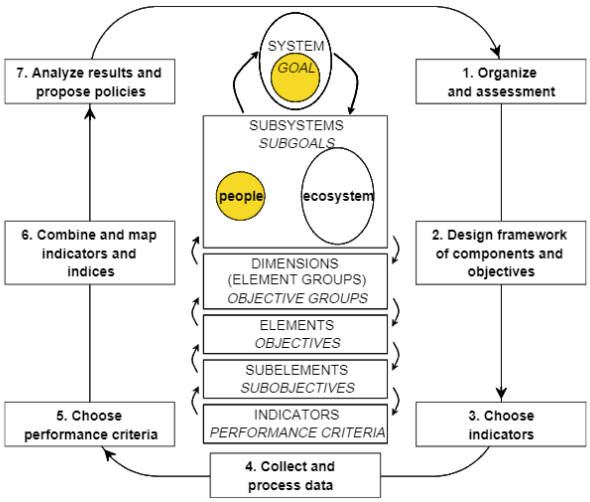

Figure 2: Normal Environmental Decision Making Process

support CCS technologies because there is so little public awareness about the technology. This is also the cause of the failure of step 4 in which there are not enough existing plants to be able to collect data from (Moon 2020, pg. 3). Without these two items to aid in the process of policy making, it becomes clear a different method of thinking must be used to push the CCS agenda.

All of these sources of information can be used in tandem with a concept developed by Frank Geels. He introduces the concept of a multi-level perspective being applied to sustainability transitions. The multi-level perspective (MLP) work by looking at a landscape, in this case, the climate change mitigation technology landscape, and seeing all of the different levels of networks that play a part in addressing the topic (Geels 2011, pg. 1). At the top, the most overarching network is the landscape itself which is broken down into different regimes.

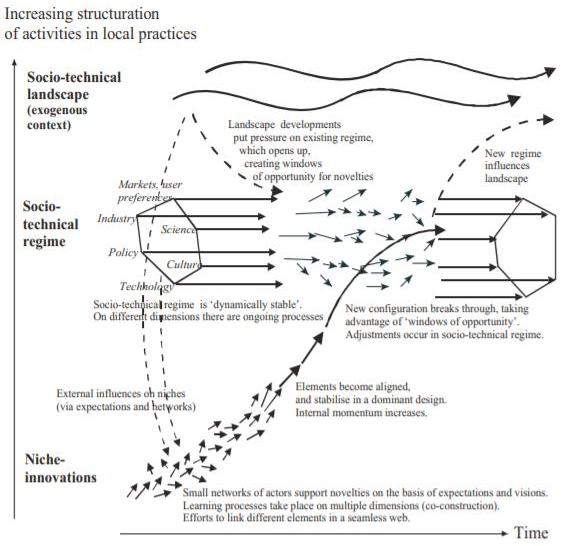

Figure 3: How information Flows to Affect Change in a Landscape

Each regime is an important aspect of the landscape that shapes it and develops it. Geels uses 5 different general regimes which are the technological, global, user and market, socio-cultural, and policy (Geels 2011, pg. 4). It should be noted that these are just general regimes and the framework can be changed to include more or less and different regimes than the ones given, but for the purposes of this study, these will adequately describe the problem at hand. Each regime is broken down into niches, which are small, strong networks of stakeholders that influence the regime. Each level of the MLP is distinguished by its difference in the amount of social capital that it possesses (Geels 2011, pg. 6). Figure 3 shows how social capital and information flows

from niches into regimes that affect the landscape. This MLP is valuable because it provides a way to analyze some important cause and effect relationships that will be driven by the data provided by Moon and Terwel. With the aid of Geels, a strong solution can not only be found but also described in how social capital can be used to enact changes from different parts of a larger community. This is so, because Geels provides a framework in which the effects of niches on each other from a far can be analyzed and studied to understand how taking certain courses of action will impact policy making for CCS technologies.

Fatal Flaws in Bottom-Up and why Top-Down Provides a Valid Solution

Looking at the work done by Moon and Terwel, one of the primary findings of this study becomes apparent; it will be necessary to manipulate public policy making for CCS not by increasing awareness and knowledge in local communities, but by targeting specific stake holders in the community that have large social capital and can directly impact policy making. Once these individuals are convinced of the importance and urgency of implementing CCS policy, they will be more likely to support and push legislation that will be friendly to the implementation of a CCS incorporating power plant. However, it is important that only certain stake holders come forward in support of the technology (Terwel 2011, pg. 7). If any stakeholders that carry large amounts of negative social capital are associated with the project, it will not be viewed in a favorable light (Moon 2020, pg. 6). In fact, in some cases, particularly if the stakeholder is viewed as having low amounts of integrity, it will hurt the cause and force the public to support legislation that directly combats the efforts of this stakeholder. Unlike most technologies, the source of money, time, and human resources that get invested into developing the technology will matter to the public. This is most likely because it is a bridging technology. By definition, it will not capture the attention of the public as being a permanent solution to the

climate change problem, ergo the public will not be incentivized to learn about it and invest time and resources into developing it. These factors mean that the public will instead look to who or what supports the technology and its policymaking to base their own support off of. If they do not trust the source of the funding, for example a company that is morally questionable, they will try to combat the actions of that company.

What kind of stakeholders fit the mold that has been described as one that carries a large amount of community trust and ability to affect policy making? There is not one clear answer, but rather multiple members across the community will be necessary to ensuring successful implementation of CCS on a local level. Some of which will be long term local elected officials. These are obvious choices as people who can make an impact on local policymaking but also the length of their term in office can be used as a means of measuring the local community's trust in that individual. It is not a poor assumption to make that an individual who has held their office for multiple terms has the trust of their local community. Of course, this is the ideal candidate but most elected officials will need to be prompted by their constituents to take action on something. This is where non-profits and local organizations that are interested in cleaning up the environment come into play. Representatives from these agencies will be able to meet with elected officials and represent a multitude of people giving them a certain level of credit that would not come with a single individual. This becomes even more effective the larger the non-profit is, especially if they are a nationally recognized organization. These organizations can reach out to officials across multiple communities that might share the same power distribution network.

These ideas make even more sense when placed in the context of Geel's multilevel perspective framework. While most of the time the MLP framework is applied to solutions that

work from the bottom-up framework analysis, this would need to be a top-down method, but the MLP is still well suited for this method of thinking (Geels 2011, pg. 9). Using the five basic regimes presented by Geels, technological, science, user and market, socio-cultural, and policy, it is easy to see how a top-down solution would be much more effective than a bottom up. The technological regime is already well developed as a functional pilot plant for this design has already been built and operational for some time now. In addition, the science regime is well developed as climate change data has been validated and proven for several decades at this point. Furthermore, the user and marker regime is developed and will continue to grow the current energy demands of the world which are projected to grow tremendously by 2040.

The only two regimes that are lacking are the socio-cultural and policy regimes. In the case of American society, the two are relatively co-dependent because of the representative democracy. Without interest from the general public, politicians are unlikely to support policymaking in favor of an unknown quantity. Aire Rip explains that the landscape can in fact influence the niches directly through the regimes. As a general point changes in the landscape can are almost guaranteed to have an impact on all of the niches that make it up. In this manner niches that are seemingly unrelated to each other can exert their influence on one another from afar (Rip 1998, pg. 330-3). In the case of CCS, this is particularly important because without the ability of niches to exert influence on each other from afar, it would be very difficult to garner any support for the technology at all, let alone have it spread to multiple local communities. Furthermore, it allows for niches that are already in support of the technology to help spread their support to other niches.

At the surface level American politics seems even more unsuitable for a top-down approach than other forms of government, but this problem can be addressed as well. The one

major development that the policy regime has is the Paris Agreement. Being a part of the Agreement is putting international pressure on America to meet the demands set forward by most of the globe. That pressure is the cornerstone on which this argument is based. It proves two things. The first is that in order to join the Paris Agreement, an administration had to be elected that supported being a part of the Paris Agreement ("Status of the ratification of the convention", 2020 n.p.). That allows for the conclusion that niches of climate minded networks already exist in the socio-cultural regime. Furthermore, it provides the perfect top-down pressure needed for the policy regime to develop. In some sense, the American policy regime is already established by the Paris Agreement, but not in the traditional way. Instead of being propped up and supported by niches that are based in America, it is supported by suspension cables from the global climate landscape. The cables connecting the American policy making regime to the landscape have been forged by the niches in foreign countries that have already activated local levels in those nations. The pressure exerted by the landscape on the policy regime will eventually trickle down to local niche networks if given proper time.

That works great in the favor of this solution because as established earlier, those niches already exist but are in somewhat of a "dormant" state, or passively support the idea of CCS climate change but either do not realize the need for or urgency of implementing the technology in power plants. They need some kind of unifying pressure from above to activate and force local policymakers to take action. Unfortunately, local communities will not feel the pressure of the Paris Agreement any time soon due to it still having to trickle down into federal policy making; however, special interest groups and non-profit organizations are the perfect lobbyist for exerting that kind of pressure. Those networks are already well developed by other regimes and proven to be trusted by smaller niches in the socio-cultural regime. Because they are so well

developed, they also come with a large amount of social capital that can act as a catalyst for "activating" dormant networks of voters that supported administrations to join the Paris Agreement. Again, the major problem with CCS technologies is the lack of public awareness about CCS as a possible and viable solution. By pushing for local policy makers to push legislation on the matter, it will become part of their platform which will force voters and the media to cover the subject more. Those actions will undoubtedly result in larger socio-cultural awareness of the technology as a viable option.

Putting all of these facts together, a plan for how to start policymaking for CCS technologies becomes clear. Using other regimes, and their well-developed nice networks that have the social capital necessary to be recognizable, need to lobby local policymakers to put forward a small bill supporting CCS technologies. This small spark will likely light a chain reaction of events that will have compounding effects on each other to produce exactly the amount of awareness and policy needed to support a CCS incorporation powerplant. The initial policy will engender "unactivated" niches in the socio-cultural regime to take note and also listen to the same niche networks from other regimes. The public will be likely to trust those networks and be receptive to policy making and even support it in the future. In combination with the pressure exerted from above by the climate landscape with the Paris Agreement will further cause the policy makers to search for ready to go solutions to help in the fight against climate change. Because CCS is already technologically sound and ready to be built, it will be a good candidate to be the focus of those policy makers.

Conclusion: Top-Down is Demanded by the Climate Crisis

CCS is a good a viable solution to helping mitigate climate change. It fills a gap that exists between current climate needs and a lack of energy technology that is suited to meet both

climate change needs and intense energy demands. However, due to a lack of public awareness of the technology it is not widely used or considered as a viable solution to the climate change problem. To fix this problem, a top-down method of disseminating information will need to be used as opposed to other, more conventional bottom-up approaches used for other climate change mitigation technologies. This is due in part, because of the urgency behind finding valid and effective climate change mitigation technologies. The other major motivation for using this method of introducing CCS technologies is because of the insights gained by applying Geels framework to the climate change mitigation landscape. It is apparent that only half of the infrastructure is well developed at the regime level and many of the American policy niches are not strong networks, whereas there is strong international policy in the landscape. Using these motivations and frameworks in combination with the information discovered by Terwel and Moon, it further becomes clear that a top-down approach is the best solution method. The top-down solution method is best implemented by using larger non-profit organizations to lobby local policy makers in good standing with their community to begin making policy favorable to construction of CCS power plants. People are likely to trust and accept legislation that is backed by organizations that the public trust and perceive to have high levels of integrity. By getting the public to see a large network to be a proponent of CCS technology, lots of niche socio-cultural networks that elected the administrations that joined the Paris accord will "activate" to become proponents and supporters of the CCS technologies. In this way small pressure points can be used to broadly disseminate awareness surrounding CCS power plants. This solution is undoubtedly useful for climate change supporters, and people who hope to be able to build CCS powerplants.

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