Appendix F: Modeling Civil Disagreement on an Email List

This appendix excerpts two discussions on a moderated email list for electricity policy experts. Both reflect disagreement among list members about some issues discussed in the book. These discussions manage to explore the roots of disagreement without alienating the discussants and so promote learning far better than most social media exchanges do. Much of this is probably attributable to list rules which require use of participants' real names and so discourage destructive and debate-stopping rhetoric. Information that could identify participants has been omitted. (I was not a participant in either discussion; rather, I observed.)

Example #1: Regulatory Capture

This example shows an edited version of the first 5 days of list discussion of the incidence of pro-industry bias at state public utility commissions. It illustrates how easy inferences of regulatory capture obscure the complexity of regulatory decision-making, even in cases involving the so-called "lobbying revolving door" between industry and regulatory agencies. (Click here, here, here, and here for a selection of recent treatments of this issue by political scientists.) The full thread was almost entirely free of derision or snide remarks and evolved in informative and interesting ways consistent with the prescriptions in Chapter 6: ways that coupled disagreement with space for participants to think critically about their own views.

Example #1: Regulatory Capture		
Email Author	**Date & Time**	**Email Text**
Electricity Industry **Consultant #1** (economist)	6/9/2023, 1:04pm	Some of you will find this article of interest. [link to article omitted]. In addition to the cases cited by [the writer], a few decades ago, a former president of **[a state utilities commission, "Commissioner A"]**, became president of one of [the state's] investor-owned utilities that the commission had regulated. Just a few years ago, **["Commissioner B"]** took on the role of senior vice president at the same utility as **Commissioner A** and later took a job at another utility in [state] as executive vice president. **These revolving door policies need to end. They cast a shadow on the integrity of the regulatory process and they give credence to the theory of regulatory capture.** If commissioners do want to take on other jobs in the private sector, they should not be allowed to take them at the utilities which they once regulated. Why does an inner voice not tell them to not take that job? Where is there moral conscience? This is unethical.

Example #1: Regulatory Capture		
Email Author	**Date & Time**	**Email Text**
Electricity Industry **Consultant #2** (economist/public policy)	6/9/2023, 05:26pm	**Thanks for this, but I have to take a contrary view.** The article, written from an advocate's perspective, seems to decry the involvement of commissioners who don't agree with the author's agenda. That is the author's prerogative, but doesn't make a crisis from my vantage. In terms of having regulators who know something about what they're doing, I'm for it and **have seen more problems caused by those who were ignorant of the industries** but politically well-connected enough to be appointed. In terms of post-commission employment, the scope of what they regulate or affect in California includes not just utilities but also solar companies, consumer advocates, suppliers to utilities and related businesses, ordinary industries of all sizes and kinds as consumers, and on and on through dozens and dozens of sectors. Making someone unemployable across the areas of expertise they learn in the role is a way to reduce even further the pool of potentially qualified candidates for these jobs. Also, don't neglect the existing revolving door rules that apply in [State] and presumably most or all states. They are pretty detailed, and a case for further reforms might start from a discussion of what's already in effect and why it's claimed to be inadequate. Scrutiny of individual appointees, both by the governor's staff and in a confirmation process, is also a helpful safeguard if done meaningfully. Finally, **I was personally familiar with the two ["State"] commissioners to whom you referred, and found both to be capable public servants and ethical**. I think you missed the boat by attacking them for their employment histories.
Environmental NGO Executive #1 (attorney)	6/9/2023, 02:53pm	I'm with Consultant #2. Consultant #1 **I doubt that you know Commissioner A**…. **S/he was (and is) a person of extraordinary integrity**. Not that it matters particularly, but there was a two year gap between his/her Commission service and his/her decision to join the Utility. **Your second illustration of "unethical" behavior is clearly Commissioner B, and all who know him/her will join me (and Consultant #2) in rejecting that characterization** out of hand. S/he has served, with distinction, at the [multiple state agencies and multiple utilities s/he worked for]. I am one of many Commissioner B's admirers in this group.

Example #1: Regulatory Capture		
Email Author	**Date & Time**	**Email Text**
Consultant #3 (economist, former market analyst at an ISO)	6/9/23, 6:00pm	I'm thinking this concern about regulatory capture is covering a more fundamental concern. **I think the for-profit regulated monopoly structure is the problem**. When a person of integrity goes to work for such an organization, especially at the executive level, their highest priority must be to maximize corporate profits. That mandate will orient the company's fulfillment of its public interest mandate towards solutions that maximize profits, and away from solutions that reduce profits, irrespective of the greater societal benefits of one approach or the other. For the individual corporate executive, this logic inherent in the structure they're working in. Moreover, the monopoly's ability to orient its activities toward profit maximization is reinforced by the structure of regulatory procedure, which divides the overall subject, say provision of electric service, into dozens of simultaneous proceedings that only the monopoly has the ratepayer-funded staff and resource capability to competently and completely participate in and typically dominate. **In theory, the regulator is supposed to align the behavior of the utility with the public interest** (as I learned in [Professor X's] course). **But as they say, in theory there's no difference between theory and practice; in practice there is.** If we want better outcomes, and I believe many of us do, then **we need to reconsider the for-profit regulated monopoly structure.**
Consultant #4 (authority on energy regulation and competitive energy markets)	6/10/23, 3:45am	**The biggest problem for IOUs is the formula for ROI. Rates = expenses + return on capital.** There's no margin added to expenses. The only way to increase profits is to increase investment and, therefore, ROI. There have been many attempts at PBR, with only Hawaii taking the full plunge. Having studied this challenge for many years, it's hugely difficult. EE incentives have been a great idea but challenging in practice. Any good ideas out there? It would be great if IOUs could capture some of the savings associated with DERs and, consequently, have a real financial incentive to promote them.
Energy Company Executive #1	6/10/23, 9:24am	Consultant #4, **The logic that regulated utilities will use their monopolies to block DERs unless we give them a cut, is highly problematic in my opinion (even if we all know it to be true).** The regulated part of their monopoly should prevent them from using their position to hold industries hostage.

Example #1: Regulatory Capture		
Email Author	**Date & Time**	**Email Text**
Energy Company Executive #2	6/11/23, 9:02pm	Coming in late here, but as a former regulator (apparently I'm one of the 10% that the study quoted by LAT determined was "unclassifiable" in my background before going onto my commission!), let me make a few points: **1. Commissions have institutional characteristics that aren't easily swayed by individual members**, barring truly heroic efforts (and there are some) 2. Commissioners who don't know anything about, or don't quickly learn, the subject matter of utility regulation (by which I mean the revenue regulation of utilities and the features plausibly attendant to that) are less likely to make an impact on the direction of those institutions. **If I were a governor, I'd be looking for someone who knew about, or could quickly learn about (and treat with healthy skepticism) the "utility industry."** Economic regulation, and not environmental regulation, is what PUCs do. Do-gooders who don't learn (or think they know) this stuff flame out; many such cases. 3. Commissioners who view their prerogative as creating some kind of retail market or competitive procurement process (or other style of competition for utility services) in place of traditional utility functions can often have a more salutary and long-lasting effect on the regulatory landscape, because they are able to unlock the interest of third parties in participating in Commission proceedings … 4. There are certain Commissions/ers who come into office on a 'green' note who are even more willing to give out the gravy to regulated utilities all day long, in the name of doing good for the environment, than Commissions/ers who may come from a background of having worked at a utility but have a more traditionally economic-regulatory perspective on their role. … **I strongly agree with Environmental NGO #1 that Commissioner B should not be subjected to overt or implied slander.** S/he's a sharp, talented individual who would have no problem finding employment anywhere, and if s/he wasn't in his/her role, I imagine the alternative would be worse for the public at large. I'm sure there are former regulators that are venal, but Commissioner B is not among them.
Environmental NGO Executive #2 (attorney)	6/11/23, 10:52pm	Wise … Colleagues: I dealt with Commissioner A in his/her Utility [for] years, and like[d] him/her and respected him/her. I first met Commissioner A at [a relative's] wedding …. I don't know Commissioner B. I'm not questioning the integrity of either of them. Period. I'm not steeped in State's PUC and energy politics. I don't have any reason to take a shot at either of them. **I do think that it's problematic when PUC Commissioners go to work in senior, highly-compensated positions for the utilities that they have regulated, especially fairly recently. That undermines public trust** and confidence in the fairness and integrity of the utility regulatory process. We all understand that. (And, if you don't recognize that reality, check with colleagues who do market research – polling and focus groups.) **For our respected former Commissioners**: Work for a utility in another state, work for an unregulated entity, work for a consulting/law firm (that doesn't represent the utility that you formerly regulated), work in another governmental job, work for an NGO. **Don't work for a utility that you've regulated. It's just not right or good for the public interest. No offense intended.**

Example #1: Regulatory Capture		
Email Author	**Date & Time**	**Email Text**
Law Professor (former regulator).	6/11/23, 11:26pm	**I doubt that post-commission employment, especially in top utility management, ranks among the ten most important implements for furthering regulatory capture. I suppose though that this could be one of those occasions when the public weighs a symptom much more heavily than would a scale.** "Implements for regulatory capture" would be a worthwhile list to compile with impartial and scientific thoroughness. I wonder whether NARUC would fund such an effort.
Environmental NGO Executive #2 (attorney)	6/12/23, 01:05am	Law Professor – As you know, in Illinois, the "ComEd Four," and, in Ohio, FirstEnergy representatives and Ohio legislators have been convicted or pled guilty to bribery and racketeering conspiracy charges. In the Midwest … **the long-standing revolving door problems between the PUC regulators and the regulated utilities is a key element of regulatory capture and the corrupt process.** I'll leave to [Name omitted] to comment on former Public Utilities Commission of Ohio Chair Sam Randazzo who actually received his payout from FirstEnergy shortly before taking over as PUCO Commission Chair.
Energy Think Tank Executive #1 (former PUC commissioner)	6/12/23, 02:25am	… Bribery is a form of capture to be sure, an extreme, almost contractual, form of capture, but that is recognized as a crime , so it is somewhat beyond the scope of the more subtle forms of capture, which is what the discussion began with. I know Commissioner A only casually and don't know Commissioner B at all, so I can't comment on them, but while the revolving door which they and many other regulators have gone through, certainly has appearance problems, and many, if not most states have limitations of various sorts on the movement of regulators into the industries they regulate, **I don't think that going through the revolving door at some stage in one's career means, ipso facto, one has been captured**. **I also, based on my experience and observations, [doubt] that capture is unique to utilities. Some regulators, I suspect, have been captured by non-utility actors, interests , and advocates in the energy space. It is important to note that capture can occur on a variety of levels.** The one most commonly discussed, as this conversation exemplifies, is capture by looking out for more lucrative career opportunities after serving as a regulator. **Another, of course, is simply taking the course of least political or other static, in order to retain one's position.** Those types of regulators may be even more captive grab those who are looking to leave regulation. **Perhaps, the most subtle form of capture is intellectual capture where regulators simply develop the mindset of a particular interest, often but not always utilities, and fail to bring diverse or new perspectives into their decisions.** That form of capture, which has little or nothing to do with corruption or even self serving actions, may pose the biggest threat to regulation because it is more subtle and less subject to public exposure.

Example #1: Regulatory Capture		
Email Author	**Date & Time**	**Email Text**
Energy Think Tank Executive #2	6/12/23, 01:57pm	**Utilities routinely hire the most capable employees at their regulators. That brings them two different benefits. First, they get smart employees with relevant experience. Second, they remove those smart employees with relevant experience from the regulator.** Consultant #2 is right: **the correct solutions is to both pay regulatory staff at the proper level, and also to deny recovery of any costs incurred by utilities at higher-that-comparable salaries for the regulator**. The CEO should get no more (from ratepayers) than the Chair of the Commission, and the VPs no more than the other Commissioners. The new Minnesota decision which disallows all executive compensation above $1.5 million for the top 10 people combined is on the right track.
Energy Think Tank Executive #1	6/12/23, 03:17pm	… **There is an entire book to be written about the [First Energy] scandal, but the topic being discussed was regulatory capture, and most of the scandal had little or nothing to do with regulatory capture**. … The post scandal approach by the Commission to doing anything about the fact that a regulated utility was running a major crime Minos enterprise, an approach that can be charitably described as lackadaisical, although perhaps closer to moribund…
Environmental NGO Executive #2	6/13/23, 12:43am	Regulatory capture takes many forms in practice. In this case, we've seen: · The payment in advance by FirstEnergy of $4.3 million to Sam Radazzo, the incoming Chair of the PUC. · The Commission's failure to do anything, … · And, **"Whether the PUCO's remarkable passivity in the face of such colossal misbehavior by a regulated utility was motivated by capture, by politically driven directions out of the Governor's office, or by simply not caring, is hard to determine, since the Commissioners refuse to discuss the matter."** · Thus far, the FirstEnergy ratemaking benefits achieved through Commission Orders issued under Chair Radazzo have been allowed to continue so **ratepayers continue to pay the price**. In other words, regulatory capture in practice as well as in theory. Where's the beef?

Example #2: Hourly Matching and Electricity Purchases

This example will be more difficult to follow for anyone who has not read the book, unless they are familiar with the details of electricity dispatch, markets for renewable energy credits (RECs), the Inflation Reduction Act (IRA) and the basics of "green" hydrogen production. The initial discussion concerned whether the U.S. Treasury Department should require hydrogen production facilities claiming tax credits under the IRA to engage in 'hourly matching' when procuring zero-emission electricity. (This issue is discussed in the book in Chapter 5; in December 2023 Treasury proposed to require hourly matching in 2028, but not before.) Buyers of power who claim to rely on "100% renewable energy" in other contexts may or may not use hourly matching as well. It eventually morphs into a

discussion of the practicality of relying on electric vehicles for electricity in times of higher need, and much of that latter discussion is omitted.

This exchange was not entirely free of the kind of vaguely derisive language one finds online, but overall it managed to explore the merits of a topical issue in an informative and civil way. The email exchange begins with a list member linking an article about a study by the consulting firm E3. The study concluded that hourly matching is so expensive that it would slow development of the green hydrogen production industry, because it will often add more to production costs than the value of the IRA subsidy. I have anonymized the edited exchange to hide the identity of all the participants except Arne Olson. Olson is one of the study's authors and he participated in the discussion; Olson gave me permission to use his name here. The following excerpts the first few days of the list discussion.

Example #2: Hourly Matching		
Email Author	**Date & Time**	**Email Text**
Electricity Industry **Consultant #1** (economist)	8/31/2023, 8:18pm	https://www.utilitydive.com/news/hourly-matching-clean-electricity-renewable-energy-purchases-e3/692099/ It would also be prohibitively expensive to achieve for all but the most flexible of loads. Arne Olson is senior partner, Nick Schlag is partner, Greg Gangelhoff is associate director, and Anthony Fratto is managing consultant at the consulting firm Energy and Environmental Economics (E3).
Lawyer and Academic Policy Center Director	8/31/2023, 8:34pm	This is a very important and well-reasoned piece. **Hourly matching should be, at best, an option for those that want it and are willing to pay the premium to get it. But we can't make access to renewable energy a luxury that only the elite can afford**. We have a climate to fix, or at least stop changing.
Pro-solar **NGO Director**	8/31/2023, 8:56pm	Arne makes a strong case that hourly matching would be administratively complicated and would produce diminishing returns. However, **there may be an option of using monthly or seasonal true ups to assure additionality.**
Electricity Industry **Consultant #2** (economist)	8/31/2023, 9:22pm	**I think this is just wrong.** I also just fundamentally **disagree that marginality is the correct approach to carbon**. The correct approach to carbon is total carbon intensity. The current bickering within FAANG* is bad enough without utility business model decisions being thrown into the mix. [*Facebook, Apple, Amazon, Netflix & Google]

Example #2: Hourly Matching		
Email Author	**Date & Time**	**Email Text**
Electricity Industry **Consultant #3** (economist)	8/31/2023, 9:58pm	**I think there is a legitimate problem to be addressed: Buying wind RECs in Kansas or Oklahoma generated in hours when the wind blows in Kansas or Oklahoma displaces a different mix of resources than the emissions from hourly consumption at the buyer's facilities in Idaho, Ohio, or South Carolina**. The current claims to be "100% renewable" may be somewhat defensible, but any claim to be carbon-neutral are almost certainly incorrect (and possibly more favorable, given coal consumption in MISO and SPP, and little coal consumption in some other power destination air basins). … And I'm not sure how the global buyers of RECs address curtailment. … I also agree with Arne, that hourly matching for each load is more work than it is worth and will lead to economic inefficiency. **One idea:** matching within "emission bins" meaning periods where coal, gas, and CCCT gas are *typically* at the margins. That data should not be hard to find. That may include no credit at all for hours when wind or solar are curtailed in the source air basin. **Another idea:** require acquisition of enough storage in the source air basin to allow the acquired resource to hypothetically serve the destination load 24/7. … **Yet another idea:** Impose a national (global) carbon tax at the new EPA "central value" of $190/ton, and let the carbon and electricity markets take care of the rest of the details. … After all, I'm an economist 😄
Arne Olson, E3 (study author, economist)	9/1/23, 7:39am	Thanks for the note. As discussed in the article, the REC supply can't be increased by adding generation during hours when clean energy is being curtailed. Even if the new resource gets a REC, it's at the expense of an existing resource that is curtailed and no longer generates a REC. Creating a new REC requires generating during non-curtailment hours, i.e., hours when fossil is on the margin. So there is no need for any correction to assumed marginal emissions rates from RECs generated during these hours. … [T]oday the marginal unit is usually a gas generator and our simulations show that over time it increasingly tends to be a relatively efficient gas unit as coal generation is retired and renewable penetration takes a larger and larger bite out of peaker run times. So in the long run we are mostly talking about the difference between a 7000 and 9000 heat rate gas unit. **Our view is that the benefits of increased liquidity and reduced transaction costs associated with a commoditized national certificate market would more than outweigh these relatively small inaccuracies in marginal emissions rates**. A national certificate would be a nice, simple substitute for the economically optimal but politically unobtainable $190/ton carbon tax. I do like the emissions matching approach that Meta/Tabors put out there, but even for that I worry that the administrative complexity makes it difficult to implement widely and I see the gains over a national, MWh-denominated certificate as being relatively small.
Pro-solar **NGO Director**	9/1/2023, 10:27am	How much more complicated would it be to implement 3 interconnect-wide markets for the Z-RECs with time stamps rather than a single national market? There should be enough liquidity in each and participants could use the Z-RECs to make auditable claims.

Example #2: Hourly Matching		
Email Author	**Date & Time**	**Email Text**
Electricity Industry **Consultant #2** (economist)	9/1/2023, 12:08pm	I fear this article is strong on aphorism and weak on tonnage. **In the end there is one thing that matters: The amount of CO2 going into the atmosphere.** … [T]he world view underlying it is prima facie motivated by a segment of the industry that is in desperate need of the status quo changing the least amount possible in great part because it benefits by both market design principles (and really I mean tariffs here) and Business Practices (of ye olde Business Practice Manuals) built around the concepts of efficiency from the early 90s … [I]t's time to acknowledge that most industries have had to modernize in more substantive ways as a result of disruptive technologies and the Business Practice Manual is the last refuge of the scoundrel. To be clear, we will be arguing about these things in 20 years if we are not willing to have an adult conversation about the amount of CO2 all of these practices result in. … **Additionality and its slightly inbred cousin marginality … are, in fact, distractions. What matters is the total carbon intensity of generated power**. **A few hours ago in the CAISO there were hundreds of MW more batteries charging than there are right now despite the fact that their load then was more carbon intensive then than it is now**…. Devising an accounting system that fails to acknowledge the "fuel mix" of those batteries was more carbon intensive then that it is now is stupid. **When a battery that discharges later today (at say hour ending 21:00) charged at 01:00 it will be responsible for more CO2 in the atmosphere than a battery discharging at the same hour that charged at hour ending 03:00.** The same applies if those batteries were powering a vehicle. RECs, potential REC successors, national clean energy markets, and 24X7 matching all seem to miss the fact that more CO2 was injected into the atmosphere. … I have heard a lot of whining that it's hard and/or that it undermines the value of REC markets. I'll humbly ask on behalf of my children that people get over themselves. …. Show me a compelling reason why I should care about something other than the amount of CO2 and I'll be right there, it just all seems like a distraction to me until we get that part right.
Pro-solar **NGO Director**	9/1/2023, 3:55pm	Consultant #2 - **I read the article to be focused on how to calculate the carbon intensity of hydrogen that would qualify for the federal tax credit** under the IRA when the electricity that is used for electrolysis comes from the grid. Will a system that allows for non-time-differentiated RECs to be used result in a high level of investment in new renewable projects or should some other way of accounting for the energy inputs be used?

Example #2: Hourly Matching		
Email Author	**Date & Time**	**Email Text**
University **Professor** (computer science)	9/2/23, 10:57am	Consultant #2 - Thank you for posting the [omitted] white paper …. The paper correctly draws the distinction between **location based and market based methods**. I think that **what needs work is bringing these two methods to a better alignment**, as indeed, from a carbon intensity perspective, people are very interested in both the time and the location of where their power comes from. *The global standard is market based models.* For example green certificates of various forms. I think that it is essential to maintain this standard where it is used and start using the standard where it is not. So ***location (and temporal) based models need to be subordinate to market based models***, both for corporate accounting, *and* for green claims to residential consumers. … … So we do encourage consumers to identify with local renewable power and they do try to reduce consumption at the peaks (which are carbon intensive). The safest way is to cover both claims by buying the certificate and then making further claims. In the interim, I think these things will help the development of location (and temporal) green claims; i) agree a measurement interval, probably half-hourly, ii) work on the protocol for interconnector flow (this is unstable because the pure market based method does not worry about the green electrons flowing in the opposite direction to the grey ones, but the location based method cares a lot about it) iii) work on standards of communication so that the market based and location (and temporal) based methods can work together harmoniously without confusion, distrust and dissent.

Example #2: Hourly Matching		
Email Author	**Date & Time**	**Email Text**
Electricity Industry **Consultant #2** (economist)	9/2/2023, 4:29pm	NGO Director, I agree it's (sort of) about carbon intensity of hydrogen, but the proposed resolution is really not about hydrogen, it's about carbon accounting on the grid. It's also full of catchy ideas and phrases, easy to read, and has remarkable breadth for such a short piece, all of which make it informative and a bit dangerous (because breadth is not the same as comprehensiveness). I think (hope) we can all agree that non-time-differentiated RECs were a useful market transformation tool and they will simply not work at scale (as evidenced by all of this hand waving right now). The intent is not to destroy RECs, it's to support a transparent, fact (and ideally physics) based approach to transition to something that's durable. I believe we should not be proposing an interim solution - there's not enough time for us to change this twice before 2050. On the specifics of RECs and hydrogen, I think it's a bad idea. **Hydrogen is effectively going to be free to produce if you can make it green, which means it will have a profound effect on the market for RECs if allowed. Personally I think it's likely to be a bad idea to distort the electricity market in an effort to produce not enough green hydrogen to do anything meaningful about natural gas** (that's just a guess, to be clear. I haven't tried to study it) but I'd rather not lose sight of some big picture issues related to electrolyzers in the process - 1) industrial processes and the capital that supports them generally despise low capacity factors and 2) bitcoin or heat or god forbid clean drinking water are all basically fungible and will interface with the market in a similar way. Bitcoin is probably the best analog though….

Example #2: Hourly Matching		
Email Author	**Date & Time**	**Email Text**
Electricity Industry **Consultant #2** (economist)	9/2/2023, 4:57 9pm	Thanks for the thoughts Professor. … Although you didn't state it directly so I may be assuming something inappropriate here I assume you mean *voluntary markets* not markets more broadly**. I don't necessarily agree that the global standard of voluntary markets should be maintained (I mean, a carbon tax seems pretty straightforward to me!).** I think it would be harmful to abandon voluntary markets abruptly, so that should be avoided for certain, but it needn't be as part of a transition to a physics-based approach. … If the goal is not to abruptly abandon it then what is the best path? To me, it's support physics-based accounting that can be integrated into the existing market solutions - they will either survive, adapt, or die as they should. I would prefer the physics-based approach to be flexible enough to seamlessly integrate with wholesale markets where they exist… Because ideally it's fully integrated into markets it should also function across all markets for the same operating window …. This will provide best risk management for positions taken as well as winding and unwinding of positions which should improve liquidity…. [R]educing distrust is important, but I think ultimately what we're dealing with is fear, which is a bit more challenging to address, followed closely by institutional inertia, which I have pretty much spent my whole career trying to fight against in some form or another.

Example #2: Hourly Matching		
Email Author	**Date & Time**	**Email Text**
Electricity Industry **Consultant #4** (economist)	9/2/23, 5:24pm	Consultant #2, When you say, "I have always assumed the best resource to think about are V2G cars in the RTM when thinking about solutions because they present the most challenging level of complexity," do you mean vehicle-to-grid when you say V2G? What year are you talking about? 2030? Or 2040? As we all know, **we hardly have any EVs on the road today, except in a few states, and just a few cities even in those states. The share of new cars sold last year in the US that were EVs was 5%; even in California, only one out of five cars sold were EVs. And, as you know, the vast majority of cars sold in the US that are EVs is Teslas, which don't even allow V2G.** I understand they will in a year or two but then everyone with a one-way charger will have to convert to a two-way charger. Who will pay for that? What about the Superchargers? Can they already do V2G? Or will all of them have to be converted as well? And, even if manna falls from heaven, and all one-way chargers are converted to two-way chargers, and all EVs including Teslas are capable of V2G, will all EV drivers happily engage in V2G? Have you surveyed EV drivers to see how many of them (a) keep their cars plugged in whenever they are not being driven (even at train stations, airports, shopping malls where chargers don't exist today) and (b) are happily going to let the grid buy power from their cars when they are plugged in? Will they be confident that the car will be fully charged when the time comes for them to drive it? Will the V2G technology "work like a charm?" I ask these questions because the V2G keeps coming up on social media and on this forum as the ultimate answer to the grid's myriad challenges and woes. **Whenever I come across these statements, I worry because they are too good to be true. …**
Software Co. **CEO** (engineer)	9/2/23, 9:48pm	I so much agree with you Consultant #4. There are just [too] many complexities of customer behavior, value transfer, auto warranty and standards to pin our hopes on a future of V2G. V2B perhaps.
Energy Think Tank **Executive**	9/2/23, 11:54pm	**The problem I have with part of this thread is how v2g is dismissed because not everyone with an ev will want to use its capability**. That is true but not everyone on dynamic pricing will respond either. **All we need is enough**. **The battery capacity is huge**, and if v2g has value, car makers will modify battery chemistry and size. It may be small today, but the potential will grow, roughly at the same pace loads and the need for grid upgrades grow.
Electricity Industry **Consultant #4** (economist)	9/2/23, 11:25pm	I wish I had V2B,* which for me would be V2H, during my three extended power outages last year. But I do have S2H* and B2H* … I have an actual power plant, not just a virtual power plant. [*V2B=vehicle to battery; S2H=Solar (rooftop) to home; B2H=Battery to home.]

Example #2: Hourly Matching		
Email Author	**Date & Time**	**Email Text**
Software Co. **CEO** (engineer)	9/3/23, 12:44am	So lets do some back of the envelope calculations. To start, I believe that the estimates are that US needs something like 6,000 GWh of energy storage just for daily needs. I however think that number is low unless we overbuild renewables (creating another problem) and curtail massive amounts of generation. There are about 150 million personal vehicles in the US … so if they are all electric (which will take until after 2050 to achieve) we have of about 15,000 GWh in capacity …If 50 kWh of the capacity is usable, we have about 7,500 GWh of capacity for grid balancing. Now we have to estimate possible adoption rates. At 10% we have 750 GWh... At 20% we have 1500 GWh We can assume that if we only need half of our needs to come from a V2G fleet we need to reach 40% V2G adoption. While that is possible, … we will not achieve it until long after we need it. … It is an option that should be pursued but I don't think we can pin our hopes on it because of the technical, regulatory and business model challenges.