

16:57:56 From Jordan Redell, Mayor's Office to Hosts and panelists : I will "start" webinar at 5pm and then start a Facebook livestream. We can wait a minute or two to start to allow attendees to populate.

17:07:04 From Felix M : 🙌👍

17:09:24 From Rebecca Mitchell : is electricity a better source than biofuels? Why?

17:10:00 From Paul Kiesler to Hosts and panelists : Thanks for your leadership Burlington!!!!

17:10:15 From Felix M : Calling from California. Inspired by Burlington's vision to ensure our children and grandchildren have a livable planet. Looking to get my city to do this as well.

17:12:15 From Jordan Lamb : Yep

17:14:25 From Andrew Revkin : Will this be posted on Youtube or the like swiftly?

17:15:44 From Tom Kabat : YES on the 100% replacement with electrification rate starting yesterday!

17:16:22 From Wayn Goodman : If we become more successful in electrifying our world, how do we propose to produce that electricity and have we developed a methodology for managing the waste stream of batteries, etc.?

17:20:21 From Wayn Goodman : Will that energy map be available post-live?

17:23:08 From Jeremy Schroeder : @Andrew The panelist will hopefully give you a better answer, but you can find similar videos at Rewiring America at: <https://www.rewiringamerica.org/videos>

17:25:27 From Johanna Miller : Please do drop any questions you have for Dr. Griffith or the Mayor in the Q&A and we will aim to get to as many as possible!

17:26:04 From SPENCER PUTNAM to Hosts and panelists : Will I be able to ask my question orally?

17:26:18 From Darrell Greene : Thank you for all this information

17:26:22 From Julia Bassett Schwerin : ;

17:26:24 From Laura Fraser : @Rebecca Mitchell: To power the world on biofuels we would need to pretty much burn down all the forests, with devastating climate consequences. Electricity is clean and the sun shines for free.

17:27:29 From Henry Swayze to Hosts and panelists : tell us more about how we get to \$1/W for rooftop S

17:28:08 From Randi Johns to Hosts and panelists : @Laura Fraser



17:28:24 From Andrew Revkin : ElectrifyForPeace is great, including the economic logic. But social inertia (great paper j.mp/socialinertia) facing huge forces like corporate ownership of Congress – is enormous. And up-front costs are just part of the problem. Jigar Shah estimates 100,000 workers need training per YEAR. More: <https://twitter.com/Revkin/status/1508133826643570688>

17:28:46 From Heike Naigur : Can current grids take the extra demand from this new electrification until sources get switch to renewables? E.g. from now until 2030?

17:28:51 From Jeremy Schroeder : Question for Mayor and Saul—How important was Burlington’s control of the electric utility in regards to moving toward electrification? Is Burlington’s amazing success replicable in areas serviced by monopoly utilities?

17:29:06 From Julia Bassett Schwerin : Do you acknowledge that older buildings especially in the northeast need to weatherize before you electrify, otherwise you are overbuilding heat pumps and solar without reducing the demand through efficiency. How do you propose to tackle that?

17:29:07 From Randi Johns : @Laura Fraser 🌞🌞🌞👏👏

17:29:53 From Robert Bristow-Johnson : Should heat-pump water heaters be used in a place that heats for more than 8 months? The water heater normally is inside, in the heated part of the house. A heat-pump water heater would pump heat from the heated portion of the house that would have to be replaced by the home heating system. Unless the water heater heat reservoir is outside, I don't see it as advantageous.

17:31:41 From Laura Fraser to Hosts and panelists : For the mayor: How can we incentivize landlords since over 50% of Burlingtonians are renters and don’t have control over buying heat pumps, charging stations, and other clean electric appliances?

17:32:00 From Michael Kieschnick to Hosts and panelists : I was impressed that voter passed the bond. It seemed that relatively little of the bond itself (the \$20 million) goes to incentives for consumers (all the household stuff Rewiring is talking about). If the bond was bigger, with the increment going for incentives, would it have been more or less popular with voters?

17:32:18 From Marcus Keely : One thing that hasn’t been mentioned so far are the immediate and long-term health benefits of electrifying everything – cleaner indoor and outdoor air, in particular. Interested to hear if this something that Saul (and/or others) has looked into from a quantitative/stats perspective. Is this something that is being discussed from an economic perspective as well, given healthcare costs?

17:32:46 From John McKenna : Saul – How do we overcome the seemingly insurmountable resistance from the fossil fuel industry?

17:33:02 From David Blittersdorf to Hosts and panelists : I built the windfarm that supplies 8% Burlington’s electricity. Problem: No more wind farms built since then as our Governor has killed any more wind. We need all the wind and solar we can build to have no carbon electricity in Vermont. Agree?

17:33:26 From John McKenna : I heard you mention once about buying out the fossil fuel industry – is that a realistic option/possibility?

17:34:39 From Jamie Hand : Burlington Electric Department's residential rates include tiered pricing where the initial 100 kWh has a low cost, and anything above 100 kWh has a higher cost. My understanding is that this type of rate is used to encourage efficiency. Now that electrification and GHG reduction is the goal, do you think that that rate structure should be rethought? I.e. should the marginal rate be lower to encourage electrification (or should

all-electric houses be granted a larger initial low cost block of electricity). I think this would help make heat pumps more competitive with natural gas here in Burlington.

17:35:29 From Robert Bristow-Johnson : I think we need to be careful about viewing heat pumps as a silver bullet.

17:35:45 From Dale Azaria : How do emissions from McNeil figure into our Net Zero aspirations? Are there any plans to replace the energy from McNeil with solar or wind? And, is there anything BED or the City can do to connect people (like me) who would like to have rooftop solar but don't have a suitable roof, with other BED customers who might like to host solar panels but don't have the funds to make the initial investment?

17:37:11 From Jim Holway : Thank you for this presentation. Important stuff to focus on for a number of reasons. So what do you think about the idea that Government sponsor re-education and retooling in job subsectors such as West Virginia Coal mines?

17:37:23 From Robert Bristow-Johnson : And Saul and Miro, there are at least one engineer in the audience that has taken two semesters of Thermodynamics and understands exactly how heat-pumps work (they work the same as an A/C or refrigerator by moving heat from the colder object and dumping it into the warmer object).

17:38:05 From Brian Staver : I love my Tesla P90D.

17:38:34 From Chuck DiSchino to Hosts and panelists : Nice cars!

17:38:49 From Brian Staver : I love shutting down Mustangs.

17:40:45 From Robert Bristow-Johnson : I think overconsumption is the big ethical and environmental issue. Not everyone on the planet can get away with having 4 or 5 vehicles if the planet is gonna survive.

17:41:23 From Kurt Haigis : Thanks for the enthusiasm. I live in a community of farmers and commuters. They see no reason to change. How do we convince them that this the way to go?

17:41:48 From SPENCER PUTNAM to Hosts and panelists : Can we answer some of the questions?

17:41:57 From Jim Holway : A more local question is in consideration that the 2 Electric Buses we have in the local transportation system - great advance, but they spend more time in repair bays than their fossil fuel counterparts - thus creating resistance to purchase more.. How do we get past the great electric car examples and address the mechanical reliability?

17:42:15 From Wayn Goodman : THAT's how you sell it: by expressing how many years' savings it will take to pay off your new electric vehicle!

17:42:16 From Jim Hodson : As David Attenborough says: "Don't waste anything". That saves energy all along the supply and waste streams

17:42:43 From Robert Bristow-Johnson : 👍

17:42:57 From Scott Lewis : Kurt, was just reading about one of the senators from Montana - conservative - convinced electric tractors and batteries are the way to go... they can save!!!

17:44:03 From SPENCER PUTNAM : Miro, I'd like to see you ask some of these good questions.

17:44:23 From Wayn Goodman : Tractors are a good choice for

electrification... they stay close to the source of power, can recharge overnight, and provide more torque per unit of power than fossil fuel powered alternatives!

17:44:37 From Deb Gibbs : What the bi-directional use of EV's to provide power to your house when the sun doesn't shine?

17:44:39 From Jordan Redell, Mayor's Office to Hosts and panelists : Let's try to take a few questions!

17:45:02 From Kermit Hovey : Regarding electrifying everything, this has been an eye-opening resource for me - A Pocket Guide to All-Electric Retrofits of Single-Family Homes at <https://redwoodenergy.net/wp-content/uploads/2021/11/SF-Retrofit-Guide-2021-09-08.pdf> . Redwood Energy has prepared resources for new and commercial construction as well (<https://redwoodenergy.net/research/>).

17:45:08 From Kurt Haigis : We need to find a way to make this emotional for those who do not understand the engineering or the math! I am taking on the challenge by reintroducing the concepts in our town. The Energy and Climate action committee has been dormant since 2016 because the original committee was formed to make sure that solar farms did not become more valuable than dairy farms.

17:46:13 From David Blittersdorf : Robert - too much stuff is the problem as you say. There are limits to growth and we have exceeded them. A sustainable future will require probably a 75% decrease in ALL things and energy. Renewables can probably only replace 25% of present fossil energy. It's is not easy.

17:46:29 From Erika Kazi to Hosts and panelists : Saul, have you considered the environmental impacts & carbon footprint of building a renewable energy infrastructure? How does that compare to current growth trends with non-renewable energy sources?

17:46:36 From Tiffany Grantham : In my little cottages in New England, I can heat two with natural gas for the price I heat one with electric. The houses are a hundred years old and I have maple trees, so solar on the roofs is impossible. What do I do to change?

17:47:15 From Lisa Cunningham : are you using heat pumps for heat or resistance heat?

17:48:12 From Tiffany Grantham : I think so

17:48:34 From Jock Gill to Hosts and panelists : We need community solar for those who can not have PV on their home roof.

17:48:59 From Andrew Revkin : That issue of policy and regulatory inertia (ancient codes Saul mentioned) seems huge. There in health care to the same degree. Who's doing the kind of analysis of social engineering tangle that you've done on the physical engineering and physics?

17:49:33 From Randi Johns : Will a recording and copy of the chat be available?

17:49:39 From David Blittersdorf : Mayor, need to ban natural gas in Burlington.

17:49:59 From Marcus Keely : +1 David's comment about banning natural gas in Burlington

17:50:00 From robert herendeen : If we replace home machines when

they die a natural death, the transient energy/material requirements problem more or less goes away. But waiting for natural death (using your rough numbers) sets a slower time scale than ≤ 2030 . If we move fast, there will be an early pulse. Is this a problem?

17:50:06 From Jim Hodson : @TiffanyG - In some places you can use net metering and buy a panels in the sun somewhere else but get the credit on your bill. Keep the trees!!!

17:50:18 From Wayn Goodman : @Tiffany Grantham - no one said it was a simple solution, but I suspect your little cottages could benefit tremendously from weatherization? It would be interesting to see your rate structures for each utility!

17:50:41 From Lisa Cunningham : Heat pumps are the way that you can heat and cool your homes. They are 2.5-5x as efficient as gas or electrical resistance and provide heating and cooling. No one uses resistance heat any more.

17:51:30 From Tiffany Grantham : Thanks! :)

17:51:33 From Kermit Hovey : @Tiffany - Also electric resistance heating is much less efficient than Heat Pump technology. Odd are that you currently have resistance heating

17:51:59 From Henry Swayze to Hosts and panelists : Heat pumps have an issues below zero. Solution?

17:52:10 From Kermit Hovey : @ Tiffany - what Lisa said! 😊

17:52:43 From robert herendeen : Burlington's NZE plan does not involve air travel, which is growing fast and about which we have an airport expansion debate right now. What's the general plan here?

17:52:47 From Wayn Goodman : Odds are you have 'old school' resistance heat: a wire running through a heating unit... even electric-hydronic (where fluids are heated electrically) is far more efficient

17:52:59 From Kevin Thorley to Hosts and panelists : @Andrew, I don't know if this qualifies re: the social engineering challenge, but the book Saving Us by Katharine Hayhoe is an excellent starting point for having these conversations. Saving us and Electrify were my two favorite books of 2021 on this topic

17:54:11 From Robert Bristow-Johnson : Kermit, resistance heating is 100% efficient because there is no flue or chimney for waste heat to go up. Heat pumps are more than 100% efficient because they rob heat from the colder object (outside) and pump it to the warmer object (inside).

17:54:28 From Kevin Thorley : @Andrew, I don't know if this qualifies re: the social engineering challenge, but the book Saving Us by Katharine Hayhoe is an excellent starting point for having these conversations. Saving Us and Electrify! Were my two favorite books of 2021 on this topic

17:54:29 From Robert Bristow-Johnson : But heat pumps are not so efficient if it's really cold outside.

17:54:36 From Wayn Goodman : I love it - Churchillian Optimism! TOTALLY stealing that one.

17:54:42 From Kermit Hovey : @Robert - that is exactly correct on both points.

17:54:46 From Beth Sachs to Hosts and panelists : We CANNOT wait for households and businesses to make individual decisions. We need mandates and public financing. As Saul said, we need building codes; as David said, we need bans; and we need to make policy at the local, state and federal level to MANDATE electrification and efficiency.

17:54:50 From Scott Lewis : Interesting back and forth and advice from participants here – I wonder if a city like Burlington could have home energy consultants to give advice to families/communities on what they need to totally electrify and perhaps how to get loans to help?

17:54:53 From Jim Hodson : @Mayor – Can we survey Burlington for possible land/roof/parking use and create a market so people who cannot put solar up over their head, still can ?

17:55:02 From Robert Bristow-Johnson : Kermit, do I know you from the 1980s?

17:55:03 From Richard Hopkins : I would love to have a copy of this chat discussion. I hope our hosts make it available.

17:55:18 From Mindy Elmergreen to Hosts and panelists : @Tiffany – fight back. This bill is ludicrous and unnecessary. It will undoubtedly harm many families, small business and farmers. Vermont has the fewest cars on the road and the least amount of emissions of all 50 states. Unless you have a very new home that's sealed like an envelope, an electric heat pump will not work well on Vermont's coldest days. I am waiting for them to discuss the EMF impacts on the people of Vermont who will be exposed to this "electrified city."

17:55:27 From David McFeeters : It's like Ukraine fighting against Russia!

17:55:28 From Saul Griffith to Lisa Cunningham and all panelists : Go Lisa !

17:55:38 From Kermit Hovey : @Robert – likewise. I suspect so from RPC land.

17:55:49 From Robert Bristow-Johnson : WOW!

17:56:12 From Lisa Cunningham : Widespread decarbonization will have to happen IN ADDITION TO appliance replacement when it is "time" for replacement. That is why it is so important not to keep building new buildings that use fossil fuels that will have to be decarbonized immediately at far greater cost than doing it right the first time.

17:56:18 From Andrew Revkin to Hosts and panelists : Hi hosts, I don't see a "save chat" option. Hoping someone can do so? I'll be writing on this great session. Longtime climate journalist (since 1988...) ar667@columbia.edu to send

17:57:18 From Katie Ingebretson to Hosts and panelists : Here is the plan! <https://content.rewiringamerica.org/reports/Electrify%20for%20Peace%20Policy%20Plan.pdf>

17:57:47 From Katie Ingebretson : Here is the Electrify for Peace plan! <https://content.rewiringamerica.org/reports/Electrify%20for%20Peace%20Policy%20Plan.pdf>

17:58:05 From Wayn Goodman : Thanks, @Katie!

17:58:20 From Anne Huberman to Hosts and panelists : Please distribute the recording of this wonderful session to all of us who signed up.

17:58:38 From Martine Victor to Hosts and panelists : Curious how people will afford electrification for heat. Last year my VT Castings propane stove quit because the Honeywell valve failed and couldn't be replaced. Due to supply chain issues I wasn't able to replace the stove and used back-up baseboard electric in that room - my electricity bills were on average \$500 a month during the winter (and this was just one room, though a large one with many windows) If my entire house were heated electrically it would likely be 1000 's of dollars a month. Of course, if the current gas/oil/propane prices stay high, it may be the same difference.

17:59:35 From Wayn Goodman : Very well stated - "Paying the enemy to fight us in wars..."

17:59:39 From David Blittersdorf : We import China's carbon in all the stuff we buy from them. But, we don't count that carbon and own it.

18:00:34 From Mindy Elmergreen to Hosts and panelists : Can you share some info regarding the short and long term affects of electrifying a city in terms of EMFs?

18:01:05 From Andrew Revkin : Sorry so many questions but a great discussion. EDUCATION. There are tiny models that build energy literacy - like the boiler room tour in lessons at a Bronx public high school. Just wrote on this: <https://revkin.bulletin.com/a-global-teach-in-explores-paths-from-classrooms-to-climate-change-impact>

18:01:43 From Joel Rosenberg to Hosts and panelists : Here's Rewiring America's free guide, "Electrify Everything in Your Home" - useful for renters too: <https://www.rewiringamerica.org/electrify-home-guide>

18:02:06 From Joel Rosenberg : <https://www.rewiringamerica.org/electrify-home-guide>

18:02:23 From Joel Rosenberg : Rewiring America's free guide to electrifying everything in your home - good for renters too.

18:02:28 From Greta Hasler : For more information on Vermont's network of 120+ town energy committees, and resources to get involved in energy and climate action work in your community, check out VECAN's website here: <https://vecan.net/>

18:02:42 From Tom Kabat : +1 to Joel's Guide! And here's a link to a few more: <https://redwoodenergy.net/research/>

18:05:17 From Tom Kabat : This site helps look at electrification without upsizing so the grid has more room for more of us to electrify quickly and cost effectively. <https://redwoodenergy.net/watt-diet-calculator/>

18:05:54 From Mindy Elmergreen to Hosts and panelists : How will this affect agricultural business and forestry? Will forest equipment be exempt?

18:06:04 From Martine Victor : Curious how people will afford electrification for heat. Last year my VT Castings stove quit because the Honeywell gas valve failed and couldn't be replaced. Due to supply chain issues, I couldn't replace the stove and used back-up baseboard electric in that room - my electricity bills were on average over \$500 a month during the winter (and this was just one room, though a large

one with many windows) if my entire house used electric heat it would likely be 1000's of dollars a month. Of course, if gas/propane, oil prices stay high it may be the same difference.

18:07:51 From Wayn Goodman : Perhaps consider WindowDressers for interior storms for next winter? And back-up baseboard electric is probably the most expensive way to heat a space...

18:08:07 From Joel Rosenberg : Martine, baseboard electric uses 4x more energy than a heat pump, so your bill would've been closer to \$100 a month instead.

18:08:14 From Tom Kabat : @ Martine, Those Guides above show how heat pumps use only 1/3 the electricity of resistance devices. So they have low operating costs.

18:09:22 From David McFeeters : Major zoning changes are necessary to encourage roof top or ground mount solar!!

18:09:46 From Kermit Hovey : @Saul - Can we get the volume of production to meet the demand projected by you as necessary by relying only on "free market" forces or do we need NEPA to be called into play (National Emergency Production Act)?

18:10:00 From Katie Ingebretson : This site has a list of city actions to choose from! mayorsforelectrification.org

18:10:09 From Wayn Goodman : Many communities in Massachusetts are beginning to restrict the issuance of gas permits due to supply-side restraints on them. Perhaps that's a way to 'encourage' electrification?

18:10:24 From Kevin Thorley : @Martine for a specific example, the highest bill we saw (before applying solar credits) was about \$350 this winter, in January. That includes exclusively heating with heat pumps and well over 1000 miles of EV driving in winter conditions

18:10:47 From Katie Ingebretson : And a place for local elected (including select boards) to join the coalition. <https://www.rewiringamerica.org/policy/mayors-for-electrification>

18:11:02 From Lisa Cunningham to Hosts and panelists : Go Saul! Come back to Burlington next winter to kite ski on Lake Champlain!

18:11:33 From Jim Hodson : and don't charge or ticket for parking while charging !!!!

18:13:00 From Lisa Cunningham : Thank you, Saul. You are a climate hero. Anyone interested in our Massachusetts Building Electrification movement or getting information about how to start a movement in your town, city or State, feel free to contact me at lisaclimatebrookline@gmail.com.

18:13:06 From Randi Johns : We need stories that paint pictures of a better future where we've electrified everything. On it! 👉📺📽

18:13:12 From Andrew Revkin to Hosts and panelists : p.s. I would love to re-stream this on my Sustain What webcast if you'd be okay with that. Streams to Facebook YouTube linkedin and twitter. Through Columbia Climate School (non commercial). <http://J.mp/sustainwhatlive> I've done this with National Academy of Sciences presentations, e.g. ar667@columbia.edu

18:13:13 From Susan Kircher : Thank you all for the presentation. Go Burlington. Feel better Dr. Griffith

18:13:28 From Kurt Haigis : simple answer – its like the difference between copper vs fiber. for telecommunications

18:13:30 From Mindy Elmergreen to Hosts and panelists : The legislature will be getting a report on the projected costs and benefits of the Clean Heat Standard on March 15, 2023. I assume we will be reviewing the results with the residents of Burlington before this bill progresses. Mr. Weinberger, can you confirm that we will wait for the report in March 2023?

18:13:51 From Tom Kabat : As a utility guy, I agree we need to move part of our revenue collection off of energy charges and onto a 10 cents per Amp-month connection size charge. That will encourage efficient electrification.

18:14:02 From Kevin Thorley : Thank you all, this was excellent!

18:14:06 From Henry Swayze to Hosts and panelists : Can we have a replay link?

18:14:07 From David Blittersdorf : Most homes have 200 amp service at 240 VAC which is 48,000 watts! No problem with electric load increases!

18:14:16 From Marcus Keely : Likewise, thank you to the City of Burlington for setting this up. And thank you, Dr. Griffith. Feel better! Thank you for all of your work on this important matter!

18:14:44 From Wayn Goodman : Thanks, everyone, for your participation, your passion and for sharing your knowledge!

18:14:49 From Kermit Hovey : will the chat be saved and shared? many resources and thoughtful comments, but "save chat" is not an option for attendees.

18:14:59 From John McKenna : Thank you – always great hear Saul and big thanks to Burlington for having a goal to be net zero by 2030.

18:15:43 From Tiffany Grantham : Thank you all!

18:15:47 From Kermit Hovey : Put a price on Carbon!! Citizens' climate Lobby is all on board for that!

18:16:10 From Henry Swayze to Hosts and panelists : Yes Yes

18:16:54 From Richard Hopkins : 👍

18:17:27 From Wayn Goodman : If I see an invite in my inbox, I'm there!!

18:17:32 From Jordan Redell, Mayor's Office : Here is the next meeting: <https://www.facebook.com/events/303762851804000>

18:17:36 From Johanna Miller : Thank you, Mayor, Dr. Griffith and all. Let's DO this!

18:17:40 From Kermit Hovey : ENROADS is an eye opening model... surprise, it clearly shows that a carbon price is the big policy shift for a big impact.

18:17:52 From Felix M : 🙌🥳

18:17:58 From Susan Kircher : good job!!!

18:18:00 From Andrew Revkin : Mayor of Vermont. Liking that. 😊

18:18:08 From Michael Oman : what about those of us who don't use fb?

18:18:28 From Kevin Thorley : https://us02web.zoom.us/webinar/register/WN_kHdjQNPoStiu3DzTv0_lEw?fbclid=IwAR1-8PSUtyHWP-Pul556tjX9CJkQdnGxSKzcr7Jjg5afdZz77sSL4RhPFQ

18:18:56 From Wayn Goodman : Thanks, @Kevin!
18:19:09 From Andrew Revkin : Good rant.