

DISCUSSION DRAFT 5.5.21

Item 2: GHG Inventory

SUBCOMMITTEE GOAL/PURPOSE: reviewing the suitability of Vermont’s current GHG emissions inventory for assessing progress toward meeting the requirements of the GWSA.

What are the key questions that need to be answered?*	How should the committee go about answering them?	Prioritization level/proposed timeline
Difference between 10 VSA 582 and GWSA requirements	DEC Presentation/Subcommittee Discussion	Completed
Overview of current tools/methods used in current inventory for each sector	DEC Presentation	High priority
What type of data is needed for each type of inventory (consumption, production, lifecycle)? How would inventory be used in Vermont? Should the current inventory be supplemented or revised with other methodologies or analyses? If yes, what resources would be necessary to complete such work, and what frequency should it be completed?	DEC presentation/discussion on basic terms/types Technical Consultant recommendation Subcommittee Discussion	High Priority
Discussion of other jurisdictions data/methods for their inventories through time	Technical consultant summary	May-June
What methodological guidance should be considered? (e.g. IPCC, statute, other source data)	DEC, Technical consultant/Subcommittee discussion	May-June
How should we define certain terms such as gross and net emissions, biogenic CO ₂ , and land-use, land use change, forestry (LULUCF)?	Technical consultant/Subcommittee discussion	
What timeframe is appropriate for use? In other words, GWP100, GWP20, or other?	DEC, Technical consultant/Subcommittee discussion	May-June
Do policy/program emissions calculations need to be calculated the same as the Climate Inventory? What are the implications?	Technical Consultant/Subcommittee discussion	May-June
What is the appropriate treatment of specific areas, including REC accounting (hourly vs. annual emissions), hydro electricity, biomass, natural gas, and other fuel sources emissions, methane releases from agriculture treated differently, GHG emissions related to livestock, etc.?	Technical Consultant/Subcommittee discussion	May-June

Item 3: Modeling of Energy & Non-Energy Emissions Scenarios via LEAP

SUBCOMMITTEE GOAL/PURPOSE: Engage with base energy & emissions modeling, vetting assumptions, make recommendations with regard to any data improvements

What are the key questions that need to be answered?	How should the committee go about answering them?	Prioritization level/proposed timeline
What tool should be used to model?	CEP LEAP tool – presentation to subcommittee and full council about the modeling expected and timeline provided comfort	Already Occurred
Are assumptions made/calculations reasonable?	PSD presentation on assumptions, Subcommittee review/discussion; comparison between EAN model	PSD initial presentation Week of May 17 re: Business as Usual, June/July for pathways
How have geographic and demographic emissions been modeled, if at all? How should they be modeled?	LEAP modeling effort (PSD) Subcommittee Discussion	Week of May 17 re: Business as Usual, June/July for pathways
What data would improve upon the calculation of energy use/emissions?	Subcommittee Discussion, Stakeholder/Public Outreach?	Week of May 17 re: Business as Usual, June/July for pathways
Item 6: Social Cost of Carbon		
SUBCOMMITTEE GOAL/PURPOSE: Recommend a Social Cost of Carbon Value for consideration by the full Council		
What are the key questions that need to be answered?	How should the committee go about answering them?	Prioritization level/proposed timeline
Should the subcommittee direct creation of a social cost of carbon value or utilize currently available methodology?	Previous discussions have determined using currently available methodology - Subcommittee discussion informed by Technical Consultant summary of available options?	Technical Consultant recommendation/review
What is the appropriate discount rate for Vermont?	Technical Consultant interview each Council Member to determine an appropriate discount rate	Technical Consultant Recommendation/review
How are demographic, intergenerational impacts addressed?	Technical Consultant	Technical Consultant Recommendation/review
Item 6a: Cost-Benefit Analysis		
SUBCOMMITTEE GOAL/PURPOSE: Identify the appropriate inputs to policy/pathway cost-benefit analysis.		
What are the key questions that need to be answered?	How should the committee go about answering them?	Prioritization level/proposed timeline
How do costs/benefits change based on demographics (e.g. income, geography,	Analysis may not get to this level – illustrative analysis? Technical	Technical Consultant Recommendation/review

race), and characteristics (fuel use, electric service territory, housing type, etc.)?	Consultant consideration.	
What are the broad economic impacts of policy/scenario choices?	Technical Consultant Economic modeling based on LEAP outputs	August/September
What is the appropriate boundary for the cost-benefit tests? (e.g. customer, public investment, and/or “societal”) What are the core drivers and level of uncertainties?	Subcommittee Discussion informed by Technical Consultant	June ?
What are the potential CO2e benefits/costs from each mitigation measure and the cost for each? “cost of GHG reductions model”	Technical Consultant Review/Recommend	Summer
What are the co-benefits/costs of GHG emissions and emissions reductions strategies? How should they be quantified?	Subcommittee Discussion informed by Technical Consultant	Determination of co-benefits – July; Recommendation of how valued – August

** Notes from Subcommittee Member Hopkins are below, as provided to the Subcommittee on 5/3

Why making active decisions about how we calculate GHG releases is important for the Vermont Climate Council’s planning process

Notes by Richard Hopkins for possible use by members of the Science and Data Subcommittee, May 3, 2021

We haven’t so far had formal discussions of these topics in our subcommittee. I apologize in advance if this starts out too elementary. My goal here is to illustrate the consequences of various apparently technical decisions on our GHG estimates and thus on the likely effect of various measures the VCC might take.

We need a ‘common currency’ for measuring greenhouse gas emissions. Releases of all greenhouse gases are expressed as carbon-dioxide-equivalents (CO2e) – so one gallon, cubic foot or pound of various fuels corresponds to a certain amount of CO2. Use of CO2e allows us to compare the impact of burning various fuels, other ways of generating energy, and other releases of greenhouse gases, as from refrigerants, livestock, wastewater treatment, and waste disposal. We also need to decide how to account for CO2 releases from activities like burning wood for heat.

Knowing the amount of CO₂e released for each unit of fuel or other activity allows us to estimate, model and compare the amount of CO₂e saved by various approaches to preventing GHG releases. The same GWPs we use in the Greenhouse Gas Assessment are used in various models.

There are choices embedded in greenhouse gas assessments that will affect how we understand the impact of various activities on GHG releases, and of various pathways to GHG reduction. In general, Vermont's approach in its GHG Assessment has been to follow the methods used by US EPA in its national assessment, which follow those recommended by the IPCC. I believe we should understand what the consequences of our choices are likely to be for our modeling and for our courses of action in the eventual state Climate Action Plan.

1. Natural gas.

For natural gas we use 11.7 pounds of CO₂ per hundred cubic feet (CCF) of natural gas consumed. This value does not take account of any releases of methane (the main component of natural gas) in the process of extracting, processing, or transporting the gas that take place out of state. Methane that is released directly to the atmosphere without burning is estimated to cause 25 times as much global warming as the same physical quantity of CO₂. US EPA estimates that 1.7% of natural gas is lost as fugitive methane, which would result in the effective pounds of CO₂ per CCF of natural gas used in VT being 14.3, rather than 11.7. Recent studies suggest that the real value is closer to 2.3%, which would yield a value of 16.3. It may be even higher – if it was 6%, the greenhouse gas impact of using natural gas would double. *In any case, by not accounting for out of state fugitive methane releases, we make lower estimates of the climate impact of using natural gas.*

2. Hydroelectric power

In Vermont's calculations, hydroelectric power from dams in Quebec is assumed to release zero greenhouse gases. Critics of Hydro Quebec say that the reservoirs behind those dams continue to release methane and other greenhouse gases, and that these should be accounted for when we estimate our GHG emissions. Hydro Quebec maintains that there are essentially zero emissions, especially after the first few years. This is an area of controversy. *A non-zero value would increase our total GHG impact from using electricity of hydropower origin.*

3. Methane

Methane is released by ruminant livestock during digestion, by all livestock from their manure, by wastewater treatment plants and onsite sewage disposal systems, and by landfills. Methane is a more potent absorber of solar energy than CO₂, pound for pound, but is degraded much more quickly in the

atmosphere. The net effect of the shorter lifetime and higher energy absorption is reflected in the GWP we use. The standard approach compares the warming potential of CO₂ and methane over 100 years. Depending on the exact methodologic choices, the GWP₁₀₀ is usually given as from 25 to 30. If the global warming of the methane is calculated over only 20 years, then the GWP is about 84. *If we used GWP₂₀ instead of GWP₁₀₀, our estimate of the global warming impact of activities that generate methane would more than triple.*

Today, a certain amount of methane is in the atmosphere due to various human activities. We are in or close to a steady state – the amount of CH₄ added to the atmosphere each year is matched by the amount removed by natural processes. However, if human activities change – for example, by adding or subtracting cows, or by capturing the methane released by waste-water treatment plants and using it for energy – then the methane concentration in the atmosphere will go up or down until it reaches a new equilibrium. In the meantime the methane added to the atmosphere is contributing to warming.

Some researchers have advocated for a different way to estimate the GWP of short-lived gases like methane, known as GWP*. The value for GWP* would be about 4. *Use of GWP* would greatly reduce our estimated GHG from agriculture, sewage treatment, and solid-waste disposal.* US EPA and IPCC have not adopted GWP*.

4. Wood

Our current approach treats burning wood for building heat as 100% renewable with respect to CO₂, on grounds that wood we cut is replaced by regrowth of the forest. This is consistent with EPA guidance. Our existing 2016 Comprehensive Energy Plan depends heavily on use of wood for home heating (in combination with cold-climate electric heat pumps and improved building energy efficiency) to achieve state-wide objectives. It is possible that adoption of electric heat pumps as a primary heat source could be enhanced if advanced wood heat is promoted as a back-up.

Treating wood as 100% 'renewable' has been challenged, on grounds that (1) we have no way to assure that the wood we use is harvested in a sustainable way and (2) the climate crisis is right now, burning wood releases CO₂ now, and the replacement even in a sustainable forest happens over a long period of time, perhaps 40 years. *If we treat wood as less than 100% renewable, then our total GHG emissions will increase accordingly and building heat will be a larger contributor to our total.*

5. Solar and wind.

Our current methods do not account for the GHG emitted in manufacturing and transporting the equipment needed for solar and wind electric generation. *Accounting for these would increase the GHG emissions related to solar and wind energy from zero to some non-zero number.*