Minnesota Pathways to Decarbonizing Transportation

Technical Stakeholder Meeting #1

MnDOT Training Center (1900 Cty Rd I | Shoreview, MN 55126)
April 18, 2019
1:00 pm to 4:00 pm

Agenda

12:30 pm Registration and Networking

1:00 pm Welcome and Project Overview from Tim Sexton

1:10 pm Introductions and Meeting Overview

1:30 pm Paired Discussion:

- What are the most important decarbonization strategies that offer the greatest promise for decarbonizing the transportation sector? (Pick three)
- What policies are most likely to achieve transportation decarbonization? (Pick three)

2:00 pm Pathways Modeling, Tory Clark

- Overview on methodology
- Options for technical stakeholder group to consider
  - Resources and technologies for transportation decarbonization
  - Policies that drive changes in the model
  - Important variables

2:30 pm Q & A with E3

3:00 pm Table Discussions based on earlier questions:

- Why is this strategy important to you?
- How do you envision this strategy playing out between now and 2050?
- What assumptions or datasets do you want to see incorporated in the modeling?
- What questions on this strategy do you hope this analysis will answer for you?

3:55 pm Closing Thoughts & Next Steps

4:00 pm Adjourn

Getting there

- **Transit:**
  - By bus: Plan your route using Metro Transit's website
- **Parking:** Ample parking is available in the lot adjacent to the MnDOT Training Center.

Additional Logistics

- Afternoon refreshments will be available.
- Upon arrival at the MnDOT Training Center, please refer to the daily event monitor for directions to the room.

GREAT PLAINS INSTITUTE

This meeting is facilitated by the Great Plains Institute, a nonpartisan, national, nonprofit organization transforming the energy system to benefit the economy and environment. Learn more at www.betterenergy.org.

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Project Overview

1) Multiple agencies are involved in this project: Department of Transportation, Minnesota Pollution Control Agency, MN Environmental Quality Board, Department of Commerce, Department of Agriculture, and McKnight Foundation
2) Project will be focused on surface transportation. Three phases of this project include:

a) Modeling to understand how to get to our targets. Electrification, biofuels, etc.: where do they get us?
b) Engaging technical stakeholders. What are some tools we should be using? What policy factors should we consider?
c) Public outreach. How does the public see decarbonizing the transportation sector? Happening late June, state-wide.
d) See slides for project calendar

Stakeholder Roles to Transportation Decarbonization Identified

- Advocacy, decarbonization with racial and social equity, works with 100% Campaign
- Biodiesel efforts and platform for renewable products
- Building on knowledge to work with communities
- Community and public engagement
- Electric vehicle community mobility movement
- Electric vehicle policy and adoption
- Electrification markets
- Electrification of transportation, regulatory and programmatic issues related to infrastructure and rates, impacts of policies
- Energy efficiency programs and delivery of renewable natural gas away from transportation sectors to buildings
- Ethanol to decarbonize the transportation system
- Focused on equity and how decarbonization technology can impact communities
- Interested in biofuels, rural communities, and how farmers fit in
- Looking for information on pricing and electrification
- Looking to electrify bus system
- Oversee the state mandate for biofuels and incentive program
- Policy issues
- Promoting bicycle and walking as cost-effective solutions; working with teachers to educate young students.
- Promotion of Ebikes, guinea pigs for shared mobility and electrification
- Public engagement, climate mitigation and adaptation
- Public support for electrification and expanding transit
- Sharing resources
- Transportation advocacy and public education
- Utility electric vehicle strategies
- Working broadly to decarbonize across the economy and has been involved in the Volkswagen settlement
- Working toward eliminating barriers to advance transportation and electrification
- Working with Duluth for zero emission

Paired discussion:

What are the most important decarbonization strategies that offer the greatest promise for decarbonizing the transportation sector? Pick three.

1) Results: [1]
   a) Infrastructure/Mobility: Autonomous, mobility as a service, solar panels on highway right-of-way.
   b) Equity/ Air Quality: Pollution reduction, air quality, rural communities
   c) Electric vehicles general: Light duty, charging
   d) Electric vehicles fleets: electrification, corporate
   e) Electric transit
   f) Transit: rural + metro, decarbonize, expand, connect regions and cities
   g) Low Carbon Fuels (Other) Hydrogen, renewable diesel
   h) Biofuels – biodiesel, ethanol, next gen, renewable natural gas
   i) Education: Bike/walk, greenhouse gas reporting, public education on solutions, network effects, how small communities effect the larger scope, public health impacts
   j) Community design: redesign cities land use planning, density, shorter travel distances
   k) Planning/ VMT: reduce VMT, alternatives to driving, multi-modal
   l) Transportation safety
   m) Carbon taxation: make driving more expensive
   n) Strategies that have dual purpose: buying electric vehicles and having tariffs that encourage taking transit during the day; time-of-use planning, vehicle electrification/smart grid strategies
   o) Other: Decrease use of single-occupancy vehicles, identify markets opportunities with best greenhouse gas potential, find immediate solutions

What policies are most likely to achieve transportation decarbonization? Pick three.

1) Results: [2]
   a) Low emission vehicle/zero emission vehicle mandates
   b) Electric vehicle charging, planning/investment
   c) Electric vehicle readiness: building codes, comprehensive plans
   d) Carbon tax
   e) Biofuel research
   f) Clean fuel policy/Low carbon fuel standard
   g) Land use/planning: transportation and land use planning, ride sharing, congestion pricing, vehicle miles traveled reduction

[1] These are summarized results. For detailed results, see Appendix B.

[2] These are summarized results. For detailed results, see Appendix B.

h) Incentives: tax rebates, purchase incentives
i) Transit funding
j) Cleaner electricity
k) Vehicle replacement
l) State could stop licensing internal combustion engines
m) Other: public-private partnerships, sector specific policies, education for public benefits and purchasing and maintenance, require fleets to meet state goals and then tackle public via fleet results, immediate solutions, petroleum replaces goals as a guiding post, fund farm to school food hubs, regulate the ride share and delivery service vehicle emissions, tax negative impacts of fossil fuel.

Presentation on transportation modeling

Full group Q&A on model with E3

- Q: When you are establishing the baseline, some assumptions are already changing now (like electric vehicle penetration). How are you factoring that in the counter-factual scenarios?
    - A: We have created two scenarios: one where nothing is changing, and another compared to the current policy scenarios.
- Q: What assumptions are made about rates of change?
    - A: Reference scenario – using current data about electric vehicle sales
    - Mitigation scenario – depends on how quickly we'll assume those adoptions
- Q: How will modeling incorporate the increase in vehicle sharing and automation that impacts vehicle sales?
    - A: Car sharing often means fewer vehicles, but similar miles driven. For automation, we must know if these cars are gasoline or electric.
        - *E3 wants feedback on what people want to see in modeling*
- Q: How will this work help communities (smaller then state-level)?
    - A: Analysis will focus on state level because of the scope of data
        - *E3 is looking for feedback on how to incorporate data from small areas*
            - Steering Committee will take this data and see how it can play out across the state. It will help lead us to next set of questions and answers about smaller communities.
- Q: Is using Energy Information Administration as the data source too conservative?
    - A: E3 is only using this data for Annual Energy Outlook scenarios
- Q: What is the outcome of this work? What is the solution?
    - A: Modeling will result in multiple scenarios; goal is to lay out the scope the options and list of opportunities.
- Q: If we have further input, how can we participate outside of today?
    - Future webinars

    - We will share slides, then you will have a short window to send and provide feedback.
    - Stakeholders will have options to provide feedback via email at http://www.dot.state.mn.us/sustainability/pathways.html
- Q: The fast-pace timeframe for technical piece might be a problem regarding equity.
    - A: Final document will recognize the gap in the process
- Q: How will we capture interactive feedback between measures?
    - A: Full-economy scenarios capture interactive effects
- Q: What strategies are we looking at for reducing vehicle mileage categories?
    - A: We don't have a list yet for MN
        - Possible considerations:
            - Mode shifting (bike, bus, carpool), car-sharing,
            - Some trends show vehicle miles traveled is going down with urbanization, using roads more efficiently, increasing public transit
            - *E3 looking for feedback*
- Q: What are your thoughts about macro-economic trends and relationships in 2050 projections?
    - Modeling acknowledges amount of uncertainty
    - E3 assumes no major shifts in economy
    - Not a macro-economic model
    - E3 focuses on key drivers and runs sensitivities (i.e. increase in UPS via amazon)
- Q: What are the assumptions around fuel cost?
    - A: Fuel cost in current model is not a driver and therefore is not reflected. E3 can capture price by seeing how many miles are driven. In the past, E3 has used Energy Information Administration tools
- Q: How would we reflect a low carbon fuels standard in this modeling?
    - A: Modeling will only capture what we tell it to model regarding low carbon fuel standard
        - Can input carbon intensity and number of electric vehicles on the front end
- Q: Do we have a cheat sheet from other locations? Can we learn from other examples?
    - A: E3 does not have this resource but wants to know specific areas stakeholders want to see comparisons.
    - According to E3, these need to be incorporated: Energy efficiency, electrification, and low carbon and gaseous fuels, and how far you push each category
        - *If there are any MN-specific considerations, let E3 know*.
- Q: How do we think about levelized cost? Are we going to think about regional/national areas and other sectors?
    - A: Xcel Energy IRP data is public
    - Could add levelized cost piece down the road if there is interest, but as of now, just focused on transportation

- Q: How recent is the data incorporated, especially in relation to vehicle sales?
    - A: E3 tried to use the most related data: State level comes from Minnesota Pollution Control Agency (emissions and modeling (2016))
    - Federal data comes from Energy Information Administration
- Q: How do we reflect the most recent data, especially high sales of SUV?
    - E3 thinks they have captured this information accurately.
    - E3 will compare any other data that stakeholders suggest and compare it with current data.

Table discussion: Notes from Flipcharts

Q1: Why is this strategy important to you?

TRANSIT/ELECTRIC TRANSIT/HEAVY DUTY

- Most immediate impact
- Can be done quickly
- Run more hours and use more car fuel than light duty
- Intersection between carbon reduction and equity – visible
- More systemic change
- Political support to expand
- Economic opportunity
    - Specific use case/duty cycle, easy win
- Big bang for the buck
- Centralized fueling for fleets
- Professional drivers matter
- Making connections between cities
- Creates win for rural and urban areas
- Job access
- Heavy duty
    - Lower volumes mean fuel transition can take place easier

COMMUNITY DESIGN/PLANNING

- Rural community must be represented
- Improves overall quality of life/more community connectedness that could improve economic developments
- Safer
- Multiple mobility options bring greater choice
- Need to change local land use to lead decarbonization
- Community design has been used to exclude certain groups and can include density, options for mobility, etc. to be more human oriented
- Free public transit = best way to do reparations/coupled with increased cost of driving
- Connection between land use/equity/transportation – core
- Connecting people with nature could be an outcome of different design

ELECTRIC VEHICLES

- "What we buy now" idea, 15-year lifecycle
- Public health impacts
- Benefits electric grid renewables
- Electric vehicle adoption already has momentum, especially for fleets. Lots of opportunity to influence bigger organizations
- Financially viable/customer satisfaction
- Technology already headed in right direction and can help advance electric vehicle technology and vice versa
- Raw materials and life cycle analysis
- Important to address, downstream impacts, copper nickel resource
- Personal impact for individuals
- MN specific issues with driving (winter, distances etc.)
- Fuel security and price stability
- Expanding ideas and innovation to greater MN, not just Twin Cities
- Jobs

BIOFUELS AND OTHER LOW CARBON FUELS

- Economy – produced here, cleaner
- Economy – rural economy
- We have a head start relative to other regions/strategies
- Great potential
- Biodiesel- blends above B20— B30/B40
- Driven by low carbon fuel standard
- Fleets can use
- Impacts without changes to consumer behavior
- Bridge to electric
- Back-up to electric vehicle range anxiety addressor
- Remote charging – B100 generator to charge cars. B100 generators already coupled with PV in certain locations
- Biofuels can mitigate other sectors (e.g. reduce methane)
- Efficiency of biofuel production has improved
- Cover crops – camelina, pennycress; positive looking processing
- Compressed natural gas –methane harvesting, reduce farm emissions
- 70% of California compressed natural gas (CNG) vehicles already on renewable natural gas (RNG)
    - Producers want market without renewable identification number (RIN) regulatory risk
- 32% of CNG market is already RNG
- Can't get renewable diesel; all is going to California
- Interest on renewable diesel in fleets

Q2: How do you envision this strategy playing out between now and 2050?

TRANSIT/ELECTRIC TRANSIT/HEAVY DUTY

- Transit could bring big growth to electrification
  - Manufacturer support
  - Turnover may be more deliberate
- Heavy duty
  - Mix of fuel cell, biofuels, electrification depending on use case and vehicle miles traveled
- Higher use of transit: growing demand
- Larger public investment: seek bipartisan support
- Transformation of ease of services: connect through apps, planning route online, etc.
- Improve expansion of transit

COMMUNITY DESIGN/PLANNING

- These changes will be expressed in local comprehensive plans
- Achieving these changes will require broad engagement; not just with nay-sayers
- Met Council and local planning tools will help cities makes these cases and decisions and inform local climate action plans
- For greater MN, important that economic value of biofuels and electrification stay/are local
- Strong local economies, strong main streets regional transportation systems
- Rural road design to accommodate bikes
- Single car households becoming more common

ELECTRIC VEHICLES

- With an international carbon trade regime
- Need to consider transportation in the future
- Next 10 years – some sort of transportation standard
- 2025 – half of all vehicles will be electric; part of global trend
- Price of electric vehicles are going down
- Infrastructure increasing
- Trend of autonomous vehicles are electric
- Fleet conversion / bulk buying opportunities
- 2035 – batteries will be twice as energy dense. Less range anxiety issues.
- Impacts on renewable energy sector
- Potential problems
  - Gas prices cause electric vehicle adoption to flatten. Need incentives or regulations
  - Time-of-use rates to be optimized and equitable

BIOFUELS AND OTHER LOW CARBON FUELS

- Engine manufactures must charge technology over time
  - Introduce higher level blends from B40 to B50 and higher (B100)
  - They need credits to manufacture things
- Petroleum companies build renewable diesel plants (starting to happen)
  - Petroleum refineries owns ethanol and biodiesel, investing in alternatives
  - Sell decarbonized fuels
  - Split in refining industry
    - Some participation
    - Some stonewalling
- Agriculture groups are embracing decarbonized biofuels
- Protein is the driver, fuels are secondary (from starch and oil)
  - Will drive starch and oil availability
- Anaerobic digestion – energy solutions for a waste problem
- All organic waste goes to renewable natural gas
  - Eco engineers – resource assessment; biggest potential
- Greens plains – information on protein driving oil availability
- Power to gas; need more data

Q3: What assumptions or datasets do you want to see incorporated in the modeling?

TRANSIT/ELECTRIC TRANSIT/HEAVY DUTY

- Cost analysis in general, but especially on fuel prices
  - Gas, diesel, electricity
- Tariff implications from utility
- Characteristics that trigger cultural shifts of transit (i.e. costs, route access)
- Assumptions
  - LCFS
  - Renewable diesel
  - Up to class 5 trucks being electric
- Like idea of carbon tax
- Vehicle miles traveled analysis and sensitivity testing
  - Congestion implications
- Impacts of increase in ridesharing and autonomous vehicles on transit
- Impacts of local politics in Midwestern states
- Cleanliness of electric grid

COMMUNITY DESIGN/PLANNING

- Strong vehicle miles traveled (VMT) reduction scenarios
  - Minneapolis = 38% VMT reduction by 2040
  - Minneapolis bike mode share goal of 15% by 2025
- Future statewide building codes require electric vehicle infrastructure

- Shared use vs. owned and ratio of electric vehicles and internal combustion engine vehicles
- Connected autonomous/electric vehicles vs. internal combustion engine vehicles
- Percent urbanization with respect to density
- Consolidation of community resources in greater MN; e.g. hospitals on VMT
- Ridership studies for planned and existing rural transit
- Aging of rural MN population and impact on mobility
- Greater Twin Cities population = younger? and more diverse? immigrants?
- Look at pricing models for other industries and how they impact demand
- E-commerce of sighted data and how that impacts VMT; private sector has lots of data on this and impacts of changing delivery models
    - How fast will this change? Drones
- Access to tourist locations (like state parks)

ELECTRIC VEHICLES

- Need to include carbon pricing scenario by 2035
- Realistic electric vehicle adoption rate
- Multiple scenarios with different adoption rates
- Fleet purchasing (happening now)
- Low carbon fuel standard, 100% standard
- Demographic assumption of population size
- Battery technology limitations and advancements
- Electric vehicle model diversity to fit more MN and implications of this change
- Potential impacts of decreased metro car ownership
- Ideas of future policy (zoning, land use)
- Backlash, level of public acceptance
- Electoral change and implications
- Range of electric vehicle pricing, brackets, and gaps
- Industry trends (e.g. manufacturing)
- “Amazon” of transportation

BIOFUELS AND OTHER LOW CARBON FUELS

- B100? Doable, need more participation from engine manufacturers
- Ethanol; high octane blends (i.e. E25/E30)
- What impacts does renewable fuel standard backsliding have?
- State policy is more of a driver than renewable fuel standard (California Low Carbon Fuel Standard)
- When does E15 become a year-round base fuel? 2025
- Life cycle analysis carbon intensity; not tailpipe
    - GREET model
- Carbon intensity of baseline petroleum. What if we moved from Canadian crude to lower carbon crude?
- Railroads
    - Big market; why are they left out?

    - They will use biodiesel if they get a price break
- New technologies?
    - Corn kernel cellulosic
        - 5-10 % increase productions from each facility
    - eRINs for electric vehicles powered by electricity for biogas

Q4: What questions on this strategy do you hope this analysis will answer for you?

TRANSIT/ELECTRIC TRANSIT/HEAVY DUTY

- Inform Xcel Energy on number of vehicles for resource planning
- Does sensitivity analysis indicate heavy duty sector is a critical strategy?
- What can scale more quickly? Light or heavy-duty electrification? And what has more impact on decarbonization?
- How much impact will transit have on carbon as it scales, regardless of fuel type?
- What level of investment/service drives the biggest reduction? Are there tipping points?
- Separate transit and heavy-duty modeling
    - Subsidized differently, direct subsidy is greater for transit
    - Offer different benefits
- What will transit/heavy duty look like in 2050?
    - Still unclear on advancements and impacts these will have
    - Leave space for high advancements in these areas
- Sensitivity analysis of transit/fleet for 2035 vs. 2050 and impacts this has; like turnover of diesel to electric
- Which of these sectors will have greatest impacts?
    - Types of fleets
    - Transit

COMMUNITY DESIGN/PLANNING

- Different scenarios articulated and quantified
- Individual family's ability to adopt different strategies
- A clearer understanding of modeling limitations and what additional questions need to be answered; including how all can benefit equity
- A scale of what level of greenhouse gas reductions can come from vehicle miles traveled reductions and the interface between local and state planning
- Where policy intervention is necessary and where the market will work
- Review strategies from past models and what was implemented and why
- Some positions of co-benefits captured including air quality implications are less quantifiable
- Some sense of interplay with electric systems and greater costs to accommodate electrification and greater rates
- A sense of sensitivity and interplay of different strategies

ELECTRIC VEHICLES

- Hope
- Individual choices and steps to take
- What are the tradeoffs of investment?
- How far do we need to go, what is our timeframe?
- What are future implications?
- What are the future drivers?
- How do assumptions rank? How do our decisions about assumptions affect the related outcomes?
- How much does public policy drive this?
- What is the role of state policy?
- Next steps? Stakeholders should be able to evaluate criteria, be transparent with communities, have fluid communications with communities, especially regarding technology and social impacts. Address the question of who needs to be involved and what do they need to say to educate others.
- What are the unintended consequences?
- Market and mandates continue to clarify with model
- How does MN compare to other states? What are our unique choices and options?

BIOFUELS AND OTHER LOW CARBON FUELS

- Does the MN policy framework make new biofuel facilities economically viable?
- Which sectors are most amenable to which fuel? E.g. biodiesel, electric vehicles, renewable natural gas, etc.
- Vehicle turnover – new vehicles allow higher blends; how long does it take to impact the market?
- How can we impact vehicle impact turnover to accelerate adoption of cleaner vehicles?
- How much impact can biofuels have on greenhouse gases? Other pollutants? Location?
- Air quality—where are the biggest impacts? Can we focus there fast?
- Can biofuels be a bridge to electric? How long will it take?
- Do new feedstocks replace or supplement older feedstock?
- Nutrient recycling from anaerobic digestion? Opportunity for farmers and can support more animal agriculture
- Organic waste as a resource
- Do not include cellulosic ethanol from corn stover
- Include wood
- Cover crops as oil seeds, biomass

Closing Thoughts & Next Steps

1) Future webinars are not scheduled yet. Updates will be sent out.
2) Outreach meetings will take place across the state (Twin Cities, Rochester, Duluth, Bemidji, Marshall) in late June. Let us know if you want to be involved.

3) If there are additional data source or targets you think E3 should consider, please email timothy.sexton@state.mn.us
4) Website can be accessed at http://www.dot.state.mn.us/sustainability/pathways.html

Appendix A: Meeting Participants

Name	Organization
In-person Participants	
Amanda Jarrett Smith*	Minnesota Pollution Control Agency
Amy Fredregill	Environmental Initiative
Andrew Twite	Fresh Energy
Ashwat Narayanan	Our Streets
Benjamin Stafford	Clean Energy Economy MN
Bill Dossett	Nice Ride
Carly Gelderman	Great Plains Institute
Cecilia Martinez	Center for Earth, Energy and Democracy
Dorian Grilley	Bicycle Alliance of MN
Erik Bigelow	Center for Transportation and the Environment
Frank Douma	Humphrey School of Public Affairs, University of Minnesota
Heidi Ries	Institute on the Environment, University of Minnesota
Jeffrey Meek	Minnesota Department of Transportation
Jessica Burdette*	Minnesota Department of Commerce
Jessi Wyatt	Great Plains Institute
Jessica Treat	Move MN
Jon Hunter	American Lung Association of MN
Josie Lonetti	Minnesota Farm Bureau
Katelyn Bocklund	Great Plains Institute
Kevin Hennessy	Minnesota Department of Agriculture
Kevin Whelan	MN350
Laurie McGinnis	Center for Transportation Studies, University of Minnesota
Lola Schoenrich	Great Plains Institute

Marcus Grubbs	Minnesota Department of Administration
Margaret Donahoe	Minnesota Transportation Alliance
Margaret Levin	Sierra Club North Star Chapter
Mauricio Leon	Metropolitan Council
Mike Youngerberg	Minnesota Soybean
Mitchell Coulter	Minnesota Corn Growers Association
Nick Mark	CenterPoint Energy
Nick Martin	Xcel Energy
Pat Jones	Metro Transit
Paul Helstrom	Minnesota Power
Paul Schroeder	HourCar
Stephanie Pinkalla	The Nature Conservancy
Stu Lourey	Minnesota Farmers Union
Tim Sexton*	Minnesota Department of Transportation
Tory Clark	Energy and Environmental Economics (E3)
Will Seuffert*	Minnesota Environmental Quality Board
Remote Participants	
Alex Jackson	City of Duluth, Climate Smart Communities
David Bael	Minnesota Pollution Control Agency
Frank Kohlasch	Minnesota Pollution Control Agency
Jason Wetzel	General Motors
Joe Halso	Sierra Club Environmental Law Program
Kevin Bright	City of Rochester, Climate Smart Communities

*Denotes Steering Committee member

Appendix B: Detailed Results

What are the most important decarbonization strategies that offer the greatest promise for decarbonizing the transportation sector? Pick three.

Planning/Vehicle Miles Traveled (reduce VMT, alternatives to driving, multi-modal)

- VMT reduction via planning, public transit, multimodal transportation
- Statewide land use with more focus on transportation – land use nexus
- Land use planning
- Charge real price for parking
- Increase access to alt. modes and mode sharing
- Reduce overall VMT
- Decrease the need for single-occupancy vehicle trips
- Land use planning
- Live closer to work

Community design (redesign cities, land use planning, density, shorter travel distances)

- Land use and community design (and density and mobility)
- Safety, mortality reduction
- Local food infrastructure
- Community design practices
- Expand infrastructure for biking and walking
- Physical activity and health
- Redesign cities and roads to decrease single occupancy vehicle use
- Land use – denser, shorter distances between destinations
- Land use and community design

Education (bike/walk, greenhouse gas reporting, public education on solutions)

- EV education and awareness
- Talk about the possible solutions to educate the public
- Network effects, culture change
- Bike/walk safety education
- Fleets reporting GHG reduction process and telling the story to the public
- Public education
- Education on options and technology available

Transit (rural + metro, decarbonize, expand, connect regions and cities)

- Expand public transit, more high-frequency routes, light rail transit and bus-rapid transit, metro and greater MN
- Fund metro transit everywhere (rural, metro)
- Increase mass transit statewide
- Connecting MN regions and cities with rail and bus services
- Increase public transit options
- Electrify and expand transit
- Transit service expansion, especially in greater MN
- Public decarbonized transportation

EVs – General (light duty EVs, EV charging)

- Discounted EV rates for overnight charging
- Build out public EV charging
- Fund EV infrastructure
- Electrification/increase EVs
- Maximize use of renewable generated by cars
- Decarbonization of the electric grid
- Electrify vehicles
- EV/electric system/smart grid
- Increase vehicle efficiency
- More efficient vehicles
- Increase public awareness of costs/benefits of EVs
- Light duty vehicle electrification
- Electrification of all vehicle types where feasible
- Electrify transportation (cars, bikes, trains, planes, pneumatic tubes)
- Electric

EVs – Fleets

- Fleet electrification (transit, corporate)
- Start with heavy-duty fleet decarbonization

EVs – Transit

- Electrifying transit
- Electrification of transit
- Increased investment in public/transit and alternative modes
- Transit expansion and electrification
- Public transit electrification
- Electrify all transit

Equity/Air Quality (pollution reduction, air quality, rural communities)

- Develop/support local food and access to other goals and services with few miles traveled
- Accelerate equitable transportation to 100% clean renewable energy
- Investing in rural community self-sufficiency
- Integrating air quality and cumulative impacts for decarbonization prioritization
- Increasing EV charging infrastructure especially in highly populated communities

Infrastructure/Mobility (autonomous, mobility as a service, solar panels on highways right-of-way

- Solar panels in highway right-of-way
- Moving to broader adoption of EV, especially for autonomous vehicles
- Inventory of the infrastructure in the state today
- Mobility as service, right price incentives

Biofuels (biodiesel, ethanol, next gen, renewable natural gas)

- Methane capture
- Biofuels as “bridge” away from fossil fuel
- Biofuels blends/tax credit for consumer
- Increase bio fuels through multi-prong approach
- Model biodiesel in heavy duty, tracking of past advances to assure viable future, renewable biogas
- Advanced biofuels
- Next generation biofuels
- EVs and biofuels
- Expand use of cleaner liquid fuels
- Coordinate infrastructure planning for lower carbon fuel options
- Research on next-gen biofuels

Low carbon Fuels (hydrogen, renewable diesel)

- Applied research to work with developing technologies, hydrogen, renewable diesel, EVs
- Accelerate transition to cleaner ways to power vehicles
- Prioritize investment list of decarbonization pathways
- Consider hydrogen fuels for heavy duty fleets

Etc.

- Immediate solutions (starting now)
- Decrease use of single-occupancy vehicles
- Identify market opportunities with best GHG potential

What policies are most likely to achieve transportation decarbonization? Pick three.

Low emission vehicle (LEV)/ Zero emission vehicle (ZEV)

- ZEV state
- State tax credit for EVs
- State policies to increase medium and heavy fleets in state ops, state contractors, other public sector fleets
- ZEV fleet standard for states, see California
- State incentives (such as rebates) to increase adoption rates of EVs
- Electric vehicles purchase rebate
- State adoption of ZEV, LEV standards
- Zero emission vehicle
- ZEV/LEV standard
- ZEV/LEV standard
- Incentivize EVs
- Zero Emission Vehicle policy (ZEV)
- Subsidize growth of electric fleet to reach tipping point
- Low Emission vehicle standard
- Zero Emissions vehicle standards Incentivize EV purchasing via state tax credit + utility rebate
- ZEV/LEV mandates
- State tax credit for electric vehicles new and used State EV tax credit $1500
- Refundable state EV tax credit that includes used vehicles

EV Charging planning/investment

- State/federal funding for charging infrastructure (for public charging)
- Electric price incentives
- Infrastructure planning process
- Optimize time of charging vehicles for renewable
- Require EV infrastructure as part of building codes or building performance standards

EV Readiness (building codes, comprehensive plans)

- Comp plan requirements related to density, EV charging stations, etc.
- Building codes regulated on new development
- EV ready infrastructure building codes EV readiness in building codes

Biofuel research

- Support for infrastructure development for biofuels
- Methane capture for energy use is best
- Greater investment in biofuels research

Carbon Tax

- Externalities in fuel cost
- Carbon tax
- Carbon tax
- Carbon tax/fee and dividend
- Carbon tax on fuels
- Carbon tax and dividend

Clean Fuels Policy/ LCFS

- Create policies to drive investment into infrastructure that reduces carbon
- Low carbon fuel standard, proactive work by DEED to align consumers w/ potential producers in MN
- Develop/adopt carbon intensity measure
- Low carbon fuel standard
- Low carbon fuel standard
- Low carbon fuel standard
- Low carbon fuel standard
- Low carbon fuel standard
- Low carbon fuel standard (declining CI, fuel + technology neutral crediting)
- Carbon value for MN that's recognizes well to wheel values
- Carbon intensity measure (put all technologies on one scale)
- Increase pricing/tax policies where fossil fuels pay more, and biofuels electric fleet pay less

Land Use/Planning (transportation planning, land use planning, ride sharing, congestion pricing, VMT reduction)

- Transportation investment policy; fund more transit, bikes, walk
- Local land use policies that encourage density and affordability along transportation corridors
- Income-based or car-value based per-mile fee on annual vehicle driving
- Incentivize behaviors for sharing rides
- Land use policy
- Promote/allow land use in urban areas that are more conducive to transit, biking, or walking
- Mixed-use high-density zoning + congestion pricing
- Coordinated state-wide land use/transportation planning
- Transportation investment in high density utility hubs
- Incentivize sharing economy including transit/EVs/autonomous/bike

Cleaner electricity (Cleaner EVs)

- 100% clean electricity by 2050
- Incentives for utilities to invest in renewables

- Incentive for electric co-ops using renewables

Incentives (tax rebates, purchasing incentives)

- Incentivize adoption (taxes, rebates) gov/utility
- Regional decarbonizing policy depending on the lay of the region
- Incentive (tac, purchase)
- Use taxes/tax incentives
- Incentives to engage in less carbon intense modes of transportation (rebates, tax breaks)

Transit Funding

- Funding for mass transit
- Free transit
- Increase funding to support transit and other modes

Vehicle Replacement

- Ban internal combustions engine vehicles
- Cash-for-clunkers vehicle buyback to accelerate EV rollout
- Personal “car-free” annual payment stipend (amortize, 10 years)
- Incorporate externalities into fuel prices – full cost of environmental impacts
- Higher tax for combustible engine vehicles
- Stop renewing/issues licenses for internal combustion vehicles

Etc.

- Tax negative impact of fossil fuel
- Regulate the ride share and delivery service vehicle emissions
- Fund farm to school and food hubs
- Petroleum replacement goals as guiding post
- Require fleets to meet state goals and then tackle public via results from fleet
- Education: public benefits; purchase + maintenance
- Public private partnership + congestion pricing
- Sector-specific targeted policies
- Immediate solutions (ones that will work and can be implemented right now)