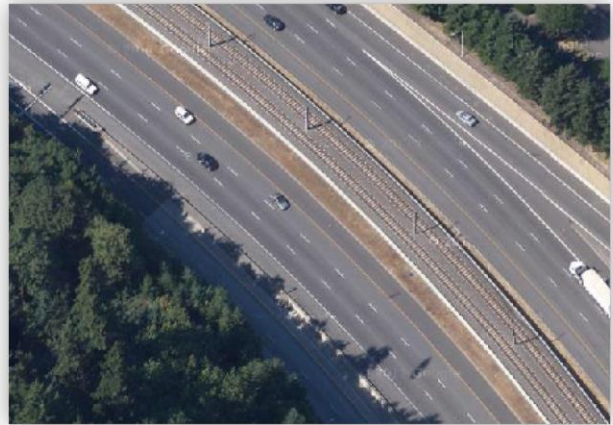The National Academies of
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TRB

TRANSPORTATION RESEARCH BOARD

TRB Air Quality Committee (ADC20)
2018 Summer Meeting Summary

November 16, 2018

1.0   Summary and Key Outcomes

The Transportation Research Board (TRB) Air Quality Committee (ADC20) and friends gathered July 31 to August 1, 2018 in Washington, D.C. to discuss cutting-edge air quality issues and help shape the committee's strategy for the future. Experts from different fields related to transportation and air quality gathered and shared their views and opinions. The committee organized three speaker sessions, two panel sessions, and two breakout sessions. Speakers included experts and end users of transportation air quality products in the government and the industry.

Doug Eisinger, the chair of the committee, and David Kall, the summer meeting organizer, addressed the attendees in the welcome session. They encouraged the attendees to think critically on the role of the committee and our vision for the committee's future.

Highlights of Technical Sessions

The 2018 summer meeting featured some unique and emerging perspectives. Emissions of criteria air pollutants in the U.S. have continued to decline significantly over the past decades, but greenhouse gas (GHG) emissions remain well above international targets. Meanwhile, disruptive mobility technologies are quickly transforming the transportation landscape, and improved computational methods are at our disposal.

David Kall (FHWA, lead meeting organizer) introduces the meeting.

Dr. Chris Frey from North Carolina State University presented on the key issues and trends in the transportation air quality field. Modern automobiles have become cleaner, yet there are still substantial uncertainties related to emissions and health effects. Topics like ultrafine particles (UFP), non-exhaust emissions, heavy duty vehicle emissions, and quantification of uncertainties are gaining importance. Victoria Martinez presented the key findings from the committee's strength, weakness, threats, and opportunities (SWOT) analysis undertaken at the January 2018 TRB annual meeting (attached as Appendix A to this report). The analysis identified cross-committee and cross-discipline collaborations as critical to the committee's future. At the summer meeting, partners from the automobile industry, public health researchers, and national energy experts identified key research needs from their perspective and identified uncertainties in assumptions regarding modeling the future that the committee could help address.

Breakout discussion sessions focused meeting participants on the important issues facing the transportation-air quality world; future directions for the committee to address these issues; and specific action items for the committee.

What are the Importation Issues our Committee is Facing?

- Key trends affecting air quality:

  - Emerging disruptive and transformative technologies, e.g., connected and automated vehicles, big data analytics.

  - Changing travel behavior trends and patterns, including the rise of transportation network companies (TNCs) and increased ride sharing.

  - Declining criteria pollutant and air toxic exhaust emissions (in the western world) contrasted against transportation-related GHG emissions trends.

  - Continually increasing generation of data from low-cost sensing systems and the Internet of things (IoT) and their related devices.

  - Increasing goods movement demands.

- Understudied transportation-air quality issues:

  - UFPs: health effects and regulatory responses.

  - Modeling chain: uncertainty, impact on decision making, model simplification.

  - Non-exhaust emissions: brake and tire wear.

  - Ozone: why ozone levels have plateaued in some areas even while emissions are going down.

  - Multipollutant hotspot analysis and spatial variability.

  - Value of conformity analysis practices.

  - Health effects: communication of risks and comparison with other risk factors; spatial and temporal variations.

  - Real-world: emissions from modern (MY 2010 and later in the U.S.) heavy duty diesel trucks, as well as light-duty diesels.

  - Environmental justice (EJ): air quality and advanced technology fleet penetration disparities between EJ and other communities.

What are the Future Directions for ADC20?

- Act as the bridge between technical research and policy/implementation decision-maker information needs.

- Coordinate across TRB committees to enhance educational opportunities and improve knowledge transfer.

- Support development and implementation of fit for purpose/contextually suitable models.

- Monitor and understand the changing landscape of new pollutants and technologies.

- Attract a new generation of students and researchers through activities such as interesting workshops, data hackathons, and participation in cross-disciplinary conferences.

ADC20 Action Items

- Put out calls for papers in the coming years based on the high priority issues identified at this meeting and during the January 2018 TRB annual meeting SWOT exercise.

- Continue/expand liaison and collaboration with other key committees. Review their relevant research needs statements to look for overlap and collaboration opportunities.

- Expand offroad/non-highway emissions analysis capabilities: Consider as a criterion when recruiting and approving new members; establish a subgroup to identify research needs; consider sponsoring a workshop.

- International issues: Form a working group to consider in more depth what we can do, and/or reach out to the Committee on Transportation in the Developing Countries (ABE90).

- Research needs priorities: form a working group or subcommittee at the January 2019 meeting to compile and prioritize the list based on committee strengths and opportunities; compare with existing research needs statements (RNS); identify new RNS to write; assign to writers; match with potential funding sources; reprioritize; distribute.

Day 1 – Tuesday, July 31, 2018

Welcome

The meeting started with greetings from the committee chair, Doug Eisinger of Sonoma Technology, Inc. (STI), and the meeting organizer, David Kall of the U.S. Federal Highway Administration (FHWA). D. Eisinger posed five questions for us to consider over the course of the meeting:

- Who is our audience?

- How do we accomplish identifying, funding, and addressing their key needs?

- Are we hitting the bullseye with our research needs?

- How do we stay at the cutting edge and help attract funding for our research?

- What should we do as a committee to continually improve our effectiveness?

Session 1: Key Issues and Trends in the Transportation-Air Quality Field

Speaker: Chris Frey, North Carolina State University

Focus: Air & Waste Management Association (A&WMA) critical review, trends in onroad transportation energy & emissions

C. Frey presented on key issues, highlighting information he prepared for the 48th Annual, 2018, Air & Waste Management Association Critical Review, which was provided as a handout. Some particularly noteworthy issues relevant to transportation air quality included:

Chris Frey (NC State) presents on key issues and trends in transportation and air quality.

- Global trends: Sales of vehicles have reached saturation levels in the U.S., but not in many other countries such as China. As electric vehicle (EV) deployment increases, the electric power sector will affect transportation emissions.

- In the U.S., light-duty greenhouse gas (GHG) emissions have increased 16% since 1990, but heavy-duty emissions have increased 79%. There is potential for roughly a one-third reduction in freight sector. However, any effect of the mid-term Federal standards reviews is unknown.

- Criteria pollutant emissions are down 70-90% from 1970 due mainly to continuing technological innovations meeting regulations. There is consistent evidence of decreasing emissions, but still limited information on uncertainty in emission factors. The latest clean technology will be nearly fully phased-in by 2035 (light-duty) and 2040 (heavy-duty); heavy-duty shares of oxides of nitrogen (NOx) and particulate matter (PM) will increase.

- New technologies to meet fuel efficiency standards have had some emissions tradeoffs, e.g., increased ultrafine particles (UFP) from gasoline direct injection.

Research needs:

- There is increasing evidence of real driving emissions greater than Euro 6 standard (in countries with that standard), and a need to improve program monitoring to reduce non-compliance.

- Inspection/maintenance (I/M) programs – need for validation of on-board diagnostic (OBD) checks, heavy vehicle control methods.

- Understanding and modeling of spatial and temporal variation of emissions, exposure, and health impacts.

- Better understanding of life cycle emissions of alternative fuels.

- Better characterization of non-exhaust emissions, e.g., brake and tire wear, methane venting.

Session 2: Strengths, Weaknesses, Threats, and Opportunities (SWOT) Analysis

Presenter and Moderator: Victoria Martinez, FHWA

Focus: Report on findings from the January 2018 TRB annual meeting SWOT analysis, Q&A

V. Martinez presented findings from the SWOT analysis the committee completed in January 2018 (**Appendix A** includes the SWOT report distributed at the summer meeting as a handout). Questions and comments from the attendees:

- Is emissions modeling the sole responsibility of ADC20 group? No, collaboration increases our visibility and brings important cross-discipline perspectives addressing multiple priorities, not just AQ.

- What is the mechanism to increase publication quality? Tailored and focused call for papers will help.

Victoria Martinez (FHWA) presents the results of the SWOT analysis conducted at the January 2018 committee meeting.

- Research should lean toward applied, not pure. Advance field while being applicable in field.

- Opportunity for more policy-focused papers (objective analysis, not advocacy).

Session 3: Perspectives and Priorities From our Partners

Moderator: Doug Ito, California Air Resources Board

Panelists: Susan Collet, Coordinating Research Council (CRC)/Toyota; Paul Leiby, TRB Transportation Energy Committee (ADC70)/Oak Ridge National Laboratory (ORNL); Rachael Nealer, TRB Alternative Transportation Fuels and Technologies Committee (ADC80)/U.S. Department of Energy (DOE); Chris Owen, U.S. Environmental Protection Agency (EPA); April Marchese, U.S. Federal Highway Administration (FHWA); Rashid Shaikh, Health Effects Institute (HEI)

Focus: Multi-disciplinary perspectives on key transportation-air quality issues

Research needs "perspectives and priorities" were distributed in advance from panelists Collet, Marchese, and Owen.

S. Collet explained that CRC conducts cooperative research between auto and oil industries and makes it available for use by the government and others. CRC's Atmospheric Impacts Committee is focused on improving science and regulations related to air quality. Project ideas are reviewed and funded on a two-year cycle; for example, 2018 ideas were due 8/24/18 and funded starting January 2019. At the Southern

California Ozone Research Symposium held in June, 2018, U.S. EPA, CARB, South Coast Air Quality Management District, and other researchers identified their top five regional research needs:

- Observational response of atmosphere (especially regarding ozone and secondary aerosols) to changes in NO_x and VOC.

- Short, medium and long-term relations and evaluation of ozone with meteorology.

- Mobile source emissions - identify gaps for truck emissions and allocation; include selective catalytic reduction (SCR), deterioration maintenance, satellite trend data.

- Biogenic vegetation issues.

- Dynamical model evaluation in southern California to examine trends in ozone, precursors for other pollutants, background ozone, and long-range transport.

R. Shaikh explained that HEI's goal is to generate and review data on health effects on air pollution, especially mobile source but also broadly. They are focused on objective review, not policy. They are funded by U.S. EPA, the automotive industry, and others from time to time. They have completed reviews of 300 studies, with 25 ongoing. A new comprehensive review of health effects of air pollution is underway. Key issues include:

- Global health effects of air pollution: 4 million premature deaths; 100 million years of healthy life lost. Estimated 250,000 deaths per year from traffic air pollution, but that is highly uncertain.

- Exposure assessment – key uncertainties: scaling up – novel methods (sensors, satellite/remote sensing); scaling down spatially and temporally; source attribution.

- Emerging pollutant issues include ultrafine particulates (UFP).

- Role of confounders and modifiers (e.g., socioeconomics, noise, green space).

- "Chain of accountability" - hard to relate outcomes just to air pollution changes.

- Technology needs: fine tune, enhance internal combustion engine (ICE); develop, market electric drive.

Panel discusses research priorities of partners: Doug Ito (CARB), Rashid Shaikh (HEI), Rachael Nealer (U.S. DOE), April Marchese (FHWA), Susan Collet (CRC/Toyota), Chris Owen (U.S. EPA), Paul Leiby (ORNL).

R. Nealer noted that TRB Committee ADC80 (Alternative Transportation Fuels and Technologies) continues to collaborate with ADC20 and others on TRB workshops, including a January 2019 workshop on electric vs. fuel-cell vehicles.

U.S. DOE Vehicle Technology Office (VTO) priorities include: battery/electric drive research and development; extreme fast-charging target (350-400 kW); lightweight materials, propulsion systems; advanced ICE systems, fuels, and lubricants; super-trucks; co-optima (fuels and engines); technology integration (Clean Cities, Alternative Fuels Data Center) and information dissemination; analysis – evaluating impacts; energy efficient mobility systems; connected/automated vehicles; and smart mobility.

P. Leiby noted that TRB Committee ADC70 (Transportation Energy) considers energy efficiency, use, impacts, and sustainability. Active subcommittees focus on international aspects, climate change/GHG, CAV implications, and integrated transport modeling (joint with ADB40, the Standing Committee on Transportation Demand Forecasting, to couple demand forecasting and energy). Research interests of the committee include:

- Fuel efficiency technologies and policy

- Regional transport climate policy

- Life-cycle assessment

- Transitions and barriers for vehicle/fuel/infrastructure, including technological uncertainty and progress

- Effect of driving conditions and behavior

Key issues and trends include:

- Oil supply, demand, and market – expectations/forecasted trends often prove incorrect

- Fuel use – growth in freight and air

- Global urbanizations and demand for travel

- Technology – electrification, connectedness, shared - independent and interactions

- Fuel economy of vehicles and impact of CAFE freeze will depend greatly on fuel prices

C. Owen's group at EPA is responsible for the AERMOD dispersion model. Research and evaluation needs include:

- Better data on traffic (volumes, mix, speed/activity profiles)

- Meteorological data – representativeness of actual site conditions

- Models need improvement, as demonstrated by monitoring data that is often significantly different than predicted. Need good data to inform development. Need to collect more targeted data for both model inputs and improvements.

A. Marchese noted potential air quality research in a number of general areas:

- Overarching: model validation; simpler/more efficient AQ analysis approaches

- Analysis/modeling: AERMOD application for highway projects; strategy interactions in GHG analysis

- Health: effects of mobile source emissions, comparison to safety risks

- Performance management: Congestion Mitigation and Air Quality Improvement Program (CMAQ) project emissions estimation, target setting approaches

- Future issues: CAV, EV modeling

D. Ito discussed CARB's new agency focus on communities, particularly disadvantaged or EJ areas. Communities have multiple priorities - land use, health, equity, jobs/economy, etc. Top priorities vary by location. Methods/tools are needed to objectively evaluate multiple priorities. Their key issues include:

- Communication strategies with communities to engage and get meaningful feedback. What do people care about? How do we identify and address multiple priorities that include a wide range issues that directly impact communities?

- What is success? What priorities/objectives are we focused on (public health, social equity, air quality, etc.), and how do we have effective implementation that results in measurable, reportable outcomes that are easy for communities to understand and identify with?

- Cross-discipline issues. For example, community solutions for zero-emission transportation (both passenger and freight) will require electrical infrastructure. How are implementation challenges such as electric plug standardization being addressed?

- Metrics and performance measures. There's a lot out there. Which are the "right" ones to effectively communicate success? Are new ones needed that communicate progress on multiple priorities?

- Role of citizen science. Some communities are actively seeking to understand their exposure to pollutants using low cost monitors and mobile technology, potentially resulting in substantial data. How can these data sources improve our understanding of exposure and inform our decision-making processes?

Questions and discussion topics:

- Shift in many states (e.g., CA) from a long-time AQ to GHG focus; AQ problems are largely under control. GHG is a global problem, not localized. But local issues are still important for toxics, UFPs, etc. Revitalize old models?

- We are neglecting key issues in dispersion models (e.g., source characterization) – not being looked at anymore. Need easier to use dispersion model for local (e.g., intersection analysis) accounting for key issues.

- "Use and abuse of AQ modeling," Current modeling tools don't work well within our regulatory framework? Not leading to delivery of better projects solving transportation and AQ needs.

- Would it be useful to have a "super-set" of assumptions? (Joint assumptions for future scenarios). E.g. vehicle technology mix, fuel economy, electricity generation mix. DOE uses some common assumptions, e.g., Annual Energy Outlook, internal technology targets. Energy Efficiency and Renewable Energy (EERE), Strategic Programs & Integrated Analysis office working to pull together common assumptions for DOE, also external, to provide more scenarios to work with. EPA emissions inventories also provide a starting point.

- Extensive discussion of modeling tradeoffs - accuracy vs. ease of use, etc. What to prioritize for improvement? Accuracy is a priority, but needs definition/bounds. Simple models are needed to support policy decisions, but complex models are needed to validate simple models. Risk assessment community is transitioning to model "evaluation" from "validation:" setting expectations re: what a model can do. Focus on model inputs that matter and outputs that are important. Emissions models are pretty good; higher uncertainty in dispersion models. Mining big data to bypass the traditional modeling chain (travel demand, emissions, dispersion, exposure, health impacts) and produce new modeling or analysis frameworks with more accurate results.

Session 4: Advancing ADC20 into the Future, Part 1: Issues and Research Needs

Moderator: Bob Chamberlin, RSG

Focus: Discuss research priorities and paths for new partnerships; build on Sessions 1-3.

R. Chamberlin noted some key takeways from the January 2018 committee SWOT analysis:

- Clean air going in the right direction, vehicle-miles traveled (VMT) and GHG not.

- Technology good, but not always. Consensus that new mobility will lower burden of travel and therefore encourage more travel (e.g., mobility-limited population, zero-occupancy vehicles). These trends will be offset by electrification, alternative fuels, operational benefits, data and analytics.

- Regulations: Good things happening internationally. In U.S. we still have challenges of unregulated pollutants, backsliding.

Discussion questions for four breakout groups:

- Big issues in transportation and air quality over the next five years?

- What research needs to be conducted?

- What is the unique role of ADC20/competitive advantage in supporting this research?

Breakout group discusses key issues and research needs: Susan Collins (CRC/Toyota), Rashid Shaikh (HEI), David Kall (FHWA), Chris Porter (Cambridge Systematics), Harold Brazil (Metropolitan Transportation Commission), Ann Hartell (National Cooperative Highway Research Program), Chris Frey (UNC).

Big Issues

- Priority emissions/pollutants: UFP, secondary organic aerosols (SOA), speciation, brake and tire-wear (non-exhaust pollutants) - Health effects and regulatory responses?

- Modeling and quantifying health risk and uncertainty

- Deregulation/regulatory rollbacks: define policy variables, modeling assumptions, communicate impacts

- Electrification - Adoption of new technologies, evolutionary technologies (fuel-tech, EV, etc.)

- Travel behavior trends – changes in VMT and congestion, effects of different ages and generations, disruptive technologies, impact of EV integration in rural communities

- Implications of smart transportation on land use decisions

- Spatial variability of hotspots and implications related to freight planning

- Why ozone level is not coming down with emissions levels (e.g., in California)

- What is the overall value of the conformity process? – Understanding co-benefits

- Evaluation of modeling and methodological frameworks – best practices, accuracy; uncertainty in the modeling chain

- Low cost monitoring for developing countries and disadvantaged communities

- Integration of travel demand models and emissions models

- Trucks and non-road sources

Research Needs

- Scenario analysis - Identify consistent set of policy scenarios develop tools for scenario planning, identify assumptions underlying travel behavior scenarios such as regarding electrification and travel behavior, modeling uncertainties and policy implications

- Model simplifications (pros and cons), especially for air quality dispersion models

- Develop tools for MOVES advanced level users

- International fine particulate matter emissions

- UFP and PM: health impacts, monitoring, emissions/AQ modeling

- Potential for low-cost community level air sensing, measurement, sensor deployment

- Communicating with public regarding policy impacts, benefits, and risks

- Modeling hotspots

- Atmospheric response to NOx, volatile organic compounds (VOC), ozone emissions

- Survey of conformity practices and best practices at the local level

Role of ADC 20

- Connect with other committees regarding key issues, e.g., CAV, travel behavior, electrification

- Joint subcommittees

- Workshops

- Liaison with outside organizations (through regular meetings)

- Publishing appropriate and focused research statements

- Propose research on travel trends at both national and international level

- Propose research on emissions trends

- Help develop models for UFP emissions

- Promote international version of MOVES

- Monitoring campaigns for UFP/PM measurements and speciation

- Connect research with funding sources and sponsors' needs (many represented on committee): NCHRP, AASHTO, FHWA, EPA, CRC, HEI, CARB.

Day 2 – Wednesday, August 1, 2018

Session 5: Advancing ADC20 into the Future, Part 2: Action Plan

Moderator: Doug Eisinger, Sonoma Technology, Inc. (STI)

Discussion Focus: Create action plan to maximize committee's effectiveness and impact

Breakout discussion groups focused on the most important takeaways from the meeting yesterday, important research topics, defining future directions for the committee, specific action items, and measures of success of the committee's efforts.

Most Important Takeaways from Yesterday

- Many dimensions of uncertainties in selecting research topics

- Success in ozone control

- Future mobility

- Many ideas on research needs; need to improve consensus on priorities

- Should cover more issues than just emissions modeling

- Mitigation strategies – need collaboration with other groups

- Unknown impact of administrative rollbacks, e.g., CAFE

- Sustainable communities modeling and model evaluation

- Public transportation, investing in infrastructure

- Rural communities

- Policy evaluation

- Application of artificial intelligence (AI) and big data

Doug Eisinger (STI) leads a discussion of the action plan for ADC20.

Important Research Areas

- Change in mobility options and implications for modeling and new data sources

- Future focus of committee given broader policy shift from AQ to GHG emphasis

- Behavioral impacts and unknowns

- Opportunity and need to engage with other committees

- Quantifying exposure to transportation related pollutants

- Policy implications → so-what questions?

Future Directions for ADC20

- Act as the bridge between technical research and policy/implementation

- Cross committee coordination → enhance educational opportunities, knowledge transfer

- Fit for purpose/contextual model development and implementation

- Monitor the changing landscape with new pollutants and technologies

- Attract new generation of students and researchers → arrange data hackathons, arrange interesting workshops, go to CRC, AWMA

ADC20 Action Items

- Expand offroad emissions analysis capabilities/membership to better cover non-highway modes (rail, ports, air, construction, etc.). Establish subgroup to identify research needs? Sponsor workshop? Consider as criterion when approving new members?

- International issues: Form working group to consider in more depth what we can do? Or just reach out to Developing Countries committee?

- Put out call for papers next year based on high priority issues we identified here.

- Continue/expand liaison and collaboration with other key committees. Review their relevant research needs statements to look for overlap and collaboration opportunities.

- Research needs priorities: working group or subcommittee to compile list from meeting, prioritize based on ADC20 strengths (and possible survey?); compare with existing RNS; identify new RNS to write; assign to writers; match with potential funding sources; reprioritize; distribute.

Measures of Success

- Diverse portfolio of papers submitted, addressing priority issues

- Research funded consistent with priorities

- Enhancements to models, data, and analysis to improve accuracy and usability

- Number of workshops and trainings (and participants engaged)

Session 6: Truck Activity and Emissions

Moderator: Chris Porter, Cambridge Systematics, Inc. (CS)

Speakers: Chris Porter (CS); Kanok Boriboonsomsin (University of California at Riverside); Reza Farzaneh, Texas A&M Transp. Institute (TTI)

Focus: recent findings on truck activity data, emissions modeling implications discussion.

This section included presentations on recent research to improve truck activity and emissions data for emissions modeling.

C. Porter presented findings from the nearly complete *NCHRP Project 08-101: Enhanced Truck Data Collection and Analysis for Emissions Modeling.* This project developed a guide to data sources for truck activity for MOVES inputs, with a focus on investigating emerging data sources. Using telematics data from various truck samples, starts and hoteling activity were found to have some values that differed significantly from the default parameters in MOVES, which are based on a limited sample of trucks from the late 1990s. However, different data sources investigated also showed significant disagreement. Other research on this topic has identified substantial differences in activity patterns by vocation, and therefore

Chris Porter (CS) presents on research for NCHRP to improve truck activity data inputs for MOVES.

the representativeness of any dataset needs to be considered. Consideration should be given to restructuring certain MOVES inputs in the future to align more closely to specific data items that may be available locally. Extended idling is a large part of the heavy truck emissions inventory and therefore a high priority for local data collection; start patterns have much less influence on emissions.

K. Boriboonsomsin presented a study examining variability in real-world activity patterns of heavy-duty vehicles by vocation. The study collected real-world vehicle and engine activity data from 90 trucks in California working in 19 different vocations. Inclusion or exclusion of idle trips and extended idling events has a large influence on average speeds and other activity parameters. In addition to varying by vocation, HDV activity patterns can also vary by geographic area, even for the same vocation. This variability needs to be addressed in emission inventory development.

R. Farzaneh presented on a study examining extended idling activities of heavy-duty trucks in Texas. The study developed an inventory of truck parking spaces, distribution of trucks stopped by hour and facility type; distribution of hours of idling by facility type and day of week; and idling modes (engine or auxiliary power unit). The study made use of big data (trip patterns), field observations, and a driver survey. The relationship between parking availability by type and idling by mode was used to develop a statewide, county-level inventory of idling hours. The study demonstrates how various data sources can be combined to develop locally-specific MOVES inputs on extended idling, an important driver of emissions.

Session 7: Hot Topics and Future Innovations

Moderator: David Kall, FHWA

Speakers: Alain Kornhauser, Princeton University: VMT implications of "SmartDrivingCars"; Francisco Posada, International Council on Clean Transportation (ICCT): Implications of VW and Dieselgate; Randall Guensler, Georgia Tech: Advances in Integrated Modeling

A. Kornhauser discussed that while agencies have defined multiple levels of automation, the real game-changer for VMT and emissions will be vehicles that can drive themselves. If AVs are to reduce VMT, they must be fleet operated (not personally owned) at high levels of utilization. A simulation of all trips in the U.S., assuming ride-matching with a 5 minute or less walk to a meeting point, suggests that peak hour VMT could be reduced by half, but that there is much less opportunity for off-peak VMT reduction. Fleet operation of AVs will be economically attractive for vehicle manufacturers, and will be required to achieve the scale economies necessary to reduce VMT.

F. Posada discussed ICCT's efforts to work globally with different cities and regulatory agencies to improve in-use monitoring of emissions. Tests in Europe in 2016 found that every manufacturer has some sort of defeat device – not just VW. However, regulators lack a legal or regulatory basis to enforce standards. The European Union is responding with new regulatory powers and in-service conformity provisions (meaning compliance, not "transportation conformity"). Manufacturers are also abandoning diesel vehicles, and some cities are banning them. The diesel share of the Euro market has dropped from 56% in 2012 to 45% in 2017.

R. Guensler noted that multi-resolution modeling of traffic along with integrated emissions estimators have opened new opportunities for air quality analysis. However, there are plenty of computational and methodological challenges that need to be solved before implementing such a modeling framework. Current models still need improvement; for example, they have found that AERMOD overpredicts pollutant concentrations near the source but underpredicts away from the source. He also discussed the "Commute Warrior" app they have been developing to give travelers energy and emissions feedback and help them optimize travel based on time, cost, and energy.

Conclusions

Together, the proceedings of this meeting and the SWOT analysis conducted in January 2018 provide some insights with respect to the key questions initially posed to the group.

Who is our audience?

- Our audience includes a variety of sponsors and consumers of research on transportation and air quality issues. The committee needs to think broadly to collaboratively identify research priorities, to match those research needs to targeted members of the community, and to widely disseminate research findings. For example, funding organizations in the transportation-air quality community include NCHRP, AASHTO, FHWA, EPA, CRC, HEI, CARB, and state DOTs (to name a few). Traditionally, the committee focused RNS writing efforts to attract NCHRP support. Since NCHRP has limited resources, the committee should expand its view to attract support not only from NCHRP, but from an array of funders.

How do we accomplish identifying, funding, and addressing their key needs?

- Outreach and engagement of partners to identify research and information needs expressed by specific constituencies.

- Collaborative prioritization of needs.

- Development of research needs statements addressing priority needs.

- Outreach and engagement of partners to identify funding opportunities.

- Dissemination of research findings via conference sessions, meetings, webinars, and committee website.

Are we hitting the bullseye with our research needs?

- The committee's paper review organization and selection process has led to strong presentations and papers at the annual meeting.

- The committee has done a good job generating, tracking, and funding research needs.

- The committee should increase the diversity of topics addressed by expanding expertise across transportation modes and increasing interactions with other committees.

- The connection between research paper results and practical application needs to be strengthened.

- There are a number of emerging topics where a greater research focus is needed.

How do we stay at the cutting edge and help attract funding for our research?

- Focus on emerging/future issues (e.g., UFPs, GHGs, CAVs, ride sharing) and not just continue to study traditional air quality issues.

- Continue to engage researchers and practitioners from a broad spectrum of interests (academia, government, nonprofit, and industry) to ensure that research topics are matched with funders' needs and results are oriented towards practical application.

- Attract a new generation of students and researchers through activities such as interesting workshops, data hackathons, and participation in cross-disciplinary conferences.

What should we do as a committee to continually improve our effectiveness?

- Expand committee breadth of expertise and cross committee coordination to enhance educational opportunities and improve knowledge transfer.

- Continually re-evaluate, compile, and advance priority research needs.

Members of the TRB Air Quality Committee summer meeting planning workgroup gather in the lobby of the National Academies: Doug Eisinger (STI), Bob Chamberlin (RSG), Victoria Martinez (FHWA), David Kall (FHWA), Doug Ito (CARB), Chris Porter (CS), Mike Claggett (FHWA). Contributors not pictured: Rich Baldauf (EPA), Alex Bigazzi (Univ. of British Columbia), Georges Bou-Saab (Iowa St. Univ.), Marianne Hatzopoulou (Univ. of Toronto), Razieh Nadafianshahamabadi (Univ. of New Mexico), Jenny Narvaez (NCTCOG), Scott Peterson (Boston CTPS), Greg Rowangould (Univ. of New Mexico), Shams Tanvir (N. Carolina St. Univ.), Mohammad Tayarani (Univ. of New Mexico).

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Special congratulations to two graduate students who won competitively selected scholarships to support their participation in the summer meeting: Georges Bou-Saab and Razieh Nadafianshahamabadi.

Appendix A: ADC20 TRB 2018 SWOT Analysis Report

Findings from a SWOT exercise held January 10, 2018, during the ADC20 annual meeting in Washington D.C.

ADC20 TRB 2018
SWOT Analysis Report
Prepared by: Victoria Martinez (FHWA) and Heng Wei (University of Cincinnati)
May 1, 2018

Purpose: The ADC20 Committee Leadership wanted to use the annual meeting as an opportunity to engage in some Strategic Planning. Using the Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis technique as a tool to better understand what the committee members, friends of the committee and other attendees thought about how the committee works best and where we can look for meaningful changes to make a better committee.

Organization: During the strategic planning breakout at the ADC20 committee meeting on January 10, 2018, the room was broken into three breakout groups: Environmental Agencies, Transportation Agencies, and Non-governmental Organizations (NGOs). Each group was given a leader, a note taker and a flip chart,

Group of NGOs

and asked to think about the ADC20 Committee through the "SWOT" lens to discuss our *Strengths*: what does ADC20 do really well? Our *Weaknesses*: where can ADC20 improve? *Opportunities*: where should ADC20 lead on topics, partnerships, other things? And *Threats*: what can reduce ADC20's effectiveness and how should we respond? These three groups were composed of attendees from EPA, FHWA, state DOTs, MPOs, Universities, NGOs, and consultants. A special thanks goes to the voluntary facilitators: Bob Chamberlin (RSG), Reza Farzaneh (TTI), Karin Landsberg (WSDOT), Ray Minjares (ICCT), Greg Rowangould (U.NM), and Song Bai (STI).

Strengths: **What does ADC20 do really well?**

The committee offers an opportunity to learn from others and exchange ideas, and people like that it attracts a strong, diverse representation (e.g. government, academic, private, international) with multidisciplinary expertise, with a focus on modeling and technical analysis. The committee's paper review organization and selection process leads to some of the best presentations and/or papers in the annual meeting. Additionally, the committee's ability to generate research ideas from statement submissions, and to attract funding, are seen as what the committee does well.

Weaknesses: **Where can ADC20 improve?**

The committee could be improved and strengthened by including more transportation modes and increasing interactions with other committees. Participants saw that other weaknesses were the disconnect between paper topics (e.g., focus of papers on emission modeling) and what practitioners can apply, and researchers' limited understanding of agency research needs.

Also viewed as an area of weakness by these groups was the alignment of important research topics from the annual meeting, and the transparency and connection between those topics and RFPs that later emerge (e.g., through the NCHRP process). There was feedback that the committee could increase the diversity of topics it addressed (and funded) if other travel modes were addressed and ADC20 was better connected to other committees.

Group of Environmental Agencies

Communications outside of meetings, the website, and too few opportunities to contribute or brainstorm during the TRB annual meetings and committee meetings, as well as the limited international perspective was also discussed.

Opportunities: Where should ADC20 lead on topics, partnerships, other things?

To make the most of the committee and accompanying expertise, we need to recognize that the source profiling is changing (e.g., ultra-fines) and non-exhaust tire/break wear/dust and nonroad sources are projected to become more important. It was suggested that a Taskforce on non-road emissions be formed.

Group of Transportation Agencies

These changes may require us to change models, policies, and how we interact with other committees.

We should be looking to better link research with policy goals, strategic planning and application, so we can better guide theory into practice. We should be promoting research topics that meet the DOT needs with an emphasis on interdisciplinary collaborations and cross-cutting research, including collaborations with other air quality and health communities' scientists with use of data on electric vehicles and other emerging technologies.

The makeup of the committee, and the ability to sustain it in the years to come, might benefit by attracting more health/exposure papers/research and health professionals, young professionals, graduate students, and international participants.

Communicating and disseminating information and research would be more effective if we utilized our website to periodically produce newsletters, blogs, and used social media better. It was also recommended that we blog to share ideas, archive communications, and preserve historical information for new members and friends.

Partnering with committees outside the environment arena (e.g. planning) and more involvement in joint subcommittees such as energy, travel demand, operations, and intelligent technologies, may support many of these opportunities. Liaisons to other related committees was one suggested option.

Threats: What can reduce ADC20's effectiveness and how should we respond?

While there was an increase in paper submissions, it was at the expense of topic diversity and rigor. Paper quality is an issue for the committee. We cannot be too focused on one area (e.g. modeling); yet, we continue to see a small number of specific, predictable research themes. The declining participation of key Air Quality (AQ) researchers, through retirement or migration to other topics, may be contributing to this threat.

The AQ committee needs to be poised to help our community understand upcoming AQ impacts. The committee needs to recognize and address:

- With technology advances, more information and "big data" are coming on line rapidly
- Funding availability from a more diverse selection of funders
- The need for better coordination/collaboration among stakeholders to help the community access funds efficiently
- Shifts and updates to the substance and quality of guidance and regulation
- Rapid and on-going changes in how we assess progress, such as through regulatory or statutory performance measures
- Shifts to increasingly multi-modal transportation, facilitated by technology.

Since air quality is an issue for many communities (such as energy, sustainability, environment, and transportation planning), our work may be overlapping with other committees. All of this is against a back drop of improved air quality.

Common Themes:

Summary of Top Three in Each Category of the SWOT

STRENGTHS	WEAKNESSES	OPPORTUNITES	THREATS
Active/Diverse Membership	Interaction with other Committees	Collaboration with other Committees and AQ community	Relevancy due to changes in AQ, technology, other committees
Paper Review	Communication	Communication/Social Media	Paper Quality/Weak Diversity/Rigor
Research Ideas and Funding	Applicability of Research to Practice	Link Research to Practitioner's Needs	Focus on Emissions Modeling

The three most common themes overall were:

- Too narrowly focused on on-road emissions modeling.
- Research funding and transparency need to be considered, so that we are getting research that is less theoretical and more applicable to what practitioners need.
- Communication and collaboration within the committee, with other TRB committees and other AQ groups needs to expand.

Recommendations:

- Be more specific in research proposals and calls for papers, to expand beyond emissions modeling and to support practitioners.
- Establish a liaison to improve outreach and communication with other TRB committees and AQ communities.
- Consider ways to improve dissemination of research and improve internal communication.