State of Utah
DEPARTMENT OF COMMERCE
Office of Consumer Services

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To: The Public Service Commission of Utah

From: The Office of Consumer Services

Michele Beck, Director
Béla Vastag, Utility Analyst

Date: April 23, 2021

Subject: Docket 16-035-36

In the Matter of: Rocky Mountain Power's Application to Implement Programs Authorized by the Sustainable Transportation and Energy Plan (STEP) Act

INTRODUCTION

On March 3, 2021, Rocky Mountain Power (RMP) filed a request with the Utah Public Service Commission (PSC) for approval to use $200,715 of STEP funds to sponsor a proposed Utah State University (USU) study entitled "Projecting the Impact of the Electrification of the Uinta Basin Oil and Gas Fields on Air Quality" (Uinta Basin Study). The Utah Office of Consumer Services (OCS) and the Utah Division of Public Utilities (DPU) filed initial comments on April 16, 2021 on RMP's request to fund the Uinta Basin Study. The PSC's March 16, 2021 Scheduling Order in this docket set a deadline of April 23, 2021 for parties to file reply comments. Per the PSC's ordered schedule, the Utah Office of Consumer Services (OCS) submits these reply comments.

DETERMINING THE REASONABLENESS OF USU'S PROPOSED BUDGET

In our initial comments, the OCS outlined some concerns regarding RMP's and USU's proposed budget for the Uinta Basin Study. The OCS was concerned whether the levels of cost in the proposed budget in this docket were reasonable. For example, the USU proposal in RMP's application did not provide the same level of budget detail as similar proposals USU has submitted to the Utah Division of Air Quality (UDAQ), part of the Utah Department of Environmental Quality (DEQ).

As a result of RMP's response to discovery request DPU 16.12 (see below), the OCS also became aware that UDAQ uses a competitive RFP process to determine which proposals to fund. In addition, a review of UDAQ's RFP submission requirements revealed that UDAQ prefers that no indirect costs be added to the budgets of the proposals it accepts, but if a bidder insists, UDAQ limits indirect costs to 10%.[1]

> **DPU Data Request 16.12**
> Has USU and/or SLR received, or potentially will receive grant money from any other agency for this proposed study? Please explain.
>
> **Response to DPU Data Request 16.12**
> Utah State University (USU) has submitted a funding proposal to Utah Division of Air Quality (UDAQ) with a similar goal of understanding whether the Uinta Basin is nitrogen oxide (NOx) limited. However, no decision on that submission has been made. The UDAQ award will be very competitive, with many different academic groups competing, making USU's chances for receiving this funding low. The UDAQ award announcement will be made in mid-summer 2021.

The OCS submitted to RMP a follow up discovery request based on DPU 16.12. This response was not available until after the OCS had filed its initial comments.

> **OCS Data Request 30.1**
> RMP's response to DPU 16.12 states "Utah State University (USU) has submitted a funding proposal to Utah Division of Air Quality (UDAQ) with a similar goal of understanding whether the Uinta Basin is nitrogen oxide (NOx) limited." Please provide a copy of the referenced funding proposal that USU has submitted to UDAQ. Also, if USU has submitted any other proposals, with similar goals as the proposed Uinta Basin Study in this docket, to UDAQ or to any other entities, please provide copies of those proposals also.
>
> **Response to OCS Data Request 30.1**
> Please refer to Attachment OCS 30.1 for the referenced funding proposal. Utah State University (USU) has not submitted any other proposals with similar goals to the Uinta Basin Study.

The requested funding proposal provided by RMP in OCS 30.1 is attached to these comments. The OCS notes that the budget information is missing from this proposal, despite UDAQ's RFP requirements to provide detailed budget information.[2] The missing budget information is troubling. This leaves us unable to compare the proposed costs for the Uinta Basin Study in this docket with a similar proposal submitted by USU

[1] See OCS April 16, 2021 comments, page 3 – 4.
[2] Ibid, see page 4, excerpt from UDAQ's RFP submission requirements.

to UDAQ, a proposal described in RMP's response to DPU 16.12 as having a "similar goal" as the proposed Uinta Basin Study.

The OCS had hoped that a comparison of the two proposals' budgets would provide a test of reasonableness of the proposed costs in this docket which would help ensure that ratepayer funds are spent wisely. Unfortunately, this comparison cannot be done at this time. Therefore, at a minimum, it is reasonable that the PSC should impose similar requirements as do other Utah state agencies, DEQ in this case, for these types of proposals. DEQ requires a detailed budget and limits indirect costs to 10%. Even though the proposed Uinta Basin Study appears to meet the intent of the STEP statute, the PSC should still ensure that ratepayer funds are prudently spent.

RECOMMENDATION

The OCS continues to recommend the restricted allocation of funding and the reduced budget that we detailed in our April 16, 2021 initial comments. As stated in those comments, the PSC should only approve the proposed Uinta Basin Study if the following two conditions are met:

1. Reduce the approved budget to $141,197 to eliminate excessive indirect costs, consistent with requirements imposed by other Utah state agencies in granting public funding.

2. Require funding be allocated in two phases – one half at the start of the project and the remaining one half only after USU has demonstrated that Uinta Basin ozone pollution can be significantly reduced by controlling NO_x emissions.

cc:

Jana Saba & Marie Bradshaw Durrant, Rocky Mountain Power
Chris Parker, Division of Public Utilities
Email Service List

SUMMARY INFORMATION PAGE

Project Title: NO_x Emissions in the Uinta Basin

Applicant Information

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Project period

July 1, 2021 to June 30, 2022

Consultant

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This proposal has been prepared in response to the Request for Proposals, Science for Solutions FY 2022, of the Utah Division of Air Quality. It targets the goal IV.A.4, Emissions Inventory Improvements, specifically NO_x emissions in the Uinta Basin.

SCOPE OF WORK

Abstract

This proposal has been prepared in response to the Request for Proposals, Science for Solutions FY 2022, of the Utah Division of Air Quality. It targets the goal IV.A.4, Emissions Inventory Improvements, specifically NO_x emissions in the Uinta Basin. This will represent a joint project between the Bingham Research Center at Utah State University Uinta Basin and SLR International.

Winter ozone pollution in the Uinta Basin has seen a statistically significant decline since the first measurements in 2010. [Mansfield & Lyman 2021, Atmosphere, 12, 4] The reasons for the decline are probably (1) a decrease in many industrial activities over the last decade, and (2) pollution controls that have come online, also during the last decade. However, these pollution controls, e.g., Quad-O and Quad-Oa, address VOC emissions, while several modeling, data analysis, and measurement results imply that the Uinta Basin ozone system may be NO_x-limited. This may mean that the pollution controls have had only minimal impacts and that decreases in NO_x emissions because of industrial decline have had the greater impact. Two questions, (1) whether ozone concentrations will again rise when industrial activity returns, and (2) whether controls specifically addressing NO_x emissions are needed, both hinge on this question of NO_x- vs. VOC-control.

This project will address three broad goals:

Historical characterization of NO_x sources, emissions, and concentrations over the previous decade. The Utah DAQ emissions inventories for 2014 and 2017 will be the starting point for this goal. We will also apply a fuel-based technique for estimating NO_x emissions pioneered by personnel from CIRES and NOAA [Negron et al. 2018, Environmental Science and Technology, 52, 10175-10185] and emissions estimates from permits submitted to the Bureau of Land Management (BLM). The goal will be to obtain as much temporal and spatial resolution as possible. UDOGM data on well and engine locations will aid in this development. Modeling requires emissions estimates, but ozone concentrations also correlate with precursor concentrations, so we will also construct the history of NO_x concentrations, using measurements by UDAQ and USU, and satellite NO2 column measurements.

Modeling the impact of infrastructure developments and the issue of NO_x control. The proposed Uinta Basin railway is expected to have a mixed impact on NO_x emissions. Tanker trucks will travel fewer miles, but there will probably be more of them. Many pump jacks are powered by internal combustion engines, so electrification of the oil and gas fields should produce lower NO_x emissions. We will perform modeling to examine the impacts of these two proposed infrastructure developments. Since understanding whether the Uinta Basin ozone system is under NO_x or VOC control is so important, we will also apply modeling to address this question.

Data analysis and synthesis. Statistical data analysis and synthesis will be used to quantify the correlations between NO_x emissions and concentrations, and ozone concentrations.

Basis and Rationale

Ten-year downward trend in ozone concentrations.

The data in this section are presented in full in a recently published paper, "Winter Ozone Pollution in Utah's Uinta Basin is Attenuating." [Mansfield & Lyman 2021, Atmosphere 12, 4] Figure 1 displays the annual number of ozone exceedance days that can be attributed to winter ozone in each of eleven seasons since 2010. The trend line has a statistically-significant downward slope of about four exceedances per season and trends to zero in 2021.

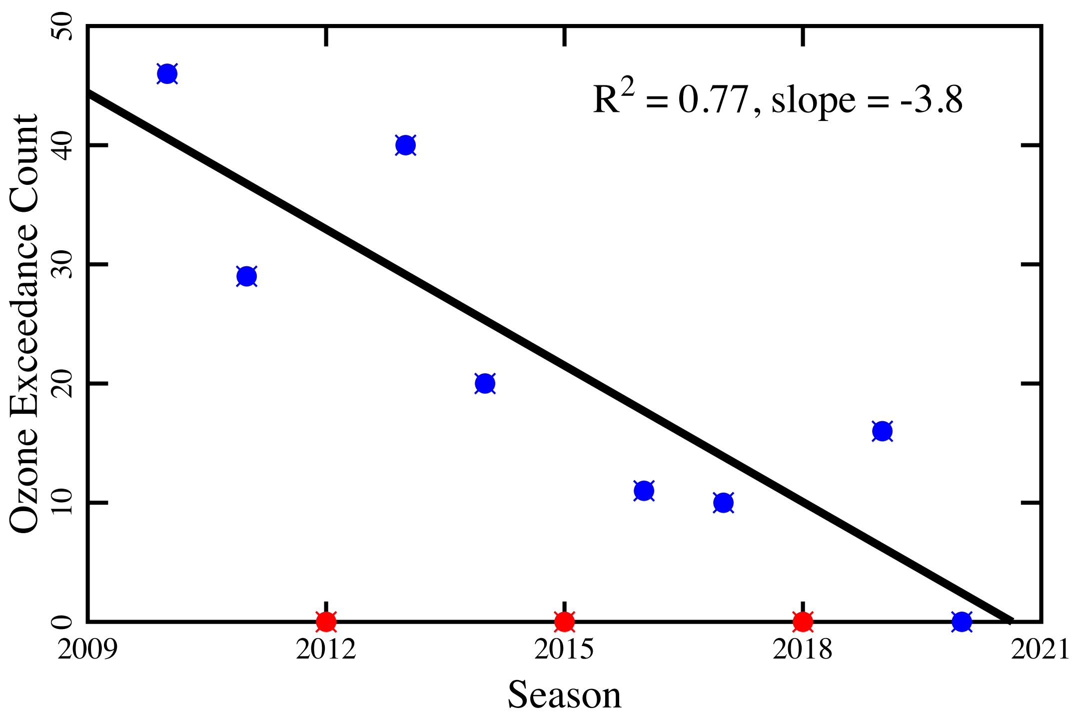

Figure 1. Number of ozone exceedance days at Ouray, Utah each winter season attributable to the winter ozone phenomenon. Blue and red indicate, respectively, seasons with and without snow cover.

Figure 2 also demonstrates a statistically significant downward trend in ozone concentrations. We took all available ozone concentration measurements from all available stations. Through linear regression, we estimated at each site and in each season the expected ozone concentration when the lapse rate is −15 K/km. This expectation value is denoted $\langle [O_3] \rangle_{-15}$. Each box-whisker construction in Figure 2 displays the values of $\langle [O_3] \rangle_{-15}$ distributed across sites in the indicated season. Two trend lines, one for seasons with snow cover and one for seasons without, have been drawn through the medians of each distribution. The upper trend line suggests a gradual decline in ozone concentration of about 3.0 ppb each season over the decade, which we have demonstrated to be statistically significant. An upward trend of about 1.8 ppb per season is displayed by the seasons without snow, but with only three such seasons, we are unable to confirm statistical significance.

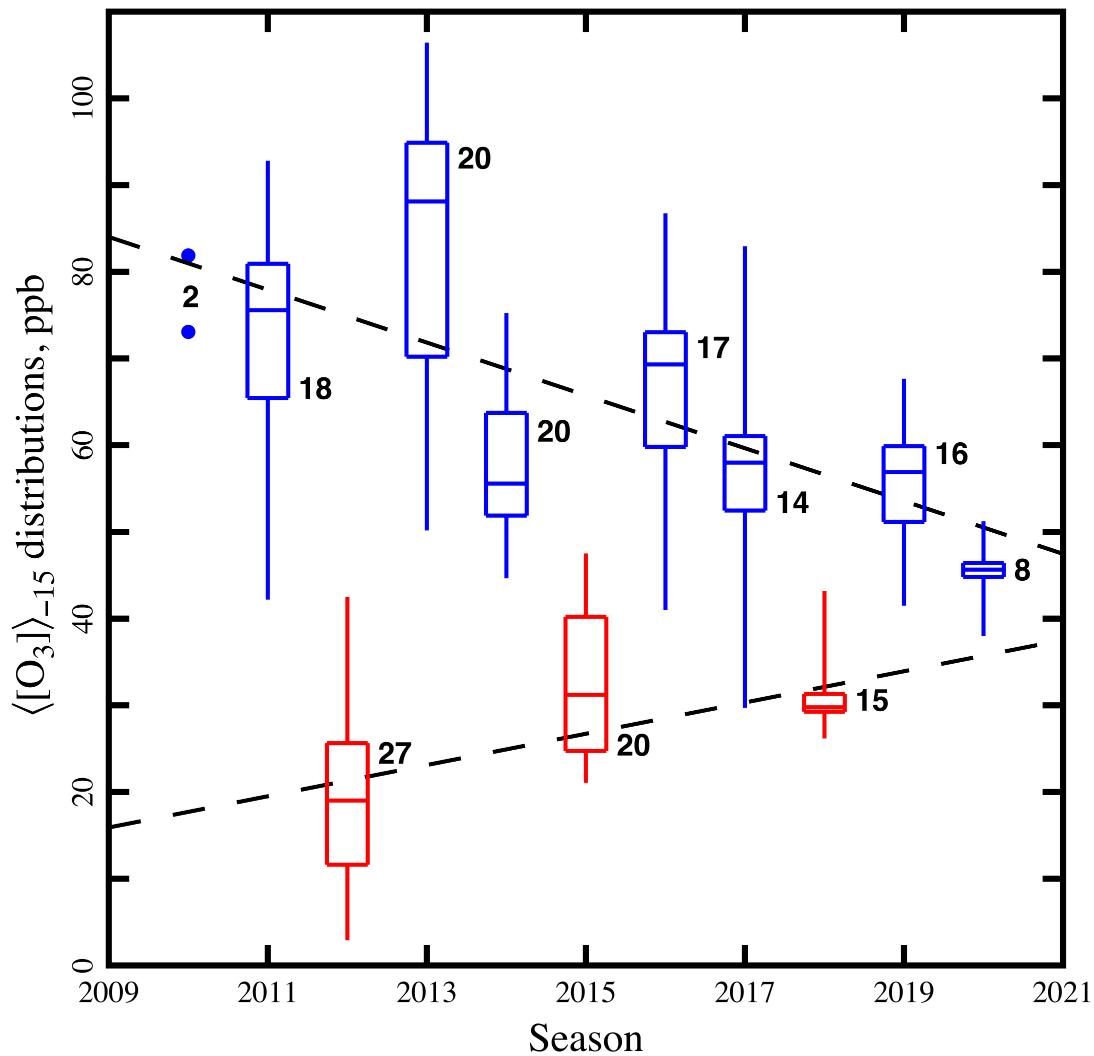

Figure 2. Box-whisker plots of the distribution of $\langle [O_3] \rangle_{-15}$ over all sites in any given season. Whiskers extend from the minimum to the maximum, boxes extend from the 25th to the 75th percentile, with medians also shown. Each box is labeled with the number of sites in any given season. With only two sites operating in 2010, a box-whisker construction was not possible. Blue and red designate seasons with and without snow, respectively. Trend lines are drawn through the medians.

Winter background ozone in the basin is about 40 ppb. With snow cover, ozone concentrations are above background. Without snow, the concentrations are below background, suggesting that NO_x titrates ozone away. We are not certain that the no-snow trend is statistically significant, but if it is, then it indicates a decrease in NO_x. Interestingly, both trend lines are converging to background values.

Trends in precursor concentrations.

Figure 3 displays trends in NO_x and VOC concentrations over the previous decade. Median NO_x concentrations show a statistically significant downward trend since 2010 at the rate of about 0.3 ppb per season. Average NO_x concentration for the period 2017-2020 is only 58% of that for 2010-2013. Total non-methane hydrocarbons (TNMHC) and ethane concentrations in Roosevelt and Horsepool fell in 2018 or 2019 to about 20-50% of their values in 2012 or 2013, but then rebounded to about 50-95% in 2020. We are unable to explain this recent increase.

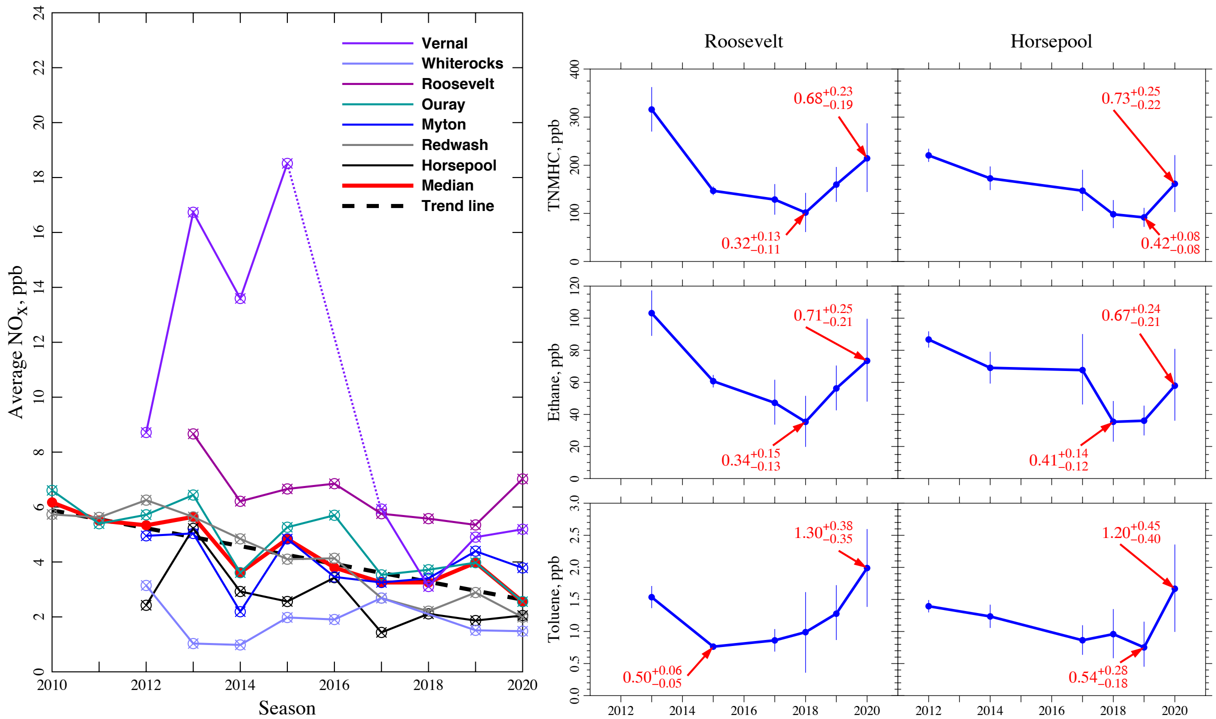

Figure 3. (a) Average wintertime NO_x concentrations at the indicated stations. The trace for Vernal shows a large discontinuity between 2015 and 2017 when the Vernal site was relocated by several km. Nevertheless, Vernal readings always exceed the median and so the discontinuity does not appear in the median. The trend line is drawn through the medians. (b) Average wintertime concentrations of TNMHC, ethane, and toluene at Roosevelt and Horsepool. Blue whiskers give the 95% bootstrap confidence intervals. Red annotations give the ratio of the average concentration in the indicated season to the season of the maximum, 2012 or 2013, along with the limits of the 95% bootstrap confidence intervals.

Is the Uinta Basin ozone system under NO_x control?

The question of NO_x vs. VOC control is often difficult to answer, and there are no completely definitive results for the Uinta Basin. However, several pieces of evidence suggest that the winter ozone system is more sensitive to NO_x than to VOC:

Analysis of existing data. Wood et al. [Atmospheric Chemistry and Physics, 9, 2499-2516, 2009] have developed an analysis technique based on O_3, NO_x, and NO_z concentrations. Results of this analysis are presented in Section 4.5 of the Bingham Center's 2018 Annual Report. [https://binghamresearch.usu.edu/files/reports/UBAQR_2018_AnnualReport.pdf] The analysis indicates a relatively strong sensitivity to NO_x. It also indicates that NO_x sensitivity increases throughout the winter: The system is more NO_x sensitive in late February and early March than it is in January or early February. The change in sensitivity is probably due to several factors, including absolute humidity, temperature, and solar angle. The analysis gives no information on VOC sensitivity, so we still cannot say anything about the relative sensitivity of the two precursor classes.

Box modeling. A box model developed by Edwards et al. [Nature, 514, 351-354 (2014)] indicates that the basin is under NO_x control, but with some sensitivity to VOC. They only modeled conditions in early February 2013, and so their work cannot confirm the early-to-late-winter trend cited in the previous paragraph.

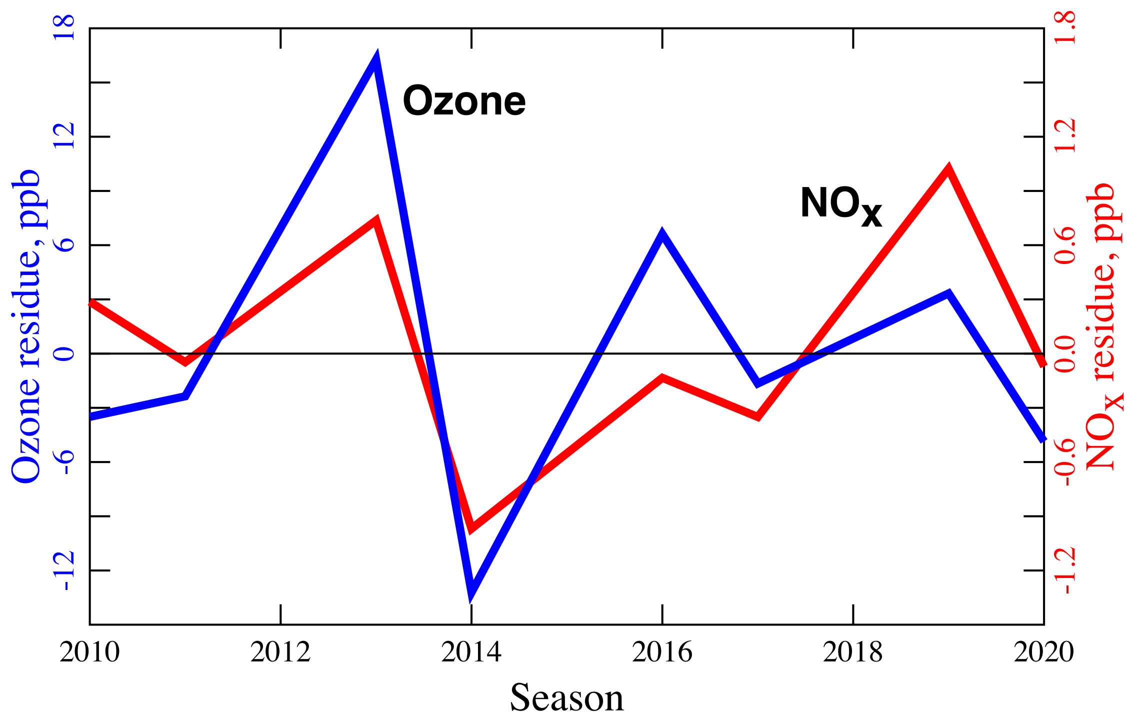

Figure 4. Plots of the residues from Figure 2 and Figure 3a. The two traces zig and zag synchronously.

Correlations between NO_x, VOC, and ozone concentrations. As seen in Figures 1 – 3, downward ozone trends are accompanied by generally downward trends in precursor concentrations. However, the NO_x-ozone correlation seems stronger because ozone concentrations failed to track the more recent upturn in VOC concentrations, and the NO_x-ozone correlation becomes even more obvious when we plot residues as in Figure 4. However, this is still not incontrovertible evidence for NO_x control, for two reasons. First, the VOC measurements only come from two sites, so it is not clear whether the VOC upturn was basin-wide or localized. Second, conditions that lead to high ozone, cold-air inversions and photochemical activity, probably also produce additional NO_x.

If the system is NO_x sensitive, then VOC controls (e.g., Quad-O and Quad-Oa) are not primarily responsible for the ozone decline. Rather, the decline must have resulted from decreases in NO_x. Two factors leading to NO_x decreases over the previous decade come to mind: First, a decrease in new-well drilling since the peak years of 2010-2013, and second, a greater proportion of oil being produced by electric pumps. The answer to the question of NO_x vs. VOC control will indicate whether we can expect ozone levels to climb to earlier levels when drilling and production activity increases and whether we can expect electrification of the oil and gas fields to mitigate these increases.

Results from the UDAQ inventories.

Figure 5 shows the results of the two UDAQ inventories for NO_x emissions. All units are tons of NO_x for the entire year. The 2017 inventory added several new emissions categories, midstream venting and State and Local Emissions Inventory System (SLEIS) point sources, but still came in about 1000 tons lower than the 2014 inventory. Presumably, if those categories had also been counted in the earlier inventory, it would have been larger than 13,400 tons. Emissions in every important category declined from 2014 to 2017. Reasons for the decline probably include

- Fewer well completions; drilling activity has decreased.
- Larger proportion of electric pump jacks.

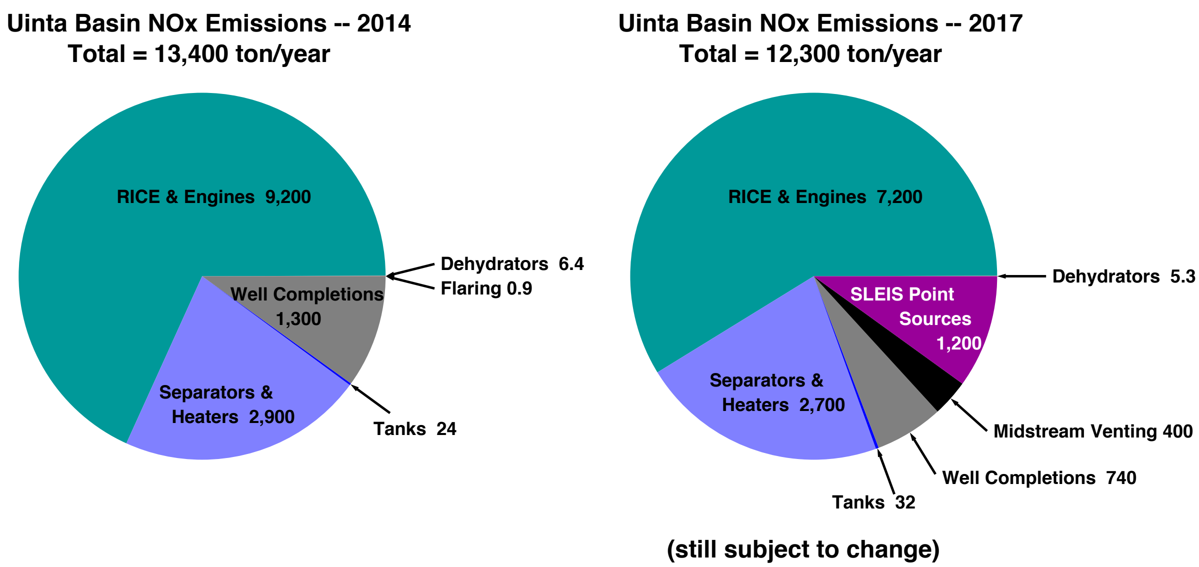

Figure 5. Results of the Utah DAQ emissions inventories for NO_x. All units are ton/year. The 2017 inventory is still open and subject to change.

The older WRAP inventories put well-completion NO_x emissions at 4,400 and 4,300 ton/year in 2006 and 2012, respectively, which if correct, indicates that the tonnage due to well completions declined drastically between 2012 and 2014.

The inventories indicate that three categories, (1) reciprocal internal combustion engines (RICE) and other engines, (2) separators and heaters, and (3) well completions, are the most significant NO_x sources.

Goals for the project.

Our project specifically targets goal IV.A.4 of the RFP, Uinta Basin NO_x emissions. Our primary objectives are to understand NO_x sources well enough to make a clearer determination of which sources should be regulated or replaced and to understand if NO_x emissions and concentrations correlate well with the ozone history. We have three main goals.

Goal A. Historical characterization of NO_x sources, emissions, and concentrations. We plan to generate as complete a picture as possible of the history of NO_x sources, concentrations, and emissions over the past decade with as much temporal and spatial resolution as possible. The starting point will be the 2014 and 2017 Utah DAQ inventories. Other techniques for determining or estimating NO_x emissions and concentrations, summarized below, will be applied in this project. The focus will be on the source categories that dominate in Figure 5. This effort will also let us further test the hypothesis that the Basin is under NO_x control.

Goal B. Modeling impacts of infrastructure development and questions of NO_x vs. VOC control. Two infrastructure developments, the proposed Uinta Basin railway and the possibility that the oil and gas fields may eventually be electrified, are expected to have an impact on air quality in the Basin. With the railway, tanker trucks carrying crude oil will travel fewer miles, but with access to new markets, oil production is expected to increase. Electrification would permit replacement of internal-combustion pumps with electric pumps, minimizing NO_x emissions. Source apportionment techniques with photochemical grid models using inputs from Goal A will be applied to accomplish this. The results of these calculations will be very helpful in guiding the regulatory decision process. As mentioned above, the balance between NO_x and VOC control may determine whether ozone levels return to the highs seen in the early 2010's. Goal A will provide one avenue to test this, but we will also perform modeling and data analysis to further examine this question.

Goal C. Data analysis and synthesis; preparation of deliverables. The final stage of research will involve analysis of the results provided by Goals A and B, and then the preparation of reports and other deliverables.

By providing further information and data about NO_x emissions, this project will address UDAQ's goal of improving NO_x emissions inventories. Additional development of the Negron method for fuel-based NO_x inventories [Negron et al. 2018, Environmental Science and Technology, 52, 10175-10185] will provide a secondary technique for truthing the standard bottom-up inventories.

The work will promote regulatory applications in at least three ways: A better understanding, first, of the NO_x- vs. VOC-control issue, second, of the relative contributions of different NO_x sources, and third, the anticipated impact of the Uinta Basin Railway and of electrification of pumping. These results will allow agencies such as UDAQ to plan effective regulatory efforts, to focus regulatory efforts on sources having larger impacts, and provide benefits reportable to the State Legislature.

Technical Approach

Goal A. Historical characterization of NO_x sources, emissions, and concentrations.

In those tasks involving construction of historical databases of concentrations or emissions, we will seek to obtain as much temporal and spatial resolution as possible. Goal A has been divided into three tasks, and Goals B and C into two each.

Task A1. Pad-by-pad reconstruction of the history of NO_x sources. Well completions (new drilling and completions) are a source of NO_x primarily from the engines used to drill and frac wells. We will develop a historical database reporting the date, location, and depth of each completion, and develop information on the engine type and fuel type used. Historical numbers and types of heaters and separators will also be tabulated. Utah Division of Oil Gas and Mining (UDOGM) maintains detailed records of the timing and location of all drilling events, as well as historical well depth and production data. We can estimate the power output by any pump jack from the number of barrels lifted from a given depth, which in turn will correlate with the NO_x emission. We will use information from State of Utah emission inventories in conjunction with DOGM well location information to determine which wells appear to operate pumping units using electric powered pumps. We will supplement information on electric powered pumps, as opposed to engine powered pumps, by gathering information from the electric power providers and from operators. An objective approach will be developed to fill in any missing information. These may include representative stack parameters, average drilling/completion times by well type or formation. We will develop a historical database reporting these data. Task A1 will be completed primarily by SLR personnel with some assistance from USU as well.

Task A2. Pad-by-pad history of NO_x emissions. Using appropriate emissions factors, the historical data obtained from Task A1 will be used to generate a picture of NO_x emissions over the past decade with as much temporal and spatial resolution as possible. NO_x emissions estimates from new well permits submitted to BLM will also be accessed. As a check on the results, a fuel-based calculation of NO_x emissions pioneered by personnel from CIRES and NOAA [Negron et al. 2018, Environmental Science and Technology, 52, 10175-10185] will also be performed. The monthly production data will also allow us to estimate the number of oil tanker trucks on the highway and the distance they travel. We will develop a historical database reporting all these data. Task A2 will be the responsibility of the USU group with assistance from SLR.

Task A3. Reconstruction of the history of NO_x concentrations. Modeling ozone concentrations requires data on NO_x emissions. But understanding NO_x concentrations is also important: Ozone concentrations are correlated with NO_x concentrations, and an ability to predict NO_x as well as ozone concentrations is a useful test of the modeling framework. Direct measurements of NO_x concentrations obtained either by USU or UDAQ exist over most of the decade; Figure 3a was compiled using those measurements. Total satellite NO2 column data are also available for more recent years. Most NO_x remains near the surface, and under daylight conditions, NO concentrations are related to NO2 via the "photostationary state equation," [J.H. Seinfeld & S.N. Pandis, Atmospheric Chemistry and Physics, 2nd ed., 2006, Section 6.5.2] Therefore, we will combine the direct measurements along with the satellite data to generate a historical database reporting surface concentrations of NO_x. This task will be directed by the USU group with support from SLR.

Goal B: Modeling to determine the impact of infrastructure development and to address the question of NO_x control.

Modelers at USU's Bingham Research Center have recently developed several techniques in photochemical 3D grid modeling that have produced much improved prediction of winter ozone concentrations in the Uinta Basin. This modeling platform will be used to determine winter ozone concentrations using the refined NO_x inventory described in Tasks A1 and A2. It is proposed that the only difference in prior modeling will be the revised NO_x inventory for the modeling period (2013). A future year scenario, described in Task B1, will be run to determine future winter ozone concentrations should the noted infrastructure developments occur. The future year winter ozone concentrations would be compared to the baseline winter ozone concentrations based on the revised NO_x inventory.

Task B1. Source apportionment modeling of the impacts of infrastructure developments. As mentioned above, two anticipated infrastructure developments, the Uinta Basin Railway and electrification of the oil and gas fields, will have an impact on NO_x emissions in the basin. Source apportionment techniques with photochemical grid models using inputs from Goal A will be applied to estimate the impacts of these developments on NO_x emissions and ozone and NO_x concentrations. Personnel at USU and SLR will both contribute to Task B1.

Task B2. Modeling to address questions of NO_x control. Atmospheric scientists often dismiss the usefulness of box models, but they have their strengths, especially a much faster execution time compared to 3D grid models. The 3D grid models are just arrays of box models designed to transfer matter and energy among themselves. Box models use the same time-integration kernel, KPP, as the 3D grid models. They are appropriate models for smog chambers. Most of the current understanding about NO_x and VOC control was first developed using them. Because they execute so rapidly, we will use them to test many different input scenarios and uncover the most important trends about NO_x and VOC control in the Uinta Basin, including the seasonality aspect found, as explained above, with the Wood analysis. [Atmospheric Chemistry and Physics, 9, 2499-2516, 2009] Results of the most interesting box models will then be tested by 3D grid models. Personnel at USU will perform this task.

Goal C. Data analysis and synthesis; preparation of deliverables.

Task C1. Data analysis and synthesis. An important task will be to analyze and synthesize the data generated in the previous tasks. We will look for temporal and spatial correlations between NO_x emissions, NO_x concentrations, and ozone concentrations, including gathering more evidence on the question of NO_x control. We will carefully analyze all modeling results. The data will also be used to estimate the impacts of different source categories. The PI has considerable experience in statistical data analysis, including calculating student-t and bootstrap confidence intervals, multivariate linear and non-linear regression (including spline and random forest techniques), correlation analysis, Kolmogorov-Smirnov testing, and cross-validation. In a study such as this, it is difficult to predict the statistical methods that will be used to analyze the data before the data are actually in hand, but these and other methods in the PI's toolkit are expected to be useful. I believe one defect of the typical emissions inventories is that they do not include confidence intervals or error estimates. Although I also appreciate that these may be very difficult to determine, efforts will be made to determine them at every level of data analysis in this project. Task C1 will be the responsibility of the USU group.

Task C2. Preparation of reports and other deliverables. See below for a list of deliverables. Responsibility for deliverables will lie with the group responsible for the associated tasks.

Expected Outputs and Outcomes

Outputs and outcomes expected from this project are:

- Improved well-completion emissions factors for NO_x;
- Detailed historical data on NO_x emissions and concentrations;
- Uncovering possible correlations between NO_x and ozone concentrations and emissions;
- Predictions about the impacts of the Uinta Basin Railway and electrification of the oil and gas fields;
- A better understanding of whether the basin ozone system is under NO_x or VOC control.

Results will be evaluated based on our success on each of the five bullets listed above.

Deliverables

Deliverables will include three quarterly and one final report; model and data sharing; presentation of results at the Science for Solutions conference, March 2022; and eventually, peer-reviewed publications. All the databases mentioned in the Technical Approach section above will also be delivered; these will all be prepared as Excel spreadsheets and included as part of the data sharing.

Reports. The quarterly and final reports will describe completely our accomplishments in each of the tasks.

Model and data sharing. Our philosophy is that reports, models, databases, etc., need to be designed transparently, so that others can use our work, run our models, understand our procedures, examine the details of calculations, etc. All forms of digital data, including spreadsheets, computer codes, modeling implementation, final databases, etc., will be made publicly available on Utah State University's box drive and on Google Drive. The final report will include metadata on the digital data, describing each file and providing links.

Deliverables.
1. Task A1 (SLR): Spreadsheet(s) of historical NO_x sources at well pads
2. Task A2 (USU): NO_x emissions from standard emission factors
3. Task A2 (USU): NO_x emissions from fuel-based calculations
4. Task A2 (SLR): SMOKE output files for Deliverable 2 or 3
5. Task A3 (USU): Historical database of surface NO_x concentrations
6. Task B1 (USU): NO_x emissions for future year infrastructure scenario
7. Task B1 (SLR): SMOKE output files for future year infrastructure scenario
8. Task B1 (USU): Source apportioned results for base year and future year scenario, modeling implementation
9. Task B2 (USU): Results of box and 3D grid modeling of NO_x vs. VOC control, modeling implementation
10. Task C1 (USU): Results of data analysis and synthesis, including computer codes
11. (USU & SLR): Q1 report
12. (USU & SLR): Q2 report
13. (USU & SLR): Q3 report
14. (USU & SLR): Final report
15. (USU): Presentation of results at the March 2022 Science for Solutions conference
16. (USU): Peer-reviewed publication(s)

Schedule

We have planned about six months for most tasks, with staggered starts.

TASK	MONTH											
	1	2	3	4	5	6	7	8	9	10	11	12
A1. History of NO_x sources	■	■	■	■	■	■						
A2. History of NO_x emissions				■	■	■	■	■	■			
A3. History of NO_x concentrations		■	■	■	■	■	■					
B1. Infrastructure modeling					■	■	■	■	■	■		
B2. NO_x control modeling					■	■	■	■	■	■		
C1. Data analysis						■	■	■	■	■	■	
C2. Preparing reports and deliverables			■			■			■		■	■

PERSONNEL ROLES AND RESPONSIBILITIES

Marc Mansfield, Ph.D., Research Professor, USU, has experience as a physical chemist and with statistical analysis, including statistical analysis of air quality and air emissions data. He will serve as Principal Investigator on the project; will contribute to data analysis, acquisition, and interpretation; box modeling; and report writing.

Liji David, Ph.D., Senior Researcher, USU, has experience with chemical-transport modeling including ozone and $PM_{2.5}$; managing, interpreting, and curating large datasets and field data; satellite-data retrieval; and field campaigns. She will perform 3D grid modeling; data analysis, acquisition, and interpretation; and report writing.

Seth Lyman, Ph.D., Director of the Bingham Research Center and Associate Research Professor, USU, has experience in air quality measurements and analysis. He will contribute to data analysis, report writing, deliverable development, and database curation.

Robert Hammer, Project Manager, SLR, has many years' experience in environmental issues related to the oil and gas industry, both with operators and as a consultant. He will act as project manager over the SLR team and contribute to building the NO_x source historical database.

Jason Reed, CCM, Air Quality Modeling Team Leader, SLR, has extensive experience in all aspects of air quality modeling for the oil and gas industry. He will also assist in developing the NO_x source historical database and direct the SMOKE analysis and 3D grid modeling work.

Xin Qiu, Ph.D., ACM, EP, P. Met, Principal, Technical Director, Climate Change and Air Quality, SLR, oversees air quality modeling at SLR's Ontario, CN facility. He will also assist in developing the NO_x source historical database and direct SMOKE analysis and 3D grid modeling.

ROCKY MOUNTAIN POWER
A DIVISION OF PACIFICORP

1407 West North Temple
Salt Lake City, Utah 84116

January 22, 2021

Dear Science for Solutions Selection Committee:

PacifiCorp is writing this letter in support of the proposal, "NO_X Emissions in the Uinta Basin," being submitted by Utah State University with Marc Mansfield as the Principal Investigator. PacifiCorp is very interested in the outcome of the project, especially in USU's plans to study how electrification of the oil and gas fields in the Uinta Basin might contribute to improvements in regional air quality.

PacifiCorp plans to cooperate with the project through sharing of non-sensitive data, and we hope that the Utah Division of Air Quality will see fit to fund the project.

Sincerely,

Craig Eller

Craig Eller
V.P. Business Policy & Development