



# Stakeholder Survey Results to Revise the Climate Action Reserve's Nitrogen Management Project Protocol (NMPP)

March 7, 2017

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The Climate Action Reserve's Nitrogen Management Project Protocol (NMPP) was first adopted in June 2012, following two years of policy research and protocol scoping, and a year-long stakeholder-driven protocol development process. The Climate Action Reserve (Reserve) released the current version of the protocol (Version 1.1) in January 2013, making a number of usability improvements. However, to date, no projects have been registered using the NMPP and, as such, the Reserve has continued to explore further revisions, improvements, and expansions.

With the generous support of the U.S. Department of Agriculture, Natural Resources Conservation Service, under the Conservation Innovation Grant (CIG) program,<sup>1</sup> the Reserve is launching a significant NMPP revision and expansion in 2017. As a first step, in late 2016, the Reserve sought and received feedback from stakeholders, via a survey, on recommendations for the future expansion of the NMPP. Survey participants included project developers and aggregators, agricultural science professionals, government employees, members of the NMPP's Science Advisory Committee, workgroup members, methodology developers, and other interested stakeholders. Below is a summary of the results.

## Future Expansions

While the NMPP is currently applicable only to nitrogen rate (N-rate) reductions on corn crops in the North Central Region (i.e., the Midwest), the protocol was developed with the intention to be expanded in a modular fashion, adding new quantification methodologies for new regions, crops, and practices. As such, this survey asked stakeholders which regions, crops, and nutrient management practices they felt were the highest priority for inclusion in the Reserve's next update of the NMPP. The survey allowed participants to select ALL answers they considered high priority and encouraged participants to provide explanations for their choices.

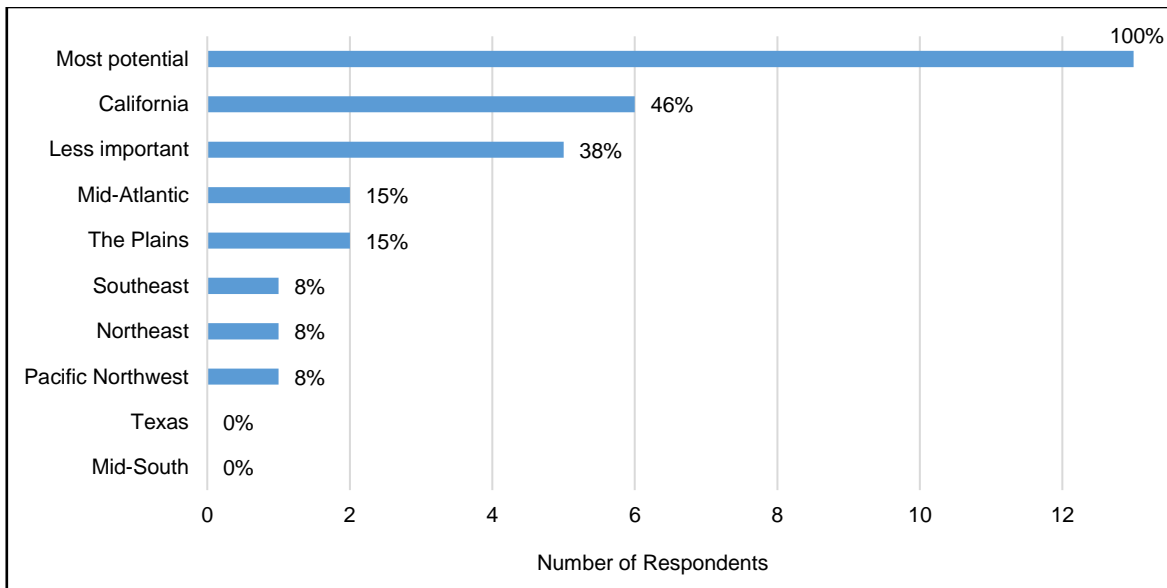
## Regions

All respondents agreed that the Reserve should expand to regions based on where there is the most potential for emission reductions (see **Figure 1**), but provided no suggestions as to where in particular that might be. However, nearly 50 percent of participants did recommend that California be included in the next protocol revision. According to their comments, it is critical for California to be included in the NMPP if the protocol is to be considered for the California compliance program. Commenters emphasized that the California Air Resources Board (ARB) is highly unlikely to adopt the protocol if it lacks any applicability in California, and therefore strongly recommended that California's incorporation into the protocol should be of high priority for the Reserve. Survey participants also highlighted the availability of new data for California and suggested they should be reviewed in greater detail by the Reserve.

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<sup>1</sup> This work is a part of the Nitrogen Management CIG led by Environmental Defense Fund (EDF), grant number 69-3A75-16-016.

Expansions to other regions were either viewed as low or no priority, with the Plains and Mid-Atlantic receiving recommendations for inclusion from just 15 percent of participants, the Northeast, Southeast, Pacific Northwest from less than 10 percent, and expansions to Texas and the Mid-South receiving no recommendations. Furthermore, roughly 40 percent of all respondents felt that “region” is less important than “crops” and “practices”, maintaining that “region” is only important to the extent that climate and soil texture may vary between regions. Throughout the survey, the Midwest was also included to provide an opportunity for stakeholder feedback; encouragingly, the Reserve’s focus to-date in the Midwest was not challenged.



**Figure 1.** Survey Results – Regions to Prioritize for Inclusion in the NMPP Revision

Note: Survey participants could select more than one answer. “Most potential” refers to expanding to regions based on where there is the most potential for emission reductions. “Less important” refers to “regions” being considered less important than “crops” and “practices”.

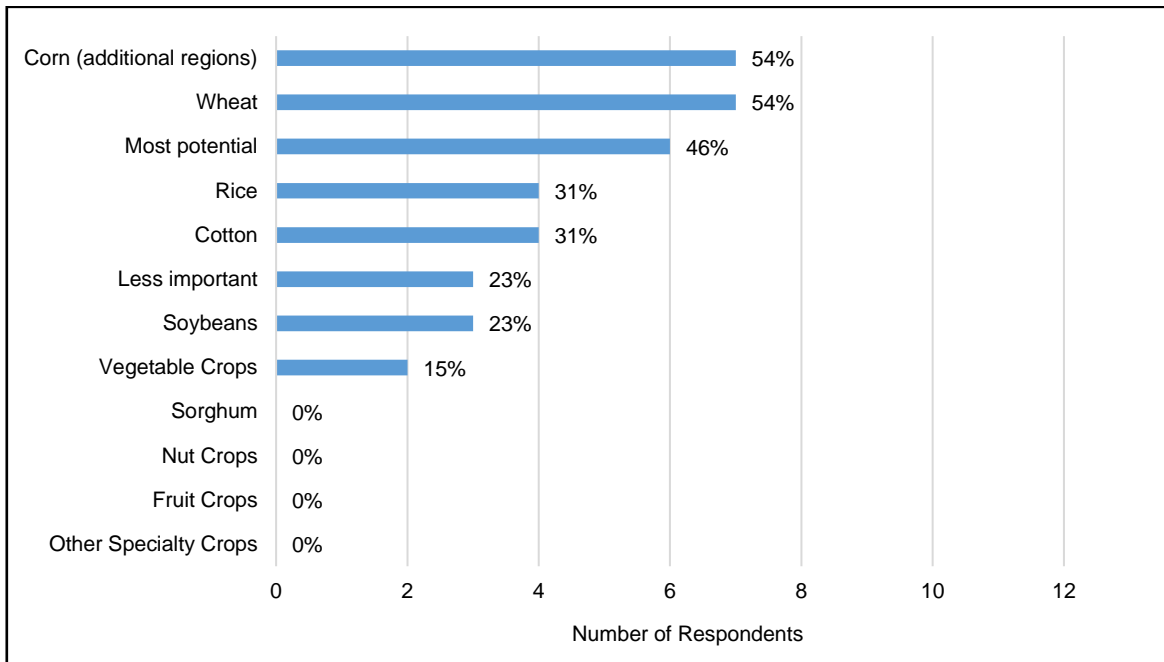
## Crops

Out of the list of crops provided to participants, corn (its expansion to additional regions) and wheat tied for most recommended, being deemed high priority by more than 50 percent of all respondents (see **Figure 2**). Over 30 percent of all respondents also suggested including cotton and rice in the revision of the NMPP. However, it is the Reserve’s opinion that nitrous oxide (N<sub>2</sub>O) emission reductions associated with rice would be better addressed in an update to the ARB’s Rice Cultivation Projects Compliance Offset Protocol.<sup>2</sup> Nearly 25 percent of all participants recommended including soybeans as well, but commenters noted emissions from soybeans seem relatively low, and suggested it

<sup>2</sup> ARB’s Rice Cultivation Projects Compliance Offset Protocol (COP) quantifies greenhouse gas (GHG) emission reductions, particularly methane emission reductions, associated with changes in rice cultivation practices. Under the current protocol, growers who use approved methods for dry seeding, drainage practices, and wetting and drying receive credits based on avoided emissions of methane. The biogeochemical model used for quantification in the protocol, DNDC, is capable of accounting for N<sub>2</sub>O emission reductions as well, once there is sufficient emissions data to calibrate and validate the model for N<sub>2</sub>O emissions. The Reserve believes that ARB could consider an expansion to the COP at that time.

might be best to target the inclusion of soybeans in crop rotations instead.<sup>3</sup> Vegetable crops were recommended for inclusion by roughly 15 percent of all respondents, but no specific vegetables were indicated and commenters acknowledged data availability may be an issue. The remaining crops listed in the survey – sorghum, fruit crops, nut crops, and “other specialty crops” – were not specifically recommended for inclusion by any survey respondent, except for one commenter, who noted there may be a significant contribution of indirect emissions associated with the high N inputs in almonds in California. Another stakeholder inquired about the incorporation of N<sub>2</sub>O emissions specifically from grasslands on dairy farms; however, they are not under consideration for inclusion in the expansion of the NMPP at this time.

Similar to the survey responses on regional preferences, a substantial amount of stakeholders (although less than half) reasoned that the Reserve should expand based on which crops have the most potential for emission reductions. Furthermore, roughly 25 percent of stakeholders felt that “crop” is less important than “regions” and “practices”. Per the comments, focusing too much on “crop” is not a good idea as emissions are more closely associated with systems and rotations than individual crops, as discussed above in the context of soybeans.



**Figure 2.** Survey Results – Crops to Prioritize for Inclusion in the NMPP Revision

Note: Survey participants could select more than one answer. “Most potential” refers to including crops that have the most potential for emission reductions (i.e., the most acreage). “Less important” refers to “crop” being considered less important than “regions” and “practices”.

<sup>3</sup> The Reserve acknowledges that a movement from monoculture systems to multi-year crop rotations has significant potential for emission reductions, as well as significant ancillary environmental co-benefits. However, it is important to note that changes to crop rotations (as a project activity) bring numerous additional challenges associated with temporal and spatial variation, most notably as it pertains to the establishment of a reasonable baseline and the potential for activity-shifting leakage when less of a given crop is grown to allow for the move from monoculture to a rotation.

## Nutrient Management Practices

The nutrient management practice options given in the survey included N-rate reduction (for additional crops and regions than in the current NMPP), the 4R's (right source, right rate, right time, right place), cover crops, manure management, the use of enhanced efficiency fertilizers (EEFs), and precision agriculture. The survey responses varied widely, and the Reserve received significant feedback on all options.

The 4R's yielded the largest positive response, and as a project activity it was perceived as high priority by more than 50 percent of the respondents (see **Figure 3**).<sup>4</sup> Commenters indicated that while rate is important, various scientific research published within the last few years has suggested that source, timing, and placement may play a larger role in reducing N<sub>2</sub>O emissions, and therefore should be included in the expansion of the NMPP. The use of EEFs (e.g., nitrification or urease inhibitors, extended release) received a similar response to that of the 4R's and was considered high priority by close to 50 percent of the survey participants. Survey comments noted there is a fair amount of evidence that EEFs can reduce N<sub>2</sub>O emissions and that there is a large amount of data available,<sup>5</sup> especially for corn and regions such as Colorado and Minnesota.<sup>6</sup> Nearly 50 percent of respondents also considered N-rate reduction (for additional crops and regions than in the current NMPP) to be of high priority. Survey participants commented that extending the work already done on the protocol should be prioritized as it was challenging enough to get to where we are now and remains challenging to perfect. Still, other respondents suggested that as no farmers have signed on to the Reserve's NMPP to date, it may be more serviceable to focus on other practices, such as the others covered in this survey.

The remaining nutrient management practices – precision agriculture, cover crops, and manure management – each gained recognition from 30-40 percent of respondents, but commenters expressed reservations. With precision agriculture, stakeholders acknowledged that the associated emission reductions may already be accounted for as a function of the N-rate reduction practice of the current NMPP, questioned data availability, and stressed the importance of capturing spatial heterogeneity. With cover crops, they noted that the full effects on N<sub>2</sub>O emissions remain inconclusive and recognized the additional challenge of distinguishing between different types of cover crops. In regards to manure management, stakeholders admitted the difficulty in determining N<sub>2</sub>O emissions resulting strictly from manure when both varying amounts of manure and synthetic fertilizer are applied.

Lastly, in addition to the specific nutrient management practices addressed in the survey, a couple of considerations reappeared in multiple comments from stakeholders and thus garner acknowledgement from the Reserve. One recurring suggestion for future NMPP expansions was to capture the various nutrient management practices' effects on indirect

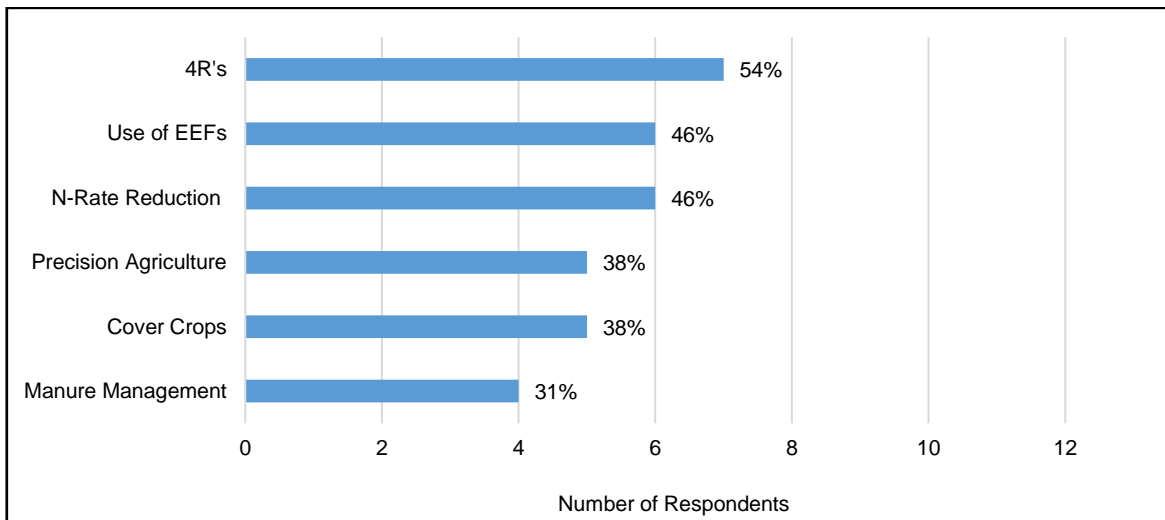
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<sup>4</sup> It should also be noted that one stakeholder suggested that precision agriculture is represented within the 4R's, further reinforcing the inclusion of the 4R's in the NMPP expansion as high priority.

<sup>5</sup> The Reserve acknowledges that the use of EEFs has significant potential to reduce N<sub>2</sub>O emissions, yet has some reservations as to whether their impacts translate universally across all regions. The Reserve will review the available data to assess the effects of EEFs on N<sub>2</sub>O emissions from one region to another and to determine their applicability in the NMPP expansion.

<sup>6</sup> Notably, the Reserve explored using some of the Colorado data noted by survey respondents to expand the protocol in 2013. At that time, the Reserve did not move forward with developing a Tier 2 methodology based on that data, as it failed to meet Reserve criteria in one critical area: replication of the study in other study sites. The Reserve will review these data and any updates, particularly as they pertain to EEFs.

N<sub>2</sub>O emissions in addition to direct N<sub>2</sub>O emissions.<sup>7</sup> Another common recommendation from stakeholders' comments was to incorporate a combination of practices and assess their combined impacts on N<sub>2</sub>O emission reductions.



**Figure 3.** Survey Results – Nutrient Management Practices to Prioritize for Inclusion in the NMPP Revision

Note: Survey participants could select more than one answer.

## Methodology Options

The NMPP currently uses a modified version of the MSU-EPRI empirical emission factor-based Tier 2 methodology for N-rate reductions, which is based off data from field trials in Michigan and extrapolated across the North Central Region. The NMPP, however, was developed with the intention that it be expanded in a modular fashion, adding new quantification methodologies for new regions, crops, and practices as sufficient data become available. Both Tier 2 and Tier 3 methodologies require significant empirical data from field trials to develop, calibrate, and validate for a given crop, region, and practice combination, which has been a challenge for both methodological options. Therefore, the Reserve asked its stakeholders, if given the choice, which type(s) of module(s) they would prefer the NMPP to include as a quantification methodology (e.g., Tier 2, Tier 3, etc.).

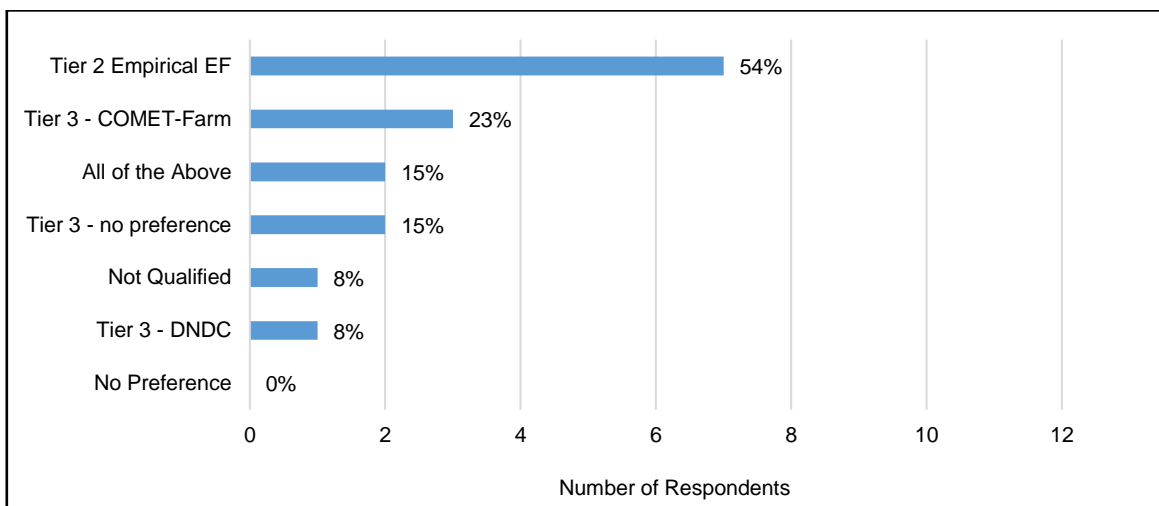
In this instance, the results of the survey were clear (see **Figure 4**). The majority of stakeholders overwhelmingly felt that Tier 2 empirical emission factor-based methodology modules should be prioritized by the Reserve above all other options. This choice was selected by more than 50 percent of the respondents, which greatly exceeded the responses to all other options. Commenters noted that Tier 2 modules are simpler and easier to implement than their more unwieldy Tier 3 counterparts. They further argued that

<sup>7</sup> It is unclear from the comments whether the stakeholders were referring to upstream indirect emissions (i.e., potential reductions from avoided fertilizer production) or off-site downstream indirect emissions (i.e., associated with leaching and volatilization). Indirect emissions associated with leaching, volatilization, and runoff are already accounted for in the current version of the NMPP and can be expected to be accounted for in future expansions of the NMPP that incorporate additional nutrient management practices. However, the Reserve recognizes that this is a source, sink and reservoir (SSR) associated with high uncertainty and accounting for that SSR can/should continue to be improved. Indirect emissions associated with upstream activities such as reduced fertilizer production are outside of the project's GHG assessment boundary, however, and will not be included in future expansions.

the simpler the approach, the greater the likelihood of participation at the farm level and the better the chance of a project developer making a viable business case for investing in this type of project. Survey comments also dismissed the notion of using complicated and time-consuming Tier 3 biogeochemical process models for the perceived idea of enhanced precision, when they could use simple-to-apply emission factors (EFs) combined with conservative risk adjustments that can be decreased over time as information on the performance and accuracy of the protocols increase. One stakeholder noted though, that any newly developed Tier 2 modules must be able to address more than just rate reductions.

However, new Tier 3 methodology modules did receive some attention from stakeholders, with roughly 25 percent of survey participants suggesting to include using COMET-Farm, in particular, in the NMPP expansion. Commenters recognized that a lot of effort is being put into calibrating the COMET-Farm model for the whole United States and thus felt it may be an increasingly reliable option. It was further suggested by the respondents for the Reserve to investigate which management practices can be simulated by COMET-Farm, and to consider developing an emission factor approach for those that cannot. They continued in saying that it would be useful to compute EFs with output from COMET-Farm for a certain region and crop and use these region/crop/management-specific EFs in the protocol. Several other comments further reinforced the idea of developing a Tier 2 and Tier 3 combination approach, so long as it would be supported by the underlying science. Still, others recommended the Reserve consider developing a Tier 3 quantification methodology only in addition to Tier 2 methodologies, and suggested that if the Reserve were to select a Tier 3 approach, it should not choose a specific software tool (e.g., DNDC, DAYCENT, COMET-Farm) to be used, but rather provide an approach for any scientifically-valid and appropriate software tool to be approved for this purpose.

Nonetheless, one stakeholder expressed doubts with Tier 2 and Tier 3 methods, claiming they both have issues due to data limitations. The commenter further explained that having limited sets of field data makes it challenging to accurately extrapolate Tier 2 modules to other regions and challenging to calibrate and validate Tier 3 modules.



**Figure 4.** Survey Results – Preferred Quantification Methodologies to Include in the NMPP Revision

Note: Survey participants could select more than one answer.



## Conclusion

The Reserve is grateful to all participating stakeholders for taking the time to complete the NMPP survey and provide their feedback. The results have been thoroughly reviewed, and the Reserve highly values the insights and recommendations offered in the comments section. Based on available resources, time, and data, the Reserve will now focus on those high priority recommendations that are feasible and manageable in the near term. While all the comments discussed above will help inform the direction of the revision and expansion of the NMPP, the Reserve's biggest takeaways from this stakeholder engagement exercise are as follows:

- **California needs to be a priority for inclusion.** The Reserve will prioritize making the protocol applicable for use in California. This should be possible due to a number of recently completed studies, and will hopefully make this protocol more attractive for any future consideration by ARB.
- **Maintain flexibility when prioritizing crops for inclusion.** It is clear that specific crop choices should not be of particular focus in the protocol expansion. Rather, the Reserve will decide which crops to include in the NMPP revision based on the availability of data and the capabilities of the regions, nutrient management practices, and quantification methodologies under consideration. At the very least, this will include evaluating the major field crops with the most acreage across the United States, specialty crops specific to California, and those crops for which quantification methodologies have been calibrated and validated. Additionally, the inclusion of multi-year crop rotations will also be reexamined.
- **N-Rate, 4R's, and EEFs seem to be the priority practices for inclusion.** At this time, N-rate reduction remains the only nitrogen management practice with the consensus to reduce N<sub>2</sub>O emissions consistently in all geographies. However, the Reserve recognizes that the body of scientific literature focused on how different N sources, N placement, N timing, and EEFs can influence N<sub>2</sub>O emissions continues to grow. Therefore, at minimum, the Reserve will attempt to include additional regions and crops with a methodology for N-rate reductions, but will prioritize inclusion of the 4R's and EEFs as well, assuming sufficient data are available to accurately quantify the emission reductions brought about by these practices in a given region. The Reserve will prioritize evaluation of these practices in a literature review, as well as perform research to confirm that these practices would be additional, for at least some regions and crops.
- **When it comes to quantification, simple and easy-to-use models are critical.** There was a clear preference for Tier 2 methodologies over Tier 3, due to the perceived simplicity of their use. However, requests for adaptable Tier 2 models might be difficult to achieve as Tier 2 models are, by their nature, most applicable to scenarios with similar conditions. While Tier 3 models were less preferred, stakeholders did recognize the merit of COMET-Farm and its increasing enhancements. Therefore, the Reserve will further explore COMET-Farm and its updates, as well as explore the development of additional simple Tier 2 approaches with an eye toward developing methodologies flexible enough to capture more than just N-rate reduction practices on corn plots in the Midwest.

The Reserve's ultimate goal with this revision of the NMPP is to develop a workable protocol that succeeds in getting projects implemented. Simplicity, while maintaining scientific credibility, will be emphasized throughout. The intent is to develop and/or

incorporate quantification methodology modules that are more user-friendly and far-reaching in geographic scope than the current protocol's quantification methodology that is based on the MSU-EPRI model. The Reserve envisions developing distinct modules including N-rate reductions (and possibly other practices) for different crops in different regions, starting with the North Central Region (where the current Tier 2 corn module applies), California, and possibly others. The mitigation potential for N<sub>2</sub>O emissions from N-rate reduction on corn farms in the North Central Region remains high, and the Reserve maintains confidence that the proposed improvements to simplify the quantification process will foster project implementation there. As part of scoping the new quantification methodologies, the Reserve will also conduct an extensive literature and database review to determine whether there are published studies and statistics supporting the N<sub>2</sub>O reduction benefits of N-rate reduction for crops specific to California and any important updates regarding corn and other major field crops in the North Central Region. This will include assessing which quantification tools have been validated for climates, soil textures, cropping systems, and N-rate reduction in both regions.

Additionally, although the Reserve always anticipated this protocol being modular, in this revision, the Reserve will also attempt to restructure the protocol into an even more overarching, umbrella framework to better facilitate future updates. This "umbrella protocol" would detail basic definitions uniform across crops, regions, and nutrient management practices, and can then be supplemented with subsidiary modules for specific crops, regions, and practices as appropriate field-level data and quantification tools become available.

The Reserve will be relaunching the Nitrogen Management workgroup in April 2017 and hopes to present an expanded Version 2.0 of the protocol to the Reserve Board of Directors in the Fall.