

MCCS Technical Review Panel 2020: Summary of Panel Discussion & Survey Results

February 2021

MCCS's Impact and Relevance in Advancing Energy Science and Technology

Overall Impact & Relevance

MCCS is conducting highly relevant and impactful research that could be further strengthened by linking to its overarching strategy.

MCCS receives high praise from the Technical Review Panel (TRP) for the impact and relevance of its research to society, industry, and the national interest. The directorate has a comprehensive portfolio that supports several important missions and high-impact energy research areas. Its strategic themes are powerful and compelling. Industry partnerships are strong. The addition of the computational group to MCCS is a big plus, allowing more seamless work with experimental groups and the efficient identification of relevant problems to solve. Noteworthy examples where MCCS is taking an important national leadership role include:

- Research in perovskite solar cells with record efficiencies and fundamental mechanisms, and helping PV firms with cell technology
- Furthering the science of reliability across application domains
- Bringing science and economics to the circular economy concept, supporting policy making at the national level
- Work on hydrogen, which is necessary to enable the renewable economy at many levels.

While the TRP commends MCCS for its overall impact and relevance in advancing renewable energy, the group advises that MCCS continue to sharpen its focus on the most impactful programs and projects—at both directorate level and individual project level. An overarching research strategy is key in this regard. NREL and MCCS have done a good job of developing such a strategy, but some individual projects are not yet fully integrated into it. In project presentations, TRP members frequently heard “this is what we’re working on,” but less frequently “this is why we’re working on this.”

Looking forward, MCCS should take advantage of its new computational resources and work with experimental groups to seek out relevant, impactful problems to solve through joint efforts. The directorate should also consider looking beyond DOE programs and find opportunities to seek out enhanced funding from industry or local governments. MCCS should also tap into the potential of involving industry in research through more DOE CRADAs and TCF opportunities (similar to the CO₂ electroreduction project). Finally, the TRP advises that MCCS should consider increasing its hydrogen research as a high impact part of its portfolio.

MCCS Strengths

MCCS benefits from a skilled and passionate workforce that possesses (and collaborates using) a wide range of expertise.

One of MCCS's greatest strengths is its research scientists, considered world-class through their depth of expertise and a repeated pattern of excellence in their work. The young researchers and postdocs are well integrated into research teams, and their enthusiasm, energy, and creativity were reflected in their presentations and well received.

Another primary strength of the directorate is blending fundamental R&D with applications. MCCS is known for providing vision in new research areas and technologies and demonstrating what those developments can do to benefit stakeholders, particularly in industry. Examples include reliability research—a long and important history of PV research—and sustainable materials cycles including hydrogen and carbon. Other key strengths that can have wide-ranging impact include the H2NEW launch, ARIES, CEEM, E2M, alternative oxidative chemistries, roll-to-roll manufacturing development, and electrochemical MEA development.

MCCS has also been very effective at securing large awards and participating in (and leading) large collaborative efforts. This pattern reinforces MCCS as a cross-sector leader in renewables research, and the TRP encourages MCCS leadership to continue and augment these efforts.

Areas for Improvement

MCCS should focus more on projects that further its strategic directions and avoid spreading itself too thin across research areas.

While providing strong leadership for research and industry, the TRP feels that the MCCS directorate needs to clarify its focus and priorities to best serve its overall mission and vision. This is especially important in the context of the significant number of new initiatives underway and changing priorities of the new administration.

With the addition of computational science and other initiatives, MCCS could become spread thin. In order to clarify priorities and focus, each program should have a clear link to mission and potential impact. Those that don't deliver against these criteria should be minimized or eliminated to provide more bandwidth for meaningful progress against strategic goals. For example, the TRP agreed there are a large number of resources devoted to concentrating solar power, while hydrogen research is high impact and could benefit from additional support. A few TRP members wondered if materials science fundamentals are central to the directorate's core strengths or if that work is better done in partnership with other academic institutions.

In essence, the TRP worries that important research may be diluted of funding, focus, and high-performing researchers because of external funding availability elsewhere. This critique leads into concerns that DOE dictates and funds the national renewable energy agenda, and NREL/MCCS is in the position only to respond with the appropriate research. MCCS should review its research programs, consider which areas it should focus on, and then strive to advocate and negotiate with DOE to pursue those areas. TRP members recognize that they may

also have a role to play in encouraging DOE to give the national labs more latitude to guide research directions.

Another concern is that NREL and other national labs have come to rely more and more on short-term funding sources and are losing some of the long-term, strategic funding that has traditionally allowed the labs to build strength. Of course, the national labs also play a key role in training the next generation of experts, so it is understandable that some short-term projects may be key to keeping postdocs funded.

Integrating computational sciences as effectively as possible into MCCS research is a new area for improvement. The TRP suggests that the directorate should consider doing more experimental work leveraging computational sciences and increasing the commercialization of computational science research.

Additionally, MCCS should enhance the E2M program with research beyond CO₂ and H₂ into more novel and higher-margin products that can be made from electrochemical pathways instead of thermochemical ones. Finally, MCCS postdocs need ample guidance and training to be prepared for their leadership roles in the next generation of energy science. Many need a better grasp of (or need to be better at communicating) how their research fits into the bigger picture.

MCCS Strategic Directions

Alignment with MCCS Strengths and Competencies

Generally, MCCS's strategy and competencies are aligned, although a few areas could be augmented, and even further engagement with industry is recommended.

Overall, the directorate's strategy is closely aligned with its strengths and competencies, particularly in collaborations with industry and overall technology development. Examples are MCCS's commitment to PV reliability and the circular economy initiative, where scientists are poised to make unique contributions.

However, MCCS's strategy appears to be ahead of its infrastructure and staffing in hydrogen and energy storage. For example, one TRP member noted the potential for closer integration between ARIES and MCCS hydrogen research. It is clear that MCCS is working hard to grow its hydrogen and energy storage portfolios, so this is a work in progress.

Some TRP members also noted that MCCS has opportunities to expand its research in the next generation of PV materials (at the TRP, there was no mention of efforts to model and synthesize new candidate materials). Additionally, MCCS should further strengthen industry partnerships if MCCS wants to continue the rapid tech-to-market efforts. Another TRP member suggestion for greater alignment is to integrate the directorate's innovations with advocacy for policies needed to implement these innovations; otherwise, these efforts could be futile.

Partnerships

MCCS's partnerships are effective and should continue to be expanded.

While some TRP members commented they did not receive enough information during the meeting to comment on the directorate's partnerships, many felt that MCCS's collaborations—especially with industry—are exemplary, well planned, and high functioning. A recurring comment, however, is for the directorate to strengthen its interaction with DOE to provide leadership for the national direction on renewable energy. Another repeated suggestion is that MCCS continues to widen its connection with industry partners to expedite technologies such as next-generation PV and hydrogen for commercial use, increasing the directorate's revenue and impact.

As MCCS expands its research areas, it should also continue to connect with new academic partners to reflect these research topics. Finally, the directorate should focus on partnerships that are strategic, as some of the current partnerships felt a bit “ad hoc” or opportunistic. Finally, MCCS should consider the current environment as an opportunity to “bring all parties to the table,” even including “naysayers” who were not approachable in the past.

New Directions for Innovation

Opportunities to Increase Impact

The TRP had numerous recommendations to increase impact, but generally agreed that MCCS should continue to focus on its core strengths.

A continuing theme in this report is that MCCS needs to evolve its relationship with DOE and its various offices so that MCCS can take a leadership role in setting research goals and agendas with a long-term perspective. The directorate should also continue to review its strengths and competencies and be careful not to be spread too thin with all of the opportunities for R&D in renewable energy.

In light of the new administration, MCCS should continue to address issues in PV including cost, reliability, lifetime, and system integration. Another suggestion is to focus on “underdog technologies” such as low-voltage power electronics, railroad systems, and roll-to-roll manufacturing of E2M electrodes. One member suggested MCCS create generic data acquisition, mapping, modeling, and organization tools that specific companies could easily tailor to their R&D needs through a CRADA.

Another suggestion is for interdisciplinary MCCS teams to write more perspective articles for publication, leveraging their unique, combined expertise to influence and advocate for technically sound policy. NREL has excellent talent in technoeconomic analysis; this could be applied more broadly across MCCS, especially in applications relevant to industry. The directorate should also work to better measure its success and impact with metrics, especially in technologies that are pushing the megawatt and gigawatt scales.

Finally, while MCCA is obviously striving to support its postdocs, there are opportunities here. Postdocs could benefit from leadership training and learning to better explain the motivations and context behind their projects. MCCA might also consider organizing a career day to better expose postdocs to opportunities in industry.

Areas of Concern in MCCA's Current Portfolio or Future Directions

The TRP's main area of concern is for stability of funding—especially long-term, big-picture funding—in key strategic areas. Several members voiced other concerns as well.

One area of concern centers on funding mechanisms and providing a pathway to continue funding streams (through DOE or other partners) that currently have definitive end points. For example, TRP members felt that lower TRL programs (such as HydroGEN) should not be eliminated when their current DOE funding expires. As already indicated, MCCA should identify and diversify future funding opportunities for key strategic areas like hydrogen and energy storage. Relatedly, the Circular Economy for Energy Materials program is a worthy new effort, and significant sustained support will be necessary to make it a success. MCCA should be careful to avoid CEEM research becoming siloed in different groups and disciplines. Many TRP members felt that CSP research did not have a good outlook and did not fit well into MCCA's long-term strategy. If DOE requires research in this area, it could make sense for MCCA to focus on potential crossover areas, such as material reliability in high-temperature environments.

Several TRP members suggested that research efforts in hydrogen, energy storage, and next-generation materials for PV cells need to be further expanded. One member wondered if photoelectrochemistry (PEC) for hydrogen production might better belong in academic settings because of its over-constrained set of requirements and other practical implementation issues. A similar comment was made for reactive capture with E2M due to its newness and low TRL. Finally, one member noted the directorate should better integrate education and policy into its work.

Comments on the TRP Process

The virtual TRP process worked very well overall. The main suggestion is enhanced read-ahead material for future years.

Despite being virtual and hoping to meet in person next year, the TRP felt that the 2020 meeting was amazingly effective and well organized, facilitating strong interaction and discussion. The different Teams rooms worked well to split off and hear about different focus areas.

While the TRP found the read-ahead PDFs very helpful, they would like to see even more extensive pre-reading content, such as selected publications for each area shared 2–3 weeks before the meeting. Understandably, some of the sessions were rushed, and more time would have been beneficial to interact with the postdocs and hear additional details about their research and challenges. It would be useful to have a session with junior researchers as well.

The TRP wishes to commend and thank the MCCA and support staff for a job very well done under difficult circumstances.