Introduction to Challenges and Summary

The field of LENR has all the challenges of any accepted part of science, plus the burden of gaining acceptance and recognition as a legitimate field of scientific inquiry. The normal challenges include the design and performance of sound experiments, and the development and application of theories to explain past observations or make predictions. They also include communications of results through discussions, presentations and journal articles. Now, all of these things do apply to LENR, although it is difficult or impossible to get many of the appropriate journals to even consider papers from scientists in the field.

The problem of LENR becoming a recognized field of scientific research is very challenging. Acceptance as a part of science would have far reaching consequences. Now, in the US, responsible people in both the Congress and the Administration correctly assert that they are not scientists. They are waiting for the scientific community to examine LENR and pronounce judgment, not on its details, but only whether or not it should be considered as a science. Administrators in the US Patent and Trademark Office, who are not scientists, have the same refrain. They await scientists with relevant competencies to examine information on LENR and render an opinion on its being, or not being, part of science. Those responsible for documentation and communication of scientific results, the editors of scientific journals and magazines, also correctly assert note that they are not scientists (even though many of them were scientists earlier in their careers). They want others, who are now practicing (publishing) scientists, to examine results on LENR and say what they think about the field as a science.

So, why is are key scientists individually and the scientific community, broadly considered, unwilling to (a) examine the evidence, (b) draw conclusions about the nature of work on LENR and (c) communicate them to other scientists and the public? Part of the reason is that most scientists are busy with their own research, and not willing to spend time on examining LENR information. There is, after all, little likelihood of either support or fame in such an activity. Some scientists are fear-filled as a result of the residual poor reputation of the field. They are afraid that their reputations would be tainted and, maybe, their careers destroyed. Then, there are a few very prominent and vocal ex-scientists who speak out against the field even though they seem not to be aware of key results from LENR research. They may have had strong scientific careers at one time, but they no longer contribute to the advancement of knowledge by actually doing research and publishing the results. Whatever motivates these people, money or ego or anything else, they do themselves and the field a real disservice. This is especially true in the case of LENR.

It is uncertain if and when the current research phase of LENR will be the basis for practical energy sources. However, the prospects of small distributed nuclear power sources, without dangerous prompt radiation nor significant radioactive waste, deserves consideration. Those possibilities are in addition to the wonderful scientific challenge of understanding how it is possible to stimulate MeV nuclear reactions by using eV chemical energies.

Whether or not LENR energy sources prove to be important, there are some basic requirements for the operation of LENR experiments. One of the most fundamental is replication. Hence, this conference included an invited paper by McKubre on replication. He defines it as the ability to demonstrate an effect of interest on demand. In that paper, McKubre provides an important summary of the temperature dependence of the ability to produce excess heat, as summarized in this table:

Temperature Range	Energy Gain in a LENR experiment
Below 70°C	0 to 5 %
70 to 99°C	About 10 %
At boiling	Up to 150 %

McKubre ends with the assertion that replication, however significant, is not as important as proving that the energy produced in LENR experiments is nuclear and not chemical.

Swartz confronted the critical challenge of getting enough electrical power out of a LANR cell to do useful electrical work, and to feed back power to drive the cell in a steady-state condition, which he calls “renewable electricity”. Such as system is termed a “Self Sustaining Electrical Generator”. Swartz is particularly concerned with the poor energy conversion in going from heat to electricity, which he found to be in the range 13-19%. He also measured the ability to use energy from LANR to operate fuel cells. But, that was found to have high loses in both gas generation (13-20%) and water (energy) generation (54-69%). While high efficiencies were not achieved, this is an important start on the serious electrical generation from the heat generated by LANR electrochemical cells.

The paper by David and Giles is in a class by itself. It seeks to directly convert the results of LENR into a voltage, rather than into heat that might then be transformed into electricity. Their gas phase device contains a mixture of powders of Pd and semiconductors. Voltages of 0.5 V have been measured. These authors note that the power to weight ratio in their device is similar to that of the first atomic pile made by Fermi and his team in Chicago in 1942.

The question of the Fleischman-Pons effect being real and nuclear is the focus of two other papers in this section. In the first, Johnson and Melich provide a Bayesian probabilistic analysis for the criteria offered by Cravens and Letts as being necessary for the operation of the FPE. That set of criteria is in the first paper in the section on Heat Measurements in these Proceedings. They show that, on the basis of only eight papers, the likelihood ratio (the FPE Effect is real/the FPE Effect is not real) is over 10. This analysis could be usefully extended to include more papers. However, with only those few papers, the conclusion of the reality of the FPE effect (and its subsequent conclusion of necessarily being nuclear) is already quite robust.

Kowalski also confronts the question of nuclear or not? He summarizes results for an affirmative conclusion in what he calls the “protoscience” of LENR. Excess heat, its correlation with Helium production, changes in isotope distributions, production of new elements, chemically-induced changes in radioactive decay rates and the emissions of high-energy photons and particles are cited.

Grimshaw provided a study of modern approaches to Condensed Matter Nuclear Science. He advocates what is called “Open Source Science” or OSSc. This idea is modeled on the widespread use of open source software, for which there are many successful examples. He notes that the common usage of the internet by LENR researchers for posting papers and for discussions already makes the field part of Open Source Science. He asserts: “The prospects of cold fusion success may be significantly enhanced by extending the current informal and implicit use of OSSc-type methods to more organized and explicit deployment under the sponsorship of a recognized professional organization such as the International Society for Condensed Matter Nuclear Science.”

A summary of ICCF-14 was written by Passel, and is the final paper in this section. In that paper, he provided both a sociological context and a review of a sampling of the results presented at the conference. Passel notes correctly that the field, although 20 years old, has done only a very small fraction of possible experiments. Many of us, who have been in the field since the outset, look forward to the day when LENR is a part of recognized scientific research with funding to attract new scientists with useful skills and equipments. Then, many more of the needed experiments will be done and reported.