I was asked by Achim to reflect on “5 years of Entria”, and I thank you, Achim, for this opportunity. I am not sure whether this is supposed to be rather a project report or rather a ceremonial speech. Anyway, I am afraid I have to extend the scope of my talk a little bit. Apart from the point that we still have more than a year to go and it is therefore to be going an interim reflection on the past 3.5 years rather than a final assessment, I would also like to embed my remarks into considerations about the the wider context of German radwaste management policy.

But let’s start with ENTRIA. As always, there might be more than one narrative about the origins of ENTRIA – here is mine: In the first decade of the century, Germany’s situation with regard to radwaste management was characterized by muddling-through and by the absence of any strategy deserving this name. The societal conflict about nuclear power, lobbyism and opportunism of decision makers from all political directions and at all levels caused sometimes stalemate, sometimes to-and-fro at all levels: A nuclear phase-out was watered down then years later, spent nuclear fuel was first meant to be stored centrally, but the one arising later was left scattered over the whole country and stored at 12 facilities, which will outlive the adjacent power plants by decades. This will cause managerial, safety and security problems as you might imagine. The Gorleben site was chosen for HLW and SNF disposal, investigated, the investigation then stopped for 10 years, then restarted. Conflicts arose and intensified especially in the Federal State of Lower Saxony, which is hosting the Gorleben, Konrad and Asse sites. Lower Saxony also was and is hosting several institutions involved in implementation and regulation of radwaste disposal and related research.

The idea to create radwaste management research capacity in Lower Saxony beyond the existing institutional framework evolved over the years and was promoted by several actors from science and politics. The thoughts brought forward at that time included involving academic research, communicating with stakeholders, and creating a research institution formally separated from the usual implementer-regulator relationship. From 2010 on, things focused around a group consisting of university professors from Hannover, Braunschweig and Clausthal, mostly natural scientists and engineers, and of representatives from two lower-saxon ministries. In the process, it became clear that reinforcement from nontechnical disciplines from other parts of Germany was needed to develop interdisciplinary approaches, and that there were political boundary conditions for funding a project rather than an institution.

So the ENTRIA project was formed: funded by the Federal Ministry of research BMBF for five years (2013-2017) and unifying twelve institutes at German universities and research facilities as well as one partner from Switzerland. The project’s overarching idea was inspired by the observation, that politicians and media often brought forward thoughts about retrievability and long-term storage which were often neither technically sound nor backed by thorough argumentation. So we decided to investigate the three radwaste management options final disposal without retrievability measures, deep disposal with retrievability and monitoring, and long-term surface storage from the angles of natural science, science of technology, political and social science, law, and philosophy.

Of course the intent was to go far beyond simply bringing together these disciplines in an additive way; what we wanted to get was real synergy and interdisciplinarity. The consideration of the three management options was meant to become a pivot point for this objective. And indeed it became at least a starting point: Very early the team leaders developed a memorandum naming several areas of tension – or perhaps even target conflicts – when considering radwaste management options. The memorandum became a starting point for the option interdisciplinary evaluation which is still underway.

However, ENTRIA's interdisciplinary research is by far not restricted to such top-down undertakings, and this has to do with another important objective of the project: Germany has to deal with a serious recruitment problem in our field. Our project is aiming at contributing to a solution of this problem, but of course, we want to take advantage of our interdisciplinary setting and to go beyond academic education in single disciplines. Our goal is to provide our PhD students and postdocs with basic knowledge in the various disciplines involved in the project. One of the ways of doing this is defining themes for PhD theses for which more than one discipline is relevant, e. g. on public perception of radiation protection issues or on their technical and legal aspects. We do not have too many of such PhD topics, though, which in part is due to the formal difficulties you run into if you want to do a doctorate at two faculties at two different universities in two different fields and with quite different rules.

A considerable contribution to interdisciplinary exchange and education came from the academic self-organisation of our youngsters. PhD students and post-docs gathered together on a regular basis, presented their research topics, invited lecturers and discussed selected topics of relevance for the several disciplines. From there and from the regular projects a couple of interdisciplinary co-operations emerged which were not planned for or foreseen in the beginning of the project, e. g. anthologies, workshops, and research papers. Topics were e. g. the concept of voluntarism, the generation and role of radiological dose limits, or procedures for public participation. Besides of several publications emerging from these activities, we also developed a culture of running events such as presentations and other public events by mixed teams, usually consisting of at least one "technician" and one "non-technician". This improved the professional quality and allowed for looking at the issues from different angles, which greatly contributed to the communication with the audience.

Of course it was neither easy nor relaxing to run a project like this. I remember moments like the one when after 20 minutes of conversation with a colleague from a discipline "far away" from mine he asked me "Why are you looking at me like that?" My Reply was "Oh, I am just trying to figure out what the hell you try to tell me all this time." Young engineers had to get used to discussing in circles of chairs, and social scientists were confronted by "death by powerpoint".

The biggest challenge was probably to bring so different mentalities, working cultures and approaches together into one working project. But ENTRIA was also a place for great, also personal, benefits:

If you asked me these days what I got so far from ENTRIA, the answer would include at least two things: It was a great and very inspiring experience to work together with so many young people from so different environments. And I had the chance to learn during these 3.5 years much more than it is usual in a "ordinary" academic environment.

ENTRIA did not evolve in an academic ivory tower, though: During the time when we applied for the project, the German Site Selection Act was prepared, it was passed in 2013 – the first year of our project. The Act became possible due to the wide-ranging political consensus on a nuclear phase-out after the Fukushima reactor accidents. Given this, the hope emerged that a restart of the otherwise quite messy German radwaste management policy would become possible, and indeed the Act was supported by an unusually broad majority in the parliament. The Act required the work of a Commission which, amongst many other things, was requested to develop recommendations about various waste management options. The parallel to our project was obvious, and it was sometimes hard to draw a clear and visible line between our academic research on one hand and politics on the other, and to resist the desire of some to simply politically highjack the project.

Now in 2016, the Commission submitted its report to the parliament. What did we get? 700 pages of report, accompanied by a couple of dissenting opinions of varying nature. Amongst other things, the Commission recommends reversible deep disposal as preferred management option and makes recommendations for siting procedures and criteria. Immediately after release, there was a lot of criticism from the scientific-technical community. And when having read the report, I understood a lot of these criticisms. However, then I stepped back and asked myself: What did you expect from such a report?

So let's look back – what was the situation in 2013 when the Site Selection Act was passed? In the scientific community, you could see a mixture of hope and skepticism. Everyone recognized that the problem was not to be solved by natural science and engineering alone. In the community I belong to, often even the view was expressed that the problem was, if not yet completely solved from an engineering point of view, it was at least close enough to a technical solution to blame only politics for not adapting it. Thus, it was only logical that politics – or society at large – and science had to come together to address the issue. And then we got – as a consequence – this Commission composed of politicians, scientists and representatives of societal groups. A rather unusual and potentially dangerous composition, I was told by many colleagues from abroad. They did not refer to the fact that scientists and societal representatives worked together – this has happened in other cases as well. But the additional involvement of politicians was seen as an additional challenge due to the different motivations, responsibilities, and rationalities involved. Nevertheless, there was much hope associated with this restart, sometimes perhaps accompanied by the notion that this might be the only chance we might ever get.

Now in 2016 probably the most important message is that the Commission came up with a report supported by a vast majority of its members. Even the dissenting opinions – with one exception – address selected points and details without putting into question the report as a whole. This in itself is certainly a considerable achievement. What is more: The Commission recommends unanimously an overall sensible waste management option: Deep disposal with reversibility, and it recommends to move forward without unnecessary delays. This is very much appreciated.

However, one of the dissenting opinions, the one about the temperature criterion, sheds light on the fact that the report sometimes meander between scientific consensus and political compromise. In the discussion about this technical criterion, apparently no technician was involved. Is this the way of the future?

To be clear: I am not so much concerned about this single criterion which, in my view, is much less critical than some seem to believe. But there are points in the report which are even considerably weaker: In the attempt to be somehow "fair" when addressing different host rocks, the report ends up with a set of criteria inherited from earlier work which focused on salt and clay host rocks but not on crystalline. The attempt to adapt these criteria somehow in a way that crystalline might pass them as well ended up in a conceptual nightmare. This is criticized in some of the dissenting opinions, and rightly so, but with questionable motivation: The opinions come from Federal States with abundance of potential crystalline host rock. We will see how scientists and technicians will deal with the issue in the future.

Again the question: Is this the way of the future? Somehow merging scientific discourse and political compromise? Scientific issues politically negotiated? Perhaps the panel discussion can spend a bit of time on the issue, but the final proof of the pudding will be the eating. We will see.

This were just examples of weaknesses and problems. In general, however, I get signals from the scientific and technical community telling that no one is overly optimistic but that everyone is ready and willing to take the challenge and to move forward on the basis of what we have got. I understand from my colleagues from social and political sciences, that they see weaknesses in the report concerning governance and procedural issues as well, but their general attitude is the same.

As far as ENTRIA is concerned: Of course we are of the opinion that the momentum generated by the project needs to be kept by further funding this kind of interdisciplinary research. We are also of the opinion that the process in our country will desparately need this kind of research as well as the efforts we undertake with respect to education.

So far, however, we are still struggling to find appropriate place in the new organizational structure in our country (also a recommendation by the Commission), and to gain sufficient support. The project is being acknowledged and praised by many actors, but sound commitments are so far missing.

So, again, as for the general situation in Germany, I am able to say: We are not overly optimistic, but we are ready to contribute.

I would like to conclude my talk by thanking all my ENTRIA co-workers for – so far – 3.5 years of challenge and inspiration – and fun! And I would like to thank you for your attention.