

Energy and Sustainability Research Institute Groningen
Research assessment 2010-2013

April 2014

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1 Introduction

The Netherlands system of research quality assessment

An external Committee of Peers evaluated the research quality of the Energy and Sustainability Research Institute Groningen in April 2014 and reports its findings in the present document.

This quality assessment is part of the assessment system for all publicly funded Dutch research, as organized by the Association of Universities in the Netherlands (VSNU), the Royal Netherlands Academy of Arts and Sciences (KNAW) and the Netherlands Organisation for Scientific Research (NWO).

The aims of this assessment system are:

- Improvement of research quality
- Accountability to the board of the research organization, and towards funding agencies, government and society at large

The assessment takes place at the level of research institutes and research programs within the institutes.

A site visit to each institute by an external Committee, once every six years, is an essential part of the assessment system. A Committee of Peers (Evaluation Committee) is appointed and asked to review the research. Important elements of the site visit are the interviews which the Evaluation Committee conducts with the management (university board, faculty board) and the director of the institute and its program leaders, as well as with PhD students, post docs, and stakeholders. In between these visits, a midterm review is organized, which is mostly an internal process.

Before the site visit, the research institute submits a self-evaluation report, containing a short outline of the mission of the institute, the objective of each of its research programs, a description of the results that have been achieved in the programs during the previous six years (including quantitative data about staff input, PhD's, publications, financial resources), and developments anticipated in the future.

Scope of the assessment

This assessment of the Energy and Sustainability Research Institute Groningen (ESRIG) was commissioned by the Faculty of Mathematics and Natural Sciences of the University of Groningen (FMNS), of which ESRIG is part. It covers the period 2010-2013; recent developments have been taken into account as much as possible.

ESRIG was founded in 2010. The present review is the first evaluation of the institute. It was scheduled as a midterm review, but the Faculty decided to extend it and appoint a Committee of external peers to get timely feedback and advice on the mission and strategy of the institute for the future.

The Committee was asked to operate according to the Standard Evaluation Protocol 2009-2015 for Public Research Universities, and all members received a copy of this document.

The protocol specifies the information that must be provided to the Committee and the criteria for the research assessment.

ESRIG consists of six research programs (basic units, research groups), five of which have been evaluated in the past few years in national disciplinary settings (for a short description of the institute, see Appendix 1). The current Committee was asked to pay extra attention to the institute as a whole and to assess its added value for the participating groups, the university and society, as well as the importance of the research programs for the institute. More specifically, ESRIG and the Board of the Faculty asked the Evaluation Committee to answer the following questions:

- What is the Committee's opinion about ESRIG's process of developing the originally multi-disciplinary institute into an interdisciplinary institute?
- Does the participation of the separate groups within the institute confer an added value to the groups? Do the groups enhance each other's impact and contribute to a coherent institute program? Are there opportunities to strengthen the focus of the institute in the field of Energy and Sustainability?
- Given the breadth of the institute, what are its specific opportunities, for instance to acquire a leading role worldwide in the broad field of Energy and Sustainability and to compete for major extramural funding sources?
- Are the institute and its groups agile and effective in taking advantage of existing opportunities to fund research in Energy and Sustainability?
- Are the directions suggested for the possible new groups (hydrogen production from renewables, bio-solar activities) well-chosen or are better choices possible?
- What is the Committee's opinion about the fundamental-applied balance of ESRIG?

The Evaluation Committee

The Evaluation Committee consisted of:

- Prof. dr. Martin Heimann, Max-Planck-Institute for Biogeochemistry, Jena (Chair)
- Prof. em. Roland W. Scholz, Eidgenössische Technische Hochschule Zürich.
- Prof. dr. ir. Jan Dirk Jansen, Delft University of Technology.
- Prof. dr. ir. Theo H. van der Meer, University of Twente.
- Prof. dr. Dieter Wolf-Gladrow, Alfred Wegener Institute for Polar and Marine Research.

Mrs. Willy van Strien (science journalist, Leiden, the Netherlands) was appointed secretary to the Evaluation Committee.

A short curriculum vitae of each of the members is included in Appendix 2.

All members of the Committee signed a statement of independence to ensure that they would judge without bias, personal preference or personal interest, and that their judgment is made without undue influence from persons or parties committed to the institute or programs under review, or from other stakeholders.

Procedures

Before the site visit, Committee members received the self-evaluation report, and for each research program a list of publications and PhD theses and key publications. They also received the Standard Evaluation Protocol (SEP) as well as the Terms of Reference. The Chair of the Committee asked each member to pay special attention to the information on one or two research programs, according to their expertise, and take the lead in the interviews with and reporting on these research programs.

The visit took place on April 2; the program of the visit is included in Appendix 3. On the evening before the visit, the Committee assembled, met with the director of ESRIG, prof. dr. H.A.J. Meijer, met with the Dean of the FMNS, prof. dr. J. Knoester, and prepared the site visit.

During the visit, the Committee interviewed the program leaders, a delegate of PhD students and post docs, and a selection of stakeholders. On request of the Committee, a skype session was arranged with prof. dr. G.P.J. Dijkema, currently at Delft University of Technology, who is appointed head of basic unit IVEM from June/July 2014. The Committee viewed the labs. At the end of the day, the Chair of the Committee presented the main findings.

A draft of the evaluation report was prepared and sent to the institute for a check on factual errors, and submitted to the faculty.

Criteria and assessment scale

The Standard Evaluation Protocol requires the Evaluation Committee to assess the research on four main criteria:

- Quality (the level of the research conducted)
- Productivity (relationship between input and output)
- Societal relevance (social, economic and cultural relevance of the research)
- Vitality and feasibility (flexibility, possibilities for improvement)

The ratings used are on a five-point scale that is described in the Standard Evaluation Protocol as follows:

Excellent (5) – Research is world leading. Researchers are working at the forefront of their field internationally and their research has an important and substantial impact in the field.

Very Good (4) – Research is internationally competitive and makes a significant contribution to the field. Research is considered nationally leading.

Good (3) – Work is competitive at the national level and will probably make a valuable contribution in the international field. Research is considered internationally visible.

Satisfactory (2) – Work adds to our understanding and is solid, but not exciting. Research is nationally visible.

Unsatisfactory (1) – Work that is neither solid nor exciting, flawed in the scientific and or technical approach, repetitions of other work, etc.

2 Energy and Sustainability Research Institute Groningen (ESRIG)

ESRIG is one of twelve research institutes of the Faculty of Mathematics and Natural Sciences (FMNS) of the University of Groningen. It is an interdisciplinary institute of researchers around a common theme: energy. ESRIG aims to contribute to the global *energy* supply in the coming century, for more people, and in a more *sustainable* way. A short description of the institute is included in Appendix 1.

Profile

The overall topic and thematic focus of ESRIG - energy and sustainability - are significant, of scientific interest and high societal relevance. The three issues (1) energy systems transition (including food), (2) carbon cycle and (3) selected technologies such as carbon capture and storage (CCS), combustion, geothermal energy etc. provide in principle an excellent thematic profile.

However, how the terms ‘energy’ and ‘sustainability’ are seen by the different actors in ESRIG and to what aspects of sustainability ESRIG wants to contribute is not very visible from the outside. The Committee recommends a sharpening of the institute profile by carefully refining what these overall terms mean and imply for the actual work of ESRIG.

Cohesion

ESRIG currently consists of 6 research groups (basic units). Each unit performs research on good to excellent level as assessed by the Evaluation Committee in the individual sections below.

While there are many opportunities for synergies between the present units of ESRIG, the overall theme is covered only in rather scattered way. The overall productivity is still primarily limited to the contributions of the individual research units. Indeed, most key publications listed in the self-evaluation report have been published under the affiliation of the individual research units and not as ‘ESRIG publications’. Also, the synergies of ESRIG as whole for enhancing research funding in ‘energy and sustainability’ are not very visible. For instance, tenure track positions are not proposed by the institute as a whole, but by single basic units.

The overall cohesion of ESRIG is currently induced primarily by a bottom-up process, driven by individual good to excellent initiatives. As a consequence, it is difficult to discern a clear vision for groundbreaking and innovative research behind the institute’s activities. The Evaluation Committee recommends a strengthening of the top-down leadership for developing a sharper institute profile as discussed above, in order to increase cohesion and integration between groups.

Strategy

ESRIG is still a young institute, which is trying to find its niche in the scientific landscape. ‘Energy and sustainability’ is a very broad umbrella topic, which cannot be covered in a comprehensive way given the limited resources of ESRIG. The Evaluation Committee strongly recommends ESRIG to conduct a strategic discussion to sharpen the focus of the institute to perhaps 2-3 major themes, to be addressed jointly by several of the institute’s research units. This discussion should be developed not only by the group leaders, but also by other scientific staff, including post docs.

The recommended strategic discussion also will help to increase the visibility of ESRIG, also in view of taking opportunities in funding.

A stronger focusing of research activities will take much time and requires the appointment of vacant/new positions to strengthen the research profile of ESRIG and to increase the links

between the groups within ESRIG. The contribution of candidates to an ‘ESRIG corporate identity’ should be an important criterion of selection. A number of good organized retreats may offer an opportunity for the development and fostering of this ESRIG identity among the students and the scientific staff.

A sharper institute profile and joint ESRIG outreach activities will also strengthen ESRIG’s position within the university and foster the visibility of ESRIG in the faculty, the university and the Netherlands’ scientific landscape.

The Committee also recommends establishing an international scientific advisory board, potentially with stakeholder participation for an outside guidance, to secure that the scientific relevance of the subjects investigated is maintained.

ESRIG proposed two new research topics: hydrogen production from renewables and bio-solar activities. These additions are considered feasible, however the Committee refrains from prescribing the specific research direction of ESRIG. If and how new groups are incorporated in ESRIG should be made in conjunction with the necessary strategic discussion for sharpening the institute profile and focus.

Critical assets of ESRIG are its PhD students. The thematic breadth of ESRIG provides a unique opportunity for providing an interdisciplinary education profile. This profile should be strengthened by giving it more visibility, active recruiting and by developing more PhD projects with joint advisors from several of the research units. The Committee got the impression that the PhD students have a high potential for innovation.

Interaction science and society

ESRIG’s mission involves interaction between science and society. ESRIG has developed an impressive amount of contacts and joint activities with a host of stakeholders, covering public authorities, private companies and nongovernmental organizations, and the Committee noticed that the stakeholders overall are content with the collaboration. Much of the interaction rooted in the relations to practice developed by the former head of IVEM, Ton Schoot Uiterkamp and through the former industry position of Rien Herber.

In the upcoming sustainability science, many forms of collaboration between science and practice are currently being developed which go beyond consultancy. Surprisingly, no elaborated methodology of science-practice cooperation (such as transdisciplinary or (specific) variants of action research etc.) has been mentioned in the self-evaluation or in the interviews. The Evaluation Committee recommends ESRIG to develop and agree upon a methodology, together with all group leaders.

The Evaluation Committee judges the balance between fundamental and applied science within ESRIG to be adequate.

Integration with social science

Integrating social science knowledge into natural science and environmental engineering work, as is ESRIG’s ambition, is a challenge. ESRIG might need a quantitatively oriented social scientist with experience in science technology studies or environmental sciences. This person should complement the more qualitative and survey oriented group of the Science and Society research unit.

Summary of specific recommendations

- Redefine the topics ‘energy and sustainability’ for sharpening the profile and focus of the institute
- Make the transition from a bottom-up to a more top-down guidance
- Include group leaders and selected scientific staff into the strategic planning

- Enhance outreach activity for visibility of ESRIG (and make this visible in the faculty/university environment)
- Take advantage of upcoming staff recruitment opportunities for sharpening the institute profile and increasing cohesion
- Establish an external advisory board that includes also stakeholders
- Establish more joint PhD projects with advisors from several research units
- Foster recruitment of PhD students e.g. by giving the PhD program more visibility and active recruiting
- Develop a methodology for enhancing collaboration between science and society

3 Research programs

3.1 Centre for Energy and Environmental Sciences (IVEM)

Chairman: Prof. dr. H.C. Moll
Tenured scientific staff in 2013: 3.3 fte

Quality: 3.5
Productivity: 3.5
Societal relevance: 4
Vitality and feasibility: 4

The objective of IVEM is to analyze, design, implement and assess transition routes towards a more sustainable and environmentally compatible use of the earth's natural resources. It has subprograms on energy and material systems; food systems and resource use; and land use and ecosystems.

Quality and productivity

Due to a vacancy stop, IVEM has been under interim management of prof. dr. H.C. Moll since 2009, when the former head prof. dr. A.J.M Schoot Uiterkamp retired. In this interim period, quality and productivity did not attain the highest level, but both have the potential to reflower from 2014, with a new full professor on board.

Societal relevance

The relevance of the research which has been done is absolutely high. This holds true for the energy transition subject as well as for food, the topics chosen for the coming years. Some innovative inputs may push this group back to be one of the leading groups in environmental sciences in the Netherlands (as it has been about 10 years ago according to VSNU rating). Schoot Uiterkamp had the gift to access stakeholders and to ask them continuously for their need.

Vitality and feasibility

The group is in transition. It is going from (material) flows to actors (having a strong transdisciplinary component) and from (environmental and material) systems to coupled human-environment systems research. In principle, the new head of IVEM, prof. dr.ir. G.P.J. Dijkema, matches very well into this frame. He will provide new inputs from the integrated modeling and methodological perspective. However, IVEM should take special care to keep the strong science society interaction. The viability and feasibility are very high, the group is very innovative and committed PhD students will facilitate the transition.

Place within ESRIG

Thematically, this group is in the core of the institute. The subjects of research - fossil fuel, materials and land use changes - are well chosen. Research on energy system transition is interdisciplinary work that needs natural, engineering and social sciences. The leaders of IVEM are well aware of this.

3.2 Centre for Isotope Research (CIO)

Chairman: Prof. dr. H.A.J. Meijer
Tenured scientific staff in 2013: 2.8 fte

Quality: 4.5
Productivity: 4.5
Societal relevance: 3.5
Vitality and feasibility: 4.5

CIO performs isotope and related measurements for application to several energy- and sustainability-related issues. Subprograms are on ^{14}C and paleo-environment; atmospheric greenhouse gases; water isotopes in the global water cycle; and biological/medical behavioral and energy studies.

Quality and productivity

CIO has a long-standing reputation as an internationally leading research unit in high-quality/high accuracy isotope and radiocarbon measurements. This methodological leading edge makes CIO an excellent partner in many research projects that require such measurements. This gives CIO access to top-level scientific investigations fostering an excellent to outstanding publication record. It also provides a substantial financial income. Historically, CIO has been focusing its research efforts on method development. The Evaluation Committee welcomes the recent widening of the research unit profile (air core work, atmospheric modeling), which will clearly lead to more research efforts under CIO leadership.

Societal relevance

CIO performs primarily fundamental research, which, however, can be very useful for societal relevant applications. CIO is substantially involved in the national and European ICOS consortium (Integrated Carbon Observation System). ICOS provides primarily a critical research infrastructure, which is not only fundamental for greenhouse gas cycles understanding, but also essential for the independent quantification of regional greenhouse gas emissions. This is highly relevant in the societal/political context regarding greenhouse gas emission mitigation.

Vitality and feasibility

CIO enjoys a strong and vital internationally well-recognized position; primarily based on its methodological excellence in radiocarbon, trace gas and stable isotope measurements. This leadership should be maintained by all means, also because it contributes a key element to the overall goals of ESRIG. The recent hiring of H. Chen and W. Peters provide an excellent opportunity for a widening of the research profile of CIO and opening new scientific applications for the in-house analytical expertise. The forthcoming hiring of an aerosol specialist will further widen the research profile.

However both atmospheric inverse modeling and aerosol science are rather wide research domains with an internationally quite large research community. CIO will have to be careful in finding its proper niches in these new domains in order to become competitive, given the rather small in-house available scientific staff.

Place in ESRIG

CIO is within ESRIG the unit that is most devoted to fundamental research. It provides the crucial natural science basis within the research mission of ESRIG.

3.3 Science and Society Group (SSG)

Chairman: Dr. H.J. van der Windt
Tenured scientific staff in 2013: 1.8 fte

Quality: 2.5
Productivity: 2
Societal relevance: 4.5
Vitality and feasibility: 3

The dynamics of the interaction between natural sciences and society is the focus of SSG's research. Research is performed on three sub programs: multi-level governance in natural resource management and nature conservation; sustainable innovation and co-creation in bio-, pharma- and energy technology; ethics of science.

Quality and productivity

The number of publications and the quality of publications are (still) on a very low level. This may be explained as the group (primarily natural scientists from their background) is in a transition after joining ESRIG and until now is not reinforced by the appointment of a full professor, as had been promised. Such appointment is needed, as the interface between social and natural sciences should be kept and developed.

Societal relevance

This group received the highest score of all groups with respect to societal relevance. The Committee sees a very high potential, as transition of energy systems and bio-fuel management - these issues were named as topics of research in the oral presentation, but were not included in the self-evaluation - are socio-technological issues which ask for a coupled human environment research. This has been acknowledged by many groups and people (including the stakeholders with whom the Committee talked). The work of the Nobel Prize winner Elinor Ostrom shows that this is acknowledged by the international scientific community.

The current research focus is on how scientists interact with society. The research is done from a sociology-of-science and partially from a philosophy-of-science perspective, rather in a qualitative mode. SSG's planned research topics - sustainable bio-fuel, management of natural resources and science society cooperation in transition of energy systems - are well chosen.

Vitality and feasibility

The Science and Society Group received good feedback from stakeholders and PhD students; current Professors, leaders from different ESRIG groups and PhD students from various groups showed high commitment, thus the viability is given. The current SSG group, however, is too small.

A stronger international collaboration, in particular with groups who have developed coupled human environment and socio-ecological research (e.g. in Sweden, Germany, US, or Switzerland) is recommended.

Place within ESRIG

There seems to be a strong need in ESRIG for quantitative social science research. Such research may support integrated modeling, energy system analysis, assessment of the viability of certain energy systems or of new energy technologies when they are entering the market.

Thus, there is a need for a social scientist as the leader of SSG, who may help to do research at the social and natural/engineering science interface in sustainable transitioning. This 'interface researcher' may act as a pivot and help ESRIG's groups to find the right access to social science research and partners. This professor (working in statistics or modeling of social, sociotechnological, socioecological etc. systems) should be best a member of both the Faculty of Mathematics and Natural Sciences and the Faculty of Behavioural and Social Sciences.

3.4 Ocean Ecosystems (OE)

Chairman: Prof. dr. A.G.J. Buma
Tenured scientific staff in 2013: 1.8 fte

Quality: 4.5
Productivity: 4.5
Societal relevance: 3.5
Vitality and feasibility: 4

OE aims to reveal the impacts of climate change on marine organisms and ecosystems and to contribute to the development of sustainable energy and marine management scenarios. Sub programs concern climate change impacts on marine primary production and diversity; interactions of trace elements in the oceans with the carbon cycle; and marine behavioral mechanics, energetics and biomimetics.

Quality

OE is producing scientific results of very good to excellent quality. The scientists of OE were very successful in applications for larger research grants and were project leaders on the international level (EC grants). They gave quite a number of invited talks and were often present in the media. The international visibility is very high.

Productivity

The productivity is very high (Buma: 84 articles, 2084 citations, h-index 26; De Baar: 172 articles, 7225 citations, h-index 45; Stamhuis: 36 articles, 824 citations, h-index 16).

Societal relevance

The societal relevance of the research is high (algal physiology, marine biogeochemistry, impact of global change on marine ecosystems with possible consequences for fisheries) or potentially high (production of specific organic compounds as, for example, poly-unsaturated fatty acids from cultivation of microalgae, biofuel from unused algal components as a side-product, optimization of ship hulls (reduced fuel demand) or wind mills (high energy generation over a large range of wind speeds)).

Vitality and feasibility

Given the competence of the leading scientists and their success in application for grants etc. the viability and feasibility of the group is very high. The group is involved in the national research consortium 'Towards Biosolar Cells' and cooperates with companies cultivating algae or treating waste waters. The plan to advertise a tenure track position in the research area 'Marine CO₂-fluxes/global carbon cycle' (with the implication of a close cooperation with CIO) is fully supported by the Review Committee.

Place within ESRIG

Although the main focus of OE is fundamental research outside the 'energy' topic (for example, Buma has long term commitments with respect to research at the NWO Dirck Gerritsz Laboratory, established at the Rothera Research Station, Antarctica), the group has to offer a lot of knowledge and ideas of relevance for other research groups within ESRIG. Cooperations with CIO exist, however, could be strengthened (for example, by joint PhD supervision or the new tenure track position in the research area 'Marine CO₂-fluxes/global carbon cycle'). According to the Committee, shared projects are possible with IVEM and CT.

Currently, it is not clear whether the work of Stamhuis - which is potentially of high relevance for saving (ships) or producing (wind mills) energy - will lead to a technological breakthrough and thus it might be called a risky project. Risky projects with potentially large impacts is exactly what is expected from an institute like ESRIG.

3.5 Combustion Technology (CT)

Chairman: Prof. dr. H.B. Levinsky
Tenured scientific staff in 2013: 1.3 fte

Quality: 4
Productivity: 2.5
Societal relevance: 4
Vitality and feasibility: 3

The mission of CT is to study combustion on a microscopic level and to produce a theoretically coherent description. The emphasis has been on NO formation under low-oxygen, high temperature conditions and its relation to flame structure; the effect of fuel composition on combustion performance; and the formation of silica in high-temperature reacting systems.

Quality

The group has a specialized and focused research portfolio. The quality of the research and of the publications is very good and internationally recognized. The group cooperates with distinguished international researchers. The research infrastructure is excellent with up to date laser diagnostic measurement equipment like LIF, Raman, LII and CARS.

The dissemination of the knowledge to practical communities and to policy makers and the translation of the knowledge into the engineering practice, which are part of the mission of the group, are being fulfilled in a natural way because the group leader also has a position at DNV GL. On these aspects of the mission there are possibilities for further cooperation with ESRIG groups like IVEM, GE and SSG.

Productivity

After the move from Chemistry to Physics the group has decided to focus on teaching and in this way increase visibility and attract bachelor and master students from the Physics department. The group made a choice not to recruit PhD's from another Dutch university or from abroad and to rely fully on their own 'breed'. This policy has led to a long period without any PhD in the group. From 2010 till 2013 all research projects were carried out by post docs. The presence of PhD's is crucial for a research group. The absence of PhD's is reflected in the low score on productivity.

Societal relevance

The relevance of the research of this group is high. The introduction of new biomass derived fuel leads to fundamental and technical problems, which are addressed by the group. Also the fact that DNV GL has been sponsoring the Chair in the past and will do so in future means that the societal relevance of the research is high.

Vitality and feasibility

The combustion technology group is very small and certainly has to grow in the coming years.

The group is very dependent on the sponsoring of DNV GL. This makes the group vulnerable. Without the DNV GL contribution the group would run into financial problems. The productivity especially in the form of number of PhD students has to increase in order to make the group financially sound. The group should not only rely on the recruitment of PhD's educated at RUG, but also recruit externally.

Place within ESRIG

At present the group has a rather narrow, specialized research line. It seems to be a bit isolated within ESRIG. There are possibilities however to make more links with other groups within the institute, e.g. in the area of the natural gas infrastructure. This will also increase the group's visibility for bachelor and master students.

3.6 Geo-Energy (GE)

Chairman: Prof. M.A. Herber
Tenured scientific staff in 2013: 1.0 fte

Quality: 3
Productivity: 3.5
Societal relevance: 4.5
Vitality and feasibility: 3.5

GE is a newly formed group within ESRIG. Its mission is to search for optimization of exploration and production of fossil fuels and the identification of new, renewable energy sources. Main research topics are subsurface storage of CO₂; geothermal energy; and spatial coordination of subsurface activities.

Scores

The Review Committee is of the opinion that the Geo-Energy group has been in existence too short (the first research activities having started only in 2010) and is of a too small size (one permanent staff member) to justify a full quantitative evaluation according to the SEP, and, in hindsight, should only have been included for a qualitative evaluation. However, in line with the terms of reference, the Committee did score the group. All scores should be interpreted as having a wide range of uncertainty.

Quality

During the evaluation period (2010-2013), the group produced two peer-reviewed publications, with another five just published early 2014, which are of good quality. In particular the work on injectivity reduction caused by impurities in CO₂ is of considerable scientific and technical interest. However, the small number of peer-reviewed publications, distributed over several topics (radon flux, electrodialysis, and the physics and social acceptance of CO₂ injection) hampers the assessment.

In addition to the topics listed above, the group also addressed geothermal engineering, shale gas production, induced seismicity, and subsurface spatial planning. These research topics, focused on the use of the subsurface in the Netherlands, have been carefully chosen to avoid major overlap with research efforts of other players in the Dutch earth sciences community, while also in an international perspective they are relevant. However, the Committee considered it a far too broad range, given the very small size of the group during the review period. The planned expansion with a tenure track position in 2014 will somewhat improve this situation. Concentration on two or three topics, e.g. geothermal engineering and near-surface seismic response, as indicated by the group leader during the interview, will be essential to strengthen the academic profile of the group.

Productivity

The low number of peer-reviewed publications mentioned above can be explained by the recent start of the group, as well as by the special situation of its only permanent staff member who recently took up his academic position after an industry career. To justify its scientific existence, the group will have to substantially increase its peer-reviewed output over the coming years. The number of publications for the general public, however, is very high (23 over the review period), and covers a wide range of media, illustrating the very good visibility of the group leader and his highly valued opinion in the public debate.

Societal relevance

The societal and economic relevance of the topics covered by the geo-energy group is very high. Geo-energy, in the form of oil and gas production, has, for many decades, been the prime source of energy for the country, and, with production gradually declining, additional research to extend tail-end gas production is of high economic value. Moreover, the transition to a more sustainable, non-fossil, energy supply will require many sources, and geothermal energy will be one of those. Especially the re-use of abandoned gas wells for geothermal energy production, as proposed and investigated by the group, is a potentially attractive solution for the Northern part of the country which is densely covered with wells. Finally, the recent public outrage about CO₂ injection, shale gas production, and gas-production-induced seismicity further underpin the societal relevance of the geo-energy group's activities.

Vitality and feasibility

As discussed above, the Committee deems the current very small size of the group, especially in combination with its wide range of research topics, undesirable and unsustainable. The foreseen addition of a tenure-track staff member, with the corresponding expected increase in the number of PhD students, will improve the situation. Nevertheless, the Committee strongly recommends a clear focus, i.e. a reduction of the number of research topics, and the avoidance of being driven by ad-hoc funding opportunities. Instead, it is recommended that the new tenure-track staff member actively pursues Dutch government (e.g. NWO Veni, STW 'perspectief') and EU (H2020) grants, as a supplement to the industrial funding sources which have been successfully exploited by the group so-far.

Another suggestion concerns the possibility to increase the 'supervision capacity' of the group through teaming up with other research groups and developing a system of dual supervision of PhD students (i.e. two promotors per PhD student, one of each group). These steps, in combination with the strong network and broad industry experience of the group leader, and the high level of enthusiasm and motivation of the current group members, will form a good basis for a further development of the group.

Place within ESRIG

The high societal relevance of geo-energy, as described above, makes the geo-energy group an important player in ESRIG. The Committee sees many opportunities to increase the cooperation between the various groups in the institute, and this also holds for the geo-energy group. In particular there exist clear links with some of the research performed in IVEM, CIO and SSG, and the Committee recommends an active strategy to pursue joint research proposals (both for government grants and industrial funding) and dually supervised PhD positions.

The broad experience of the group leader with stake-holder communication could form the basis of the development of a trans-disciplinary research approach, not only for the geo-energy group but for the institute as a whole.

Appendix 1

Description of the institute and its research activities

‘Energy’ is one of three main themes at the University of Groningen; the other themes are ‘healthy ageing’ and ‘sustainable society’. Within the Faculty of Mathematics and Natural Sciences (FMNS), the Energy and Sustainability Research Institute Groningen (ESRIG) was founded in 2010 to contribute to this theme. ESRIG was composed by uniting five existing groups from different departments to which a sixth (GE) was added.

Total research staff of ESRIG in 2013 is 34.0 fte: 12 tenured staff, 5.4 non-tenured staff and 16.6 internal PhD students. The institute’s director is prof. dr. H.A.J. Meijer.

The mission of ESRIG is: to contribute to the global energy supply in the coming century, for more people, and in a more sustainable way. Research is driven by the awareness that an abundant and cheap supply of energy is crucial for human societies, but that it may be challenging to provide a sufficient supply on the long term. Also, environmental effects of energy use are taken into account.

Research is both fundamental and applied or orientated towards application. It concerns energy supply and conversion, energy-related sustainability and the interaction between science and society. Societal outreach is seen as important and ESRIG collaborates with a variety of stakeholders.

The six research programs (basic units) are:

Centre for Energy and Environmental Sciences (IVEM)

Centre for Isotope Research (CIO)

Science and Society Group (SSG)

Ocean Ecosystems (OE)

Combustion Technology (CT)

Geo-Energy (GE)

ESRIG is involved in undergraduate and graduate education. It contributes to several bachelor programs and offers the two-year master program Energy and Environmental Sciences. PhD students participate in the Graduate School of Science of FMNS.

Appendix 2

Curriculum vitae of committee members

Prof. Dr. Martin Heimann

Prof. Dr. Martin Heimann is director at the Max-Planck-Institut for Biogeochemistry, member of the Max-Planck-Society and honorary professor at the Friedrich-Schiller-University of Jena, Germany. Over the last four decades, Heimann has worked on analyzing and modeling the global carbon cycle and its interaction with the physical climate system.

Heimann received a PhD in physics at the University of Bern, Switzerland. In 1982 he worked as a research assistant at the Scripps Institution of Oceanography in La Jolla, California. In 1985 he became workgroup leader at the Max-Planck-Institute for Meteorology in Hamburg, Germany and in 1998 he joined the newly founded Max-Planck-Institute for Biogeochemistry in Jena, Germany.

Heimann coordinated numerous national and European projects in global and regional carbon cycle research. He has been a lead author in Working Group I of the last four assessment reports of the Intergovernmental Panel on Climate Change (IPCC), he is editor of several scientific journals, and review editor of *Science*. He is an elected member of the Academia Europaea.

<http://www.bgc-jena.mpg.de/bgc-systems/pmwiki2/pmwiki.php/Staff/HeimannMartin>

Prof. Roland W. Scholz

Prof. Roland W. Scholz has held the Chair of Environmental Sciences: Natural and Social Science Interface at the Swiss Federal Institute of Technology (ETH Zürich, Switzerland) from 1993-2012. Currently, he is adjunct professor of Psychology at the University of Zürich (Privatdozent), Professor Extraordinaire at the School of Public Leadership, University of Stellenbosch (South Africa) and project leader at Fraunhofer IWKS (Germany). Scholz was elected as the fifth holder of the King Carl XVI Gustaf Professorship 2001/2002 at Chalmers University of Technology (Sweden).

Scholz graduated in Mathematics and Psychology (Dr. phil. habil. Dipl. Math). He specialized in decision sciences and systems analysis, cognitive and organizational psychology, environmental modeling, evaluation and risk assessment. Scholz ran large scale transdisciplinary case studies since 1993 and contributed to the theory and practice of transdisciplinarity. His current research field is theory, methodology and practice of coupled human-environment systems research.

<http://www.uns.ethz.ch/people/formerhead/scholzr>

Prof. dr. ir. Jan Dirk Jansen

Prof. dr. ir. Jan Dirk Jansen is professor of Reservoir Systems and Control and department chair in the Department of Geoscience and Engineering of Delft University of Technology (TU Delft) in the Netherlands. In 2010-2011 he spent a year as Cox visiting professor at the Department of Energy Resources of Stanford University.

Earlier, he spent many years in the petroleum industry in research and operational positions in the Netherlands, Norway and Nigeria. His current research is focused on the application of systems and control theory to subsurface flow, and in particular the use of adjoint-based optimization and model-order reduction methods.

<http://www.citg.tudelft.nl/index.php?id=21383&L=1>

Prof. dr. ir. Theo H. van der Meer

Since 1999, professor Th. H. van der Meer leads the Thermal Engineering group at the University of Twente. Topics of research are: turbulent combustion, heat transfer and thermal conversion of biomass.

Van der Meer studied Applied Physics at Delft University of Technology. He finished his master's degree in 1976 and started as an assistant professor in the same research group. In 1987 he obtained his PhD degree on the topic: Heat transfer from impinging flame jets. After a sabbatical leave at the University of Waterloo in Canada, he returned to Delft as an associate professor in the Heat Transfer section, till he went to Twente in 1999.

Van der Meer is the Dutch delegate in a number of international committees, for conferences, like Eurotherm, International Centre for Heat and Mass Transfer and the Assembly for International Heat Transfer Conferences. He is (co-)author of more than 100 scientific publications.

<http://www.utwente.nl/ctw/thw/People/Professors%20and%20senior%20staff/prof/vandermeer/>

Prof. Dr. Dieter Wolf-Gladrow

Prof. Dr. Dieter Wolf-Gladrow is professor of Theoretical Marine Ecology at the University of Bremen since 1999 and head of the section Marine Biogeosciences at the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI) since 2004. His research interests are global carbon cycle; marine biogeochemistry; process-based understanding of paleo-proxies; lattice-gas cellular automata; and lattice Boltzmann models.

In 1985, Wolf-Gladrow finished his PhD in Physics at the University of Köln. He went on as a post doc at the AWI, where he got a position of senior scientist in 1990. In 1996 he achieved his Habilitation in Environmental Physics at the University of Bremen. Wolf-Gladrow published two books and more than 70 articles in peer-reviewed scientific journals. In 1994, he was awarded the Wilhelmshaven Award for Marine Research.

<http://www.awi.de/People/show?wolf>

Appendix 3

Program site visit

April 1

17.00 Welcome by the Director of ESRIG, prof. dr. H.A.J. Meijer
17.30 Preparation of the site visit by the plenary Committee
19.30 Welcome and briefing by the Dean of the Faculty, prof. dr. J. Knoester

April 2

Morning
9.00 Interviews with program leaders
Centre for Energy and Environmental Studies (IVEM): Grootjans, Moll, Nonhebel
9.30 Centre for Isotope Research (CIO): Meijer
10.00 Science & Society Group (SSG): Swart, van der Windt
10.30 Ocean Ecosystems (OE): Buma
11.00 Combustion Technology (CT): Levinsky
11.30 Geo-Energy (GE): Herber

12.15 Introduction by PhD students Dipayan Paul (CIO) and Gideon Laugs (IVEM)
12.30 Lunch with PhD students and post docs

Afternoon

13.30 Labtour starting with OE, then CT and CIO simultaneously
14.30 Interviews with selection of stakeholders
Dr. Sander Gersen, Consultant Combustion Processes, DNV GL
Dr. Monique A. Schoondorp, Managing partner, Algaecom
Dr. Frits P. Bakker, Senior Researcher Environmental Assessment, ECN
B. Pents, Natuur en Milieufederatie Groningen
W. Veldstra, ecologist and policy maker, Municipality of Groningen
16.00 Interview Meijer and Herber, director of ESRIG and Chairman of the Board of ESRIG
16.30 Interview with prof. G.P.J. Dijkema (Delft University of Technology), head of IVEM from June/July 2014, via skype
16.54 Committee discusses its findings
17.00 Presentation of the preliminary results