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INITIAL ACCREDITATION

PROFESSIONAL MASTER MATERIALS & ENERGY TRANSITION

Avans University of Applied Sciences

FULL REPORT

5 February 2024

Content

1 Peer review

The Accreditation Organisation of the Netherlands and Flanders (NVAO) determines the quality of a new programme on the basis of a peer review. This initial accreditation procedure is required when an institution wishes to award a recognised degree after the successful completion of a study programme.

The procedure for new programmes differs slightly from the approach to existing programmes that have already been accredited. Initial accreditation is in fact an ex ante assessment of a programme. Once accredited the new programme becomes subject to the regular review process.

The quality of a new programme is assessed by means of peer review. A panel of independent peers including a student reviews the plans during a site visit to the institution. A discussion amongst peer experts forms the basis for the panel's final judgement and the advisory report. The agenda for the panel visit and the documents reviewed are available from the NVAO office upon request.

The outcome of this peer review is based on the standards described and published in the limited NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2019, nr. 3198). Each standard is judged on a three-point scale: meets, does not meet or partially meets the standard. The panel will reach a conclusion about the quality of the programme, also on a three-point scale: positive, conditionally positive or negative.

NVAO takes an accreditation decision on the basis of the full report. Following a positive NVAO decision with or without conditions the institution can proceed to offer the new programme.

This report contains the findings, analysis and judgements of the panel resulting from the peer review. It also details the commendations as well as recommendations for follow-up actions. A summary report with the main outcomes of the peer review is also available.

Both the full and summary reports of each peer review are published on NVAO's website www.nvao.net. More information on NVAO and peer reviews of new programmes can also be found there.

2 New programme

2.1 General data

Institution	Avans University of Applied Sciences
Programme	Materials & Energy Transition
Variants	Fulltime
Degree	Master of Science
Locations	Breda
Study load	120 ECTS credits[1]
Field of study	Technology (Techniek)

2.2 Profile

The professional master's programme Materials & Energy Transition offers students with a background in science and/or engineering the opportunity to deepen their understanding of the materials and energy technologies as well as transition science. Graduates are 'transition engineers' who take an interdisciplinary perspective in leading transition processes at various scales of operation, and support organisations in making strategic choices. They have a practical-critical and inquisitive attitude and are able to communicate effectively with experts from different disciplines to make an impact in the transition to a more sustainable society.

The programme has been developed in close cooperation with the Avans Graduate Institute, the Academy for Life Sciences and Technology and the Centre of Expertise MNext. The Avans Graduate Institute is currently developing multiple master's programmes that promote learning, innovation and knowledge co-creation in interdisciplinary and transdisciplinary environments. It aims to empower students to act and care for the world so they can contribute to changing an increasingly complex and interconnected world.

2.3 Panel

Peer experts

- Dr. Corina Vogt (chair), programme manager and teacher in the European Master for Renewable Energy (EMRE) and Master for Sustainable Energy System Management (SESyM), Hanzehogeschool Groningen;
- Dr. Ir. Marcel den Hollander, lector Circular Design & Manufacturing, Hogeschool Rotterdam;
- Dr. Nick Verkade, teacher-researcher Circular Economy, Hogeschool van Arnhem en Nijmegen;
- Anina Jonker BSc (student member), master student Climate Studies, Wageningen University.

Assisting staff

- Anne Martens MA, secretary;
- Drs. Jona Rovers, NVAO policy advisor and process coordinator.

Site visit

Breda, 18 December 2023.

[1] European Credit Transfer and Accumulation System

3 Outcome

The NVAO approved panel reaches a positive conclusion regarding the quality of the master's programme Materials & Energy Transition (MET) offered by Avans University of Applied Sciences. The institution intends to offer the programme of 120 ECTS credits as a fulltime programme in Breda. The programme complies with the three standards of the limited NVAO assessment framework.

The programme addresses a relevant and complex topic in society: it intends to deliver 'transition engineers' who lead transition processes related to materials and energy, at various scales of operation. They have a practical-critical and inquisitive attitude and are able to communicate effectively with experts from different disciplines to contribute to a more sustainable society. The programme has thought carefully about the design of the curriculum, which covers a wide range of topics yet has sufficient depth. The master's programme goes beyond pure engineering and addresses the socio-economic context of science and technology. Students learn how to use in-depth knowledge of a specific domain as a tool to achieve results in a wide range of areas. MET also addresses professional skills related to project management, change management, interdisciplinary cooperation and communication. In addition, students learn to reflect on the usefulness and necessity of technology when developing solutions.

The MET curriculum consists of four themes – (1) generic knowledge and skills, (2) materials, (3) energy, and (4) transitions – that recur in different compositions. Throughout the programme, students work on authentic group projects that integrate all aspects of the curriculum and prepare students for project leadership. The outcome of one project is the input for the next project of a different team. This 'relay race' approach reflects professional reality. In a final graduation project, students specialise in material, energy or transitions, and experience what implementing transitions is like and how to deal with hiccups.

The panel is positive about the programme's qualified, enthusiastic and committed staff members. All core teachers have obtained a PhD and have a research assignment that is closely related to their educational assignment at MET. The panel appreciates the close involvement of lectors and external stakeholders in the development and realisation of the programme. This ensures a strong connection between education, research and professional practice.

Assessments are well-designed and have a clear link to professional practice. The Examination Board has yet to be formally appointed and the members still have to take up their formal role. Given the available experience among the Examination Board members, the panel is confident that the Graduate Institute will ensure the independent position of the Examination Board.

The panel concludes that MET is an attractive and relevant new programme. It enables students with a background in science and/or engineering to deepen their understanding of the materials and energy technologies as well as transition science. The panel agrees with the programme's argumentation regarding its choice for an English-taught curriculum and a study duration of 120 ECTS credits.

Standard	**Judgement**
1. Intended learning outcomes	meets the standard
2. Teaching-learning environment	meets the standard
3. Student assessment	meets the standard
Conclusion	*positive*

4 Commendations

The programme is commended for the following features of good practice.

1. Development – The programme has been developed in close cooperation with lectors, researchers and representatives of the professional field.

2. Skills – Students develop technical in-depth knowledge and professional skills related to project management, change management and communication.

3. Projects – Small teams of students work on authentic projects that integrate all aspects of the curriculum and prepare students for project leadership. The outcome of one project is the input for the next project of a different team. This 'relay race' approach reflects professional reality.

4. Interdisciplinary – The programme strives for a diverse student body to foster students' ability to cooperate across disciplines.

5. Assessment – Assessment is authentic and matches professional practice.

5 Recommendations

For further improvement to the programme, the panel recommends a number of follow-up actions.

1. Workload – Monitor the workload of the teaching staff.

2. Examiners – Formally require examiners of the graduation project to hold a PhD.

3. Examination Board – Ensure that the members of the Examination Board can take up their independent role, with a focus towards assessment procedures instead of the development of the programme.

6 Assessment

6.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Judgement
Meets the standard.

Findings, analysis and considerations
The master's programme Materials & Energy Transition (MET), offered by Avans University of Applied Sciences, intends to deliver graduates who can contribute to the transition to a climate-neutral, circular and emission-free society. It offers students with a background in science and/or engineering the opportunity to deepen their understanding of the materials and energy technologies as well as transition science. Graduates are 'transition engineers' who take an interdisciplinary perspective in leading transition processes at various scales of operation, and support organisations in making strategic choices. They have a practical-critical and inquisitive attitude and are able to communicate effectively with experts from different disciplines.

The panel acknowledges that the programme addresses a relevant and complex topic in society. Initially, however, the panel had concerns about the feasibility of the programme because of the wide range of topics it intends to address. The programme focuses on existing and emerging technologies for energy and materials, and on their synergistic combination. It combines these technologies with organisational and policy aspects. During the site visit, the panel talked about the programme's scope and learnt that the institution has thought carefully about the breadth, depth and complexity of the issue and how this can be conveyed to students. The programme aims to deliver graduates who can contribute to materials and energy transitions, connecting disciplines, and it prepares students to continuously develop themselves to become change agents. The panel considers this to be a reasonable, balanced and feasible goal for a professional master's programme that aligns with the expected level.

According to the panel, the programme's proposition has been translated adequately to learning outcomes. The programme has formulated eight intended learning outcomes ('final qualification elements' or 'QE') that explain the necessary competences and expected level. They address both knowledge and skills. The information file explains that the level has been derived from the European Qualification Framework (EQF) and the Professional Master Standard (Netherlands Association of Universities of Applied Sciences, 2019). The content of the QE is based on the European sustainability framework GreenComp. The panel confirms that the QE are relevant, clearly formulated, well-structured and represent the professional master's level. The international relevance of the programme is clear. MET takes an international perspective because of the international nature of the energy and materials industries, related policies, as well as sustainability and scientific activity in general.

The panel considers it a strength that the programme has been developed in cooperation with lectors and other researchers from the Centre of Expertise MNext. Additionally, the institution consulted a broad stakeholder group (BSG), with representatives from companies, local and regional governments as well as agencies. The panel spoke with engaged lectors and industry representatives who support the programme's plans and are eager to work with its students. They see concrete positions for future graduates and confirmed that the programme meets the needs of the (regional) labour market and society at large. The panel was pleased to hear that

the programme listens to its stakeholders while maintaining a critical stance in order to safeguard its profile.

The panel concludes that the programme's intended learning outcomes are in line with what is to be expected of a professional master's programme. They address both knowledge and skills related to relevant topics and are formulated clearly. The panel sees a clear link with current developments in the professional field and discipline. The panel appreciates the close involvement of lectors and external stakeholders in the development of the programme. Based on these findings and considerations, the panel concludes that the programme meets standard 1.

6.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Judgement
Meets the standard.

Findings, analysis and considerations
The panel established that the programme's intended learning outcomes have been translated adequately to a curriculum with a well-thought-out and inspiring set-up. The MET curriculum has a proposed study duration of 120 ECTS credits and lasts two years. It consists of four consecutive modules (15 ECTS credits each) in the first year and an individual graduation project that spans the entire second year. Each first-year module consists of two courses and a project in which the knowledge from the courses is applied. The programme builds up in complexity and independence. The first year is devoted to knowledge building and practice of the QE at intermediate level. In the second year, all QE are dealt with again and assessed at master's level.

The programme distinguishes four themes – (1) generic knowledge and skills, (2) materials, (3) energy, and (4) transitions – that recur in different compositions in the modules. Thus, each module has its own emphasis while it addresses all themes. In the final graduation project, students specialise in material, energy or transitions. The panel studied the first-year module manuals and electronic learning environment and confirms that the content of the courses and projects are well-documented. The panel thinks that the division into themes and their application in the modules is insightful and logical.

In line with the institute's educational vision, students receive education that meets the following six elements: (1) meaningful learning, (2) authentic, practice-oriented and problem-based education, (3) collaborative learning across borders, (4) research-driven education and research-based learning, (5) attention to autonomy, and (6) learning supported by technology. The panel recognises these elements in the design of the MET programme.

MET integrates the development of generic knowledge and core skills. The programme goes beyond pure engineering and addresses the socio-economic context of science and technology. Students learn how to use in-depth knowledge of a specific domain as a tool to achieve results in a wide range of areas. To do so, students need to master professional skills in order to connect to others and convince them. The programme therefore addresses skills related to project management, change management and communication. Students also learn to reflect on the usefulness and necessity of technology when developing solutions. The panel thinks this is a clever approach that makes the objectives of the programme feasible. The programme

offers sufficient in-depth knowledge and lets students practice their skills in a professional context.

The first-year projects are characterised as 'broad rather than deep'. Each project has the potential to make an impact on a societal challenge with material, energy and transition aspects. Students apply what they have learnt about technology and transitions. Students work in small teams and demonstrate their knowledge and skills in problem analysis (first module), product engineering or systems engineering and integration (second and third module), and implementation and evaluation (fourth module). Throughout the projects, students develop their research skills: they articulate meaningful research questions, create reliable and data-driven scientific models to analyse and solve transition problems, explore how solutions can create impact, interpret data and assess the validity, reliability and completeness of research findings. The panel appreciates how the projects integrate all aspects of the curriculum and prepare students for project leadership.

The outcome of a project in a module is the input for the project in the next module, where a different team takes over. The new team decides if and how it continues with the project and sets its own objectives. During the site visit, the panel talked about this approach to get a better understanding of the rationale and the practicalities. The panel learnt that the programme deliberately chose this design to let students experience the 'relay race' that transition engineers are part of in professional practice. They must be able to become familiar with a situation quickly, work on a project and then transfer their work to others, presenting it convincingly. If a team's results are of insufficient quality, the teaching staff will provide an alternative starting point for the next team. The panel thinks that the 'relay race' approach is a very strong one that reflects reality.

The second year is dedicated to the graduation project, an individual project that aims at making impact through applied research at master's level. It is geared towards the analysis of a specific multi-actor and multi-level problem and towards synthesising, implementing and validating a suitable engineering solution. This project is characterised as 'deep instead of broad'. It has three phases related to three deliverables: (1) a project plan (define), (2) an interim report (analyse and synthesise), and (3) a final report (implement and evaluate). Students specialise in materials, energy or transitions, including one or multiple technological solution elements. Students also specialise in a domain and a type of actor.

The graduation project is carried out during an internship at a company, government agency, MNext or other centre of expertise. Students may come up with their own project or use any of the programme's suggestions. The panel spoke with representatives of the professional field who are eager to work with MET students and have concrete and relevant projects available. They expect that students will get the chance to make an impact because there is a great need for the students' expertise. The panel is of the opinion that the graduation project will enable students to experience what implementing transitions is like and how to deal with hiccups.

After reading the information file, the panel wondered whether the programme aims for transitions at micro, meso or macro level. The panel spoke with MET representatives about this and also asked how these levels will be addressed in the curriculum. The panel concludes that MET addresses mainly small and large companies, while the other levels are touched upon because organisations have to deal with actors at other levels (e.g. national and European policy makers). Lecturers explained that business economics is addressed in every module. The panel agrees this is important because financial aspects play a major role in the acceptance of solutions and the willingness of parties to participate in transitions.

The programme is offered by the Academy for Life Sciences and Technology and is developed in close cooperation with the Academy for Life Science and Technology, the Centre of Expertise MNext and the Avans Graduate Institute. The Graduate Institute is currently developing multiple master's programmes that promote learning, innovation and knowledge co-creation in inter- and transdisciplinary environments. It aims to empower students to act and care for the world so they can contribute to changing an increasingly complex and interconnected world. The panel considers it a strength that the institution has involved external expertise on the professional master's level in the development of its new master's programmes.

MET intends to attract a diverse student population – both academically and culturally – to promote interdisciplinary cooperation and intercultural sensitivity. Applicants must have a bachelor's degree in science and/or engineering and a desire to deepen their understanding of materials and energy transitions. Suitable applicants are invited for an individual intake interview. Where possible, multidisciplinary teams will be formed and the group composition will change each module. The panel thinks this is an asset of the programme that will foster students' ability to cooperate across disciplines.

In each first-year module, the first seven weeks are devoted to regular teaching and learning activities and the remaining three to finalising project work, course assessments and a concluding project event. MET encourages students to take responsibility for their learning by using activating education and it takes a practical stance towards generative artificial intelligence: students are taught to use it in a smart and responsible way.

According to the panel, MET pays ample attention to social pedagogical prerequisites and community building. The programme organises a weekly 'Learning Community Day' with central activities (e.g., module kick-off, guest lectures, excursions, workshops) for all students, lecturers, researchers and external partners. The programme encourages peer learning, thus simulating professional practice, and student learning teams meet every two weeks. Every module ends with a joint activity (e.g., symposium) where first and second-year students connect.

In line with the programme's didactic approach, students receive a lot of personal guidance. Students are guided by teachers on subject matter as well as the development of personal and professional identity. First-year project teams have a dedicated supervisor with expertise in the project's subject. In addition, an external client from industry, MNext or another relevant organisation is involved. The panel expects this will be an appealing feature to students. During the graduation project, students are coached by multiple people: a MET supervisor, a mentor from the internship organisation and a detached critic. The supervisor challenges students to strengthen the transition thinking with substantive and technical depth. Small groups of students meet twice every quarter to exchange experiences and to learn with and from each other. Additional coaching is available for students who need extra support.

The panel is positive about the programme's qualified, enthusiastic and committed staff members. All teachers have at least a relevant master's degree and are didactically trained. A core team of five teachers is responsible for the development of the curriculum. They also deliver most of the content and fulfil complementary roles. The panel recommends to monitor their workload. All core teachers have obtained a PhD and have a research assignment that is closely related to their educational assignment at MET. This ensures a strong connection between education and research. In addition, the programme can call on a flexible shell with specialist teachers and guest lecturers. Throughout the site visit, the panel noted that all staff members work closely together and that they are aware of possible challenges MET will bring.

The programme uses the facilities of Avans University of Applied Sciences in Breda. These include a study landscape and well-equipped laboratories. The programme is strongly connected to centres of expertise (e.g., MNext) and lectorates (e.g., Smart Energy and New Materials), whose working spaces of MNext are located in the same building. The programme uses the online learning platform Brightspace. The panel reviewed the physical and digital facilities and found them to be appropriate for the programme.

The programme is offered in English. The panel agrees with the programme that this is a reasonable choice because of the international nature of the materials and energy transitions. However, students who work on projects at small and medium-sized enterprises will likely use a local working language. Nevertheless, the panel agrees that an international learning community will give students broader insights and prepare them for their future careers, where it is important to be able to communicate in English. MET is well-prepared for this: teaching staff are required to have an English language proficiency at C1 or C2 (CEFR[2]) and applicants have to provide proof of their English language skills. If necessary, Avans University of Applied Sciences provides language training. Within the institution, expertise on internationalisation and working with international classrooms is available.

The panel comes to the conclusion that MET has translated its intended learning outcomes into a relevant curriculum that is well-thought-out and has a clear structure. It addresses the three core topics materials, energy and transitions as well as relevant professional skills. The programme provides an inspiring learning environment, involving external partners from research and industry. This will ensure that the programme is fed by new developments and insights into the field of materials and energy transitions. The curriculum has been developed and will be delivered by dedicated and qualified staff members, who have thought very carefully about the programme's goals and how they can be realised. Avans University of Applied Sciences has adequately argued why the programme is taught in English and why it has an English name. All in all, the panel concludes that the programme meets the requirements of standard 2.

6.3 Standard 3: Student assessment

The programme has an adequate system of student assessment in place.

Judgement
Meets the standard.

Findings, analysis and considerations
The panel confirms that the programme has an assessment plan that is in line with Avans University of Applied Sciences' vision on assessment. Assessment is supposed to guide and stimulate learning (formative function) and to decide whether students meet the programme's requirements (summative function). Learning outcomes, learning activities and assessment fit together to provide a continuous insight into students' development and to enable careful decisions about students' professional competences. This also gives students insight into their own progress and lets them experience that feedback is relevant to their own development. The assessment content and modes should reflect the future practice and way of working of a master professional, to show how they can have an impact on their environment. For MET, the QE have been translated into learning outcomes with professional performance and the final

[2] Common European Framework of Reference for Languages

level is based on professional practice. Thus, assessment is authentic and matches reality, which the panel considers to be a strong approach.

Each first-year course and module has its own test moment, related to 5 ECTS credits. The assessments have been developed by the core staff team, who consulted stakeholders in the professional field, the connected Centres of Expertise and members of the intended Examination Board. The programme deploys a wide range of assessment methods, with only a limited number of 'classic' written exams. The QE and related knowledge and skills are tested in multiple ways to rule out bias. Students provide theoretical justification, evaluation and reflection, and present their work by means of professional presentation methods. According to the panel, this setup is likely to be inspiring and motivating to students.

Examiners calibrate and use rubrics to assess students' work, which contributes to equal treatment. The rubrics have been worked out concretely for each test and provide a representation of the master's level. They show a clear relationship between the professional performance and the learning outcome, and use measurable criteria. Students are assessed individually – also in group work – and must pass all elements of the rubrics.

The information file explained that MET works with three possible grades – fail, pass or distinctive – to reflect reality, where professionals do not get a mark but their work has to be of sufficient quality. The teaching staff acknowledged that a distinctive grade requires a good view on students' individual performance and said that they expect that the personalised approach will give them sufficient information. The panel advises to monitor this practice, especially if the student population grows. The panel learnt that students who receive a distinctive grade on at least 80% of all ECTS credits, graduate cum laude. The panel considers it important that the programme double-checks the use of grading terminology in the programme's Education and Examination Regulations.

All teaching staff are trained examiners and hold a BKE[3] qualification. In the final year, students are always assessed independently by two examiners. The panel recommends formally requiring examiners of the graduation project to hold a PhD. External clients and delegates from MNext have an advisory role in assessment and grading, which is an aspect the panel appreciates.

The Graduate Institute has established an Examination Board for all new master's programmes. The panel spoke with members of this board and learnt that they have experience in other Examination Boards, they have been trained for their role and one member is an expert on the professional master level. The panel is positive about this expertise. The members explained that they work with an assurance officer and will follow a comprehensive agenda to safeguard the quality of assessment. However, the panel understood that the board is still in its early stages and that it awaits an update of Avans University of Applied Sciences' general Education and Examination Regulations for the master programmes. The panel deems it essential that the board is put in position to fulfil its independent position and that it shifts its focus towards assessment procedures instead of the development of the programme. The panel also advises the Examination Board members to attend the examiners' calibration sessions.

The panel concludes that the programme has the foundations for a suitable system of assessment that support students' learning processes. The assessments are well-designed and have a clear link to professional practice. The panel established that students will be

[3] Basic Qualification Examination ('Basis Kwalificatie Examinering')

adequately informed about assessment procedures and criteria. Examiners are adequately prepared for their role, and rubrics and calibration sessions support equal assessment across examiners. The panel recommends formally requiring examiners of the graduation project to hold a PhD. The Examination Board has yet to be formally appointed and the members still have to take up their formal and independent role. Given the available experience among the Examination Board members, the panel is confident that the Graduate Institute will ensure the independent position of the Examination Board. Based on these findings and considerations, the panel concludes that the programme meets standard 3.

6.4 Duration of the programme

The programme provided several arguments for the study load of 120 ECTS credits. Making an impact in the materials and energy transitions requires a thorough understanding of material cycles, energy systems and how these two topics are intertwined. Students must learn the intricacies of implementing new technologies in the real world, both at the industry and governance level. This requires skills in applied research, project management, communication and reflection. In addition, the programme has an interdisciplinary focus and intends to attract students from diverse engineering backgrounds. It will bring all students to the same basic level of understanding regarding materials, energy and transitions, while allowing students to maintain and strengthen their individual expertise. Finally, external stakeholders advised a one-year graduation project so students go beyond writing an implementation plan and really experience implementing transition within an organisation.

The information file explains the position of the new master's programme as compared to related programmes within the Netherlands and abroad. In a benchmark exercise, Avans University of Applied Sciences noted that other programmes typically address one aspect (energy, materials or transitions), while MET intends to cover and combine knowledge and understanding of all three areas as well as their interrelationships. According to the institution, this approach requires an extended study duration of 120 ECTS credits.

The panel agrees with this argumentation. The programme addresses a very broad and complex issue that covers elements of three interconnected disciplines. MET intends to deliver transition engineers who can make an impact in the materials and energy transitions. This requires a thorough understanding of the topic and the development of several skills. The panel therefore agrees with the proposed study duration of 120 ECTS credits for the MET programme, based on the requirements of the professional field.

6.5 Degree and field of study

The panel advises awarding the following degree to the new programme: Master of Science. The panel supports the programme's preference for the following field of study: Technology (Techniek).

Abbreviations

ECTS	European Credit Transfer and Accumulation System
MET	Materials & Energy Transition
NVAO	Accreditation Organisation of the Netherlands and Flanders ('Nederlands-Vlaamse Accreditatieorganisatie')
QE	Qualification elements

The full report was written at the request of NVAO and is the outcome of the peer review of the new master's programme Materials & Energy Transition offered by Avans University of Applied Sciences

Application no.: AV-2112

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