



# EURYDICE

Collaborating towards a future in renewable energy

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## WP: 2.3

### D: 2.3.3. Document of the enhanced postgraduate curriculums as a proposal

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	P4	Central University of Technology, Free State (CUT)	South Africa
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## 1. Introduction

One of the main objectives in the Eurydice project is to enhance the employability of students in the field of renewable energies, based on closer collaboration between university and industry. In specific, work package 2.3 seeks to improve the education curricula on diploma, bachelor and postgraduate level by enhancing the aspect of work-integrated-learning (WIL) through industrial exposure. As a preamble to this document D:2.3.3, the reader is encouraged to read D:2.3.1 and D:2.3.2.

### 1.1. Goal of WP 2.3.3

The goal of WP2.3.3 is to analyse the post graduate programs as presented by the respective South African UoTs and use it as basis to propose enhancements to the educational process and curriculum documentation.

### 1.2. Process

Each UoT considered their individual post graduate programs and identified the modules therein which are relevant to renewable energy technologies. A workshop followed where all UoTs presented ideas or aspects which, when incorporated in the educational process, will enrich the student's experience. A list of the proposed ideas/enhancements, grouped per objective are as follow:

#### Increase industrial exposure (X)

- Industry visits to partners (real or virtual)
- Guest lecturing (Industry partners)
- Projects/practical work in conjunction with international university partners
- Incorporate career portal
- Interaction with remote & mobile labs (advanced technologies)
- Networking for university staff to build trust with industry partners
- Topics for Master thesis from the industry

#### Enhance entrepreneurial skills (E)

- Guest lecturing (Professionals & visiting Internationals).
- Include workshops on skills - communication, motivation, creativity, leadership, financials, legal.
- Promote accelerated short courses.
- Subject students to real industry problems.

#### Other (O)

- Opportunities offered by new learning technologies.
- Collaborative research with industry partners.

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Following a similar approach as in deliverable D2.3.2, each UoT matched the proposed ideas to the course modules in a manner, which enhances the curriculum and contributes to the ECSA expectations. The program enhancements presented hereafter are in the form of a design summary, followed by the detailed syllabi.

## 2. Central University of Technology (CUT)

The post graduate programs at the Central University of Technology, i.e.

- HONOURS : ENGINEERING TECHNOLOGY IN ELECTRICAL ENGINEERING (NQF: 8)
- MASTERS : ENGINEERING TECHNOLOGY IN ELECTRICAL ENGINEERING (NQF: 9)

are currently in a developmental stage and are thus not offered yet. However, the preliminary honors syllabus was considered for enhancement. The masters program which is project-based was also revised.

### 2.1. Design summary

Modules in the respective programs, which include aspects of renewable energy, are listed and for each, some enhancements are proposed. The selected enhancements (introduced in section 1.2) are categorized in columns which denotes the industrial expectations of a candidate Alternative Energy Technician (defined in D:2.3.1, Appendix A).

	Investigation	Research and development	Product design	Risk and impact	Project management	Commissioning	Maintenance
<b>Honours</b>							
Energy Management IV	E						
Research Methodology					E		
<b>Masters</b>							
Research project		O	O				

Increase industrial exposure = X / Enhance entrepreneurial skills = E / Other = O

### 2.2. Curriculum enhancements





For the identified modules, enhancements are proposed to feature in specific content areas of the module syllabus. Each area of interest is highlighted and tagged with the specific enhancement.

## Honours: Energy Management IV

		Current curriculum	Proposed enhancements	Outcome
1	Purpose of this module in relation to the programme/s	<ul style="list-style-type: none"> <li>To conduct the energy audit process in buildings and industries</li> <li>To understand different energy tariffs and be able to calculate corresponding energy bills</li> <li>To do economic analysis and life cycle cost of energy management projects</li> <li>To do energy analysis of lightings, HVAC, and electric motor drives, and write audit reports</li> </ul>		
2	Module content	<p>The following topics are covered in this module:</p> <ul style="list-style-type: none"> <li>Background of energy management in South Africa</li> <li>Introduction to energy management</li> <li><b>The energy audit process *</b></li> <li>Energy audit tools and computer software</li> <li>Economic analysis and life cycle costing</li> <li>Energy fundamentals for energy auditors</li> <li><b>Energy optimization *</b></li> <li>Writing energy audit reports</li> </ul>	<p>*Guest lecturing by industrial professionals.</p> <p>Make energy audits together with a company</p> <p>Working on a real problem from the Industry. Simulation of the Energy situation</p> <p>Interpretation and analysing of energy audit reports and verification of the results</p>	Expose students to real-world problems.





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## Honours: Research Methodology

		Current curriculum	Proposed enhancements	Outcome
1	Purpose of this module in relation to the programme/s	<ul style="list-style-type: none"> <li>To use a significant range of experimental methods for engineering research.</li> <li>To substantiate research ethics</li> <li>To demonstrate the use of electronic databases</li> <li>To design and write a research proposal</li> <li>To manage academic report writing and research projects</li> <li>To discuss the University guideline for post-graduate studies</li> </ul>		
2	Module content	<p>The following topics are covered in this module:</p> <ul style="list-style-type: none"> <li>The postgraduate research process</li> <li>Time management</li> <li>Academic writing *</li> <li>Research ethics and plagiarism</li> <li>Structure of a research project</li> <li>Research methodologies</li> <li>Oral presentation skills *</li> <li>University specific guidelines for postgraduate studies</li> </ul>	<p>* Promote accelerated short courses in writing and public speaking.</p> <p>Presentation as "Pitch" in front of Industry stakeholder</p>	<p>Equip students with skills that will enhance confidence and increase research outputs.</p> <p>Increase the awareness of presenting the key points in short time</p>

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## Masters: Research project

		Current curriculum	Proposed enhancements	Outcome
1	<b>Purpose of this module in relation to the programme/s</b>	<ul style="list-style-type: none"><li>Primarily to address a specific research question. The methodology must be well defined, and the results must be analysed and discussed. The student must also be able to draw a logical conclusion from the results of the project.</li></ul>		
2	<b>Module content</b>	<p>The following topics are covered in this module:</p> <ul style="list-style-type: none"><li>Research protocol</li><li>Project *</li><li>Dissertation</li></ul>	<p>* Collaborative research and testing with industry partners.</p>	Bidirectional stimulation.

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## 3. Tshwane University of Technology (TUT)

Programs at the Tshwane University of Technology, which address renewable energy technologies or some aspects thereof, are as follow:

- BEngTech Hons (Electrical Engineering) (NQF: 8)
- MASTERS : IN ELECTRICAL ENGINEERING (NQF: 9)

### 3.1. Design summary

The modules in the respective programs, which include aspects of renewable energy, are identified and for each, some enhancements are proposed. The selected enhancements (introduced in section 1.2) are categorized in columns which denotes the industrial expectations of a candidate Alternative Energy Technician (defined in D:2.3.1, Appendix A).

	Investigation	Research and development	Product design	Risk and impact	Project management	Commissioning	Maintenance
<b>Honours</b>							
Energy Economics and Policy	X	E		X			
Energy Efficiency & Demand Side Management	X	E		X			
Research Methodology	X			X	E		
<b>Masters</b>							
Research Project		O	O				

Increase industrial exposure = X / Enhance entrepreneurial skills = E / Other = O

### 3.2. Curriculum enhancements

For the identified modules, enhancements are proposed to feature in specific content areas of the module syllabus. Each area of interest is highlighted and tagged with the specific enhancement.





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## Honours: Energy Economics and Policy

		Current curriculum	Proposed enhancements	Outcome
1	Purpose of this module in relation to the programme/s	<ul style="list-style-type: none"> <li>To expand the knowledge of students with regard to energy economics and policy.</li> <li>To equip students in energy field with applicable theory and programs</li> </ul>		
2	Module content	<p>The following topics are covered in this module:</p> <ul style="list-style-type: none"> <li>Energy management</li> <li>Energy Accounting*</li> <li>Energy systems and Renewable Energy**</li> <li>Energy policy*</li> </ul>	<p>*Visit to industry partners.</p> <p>**Enhancement with the OpenLab and MobileLab which show cases possibilities and practical applications.</p>	Visual confirmation of theory principles.

## Honours: Energy Efficiency & Demand Side Management

		Current curriculum	Proposed enhancements	Outcome
1	Purpose of this module in relation to the programme/s	<ul style="list-style-type: none"> <li>To equip the students with effective energy management solutions required to meet the challenges and optimization of energy usage in today's challenging and often-unpredictable economic climate.</li> <li>To expose students to good understanding of energy management, heighten judicious and effective use of</li> </ul>		

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<b>2</b>	<b>Module content</b>	<p>The following topics are covered in this module:</p> <ul style="list-style-type: none"> <li>• Energy management programme design</li> <li>• <b>Energy Management Audit. *</b></li> <li>• Energy Management Process Assessment</li> <li>• Control and Process systems</li> <li>• <b>Corporate governance and good practises. *</b></li> </ul>	<p>* Invite professional from the industry (Guest lecturing).</p> <p>Master thesis- Development of Energy management programs together with the industry</p> <p>Simulation of a real control system and compare the results with the real measure data from the industry.</p>	Exposure to the current trends
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### Honours: Research Methodology

		<b>Current curriculum</b>	<b>Proposed enhancements</b>	<b>Outcome</b>
<b>1</b>	<b>Purpose of this module in relation to the programme/s</b>	<ul style="list-style-type: none"> <li>• To help students to develop an understanding of the research process and to undertake research leading to successful completion of their dissertation.</li> <li>• To assist students to develop a research proposal.</li> </ul>		
<b>2</b>	<b>Module content</b>	<p>The following topics are covered in this module:</p> <ul style="list-style-type: none"> <li>• Conceptual Design</li> <li>• <b>Technical Design*</b></li> <li>• <b>Communicating your research*</b></li> <li>• Statistics in research</li> <li>• <b>Research Professionalism*</b></li> </ul>	<p>* Invite professional from the industry (Guest lecturing).</p>	Exposure to the current trends

### Masters: Research Project

		<b>Current curriculum</b>	<b>Proposed enhancements</b>	<b>Outcome</b>





1	<b>Purpose of this module in relation to the programme/s</b>	<ul style="list-style-type: none"> <li>For students to work on research independently and expose students to Scientific Principles</li> </ul>		
2	<b>Module content</b>	The following topics are covered in this module: Dissertation (Research Project)	* Collaborative research and testing with industry partners.	Bidirectional stimulation.

## 4. Durban University of Technology (DUT)

The postgraduate program at the Durban University of Technology, which addresses renewable energy technologies or some aspects thereof, is:

- BEngTech Hons (Electronic & Computer Engineering)

This program is currently under detailed development and refinement.

A Masters program which, in a similar way, will address renewable energy technologies or some aspects thereof, is currently being drafted.

### 4.1. Design summary

The modules in the respective programs, which include aspects of renewable energy, are identified and for each, some enhancements are proposed. The selected enhancements (introduced in section 1.2) are categorized in columns which denotes the industrial expectations of a candidate Alternative Energy Technician (defined in D:2.3.1, Appendix A).

	Investigation	Research and development	Product design	Risk and impact	Project management	Commissioning	Maintenance
<b>Honours</b>							
Renewable Energy 4B	X	X		X			
Innovation Management and Entrepreneurship 4B	X	X		X	E		





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Engineering Design Project	X	X	X		E	X	X
<b>Masters</b>							
TBA							

Increase industrial exposure = X / Enhance entrepreneurial skills = E / Other = O

## 4.2. Curriculum enhancements

For the identified modules, enhancements are proposed to feature in specific content areas of the module syllabus. Each area of interest is highlighted and tagged with the specific enhancement.

### Honours: Renewable Energy 4B

		Current curriculum	Proposed enhancement	Outcome
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1	<p><b>Purpose of this module in relation to the programme/s</b></p>	<p>This subject develops the subject of Renewable Energy at the Honor's level.</p> <p>Solar energy: atomic description of silicon; light absorption and charge carriers; the electric field and PV voltage; equivalent circuit; formation of cells to modules to arrays; I-V curves. PV structures: semi-crystalline; polycrystalline; thin-film cells; Gallium Arsenide cells; multi-junction cells; characterization. View of efficiency; maximum power transfer; safety; aesthetics and the environment.</p> <p>PV arrays and systems: designing arrays to achieve specified peak power and energy; effects of ambient temperature and shading; system economics.</p> <p>Use and compile insolation data.</p> <p>Maximum power point tracking.</p> <p>Solar Power (CSP) technologies: solar dish; parabolic troughs; central receiver systems; energy storage calculations.</p> <p>Fuel cells: operation fundamentals; types of cells; energy calculations; safety.</p> <p>Battery technologies: cover the most prevalent and emerging technologies; lifetime optimisation methods; safety; maintenance.</p> <p>Wind power systems: system design fundamentals; efficiency; power transfer; safety; aesthetics and the environment.</p> <p>Distributed generation and hybrid power systems: circuit configurations; optimal power transfer; grid and off-grid solutions; power dimension exercise; case studies.</p> <ul style="list-style-type: none"> <li>• Power Electronics: design fundamentals; DC-DC converters; safety; protection.</li> </ul>		
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2	<b>Module content</b>	<p>The following topics are covered in this module:</p> <ul style="list-style-type: none"> <li>• Specified energy sources and associated technologies</li> <li>• Optimal energy transfer</li> <li>• Circuit configurations</li> <li>• Power conversion and integration technologies</li> <li>• Battery systems and associated technologies</li> </ul> <p>System design and case studies Socio-economics of renewable energy</p>	<p>Guest lecture on any of the topic points.</p> <p>Use recently acquired and yet to be acquired lab facilities and testbeds to enhance the practical investigations in the module.</p> <p>Site visits or site videos to see the renewable energy systems in action in industry</p>	<p>Sharing of global best practice in renewable energy studies.</p> <p>Improve student assimilation of knowledge through focused practical work.</p> <p>Apply ideas and data based on industry use of renewable energy systems in problem interpretation and solving.</p>
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## Honours: Research Methodology

This is an individual/group task.

		Current curriculum	Proposed enhancements	Outcome
1	<b>Purpose of this module in relation to the programme/s</b>	<ul style="list-style-type: none"><li>TBA (currently being refined)</li></ul>		
2	<b>Module content</b>	The following topics are covered in this module: TBA (currently being refined)	TBA	TBA

## Honours: Engineering Design Project

This is an individual task.

		Current curriculum	Proposed enhancements	Outcome
1	<b>Purpose of this module in relation to the programme/s</b>	<ul style="list-style-type: none"><li>TBA (currently being refined)</li></ul>		
2	<b>Module content</b>	The following topics are covered in this module: TBA (currently being refined)	TBA	TBA

Masters: TBA:

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## 5. Conclusion

The curriculum enhancements proposed in this document considered the general objective of WP:2.3. Similar to WP:2.3.2, the design process tailored to the enhancements to the current situation at each individual UoT. The common goal of improving the student's learning experience while proactively addressing the expectations of the South African governing body, ECSA and the need of industry for employable students.

In terms of the post graduate qualification structure, all three UoTs pose the same hierarchy. However, different modules are selected to substantiate the necessary qualification credits. This is mainly due to the different industry sectors, which are served by the UoTs in their corresponding provinces. As a result, the proposed enhancements vary accordingly. A summary of the proposed enhancements is as follow:

- Visit to industry partners or installed site (virtual) - Visual confirmation of theory principles, regulatory requirements and real world influences.
- Guest lecturing (Industry partners) - Apply ideas and interpret data based on industry applications of alternative energy sources.
- Promote accelerated short courses - Preparation for professional writing and public speaking.
- Collaborative research and testing – Bidirectional stimulation: students engage in viable research and industry partners can benefit from the UoT knowledge pool.

To enhance the learning experience of a post graduate student, the partnership between University and Industry is of utmost importance. The Eurydice project supports this aspect with the various work packages and hopefully, will narrow the gap between industry and universities.

## 6. Contact

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