OE
ORDEM
DOS ENGENHEIROS

Universidade do Minho

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Braga, Portugal

El título de ingeniero químico en el espacio europeo de educación superior

OUTLOOK

For some slides credits are due to Prof. Sebastião Feyo de Azevedo (FEUP)

- Ordem dos Engenheiros
- The Portuguese Chemical Industry
- From Bologna, 1999 … to London, 2007… and beyond…
  - Relevant Mobility Concepts and Instruments
  - Understanding fundamental differences between levels of qualifications
- Contributions to Chemical Engineering Education
  - Paradigm shifts in Chemical Engineering Education
  - The WPE-EFCE Recommendations; Descriptors at programme level
  - Address problems, answer demands; Incorporate new knowledge, competences and skills; Today and for the future, we have to…
- Academic Degrees in Higher Education in Portugal
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  - The Bologna Process in Portugal
- Regulación profesional y la protección del título a nivel europeo (FEANI)

- Colégios (especialidades):

  Agronómica, Ambiente, Civil, Eletrotécnica, Florestal, Geográfica, Geológica e de Minas, Informática, Materiais, Mecânica, Naval, Química e Biológica

- Categorias de Membros (níveis): Estudante, Efetivo, Senior, Conselheiro

- Graus de qualificação para membro efectivo:

  E1 – Membros com licenciatura (1º ciclo) em engenharia;

  E2 – Membros com mestrado (2º ciclo) em engenharia;

  E3 – Membros com doutoramento (3º ciclo) em engenharia.

ORDEM DOS ENGENHEIROS
COLÉGIO NACIONAL DE ENGENHARIA QUÍMICA E BIOLÓGICA

- Colégio Nacional + Colégios Regionais
- Definição dos Actos (competências) de Engenharia Química e Biológica → Lei de Serviços Profissionais (?)
- Representação na EFCE – European Federation of Chemical Engineering (Board; vários Working-Party)
- National Agency for EUR-ACE: European Accreditation of Engineering Programmes
  (5 titulaciones: 2 EQ, 3 Ebiol)

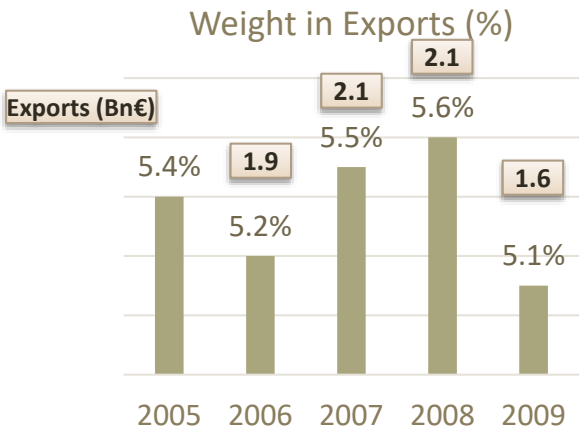
European Accreditation of Engineering Programmes
EUR-ACE®

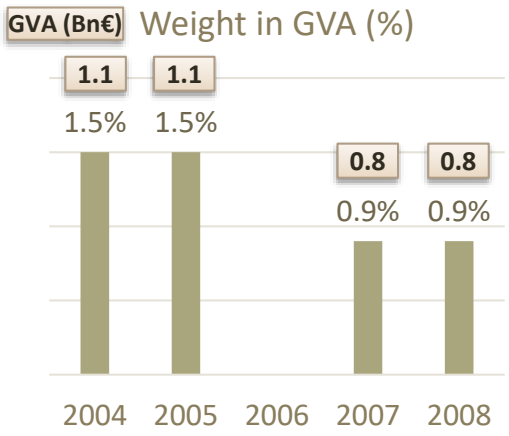
LA INDUSTRIA QUIMICA EN PORTUGAL

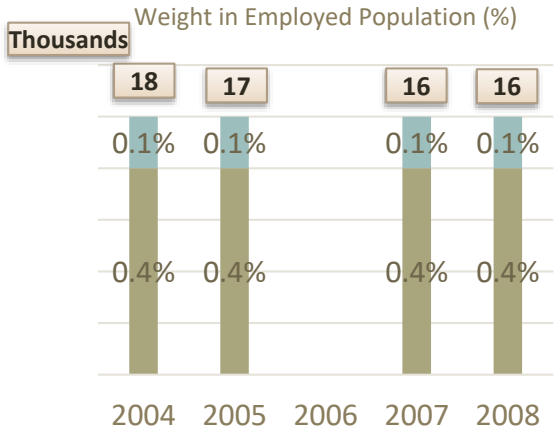
- Representa 5% del Valor añadido bruto (VAB) de la industria
- Mantiene una mano de obra cualificada y relativamente bien pagado
- En 2011 las exportaciones aumentaron un 20,9% a alrededor de 5,3 millones de euros, de pie entre las actividades más importantes de exportación

CHEMICAL AND PETROCHEMICAL INDUSTRY – MAIN FIGURES FOR PORTUGAL

- Small when compared with the European Countries
- Relevant impact in the national exports, gross value added and employment

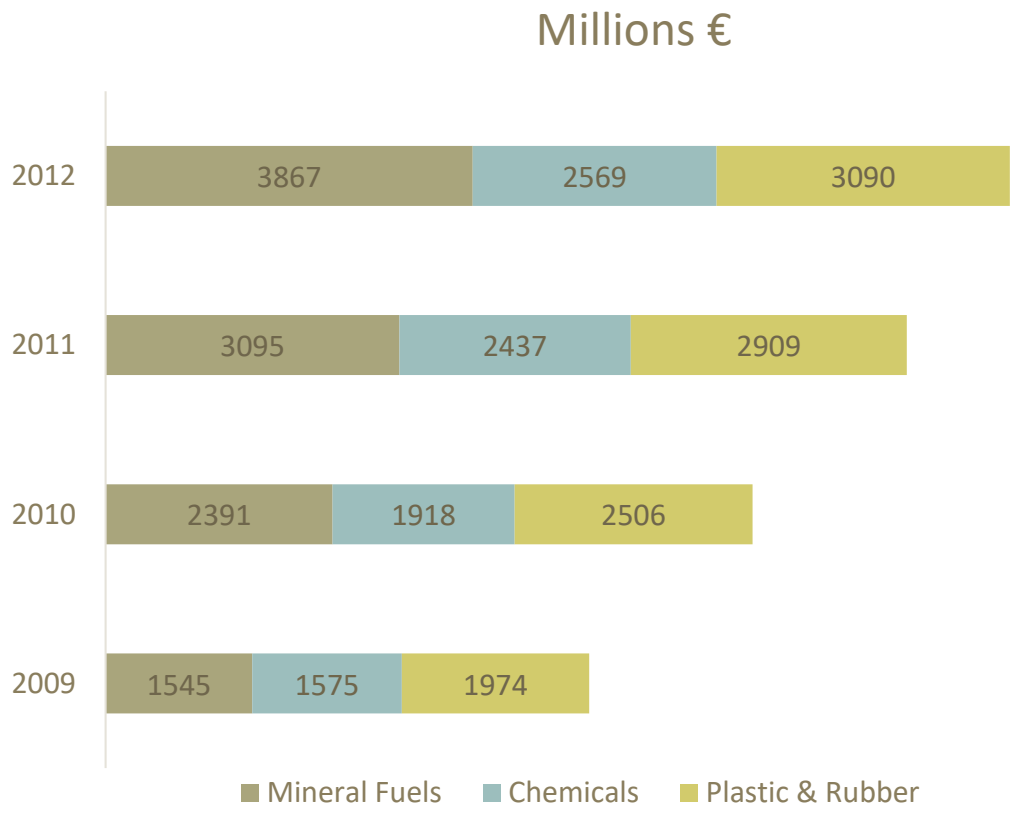






Source: AIPQR Petrochemical and Chemical Industry Association, 2011

INDUSTRY INTERNATIONAL TRADE STASTICS



Source: International Trade Statistics – Statistics Portugal, 2013

MAIN INDUSTRIAL CLUSTERS

Total Area	54 ha Petrochemicals and Chemicals 290 ha Refinery
Logistics infrastructures	2 Ports (Leixões and Aveiro) Highway connections to all major cities in Portugal and to Spain (A1, A29, A25) Railway connections to National Network

Total Area	244 ha Petrochemicals and Chemicals 345 ha Refinery
Logistics infrastructures	Sines Port (Deep water Port) Connection to highway A25 Railway connections to National Network

SINES COMPLEX
MAIN COMPANIES ON THE SITE

Biggest national petrol refinery
CAPEX: 1,400 M€
Employees: 500

Steam cracker + Polyethylene HD/LD.
CAPEX: 750 M€
Employees: 440

Thermoelectrical Power Plant
1,256 MW installed power

Industrial gases
CAPEX: 45 M€
Employees: 7

PET for food industry
CAPEX: 470 M€
Employees: 180

CAPEX: 90 M€
Employees: 28

EVONIK INDUSTRIES

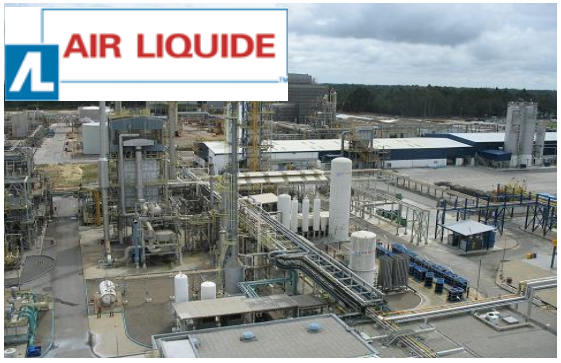
SONAE INDUSTRIA

RECIPNEU

MATOSINHOS/ESTARREJA CHEMICAL COMPLEX

Matosinhos refinery: 400 ha. It is connected to the terminal of oil tankers in the Leixões port by several pipelines 2km long. Several interconnected processing units. Large variety of derivatives or aromatic products, important raw material for the chemical and petrochemical industry, plastic, textiles, fertilizer, rubber, paint and solvents

Estarreja:
U.S. multinational company.
Produces Isocyanates

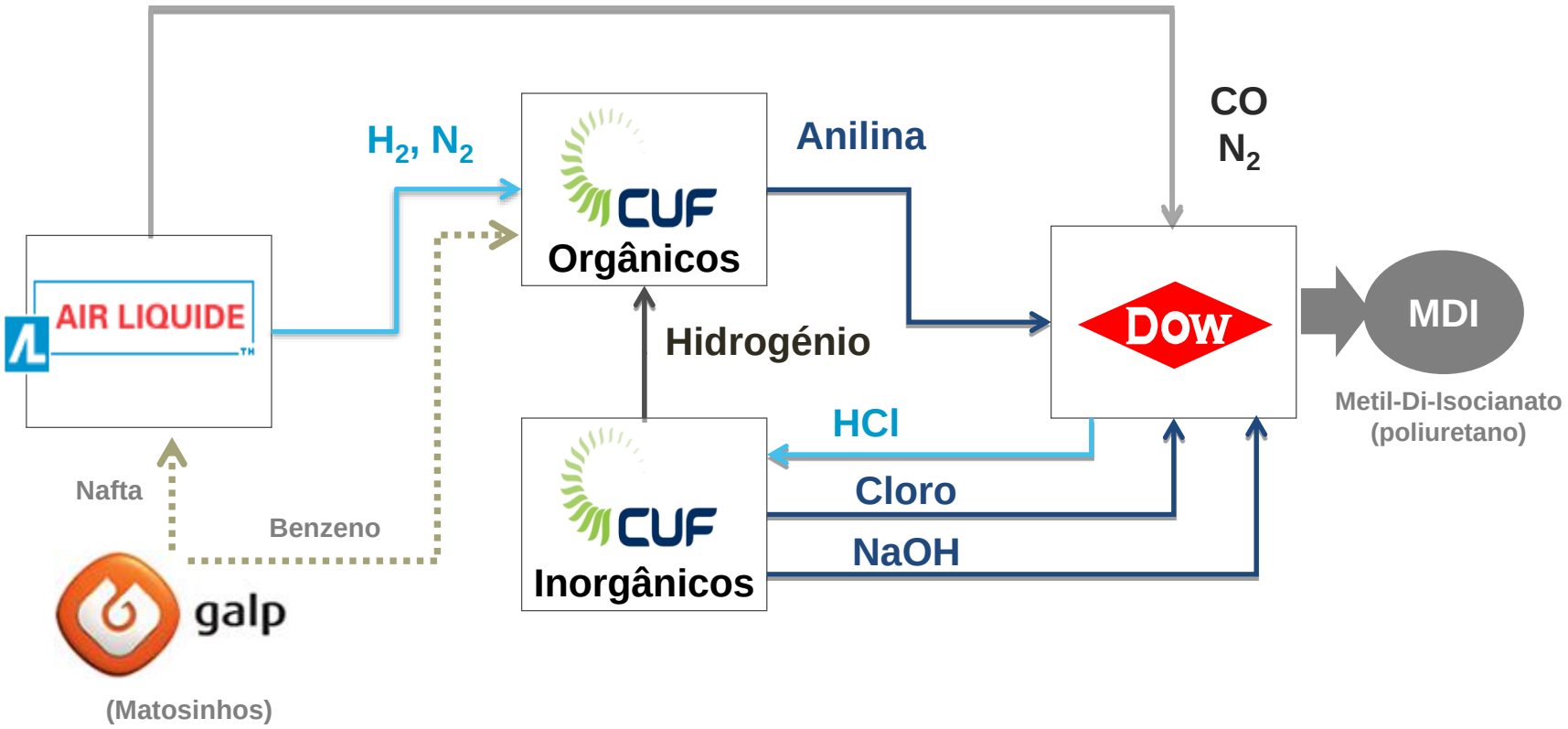


Estarreja: French multinational produces in carbon monoxide, oxygen, nitrogen, hydrogen and argon

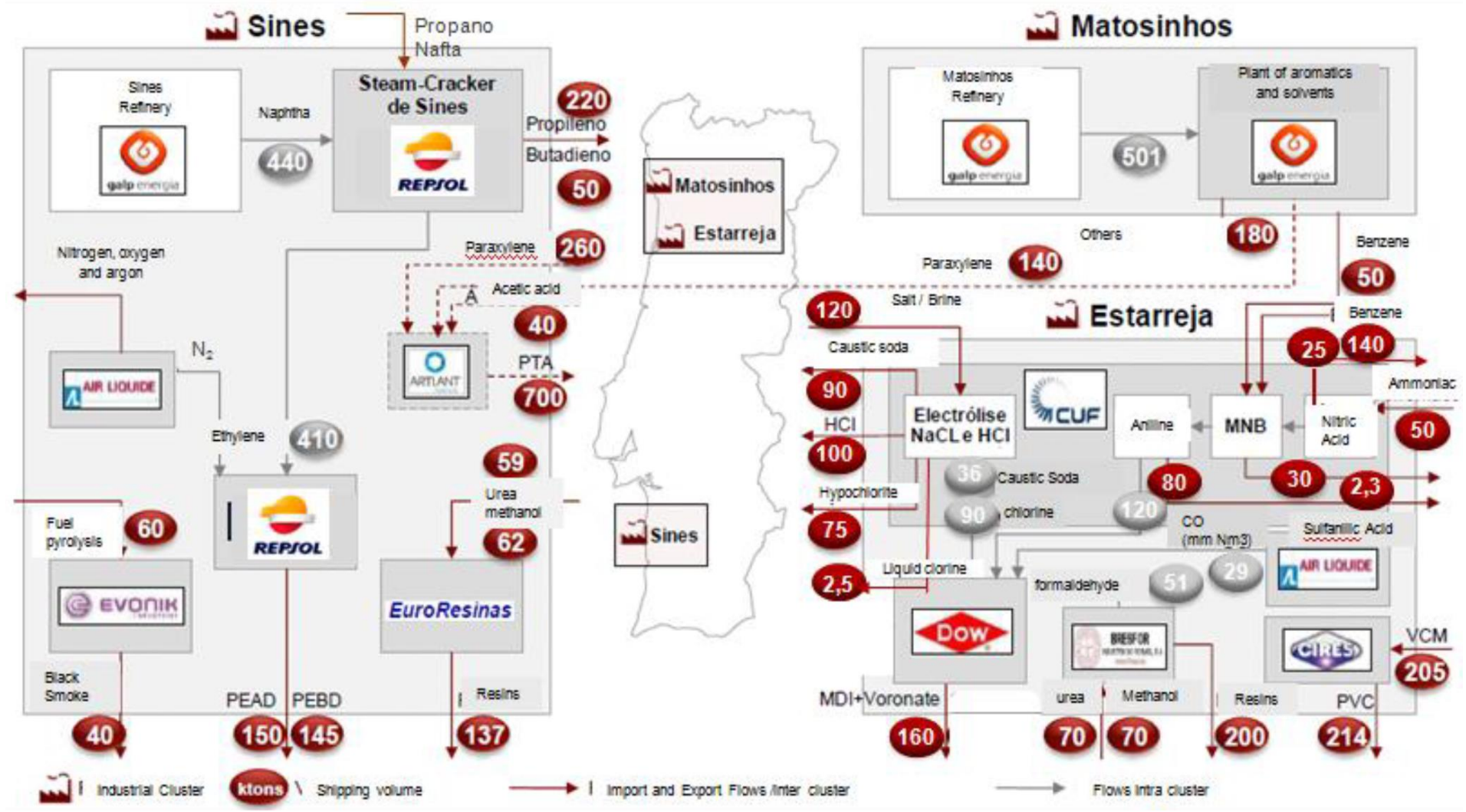
Estarreja: Biggest chemical Portuguese company: aniline, mononitrobenzene, nitric acid, chlor-alkali and fertilizers plant.

Estarreja: Japanese plant producing polyvinyl chloride.

Polo de Estarreja
Um exemplo de integração



THE CLUSTERS: MAIN FLOWS



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FROM BOLOGNA, 1999 … TO LONDON, 2007… AND BEYOND…

Key issues:

- **Mobility** – a central issue, far from a success…
- **Curricular reform** -

  Degree System and Teaching / Learning Paradigms

  Stabilising the closely related concepts of Learning Outcomes and Credit System

  Qualifications Frameworks – National Qualifications Frameworks

  Quality Assurance – implementing the Register

  Recognition of degrees and study periods

  Lifelong Learning

- **Social issues** - Employability, social dimension…
- **Global dimension** - Attractiveness

ECTS – EUROPEAN CREDIT (ACCUMULATION) AND TRANSFER SYSTEM

- ECTS is a learner-centred system for credit accumulation and transfer based on the transparency of learning outcomes and learning processes

  It aims to facilitate planning, delivery, evaluation, recognition and validation of qualifications and units of learning as well as student mobility

- ECTS credits are based on the workload students need in order to achieve expected learning outcomes

  60 ECTS credits are attached to the workload of a full-time year of formal learning (academic year) and the associated learning outcomes

- Learning outcomes describe what a learner is expected to know, understand and be able to do after successful completion of a process of learning

  They relate to level descriptors in national and European qualifications frameworks

UNDERSTANDING FUNDAMENTAL DIFFERENCES BETWEEN LEVELS OF QUALIFICATIONS

Programme Outcomes must be evaluated in relation with the level of intervention in the Engineering Activity

- Social responsability (namely, signing projects)
- Capacity to tackle large, complex problems
- Capacity to adapt to new jobs of high complexity and responsibility
- Capacity for effective activity in the production line
- .....

For the different subsets of Programme Outcomes, and for the 1st and 2nd Cycle Degrees in Engineering, the differences in outcomes are mostly related with

scope, depth and breath

For the Master degree, developing the right ATTITUDE to use knowledge or skills in a given situation is a major outcome

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A LITTLE BIT OF HISTORY: PARADIGM SHIFTS IN CHEMICAL ENGINEERING EDUCATION

1st Paradigm(s)

- In general terms – 1st quarter of the XX Century - Education close to industrial operations - Unit Operations

2nd Paradigm(s)

- In general terms – 3rd quarter of the XX Century – Education shift to Engineering Science

3rd Paradigm ?

- We are at present on the process of developing a model and of conceptualizing the evolution for a new paradigm… which is not yet quite identified…

CONTRIBUTIONS TO CHEMICAL ENGINEERING EDUCATION - THE WPE-EFCE RECOMMENDATIONS

See WPE site on www.efce.info/wpe.html

These recommendations cover

- Learning Outcomes
  - General chemical engineering skills and knowledge
  - Transferable skills
- Achieving the Learning Outcomes
  - Core curriculum
  - Teaching and learning
  - Industrial experience
  - Review of the educational process
  - Student assessment
- The core curriculum proposed covers only approx. two thirds of a 1st and a 2nd level degree study

EUROPÄISCHE FÖDERATION FÜR CHEMIE-INGENIEUR-WESEN
EUROPEAN FEDERATION OF CHEMICAL ENGINEERING
FEDERATION EUROPEENNE DU GENIE CHIMIQUE

EFCE

EFCE Bologna Recommendations

Recommendations for Chemical Engineering Education in a Bologna Three Cycle Degree System

(2nd, revised edition, 2010)
(status: final, as approved by the EFCE Executive Board, Prague 28. August 2010)

The recommendations for the 1st and the 2nd cycle adopt the EUR-ACE framework standards for accreditation of engineering programmes, being grouped in the following Programme Outcomes:

- Knowledge and Understanding
- Engineering Analysis
- Engineering Design
- Investigations
- Engineering Practice
- Transferable Skills

RECOMMENDATIONS OF THE WPE-EFCE DESCRIPTORS AT PROGRAMME LEVEL

Using as reference accumulated knowledge, competences and skills after a 2nd Cycle in Chemical Engineering

A minimum dimension is proposed to

- Basic sciences, enlarged with life sciences
- Chemical engineering sciences
- Chemical engineering core
- With engineering design,
- With a dissertation for training R&D&I,
- With diverse profiles through electives and external training

NEW DIRECTIONS FOR CHEMICAL ENGINEERING EDUCATION - ADDRESS PROBLEMS, ANSWER DEMANDS

- New concerns on energy and environmental problems and generally on sustainability
- Sharp demand for 'performance products' - specialties, food, personal care products…
- Process and product development times came down sharply (3 to 5 fold) - risk management…
- Technological and scientific developments - new paradigms on Unit Operations open for discussion - micro-systems, process intensification…

NEW DIRECTIONS FOR CHEMICAL ENGINEERING EDUCATION - INCORPORATE NEW KNOWLEDGE, COMPETENCES AND SKILLS

- Programmes are of course directed to scientific and technical knowledge (depending on the discipline)

BUT

- Should include developing of attitude, skills and competences valued by Industry and Society in general
- Skills and competences for innovation and entrepreneurship
- Job related skills: Teamwork, Communication, Leadership
- Competencies (how tasks are done): Holistic thinking, self-management, achievement of objectives..

NEW DIRECTIONS FOR CHEMICAL ENGINEERING EDUCATION - TODAY AND FOR THE FUTURE, WE HAVE TO…

Speak of

- Life sciences and of biology as one of the 4 basic sciences
- Environmental issues and sustainability
- (Nano) structures and material science issues

Speak of ENERGY and OPTIMAL Operation

- An economy based on alternative energy resources
- Systems engineering and knowledge based methods for optimised, safe, simple to operate systems

Give an answer to the demand of Society for specificity and quality

- New products – competencies in product design

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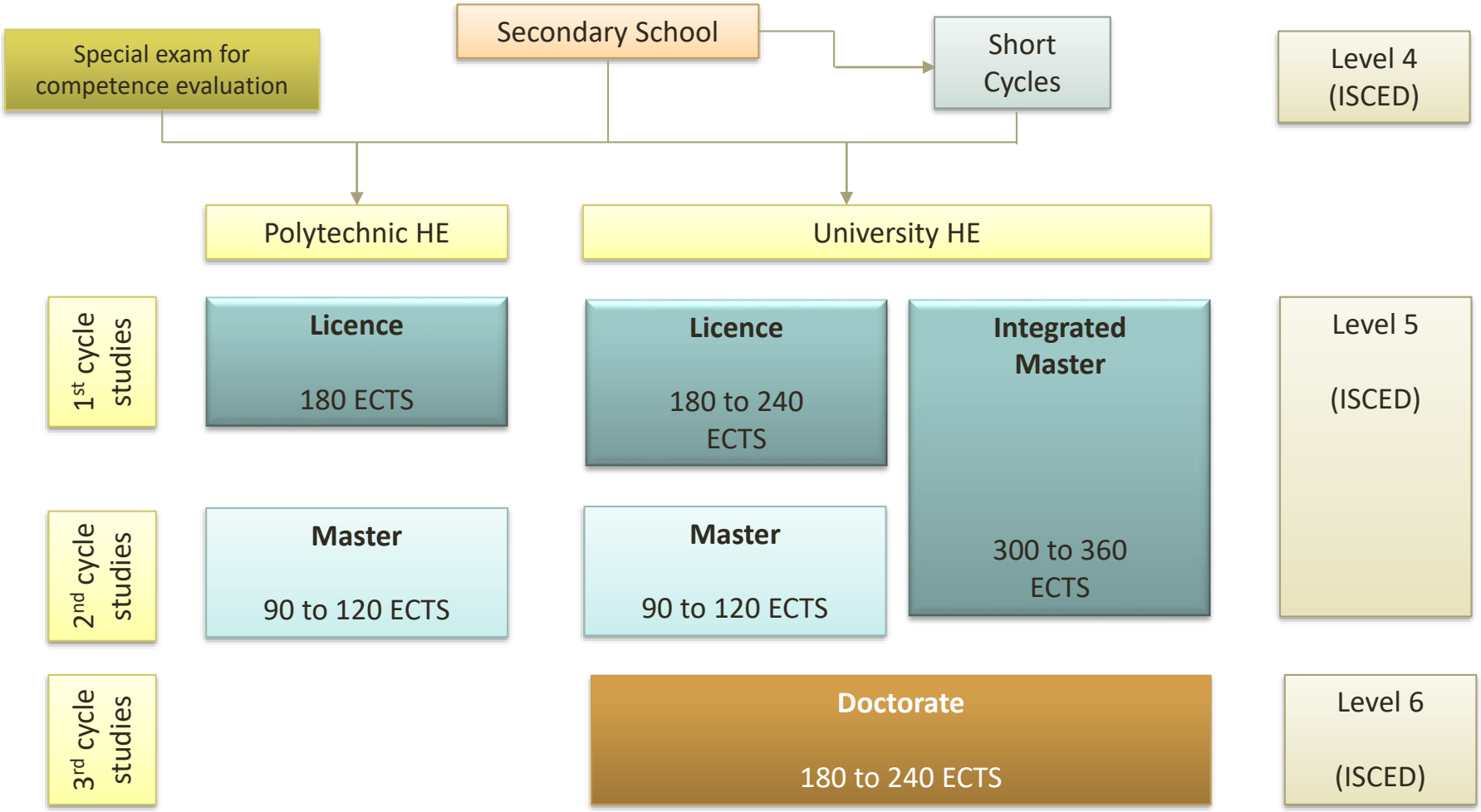
ACADEMIC DEGREES IN HIGHER EDUCATION IN PORTUGAL

Portuguese System of Higher Education after the Bologna Process



ISCED - International Standard Classification of Education (UNESCO)

NATIONAL HIGHER EDUCATION QUALIFICATIONS AND CORRESPONDING CYCLES OF THE BOLOGNA FRAMEWORK AND LEVELS OF THE EUROPEAN UNION EQF-LLL

Higher Education Qualifications of the FHEQ-Portugal	Corresponding Bologna Framework Cycles	Corresponding European Union EQF levels
Doctoral degrees	3rd cycle qualifications	8
Doctoral course diplomas	-	-
Master's degrees	2nd cycle qualifications	7
Integrated Master's degrees		
Master's course diplomas		-
"Licenciatura" degrees	1st cycle qualifications	6
Higher education short cycle diplomas / Technological Specialization Diplomas	Short cycle qualifications (within or linked to the 1st cycle)	5

EQF - European Qualifications Framework
LLL – Lifelong Learning
FHEQ - Framework for Higher Education Qualifications

THE BOLOGNA PROCESS IN PORTUGAL

- Main focus on 1st cycle studies with 180 ECTS
- Clearer picture for the binary system

  1st cycles in universities and polythecnics

  2nd cycles mainly (but not exclusively) in universities

- Positive solution in most areas of the regulated professions

  Health area, architecture, engineering, where 1st cycles are of 180 ECTS and 2nd cycles are required for the profession

  Exception are degrees in nursing and other technical degrees in the health area, where 1st cycles of 240 ECTS are the entry route for the professions

- Consolidation of 3rd cycle programmes
- Mechanisms for recognition of foreign qualifications
- Improved scenario for promotion of mobility and cooperation

REGULACIÓN PROFESIONAL Y LA PROTECCIÓN DEL TÍTULO A NIVEL EUROPEO (FEANI)

- Los países sin ninguna regulación - Bélgica, Finlandia, Países Bajos, Noruega y Suecia
- Los países que regulan sólo algunas de las actividades en algunas áreas - Austria, Bulgaria, Dinamarca, Eslovaquia, Eslovenia, Francia, Letonia, Lituania, Luxemburgo, República Checa, Rumania y Suiza
- Los países que protegen sólo el título - Reino Unido (Chartered Engineer)
- Los países que protegen el título y regulan parcialmente la profesión - Alemania, Islandia, Irlanda, Italia, Malta, Polonia y Portugal
- En general los países regulan las actividades en la mayoría de las áreas - Chipre, Grecia

http://www.deb.uminho.pt/eqedu/ Chemical Engineering Educ...

Chemical Engineering Education in Portugal

www.fe.up.pt/eqedu

An initiative of the Chemical Engineering division of the
Portuguese Institution of Engineers,
in conformance with the objectives of the
Working Party on Education in Chemical Engineering of the
European Federation of Chemical Engineering

EFCE WPE Working Party Education

[Portuguese] [English]

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(continously maintained)

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www.deb.uminho.pt/eqedu

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