

# MAPPING OF CO<sub>2</sub> CAPTURE, STORAGE, AND MANAGEMENT (CCSM) IN GRADUATE PROGRAMS:

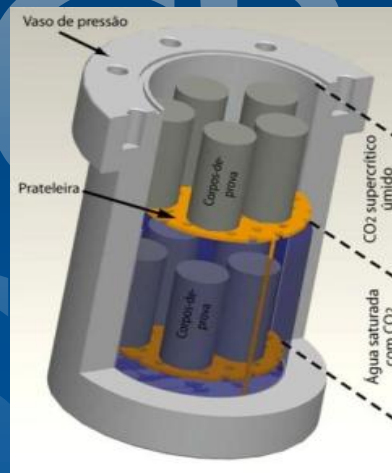
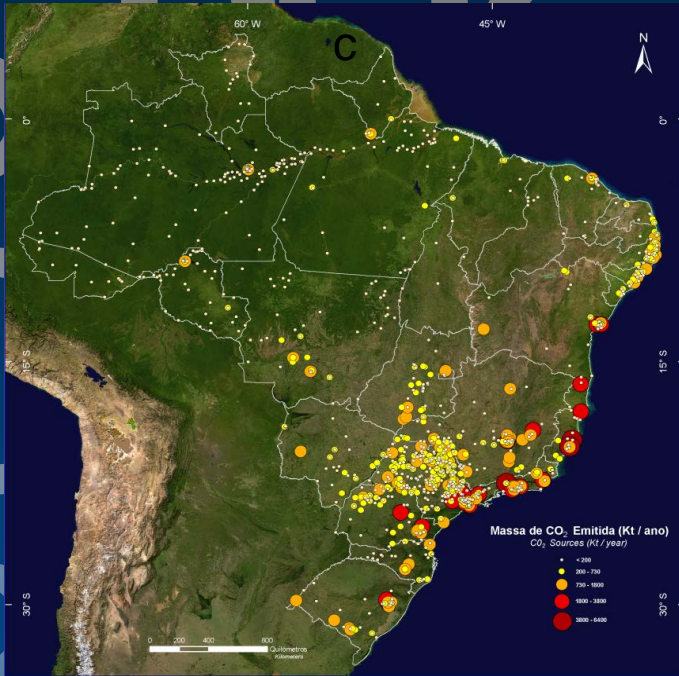
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South Wales  
CSLF CCS in Academy Task Force

**The Americas**  
**Europe**  
**Africa**  
**Asia**  
**Oceania**

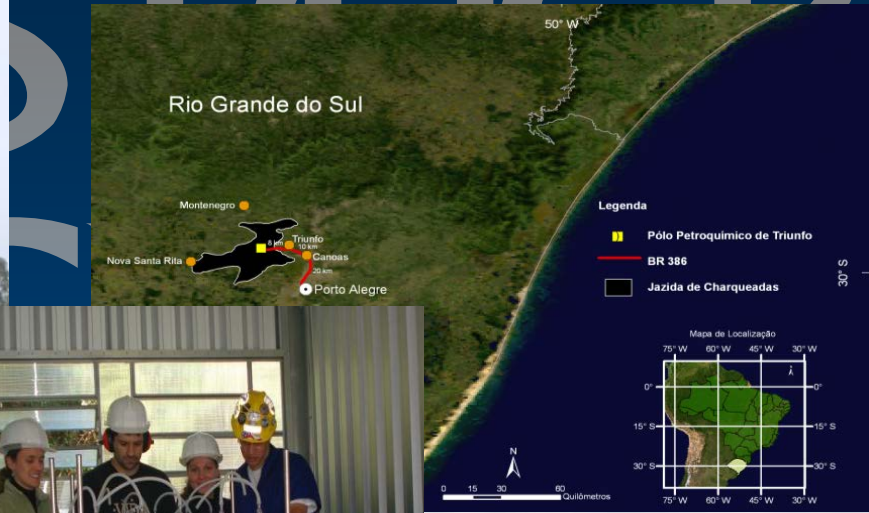
Beijing, September, 2011

# CEPAC – Center of Excellence in Research and Innovation in Petroleum, Mineral Resources and Carbon Storage



- ca. 40 researchers
- 4 main research programs
  - PRORESERVA
  - PROINPO
  - CARBMAP
  - PROCARBO
- 12 ongoing research projects overall
- 2<sup>nd</sup> CSLF Capacity Building Workshop, GCCSI/CSLF Capacity Building

# CEPAC – Center of Excellence in Research and Innovation in Petroleum, Mineral Resources and Carbon Storage



- Porto Batista ECBM Pilot Site
- Possible new CCS sites:
  1. Onshore leakage test site
  2. Offshore leakage test site



## Objective

To identify **courses in the area of CCS and Climate Change** inside the academic programs currently available in universities worldwide

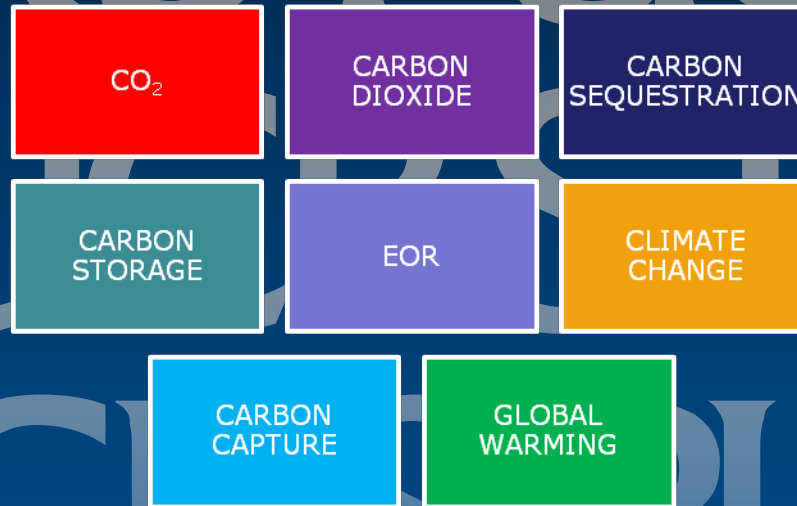
- The Americas
- Europe
- Africa (South Africa)
- Asia (Japan, Korea)
- Oceania (Australia, New Zealand)



# Methodology

The information presented in the report was obtained from **universities websites**. For the United Kingdom → internet searches, email inquiries, and actual visits to discuss courses with universities

Key words:

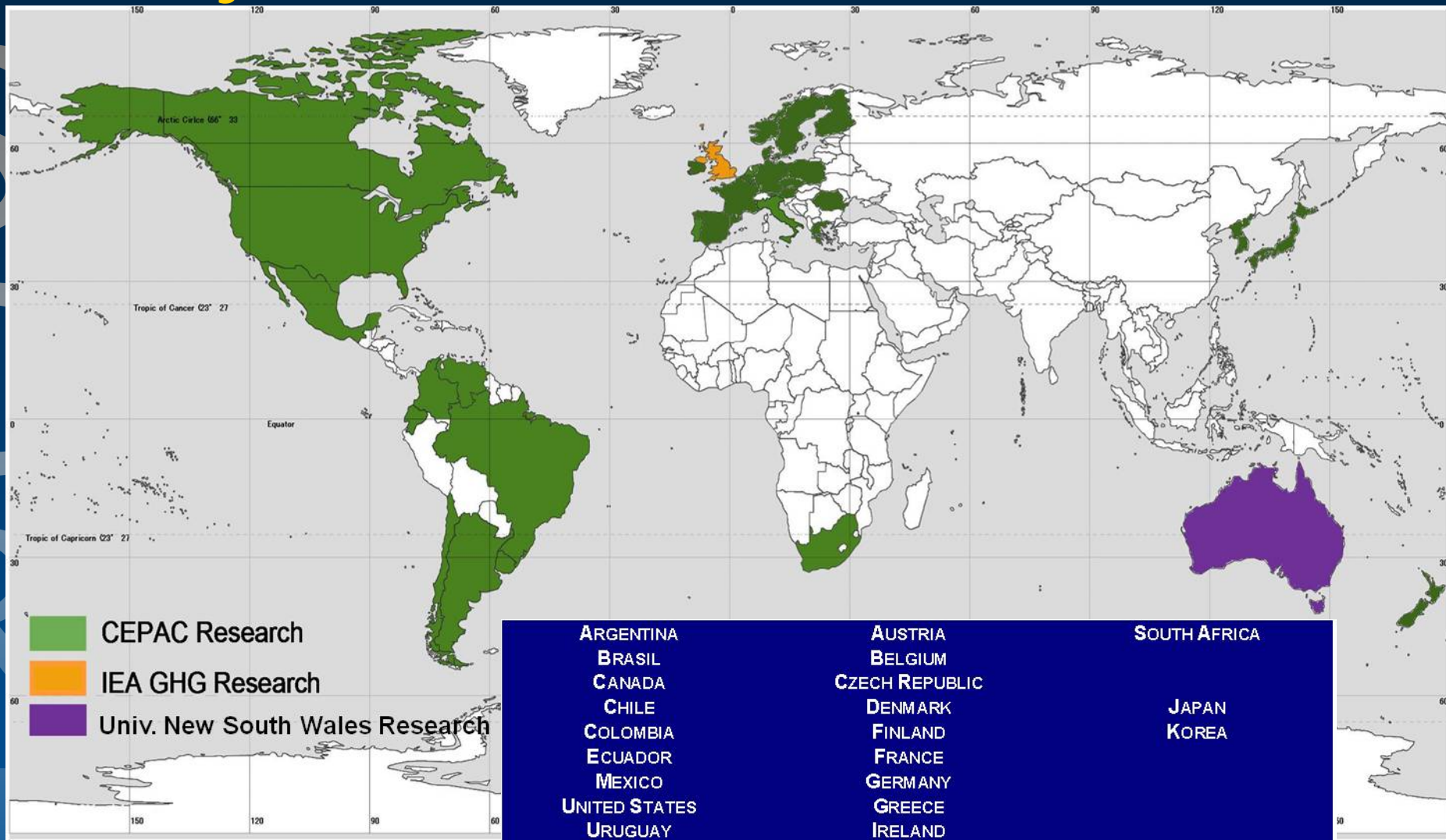


For each University, all the offered courses were summarized on tables in accordance with four themes:

- (i) **Capture:** Subjects in engineering and science of CO<sub>2</sub> capture from flue gas stream, incorporating transportation;
- (ii) **Storage:** Subjects on geology and science of CO<sub>2</sub> storage and enhanced oil recovery;
- (iii) **Environment:** Subjects on climate change, environmental sciences and management, including modeling, geography and town planning;
- **Economy, Social, Political and Legal aspects:** Subjects on economical and legal issues related to CCS projects and/or environmental impacts.



# Surveyed Countries



ARGENTINA  
BRASIL  
CANADA  
CHILE  
COLOMBIA  
ECUADOR  
MEXICO  
UNITED STATES  
URUGUAY  
VENEZUELA

AUSTRIA  
BELGIUM  
CZECH REPUBLIC  
DENMARK  
FINLAND  
FRANCE  
GERMANY  
GREECE  
IRELAND  
ITALY  
NETHERLANDS  
NORWAY  
POLAND  
PORTUGAL  
ROMANIA  
SPAIN  
SWEDEN  
UNITED KINGDOM

SOUTH AFRICA  
JAPAN  
KOREA  
AUSTRALIA  
NEW ZEALAND



# Surveyed Universities per country

## The Americas

35 Universities Surveyed

**14 UNIVERSITIES MAPPED**

### Legend

Surveyed universities in WHITE

Mapped universities in YELLOW

THE AMERICAS (total: 35 universities surveyed)	
Argentina (5)	University of Buenos Aires University of Cordoba National University of Technology University of Salvador (Universidad del Salvador) University of Palermo
Brazil (6)	Pontifical Catholic University of Rio Grande do Sul University of São Paulo State University of Rio de Janeiro Federal University of Rio de Janeiro Pontifical Catholic University of Rio de Janeiro Federal University of Rio Grande do Sul
Canada (6)	University of Alberta University of British Columbia University of Calgary University of Regina University of Saskatchewan University of Waterloo
Chile (1)	Pontifical Catholic University of Chile
Colombia (2)	University of Andes National University of Colombia
Ecuador (2)	Pontifical Catholic University of Ecuador Central University of Ecuador
Mexico (2)	National Autonomous University of Mexico University of Guadalajara
United States of America (8)	University of Tennessee University of Chicago University of Washington Princeton University University of California University of Delaware Stanford University Harvard University
Uruguay (2)	Republic University University of Montevideo
Venezuela (1)	Central University of Venezuela

# Surveyed Universities per country

Europe

94 Universities surveyed

20 UNIVERSITIES MAPPED

## EUROPE (total: 94 universities surveyed)

Austria	University of Vienna
Belgium	Catholic University of Louvain University of Antwerp University of Ghent
Czech Republic	Czech Technical University in Prague
Denmark	Aarhus University Aalborg University Technical University of Denmark University of Copenhagen
Finland	University of Eastern Finland University of Helsinki
France	Aix-Marseille University (University of Provence/ University of the Mediterranean/ Paul Cézanne University/ University of Avignon) INSA Lyon (National Institute of Applied Sciences of Lyon) Lille University of Science and Technology Toulouse 1 University Capitole University of Bordeaux (I, II, III, IV) University of Lyon University of Paris-Sorbonne (Paris IV) University of Paris X – Nanterre la Défense
Germany	Heidelberg University Technische Universitaet Darmstadt University of Leipzig University of Mannheim University of Munich University of Rostock University of Tübingen
Greece	Aristotle University of Thessaloniki University of Athens University of Macedonia
Ireland	UCD University College Dublin University of Limerick (Limerick) University College Cork (Cork) Dublin City University (Dublin) Trinity College Dublin (Dublin) National University of Ireland - Galway Dublin Institute of Technology (Dublin) National University of Ireland - Maynooth Institute of Technology Blanchardstown



# Surveyed Universities per country

..... Europe

Italy (13)	<ul style="list-style-type: none"> <li>University of Bari</li> <li>University of Bologna</li> <li>University of Brescia</li> <li>University of Cagliari</li> <li>University of Catania</li> <li>University of Florence</li> <li>University of Genoa</li> <li>University of Milan</li> <li>University of Milan - Bicocca</li> <li>University of Naples Federico II</li> <li>University of Palermo</li> <li>University of Parma</li> <li>University of Rome Tor Vergata</li> </ul>
Netherlands (11)	<ul style="list-style-type: none"> <li>University of Amsterdam</li> <li>VU University Amsterdam (Free University Amsterdam)</li> <li>University of Groningen</li> <li>Leiden University</li> <li>Maastricht University</li> <li>University of Utrecht</li> <li>Erasmus University Rotterdam</li> <li>Tilburg University</li> <li>Delft University of Technology</li> <li>Eindhoven University of Technology</li> <li>University of Twente</li> </ul>
Norway	<ul style="list-style-type: none"> <li>Norwegian University of Science and Technology (NTNU)</li> <li>The University Centre in Svalbard</li> <li>University of Agder</li> <li>University of Bergen</li> <li>University of Oslo</li> <li>University of Tromsø</li> </ul>
Poland	<ul style="list-style-type: none"> <li>Lublin University of Technology</li> <li>Nicolaus Copernicus University</li> <li>Technical University of Radom</li> <li>University of Bielsko-Biala</li> <li>University of Warmia and Mazury in Olsztyn</li> <li>University of Warsaw</li> </ul>

Portugal	<ul style="list-style-type: none"> <li>Catholic University of Portugal</li> <li>New University of Lisbon</li> <li>University of Algarve</li> <li>University of Aveiro</li> <li>University of Coimbra</li> <li>University of Évora</li> <li>University of Lisbon</li> <li>University of Minho</li> <li>University of Porto</li> </ul>
Romania	<ul style="list-style-type: none"> <li>Universitatea Babeş-Bolyai, Cluj-Napoca</li> </ul>
Spain	<ul style="list-style-type: none"> <li>University of Cordoba</li> <li>Autonomous University of Barcelona</li> <li>International University of Andalucia (Seville)</li> <li>Autonomous University of Madri</li> </ul>
Sweden	<ul style="list-style-type: none"> <li>Linköping University</li> <li>Stockholms universitet</li> <li>Lunds universitet</li> <li>Kungliga Tekniska</li> <li>Uppsala Universitet</li> <li>Swedish University of Agricultural Sciences</li> </ul>

United Kingdom	<ul style="list-style-type: none"> <li>University of Edinburgh</li> <li>EUROPEAN - University of Edinburgh (UK), University Versailles St-Quentin (France) , University of Bergen (Norway)</li> <li>Imperial College</li> <li>University of Nottingham</li> <li>Loughborough University</li> <li>University of Birmingham</li> <li>University of Glasgow</li> <li>University of Lancaster</li> </ul>
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# Surveyed Universities per country

## Asia

4 Universities surveyed

ASIA (total: 4 universities surveyed)	
Japan	The University of Tokyo Hokkaido University Kyoto University
Korea	Korea University

NO UNIVERSITIES MAPPED

## Africa

3 Universities surveyed

AFRICA (total: 3 universities)	
South Africa	University of South Africa University of Cape Town University of Pretoria

1 UNIVERSITY MAPPED



# Surveyed Universities per country

Oceania

17 Universities surveyed

14 UNIVERSITIES MAPPED

OCEANIA	
New Zealand	University of Canterbury University of Victoria University of Waikato Lincoln University University of Auckland
Australia	Australian National University Curtin University James Cook University Macquarie University Monash University Queensland University of Technology University of Adelaide University of Melbourne University of New South Wales University of Newcastle University of Queensland University of Western Australia

→ in AUSTRALIA: universities surveyed by researchers from The Univ. of New South Wales



# Mapped Universities and Postgraduate Programs



Surveyed countries in The Americas: Brasil, Argentina, Chile, Uruguai, Colombia, Ecuador, Venezuela, USA, Canada, Mexico



\* 6 in the UK

\*\* 7 in the UK

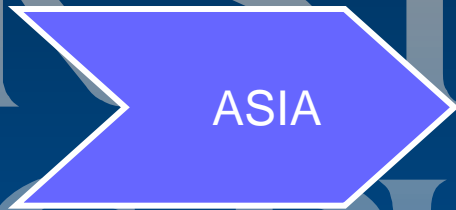
\*\*\* in the UK: 6 Master / 1 PhD / 1 Postdoctoral

Surveyed Countries in Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, UK





Surveyed Counties in Africa: South Africa



Surveyed Counties in Asia: Japan and Korea



\* 12 in Australia

\*\* 50 in Australia

\*\*\* 49 Master / 1 Doctorate in Australia

Surveyed Counties in Oceania: Australia and New Zealand



# THE AMERICAS

## Argentina



### 1. University of Palermo

*MSc. in Environmental Law*

Offered Course:

Science and Environment (Elective)

## Chile



### 1. Pontifical Catholic University of Chile

*Master in Energy Engineering*

Offered Course:

Hydrogen Production and uses (elective)



# THE AMERICAS



## Brazil

### 1. Pontifical Catholic University of Rio Grande do Sul

MSc. Engineering and Materials Technology

PhD. Engineering and Materials Technology

#### Offered Courses:

Materials and Processes for Carbon Capture and Storage (elective)

Materials and Technologies for Mitigation of Environmental Impacts (elective)

### 2. University of São Paulo

MSc Geosciences

PhD Geosciences

#### Offered Courses:

Climate Changes in Earth's present and past (elective)



# THE AMERICAS



## Canada

### 1. University of Alberta

Master of Arts / Master of Science / PhD. in Earth and Atmospheric Sciences

**Offered Courses:**

- Global Change
- Atmospheric Modelling
- Human Dimensions of Environmental Change
- Advanced Human Dimensions of Global Change

### 2. University of British Columbia (BC, Canada)

M.Eng. on Clean Energy Engineering

**Offered Courses:**

- Energy and the Environment (compulsory)
- Thermal Energy Systems (compulsory)

Master of Art / Masters of Science in Resources Management and Environmental Studies

**Offered Course:**

- Climate Change in the 21st Century (elective)





# THE AMERICAS

## Canada

### 3. University of Calgary

M.Sc. Geosciences – spec. on Reservoir Characterization

Offered Course:

Flow in Porous Media (or Waterflooding and Enhanced Oil Recovery) - elective

M.Eng. / M.Sc. / Ph. D (spec. in Chemical Engineering)

M.Eng. (spec. in Petroleum Exploration Engineering)

Offered Courses:

Thermal Recovery Methods (elective / compulsory for spec. Petroleum Engineering)

Reservoir Simulation (elective / compulsory for spec. Petroleum Engineering)

Air Pollution Control Engineering (elective)

Thermal Recovery Methods (elective)

Secondary and Tertiary Recovery (elective / compulsory for spec. Petroleum Engineering)

M.Eng / M.Sc / PhD in Electrical and Computer Engineering

Offered Courses:

Renewable Energy and Solid State Lighting for Human Development

Renewable Energy and Solid State Lighting for the Developing World



# THE AMERICAS

## Canada

### 4. University of Regina

Master of Applied Science / Master of Engineering / PhD.  
(Petroleum Systems Engineering)

**Offered Course:**

Advanced Enhanced Oil Recovery (elective)

### 5. University of Saskatchewan

Master in Sustainable Environmental Management (M.SEM.)

**Offered Courses:**

Human Dimensions of Environmental Change (compulsory)

Current Issues in Land Reclamation and Remediation (restricted set of electives)

Environmental Economics and Policy Making (restricted set of electives)

Reservoir Mechanics (elective)

Petroleum Geology

Master of Environment and Sustainability (M.E.S.)

**Offered Courses:**

Human Dimensions of Environmental Change (compulsory)

Research in Environment and Sustainability (compulsory)

Reservoir Mechanics (elective)

Petroleum Geology (elective)



# THE AMERICAS

## United States

### 1. Harvard University

#### PhD (Earth and Planetary Sciences)

##### Offered Courses:

Introduction to Meteorology and Climate  
Global Warming Debates: The Reading Course

### 2. Princeton University

#### M. Eng. / M.Sc. / PhD (Engineering and Water Resources)

##### Offered Courses:

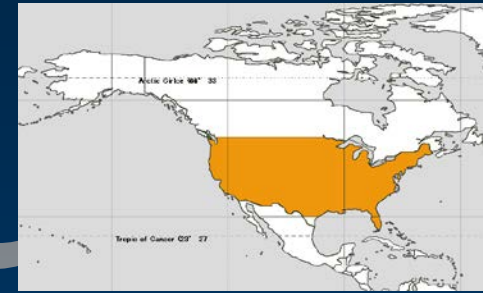
Environmental Engineering & Water Resources

### 3. University of California

#### Master / Ph.D. (Atmospheric and Oceanic Sciences)

##### Offered Courses:

Ocean Biogeochemical Dynamics and Climate (elective)



# THE AMERICAS

## United States

### 4. University of Delaware

M.Sc. / PhD (Geography)

**Offered Courses:**

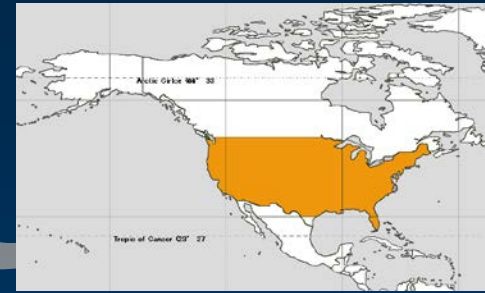
Climate and Life  
Conservation: Global Issues  
Seminar in Climate Change

### 5. University of Washington

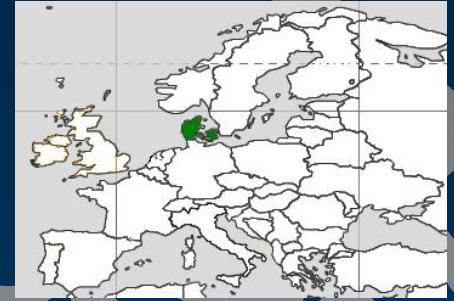
M.S. / Ph.D. (geological sciences and geophysics)

**Offered Courses:**

Climate Modeling (elective)  
Climate Impacts on the Pacific Northwest (elective)  
Current Research in Climate Change (elective)  
Climate Dynamics (elective)  
The Global Carbon Cycle and Climate (elective)



# EUROPE



## Denmark

### 1. University of Copenhagen

#### Master of Law (LLM)

#### Offered Courses:

Climate Change and the Law (10 ECTS)

International Energy Law and Sustainability (10 ECTS)

### 2. Technical University of Denmark

#### MSc. Petroleum Engineering Technological Specialisation Course

#### MSc. in Chemical and Biochemical Engineering

#### Offered Courses:

28415 Oil and gas production (5 ECTS) – compulsory optional course (Technological Specialization Courses)

28515 Enhanced Oil Recovery (5 ECTS) - compulsory optional course (Technological Specialization Courses)



# EUROPE

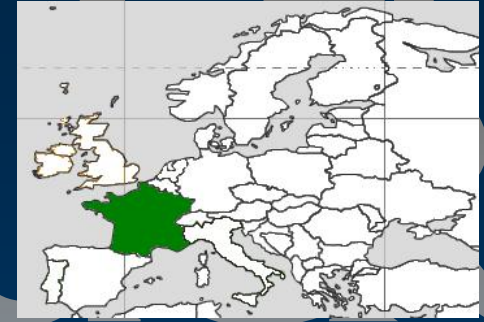
## France

### 1. University of Paris X – Nanterre la Défense

MSc – Professional Management, Economics (Speciality: Economics and politics of energy and environment)

Offered Courses:

→ specific courses were not mapped



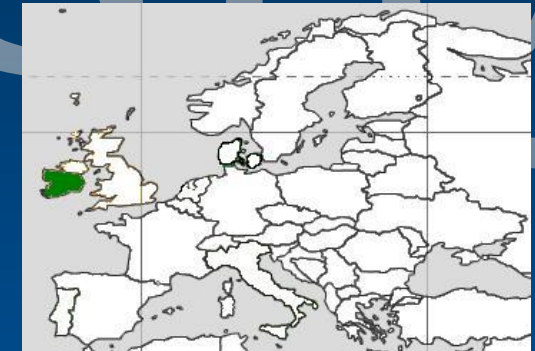
## Ireland

### 1. University College Dublin

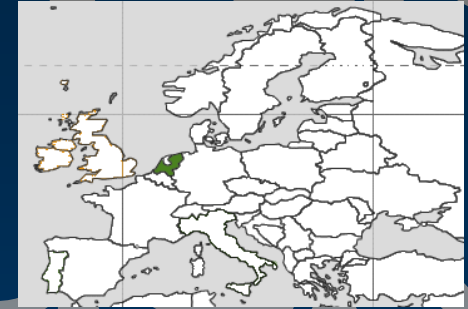
Master Energy Systems Engineering

Offered Courses:

- Energy Systems & Climate Change - compulsory
- Chemical Processes of Sustainable and Renewable Energy - compulsory
- Fossil Fuels, Carbon Capture & Storage - compulsory



# EUROPE



## The Netherlands

### 1. Delft University of Technology (TUD)

MSc Applied Earth Sciences – track Resource Engineering (Spec. Geotechnical and Environm. Engineering)

**Offered Courses:**

Environmental Geology & Geophysics - Compulsory  
Underground Waste Management – Compulsory

MSc Applied Earth Sciences - track Petroleum Engineering and Geosciences (specializations: Petroleum Engineering / Reservoir Geology)

**Offered Courses:**

Applied Reservoir Engineering & Simulation, part I - Compulsory  
Applied Reservoir Engineering & Simulation, part II – Compulsory only for spec. Petroleum Engineering  
Special Topics Geotechnology and Sustainable Development – Elective for spec. Petroleum Engineering

### 2. University of Groningen

LL.M in International Law and the Law of International Organizations  
LL.M in European Law

**Offered Courses:**

International Environmental Law – Optional / elective  
Energy Law – Elective  
European Environmental Law – Elective for LLM European Law



# EUROPE

## The Netherlands

### 3. University of Amsterdam

MSc. Earth Sciences – Environmental Management

MSc. Earth Sciences – Geo-Ecological Dynamics

#### Offered Courses:

Climate Change – Optional from the “Optional compulsory courses list” for Environmental Management / Elective for Geo-Ecological Dynamics  
Paleo-ecology and Global Change - Optional

LLM International and European Law – Public International Law

#### Offered Courses:

M2420 - International Environmental Law – Elective

### 4. VU University Amsterdam

MSc. Earth Sciences

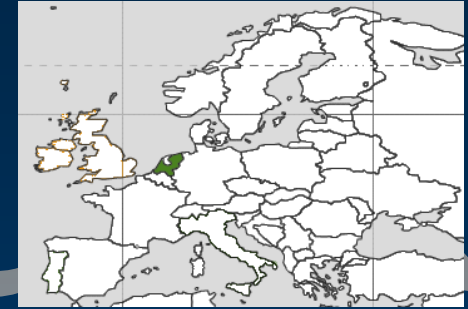
MSc. Geosciences of Basins and Lithosphere

MSc. Hydrology

#### Offered courses:

Modern Climate Systems  
Modern Geo-ecosystems  
From Source to Sink: Chemical and Physical Cycles  
Practical: Palaeoclimate Change and Environmental Impacts  
Sedimentary Environments and Climate Archives

Climate Modelling  
Climate and Policy  
International Environmental Economics  
Man and Climate: From Hominids to Modern Civilisation  
Sedimentary Environments and Climate Archives  
Spatial Ecology and Global Chang

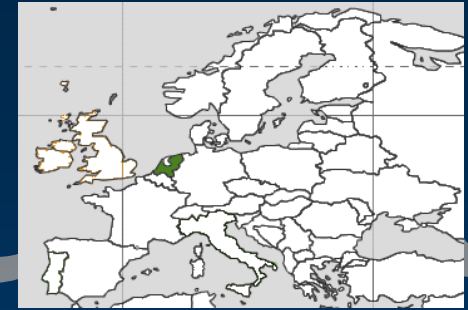




# EUROPE

## The Netherlands

### 4. VU University Amsterdam



#### MSc in Spatial, Transport and Environmental Economics

##### Offered courses:

Environmental Economics - Optional

International Environmental Economics - Optional

#### MSc in Economics (specialization Spatial Economics)

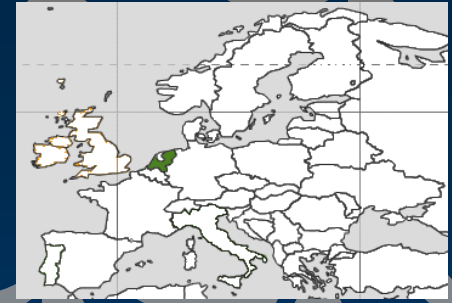
##### Offered courses:

Environmental Economics - Compulsory



# EUROPE

## The Netherlands



### 5. University of Utrecht

#### MSc. Earth Sciences - Geology (specialization Sedimentary Systems)

##### Offered Courses:

- Paleo oceanography and climate variability – Compulsory (specialization in Sedimentary Systems)
- Astronomical climate forcing & time scales – Compulsory (specialization in Sedimentary Systems)
- Organic geochemistry - Elective

#### MSc. Earth Sciences – Geochemistry

#### MSc. Earth Sciences - Hydrology (spec. Earth Surface Hydrology)

##### Offered courses:

- Paleo oceanography and climate variability - elective
- Organic geochemistry – Compulsory (Geochemistry) / Elective (Hydrology -spec. on Earth Surface Hydrology)
- Hydrology, climate change and fluvial systems – elective (Geochemistry) / Compulsory (spec. on Earth Surface Hydrology)
- Astronomical climate forcing & time scales – Elective

#### MSc. Earth Sciences - Physical Geography (spec.: Coastal Dynamics and Fluvial Systems / Natural Hazards and Earth Observation / Quaternary Geology and Climate Change)

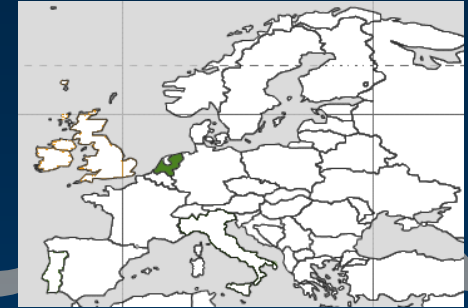
##### Offered courses:

- Hydrology, climate change and fluvial systems
- Advanced Course in Quaternary Geology and Climate Change
- Paleo oceanography and climate variability
- Organic geochemistry



# EUROPE

## The Netherlands



### 5. University of Utrecht

#### MSc. Energy Science

##### Offered courses:

- Energy and Resources Policies - Compulsory
- Research Methods for Energy and Materials - Compulsory
- Simulation of Ocean, Atmosphere and Climate – Elective
- Topics in Climate Science - Elective

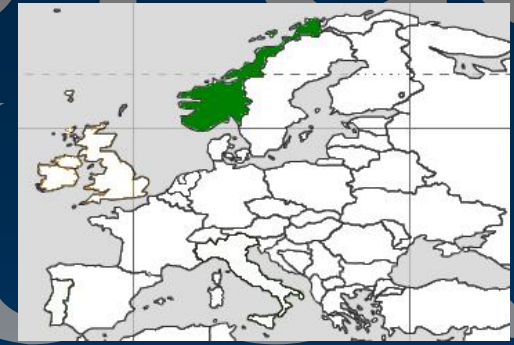
#### LLM (Master of Laws) Public International Law

##### Offered courses:

- International Environmental Law - Compulsory
- International Law of the Sea – Optional



# EUROPE



## Norway

### 1. Norwegian University of Science and Technology (NTNU)

[MSc in Petroleum Engineering \(MSG1\)](#)

[MSc. in Petroleum Geosciences \(MSG2\)](#)

[PhD](#)

#### Offered courses:

TPG4150 - Reservoir Recovery Techniques (7.5 ECTS) – compulsory for MSG1/ optional for MSG2

TPG4117 - Unconventional Oil and Gas Reservoirs (7.5 ECTS) – optional for specialization in Reservoir Engineering

PG8604 - Enhanced Oil Recovery (7.5 ECTS) – Study level: Doctoral degree level

[PhD in Energy and Process Engineering](#)

#### Offered courses:

##### → Research fields

Area 1: Thermal Energy

- Airpolution and CO<sub>2</sub> capture



# EUROPE



## Norway

(...) 1. Norwegian University of Science and Technology (NTNU)

*MSc. in Natural Gas Technology*

Offered courses:

→ Specialization option: Thermal power Cycles including CO2 capture

2. University of Oslo

*Master of Philosophy in Economics (spec. Environmental, Resource- and Development economics)*

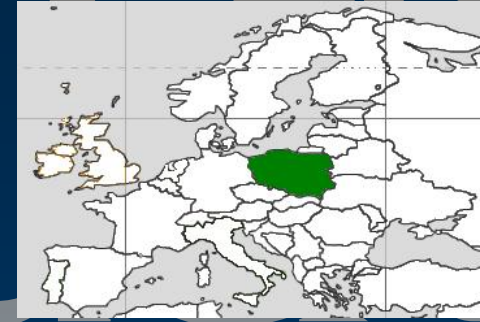
Offered courses:

ECON4910: Environmental Economics (10 credits) – optional compulsory course



# EUROPE

## Poland



### 1. University of Warsaw

*Master of Arts in Development Economics (MADE)*

Offered courses:

2400-ITC-2 International Environmental Cooperation (5 ECTS) - optional course



# EUROPE

## Portugal

### 1. New University of Lisbon + University of Lisbon

#### PhD in climate change and sustainable development policies

##### Offered courses:

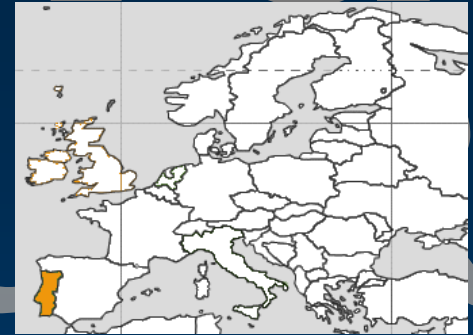
- Adaptation and Mitigation of Climate Change (compulsory)
- Science of Climate Change (compulsory)
- Economy and Market Regulation (compulsory)
- Ethics, Public Policy and Environmental Diplomacy (compulsory)
- History, Development and Environment (compulsory)
- Earth and Ocean Systems (compulsory)
- Sociology of Environment and Communication (compulsory)
- Seminar on Energy and Climate Change (compulsory)

### 2. University of Coimbra

#### Master in Environmental Engineering

##### Offered courses:

- Global changes and Climatology (compulsory)
- Risk Analysis (compulsory)



# EUROPE

## Portugal

### 3. University of Évora

Master degree in Earth, Atmospheric and Space Science  
Spec.: Atmospheric Physics and Climate // Internal Geophysics

#### Offered courses:

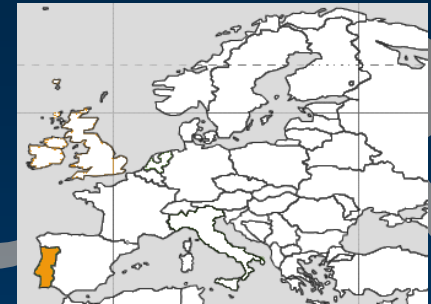
- FIS7922 - Seminar in Earth Sciences, Atmospheric and Space (compulsory spec. Internal Geophysics)
- FIS7931 - Atmosphere and Climate Physics (compulsory spec. Atm. Physics and Climate)
- FIS7757 - Resources, Energy and Environment (compulsory)
- FIS7924 - Atmosphere and Space Remote Sensing ECTS (compulsory)
- FIS7927 - Methods and observation techniques in Earth, Atmospheric and Space (compulsory)
- FIS7765 – Climate, Climate Modeling and Climate Change (compulsory)
- GEO7954 Geographic Information Systems in Earth, Atmospheric and Space I (elective)
- FIS7910 - Anthropogenic impacts on the Atmospheric Environment (elective)
- FIS7766 - Gases and Aerosols Dispersion in Atmosphere (elective)

### 4. University of Lisbon

Master in Environmental Sciences and Technologies

#### Offered courses:

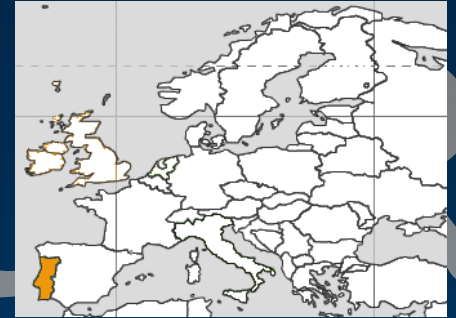
- Environmental Law and International Relations (compulsory)
- Environmental Economy (compulsory)
- Conversion Technologies and Environmental Requalification (compulsory)
- Climate Change and Renewable Energy (compulsory)
- New Markets and Environmental Affairs (compulsory)
- Socio-Economic Impacts of Environmental Policies and Markets (compulsory)





# EUROPE

## Portugal



### 5. University of Porto

#### Integrated Master Degree in Chemical Engineering

##### Offered courses:

EQ0108 - Gaseous Emissions Control and Management (compulsory)

#### PhD in Sustainable Energy Systems

##### Offered courses:

PDSSE0001 - Energy, Environment and Sustainability (compulsory)



# EUROPE

## Spain

### 1. University of Córdoba

#### Master in Climate Change: Natural resources and Sustainability

##### Offered courses:

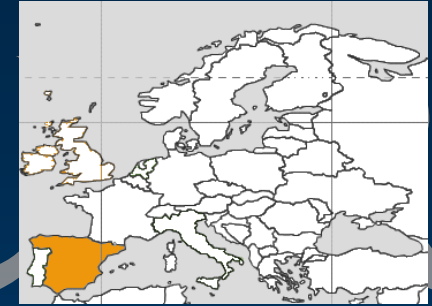
- 100348 - CAMBIO GLOBAL: CONVENIOS E INICIATIVAS INTERNACIONALES (elective)
- 100359 - EFECTOS DEL CAMBIO GLOBAL EN LOS ECOSISTEMAS (elective)
- 100350 - EVALUACIÓN Y MEDIDAS DE ADAPTACIÓN AL CAMBIO GLOBAL (elective)
- 100356 - SOCIEDAD Y CAMBIO GLOBAL (elective)

### 1. Autonomous University of Barcelona (UAB)

#### Master in Environmental Studies (spec. Global and Climate Changes)

##### Offered courses:

- 40423 – Climate change – 10 ECTS credits/ compulsory
- 40422 - Past, Present, and Future Global Change – 10 ECTS credits / compulsory



# EUROPE

## United Kingdom\*



Institution	Degree	Compulsories				Electives			
		C	S	E	X	C	S	E	X
U. of Edinburgh School of GeoSciences	Masters of Carbon Capture and Storage	█	█		█	█			█
U. of Edinburgh Business School	Masters of Carbon Management			█	█			█	█
EUROPEAN: U. of Edinburgh (UK), U. of Versailles St-Quentin (France), U. of Bergen (Norway)	PERICLES – Postdoctoral European Masters Formation on Interactions Between Climate, Environment and Society			█	█				
Imperial College Institute of Energy Futures	Masters in Sustainable Energy Futures	█			█	█		█	
U. of Nottingham, Birmingham and Loughborough Schools of Engineering	Engineering Doctorate (Industrial) and Masters in Carbon Capture	█			█	█			█
U. of Glasgow Crichton Carbon Centre	Masters of Carbon Management			█	█			█	█
U. of Lancaster School of Engineering	Masters of Low Carbon Emission			█				█	

\* IEA Greenhouse Gas R&D Programme (IEA GHG), "The Landscape of Carbon Dioxide Capture, Storage, and Management (CCSM) Education in the UK". 2009/TR5, August 2009.



# AFRICA

## South Africa

### 1. University of Cape Town

[MSc.in Engineering in Energy & Development Studies](#)

[MSc. in Engineering in Sustainable Energy Engineering](#)

Offered courses:

ENERGY & CLIMATE CHANGE (elective for MSc. Eng. Energy&Development Studies)

ENERGY MODELLING (elective)



# OCEANIA

## New Zealand



### 1. University of Canterbury

#### MSc. Zoology, Ecology or Plant Biology

##### Offered courses:

BIOL474-11W - 0.2500 EFTS Conservation Biology

BIOL479-11W - 0.2500 EFTS Global Change Biology (only Zoology and Ecology)

#### MSc. Geography

##### Offered courses:

GEOG408-11S2 - 0.2500 EFTS Cryospheric Processes and Climate Change

### 2. University of Waikato

#### Master of Law

##### Offered courses:

LAWS571C Special Topic - International Trade Regulations: Emerging Issues (30 points)



# OCEANIA

## New Zealand



### 1. University of Victoria

#### Master of Laws

##### Offered courses:

ENVI 522 Environmental Law

ENVI 528 Climate Change Issues

#### Master of Science in Physical Geography

##### Offered courses:

PHYG 414 Climate Change: Lessons from the past



# OCEANIA A

## Australia\*, \*\*



### 1. Australian National University

#### Master of Climate Change

#### Master of Environment (research or coursework)

##### Offered courses:

- CRWF8006 - Climate Change Policy Economics
- ENVS6303 – Climatology
- ENVS6307 - Climate Change Science & Policy
- ENVS8003 - Climate Change Vulnerability and Adaptation
- ENVS8005 - Climate Change Science
- LAWS8180 - International Climate Law (Master Climate Change)
- LAWS8181 - Australian Climate Law (Master Climate Change)
- ENVS6033 - International Environmental Policy (Master of Environment)
- ENVS6528 - Environmental Policy (Master of Environment)
- EMDV8026 - Introduction to Environmental Science (Master of Environment)

#### Master of Environmental Law

##### Offered courses:

- LAWS8180 - International Climate Law
- LAWS8181 - Australian Climate Law

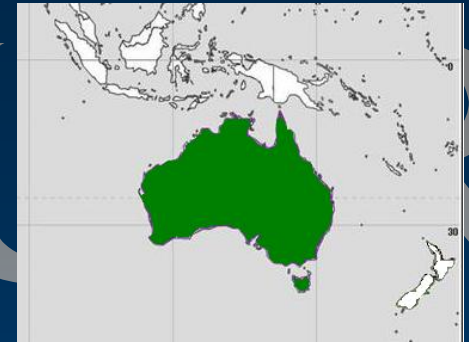
•Graduate programs in Australia were mapped by Dr Lila W. Gurba from the University of South Wales and Sustainable Energy Resources Intl. Report: "Mapping of CO2 Capture, Storage, and Management (CCSM) Graduate Programs in Australia".

\*\* In this presentation, only some of the graduate programs mapped are presented.



# OCEANIA

## Australia\*



### (...) 1. Australian National University

#### Master of Environmental Management and Development

##### Offered courses:

- CRWF8006 - Climate Change Policy Economics
- DEMO8088 - Population, Climate Change and Sustainable Development
- ENVS6307 - Climate Change Science & Policy
- ENVS8003 - Climate Change Vulnerability and Adaptation
- LAWS8180 - International Climate Law

#### Master of Science / Master of Science (Environmental Science) (research or coursework)

##### Offered courses:

- BIOL6125 – Plants and Global Climate Change
- EMSC8009 – Melting polar ice sheets, sea level variations and climate change
- ENVS6013 – Society and environmental change
- ENVS6303 – Climatology
- ENVS6307 - Climate Change Science & Policy
- ENVS8006 – Measuring forest carbon
- ENVS8003 - Climate Change Vulnerability and Adaptation
- ENVS8005 - Climate Change Science
- ENVS8007 – Climate change – a short course

\* Graduate programs in Australia were mapped by Dr Lila W. Gurba from the University of South Wales and Sustainable Energy Resources Intl. Report: "Mapping of CO2 Capture, Storage, and Management (CCSM) Graduate Programs in Australia".





# OCEANIA A

## Australia\*



### (...) 1. Australian National University

#### Master of Engineering

##### Offered courses:

ENGN6516 – World energy resources and renewable technologies

### 2. Macquarie University

#### Graduate Diploma in Climate Science

##### Key offered courses:

ENVE214: Climate Change (3 UOC)

ENVE301: Climate change, coasts and oceans (3 UOC)

ENVE304 Integrated climate science (3 UOC)

#### Master of Environmental Planning

##### Offered courses:

GSE836 Water Policy and Management (4 UOC) (compulsory)

HGEO809 Globalisation and Sustainable Development

#### Master of Environmental Law

##### Offered courses:

LAW853 Comparative Environmental Law (4 UOC) compulsory)

LAW860 International Environmental Law (4 UOC)

LAW855: Environmental Law and Sustainable Development (4 UOC)

LAW852 Trade and Environment Law (4 UOC)



# OCEANIA

## Australia\*

### 3. Monash University

#### Master of Environment and Sustainability

##### Offered courses:

- ECC3640 - Economics of climate change (6 UOC) (elective)
- ENE3048 - Energy and the environment

#### Master of International Development and Environmental Analysis

##### Key offered courses:

- CHM3960-Environmental chemistry – compulsory
- APG5762 Environmental economics and policy (6 UOC) - elective
- APG5427 - Frontiers in sustainability and environment - elective
- APG4558 - Global Change and the Earth System – elective
- ENV3022-Environmental technology (6 UOC) (elective)

### 4. Queensland University of Technology

#### Graduate Certificate In Built Environment and Engineering

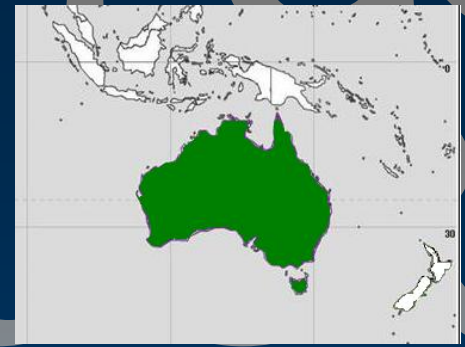
##### Offered courses:

- BEB903 Greenhouse Solutions (credit points 12). (Elective)



# OCEANIA

## Australia\*



### 5. University of Adelaide

#### Master of Carbon Management (by Coursework) (integrates Business and Resource Management) Graduate Diploma in Carbon Management

##### Offered courses:

- ENV BIOL 7016 - Climate Change: Past, Present and Future (3 UOC) (core)
- ENV BIOL 7018EX - Thinking Critically About Global Warming (3 UOC) (core)
- ECON 7221 - The Economics of Climate Change (3 UOC) (core)
- COMMGMT 7000 - Business and Carbon Management (3 UOC) (core)
- TECHCOMM 7023 - Carbon Impact and Strategy (3 UOC) (core)
- TECHCOMM 7033 - Ongoing Carbon Management (3 UOC)
- PETROENG 7061 - Carbon Capture and Storage (3 UOC)**
- TECHCOMM 7037 - Energy Management, Economics & Policy
- ENV BIOL 7305 - Carbon Management: Research Methods (3 UOC) (elective)

#### Master of Sustainability

##### offered courses:

- ENV BIOL 7019 Sustainable Development: Concepts and Applications (3 UOC)
- ENV BIOL 7018EX - Thinking Critically About Global Warming (3 UOC) (Science and the Environment) (elective)
- TECHCOMM 7025 Introduction to Climate Change (3 UOC) (Science and the Environment) (elective)
- ECON 7221 - The Economics of Climate Change (3 UOC) (Economics) (elective)



## OCEANIA A

### Australia\*

(...) 5. University of Adelaide

#### Graduate Diploma in Engineering (Mining)

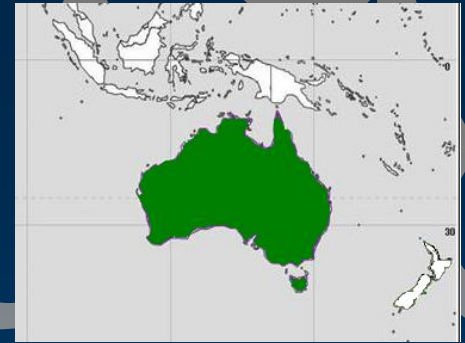
##### Offered courses:

TECHCOMM 7033 - Ongoing Carbon Management (3 UOC) (elective)

#### Master of Petroleum Engineering (Master by Coursework)

##### Offered courses:

PETROENG 7040 Enhanced Oil Recovery (3 UOC) (elective)



# OCEANIA

## Australia\*

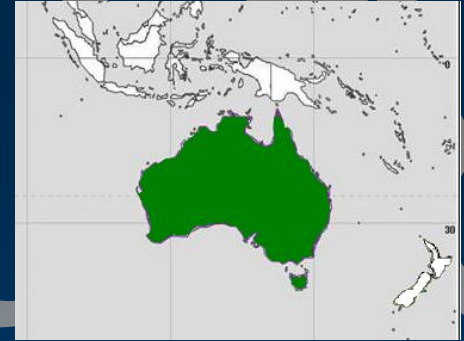
### 6. University of Melbourne

Master of Energy Systems (proposed in 2012)

Offered courses:

Elective subjects

- Electrical Power Systems
- Carbon capture and storage fundamentals
- Climate modelling and climate change
- Sustainable Buildings
- Sustainability Accounting



### 7. University of New South Wales

Graduate Diploma of Engineering Science (Petroleum Engineering)

offered courses:

- PTRL4012 Enhanced Oil & Gas Recovery (6 UOC) (Core)
- GEOL9151 Petroleum Geology (6 UOC) (elective)
- PTRL5008 Petroleum Production Economics (6 UOC) (elective)
- PTRL5007 Reservoir Engineering (6 UOC) (elective)
- PTRL5021 Reservoir Characterisation (6 UOC) (elective)



# OCEANIA A

## Australia\*

### 8. University of Queensland

#### Master of Energy Studies (MES)

##### Offered courses:

##### Key courses:

ENGY7100 Carbon Reduction Options Units: 2

ENGY7101 Carbon Policy, Law and Regulations Units: 2

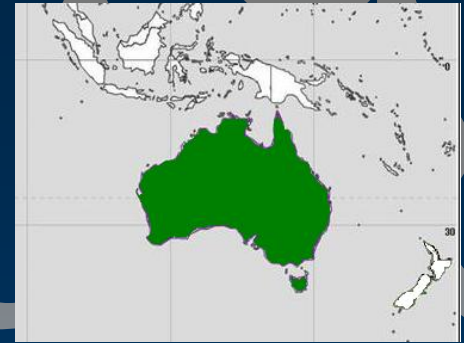
ENGY7102 Principles of Carbon Capture & Storage Units: 2

ENGY7106 Carbon Accounting 1200001255 Units: 2

ENGY7107 Economics & Finance of Carbon Management Units: 2

ENGY7108 Advanced Carbon Capture Technology Units: 2

ENGY7109 Advanced Carbon Storage Technology Units 2



# Final Remarks

## THE AMERICAS

- topics on Carbon Capture and Storage and Climate Change are being discussed inside graduate programs, but currently there are no specific graduate programs on CCS in America
- The number of **courses containing topics on CCS and climate change** in America's post graduate programs is **limited**, and the major existent **courses are not compulsory** in the academic programs
- Compulsories courses in the surveyed universities are mostly related to environmental subjects (such as climate change) and they belong to Environmental programs
- **Canada, Unites States and Brazil** lead the graduate programs that have courses related to CCS and climate changes, with 9, 5 and 2 post graduate programs respectively
- The Electrical Engineering graduate program (University of Calgary, Canada) is the only one that deals economical and political aspects related do CCS.



# Final Remarks

## EUROPE

(Surveyed Countries in Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, UK)

- Topics on CCS/Climate Change are present in a considerable number of post graduate programs in the surveyed countries
- Most of the courses of the academic institutions considered in this report are compulsory
- Courses containing CO<sub>2</sub> capture and storage aspects (in special Enhanced Oil Recovery) were found in universities in Denmark, Norway and Ireland.
- In Norway, a specialization option in a Master program and a PhD research field on CO<sub>2</sub> capture were also mapped.
- Courses on environmental economics, energy law and related topics can be found in universities in France, Norway, The Netherlands, Portugal, Spain and Poland.





**United Kingdom:** at least 5 graduate programs specifically in the area of CCS and Carbon management !!! (\*\*\*) Univ. of Edinburgh: MS degree in CCS)

the United Kingdom review was that the postgraduate programs in CCS that are presently available have *a lack of emphasis on both risk assessment and regulation, which are obviously very key areas (IEA GHG research)*



## Final Remarks

### AFRICA (surveyed country: South Africa)

→ South Africa: University of Cape Town → Master degrees with courses regarding Climate change and energy modelling

### ASIA (surveyed countries: Japan, Korea)

→ no undergraduate programs could be identified in the surveyed universities.



## Final Remarks

### OCEANIA (surveyed countries: Australia, New Zealand)

#### Australia

- Research on carbon capture and storage at Doctorate and Masters' levels are growing in Australia
- A large number of postgraduate courses on CCS-climate change were mapped in this country.

#### New Zealand

- No specific course on CCS were found in the surveyed universities, but there were mapped some courses containing related issues.



**THANK YOU!**

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