BELLONA
ENVIRONMENTAL
CCS
TEAM

BEST

Greece CCS Roadmap

Presentation to

IENE

November 23rd 2010

Who is BELLONA?

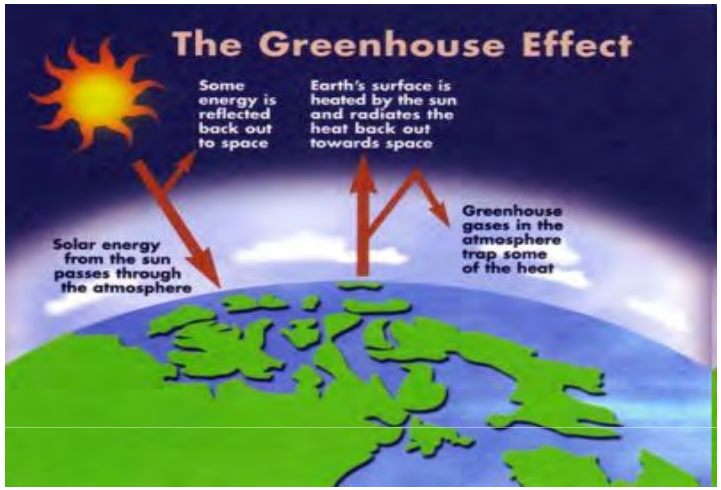
BELLONA FOUNDATION

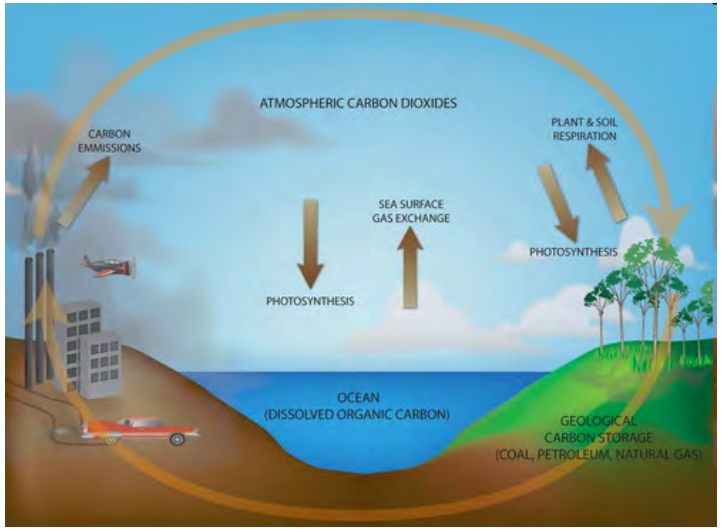
- Environmental NGO and Think Tank
- Founded in Norway 25 years ago
- Offices in Oslo, Brüssels, Washington, St.Petersburg, Murmansk
- 85 employees

OBJECTIVE

- Identify and promote solutions for combating global warming
- Work for an evironment-friendly and prosperous world

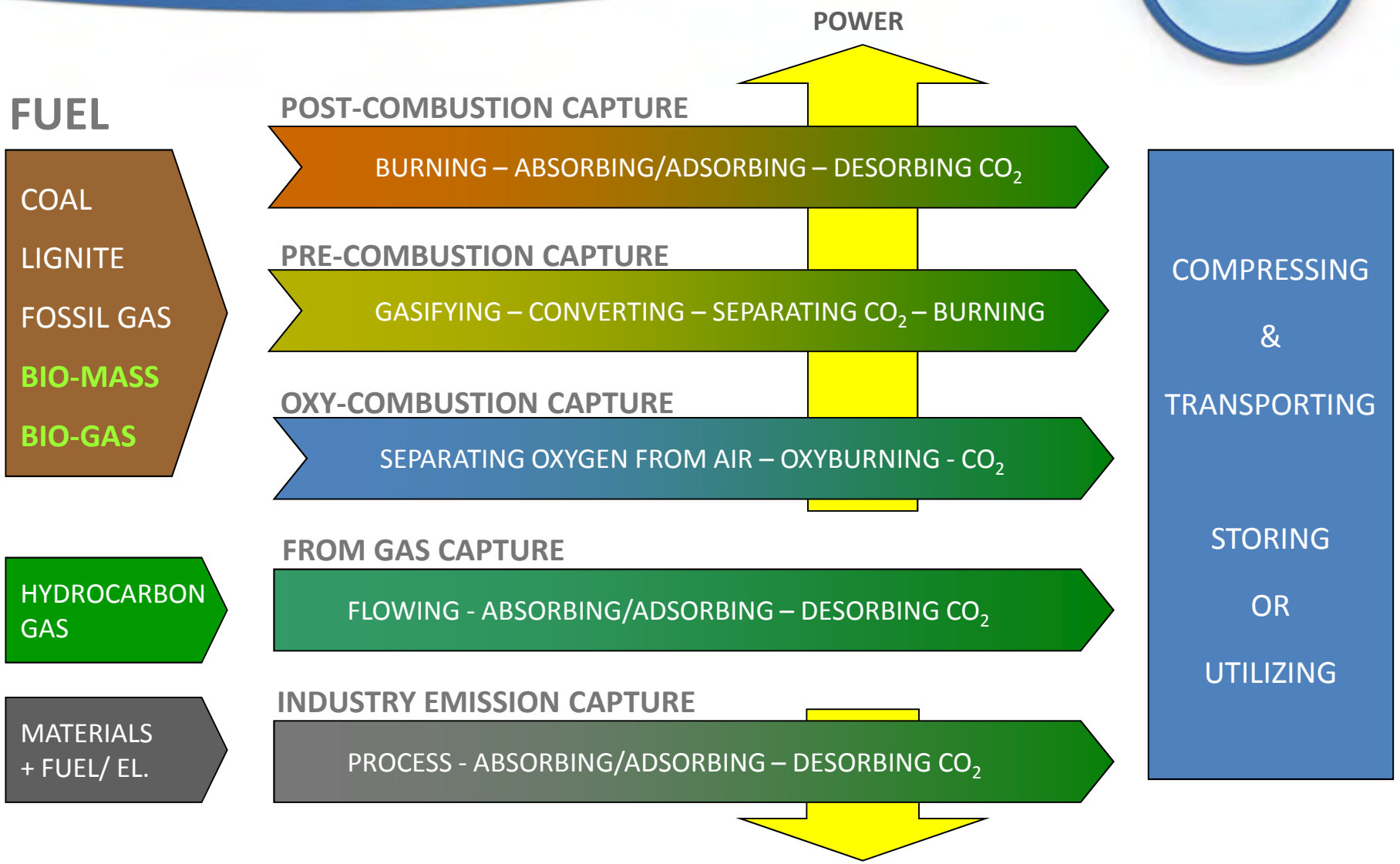
CO_2 and the climate





- Climate change is influenced by man-made CO2 emissions
- Emissions from power sector and industry sector are dominating
- Even a very fast transition to renewable energies is not sufficient to combat climate change
- Capacity to meet the future energy demand must be secured
- CCS makes fossil fuelled power a cleaner intermediate solution
- CCS provides a means for bio-fuelled carbon negative power

CO_2 Value chains



The ambition of the Roadmap

Guide stakeholders, policy makers, and actors in the deployment of CCS

- Convey the environmental and economic results of CCS
- Communicate the path forward for deployment
- Influence Strategic Policy to support CCS
- Advise on commercial/economical mechanisms
- Show how finacial barriers and other hurdles can be overcome
- Provide guidance for securing Public Acceptance

Our approach to the roadmapping

Energy demand

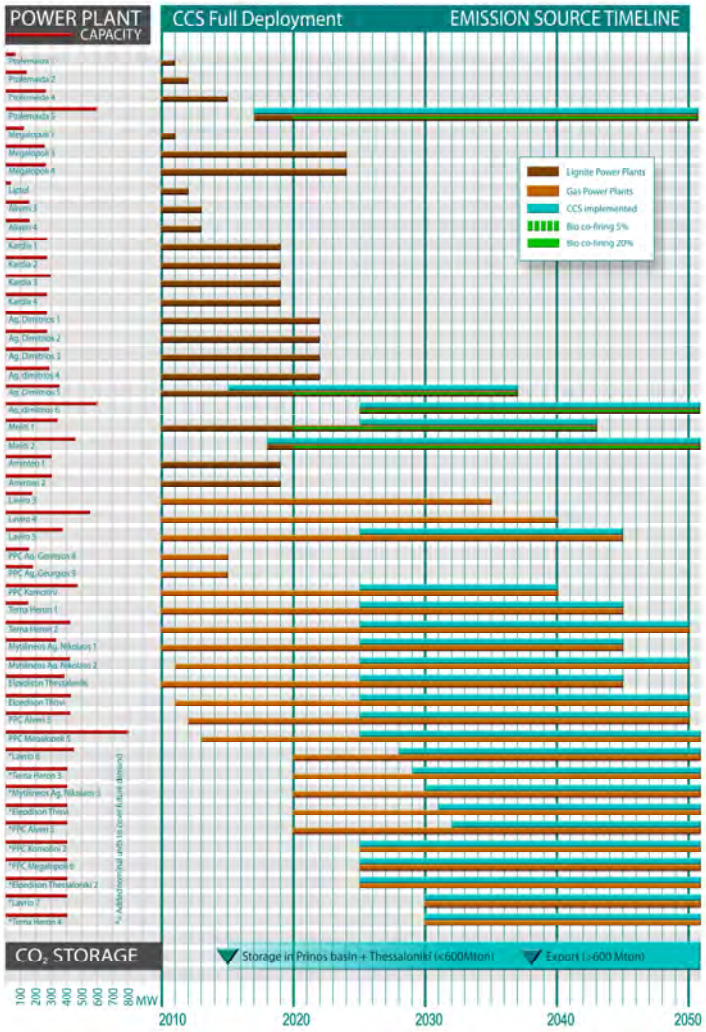
Energy capacity

Energy mix

Emission sources

CCS deployment

SCENARIOS:
No deployment
Constrained deployment
Full deployment
- modelled in LEAP



Timeline and CCS deployment

Data integrity check

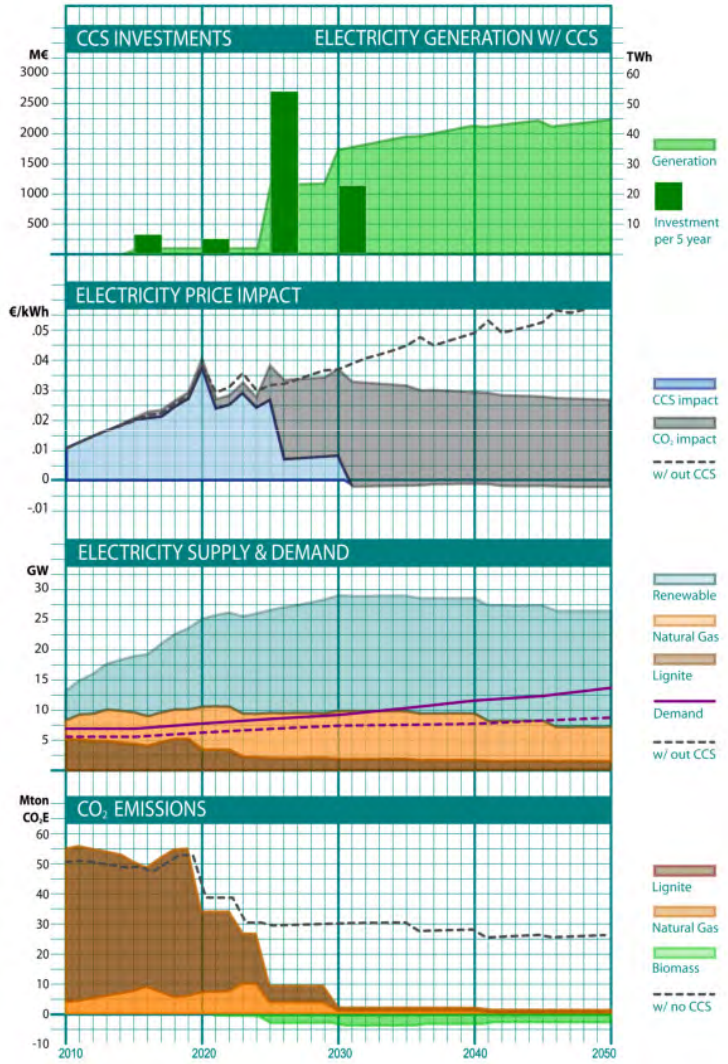
Energy & Emission Modelling

Develop Assumptions

LEAP

Our approach to the roadmapping

Compute data
Interpret results
Develop Projections
Combine & correlate
Create composite graphs
Visualise 'Message'



Identify challenges
Provide recommendations
Promote opportunities

'Centrefold' for Roadmap to provide a visual story

Results from the Scenario modelling

Roadmap at a glance


CCS DEPLOYMENT SCENARIOS

AVOIDED GHG EMISSIONS

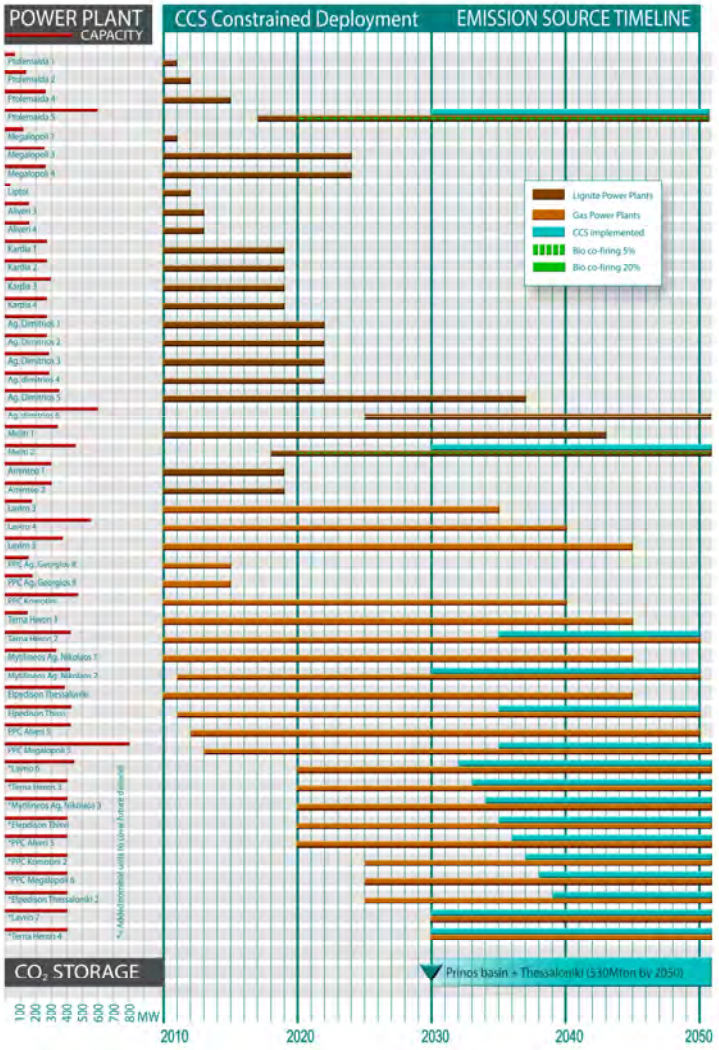
2.3 SCENARIO RESULTS

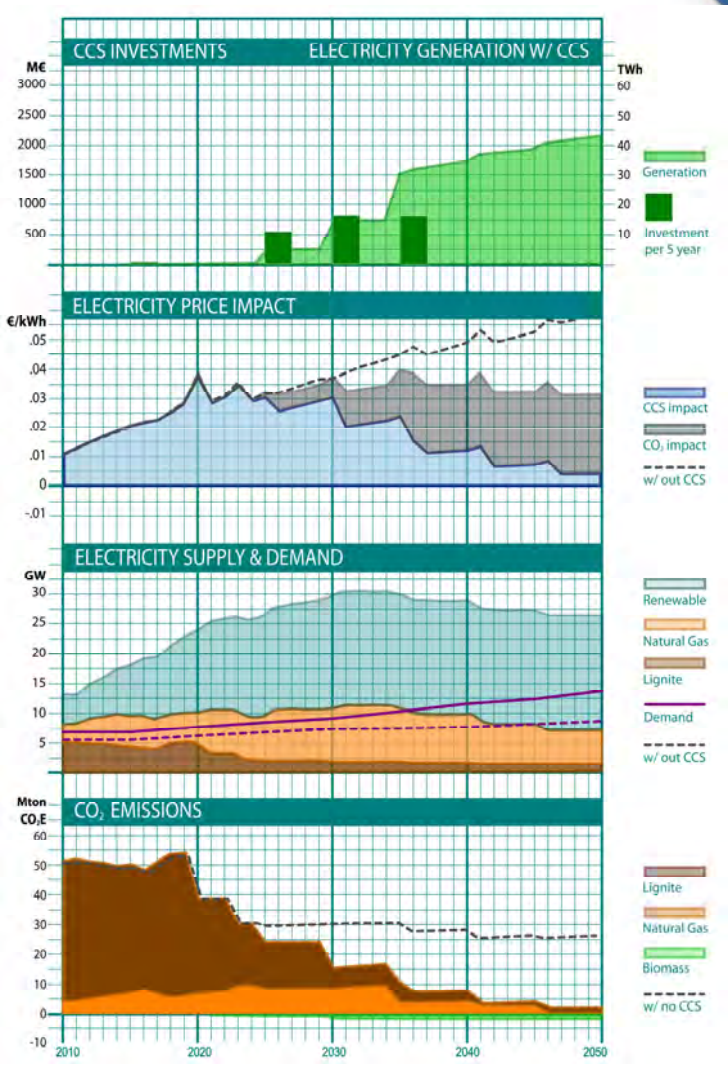
SENSITIVITY OF CO2 AVOIDANCE COSTS IN THE POWER SECTOR

The Roadmap

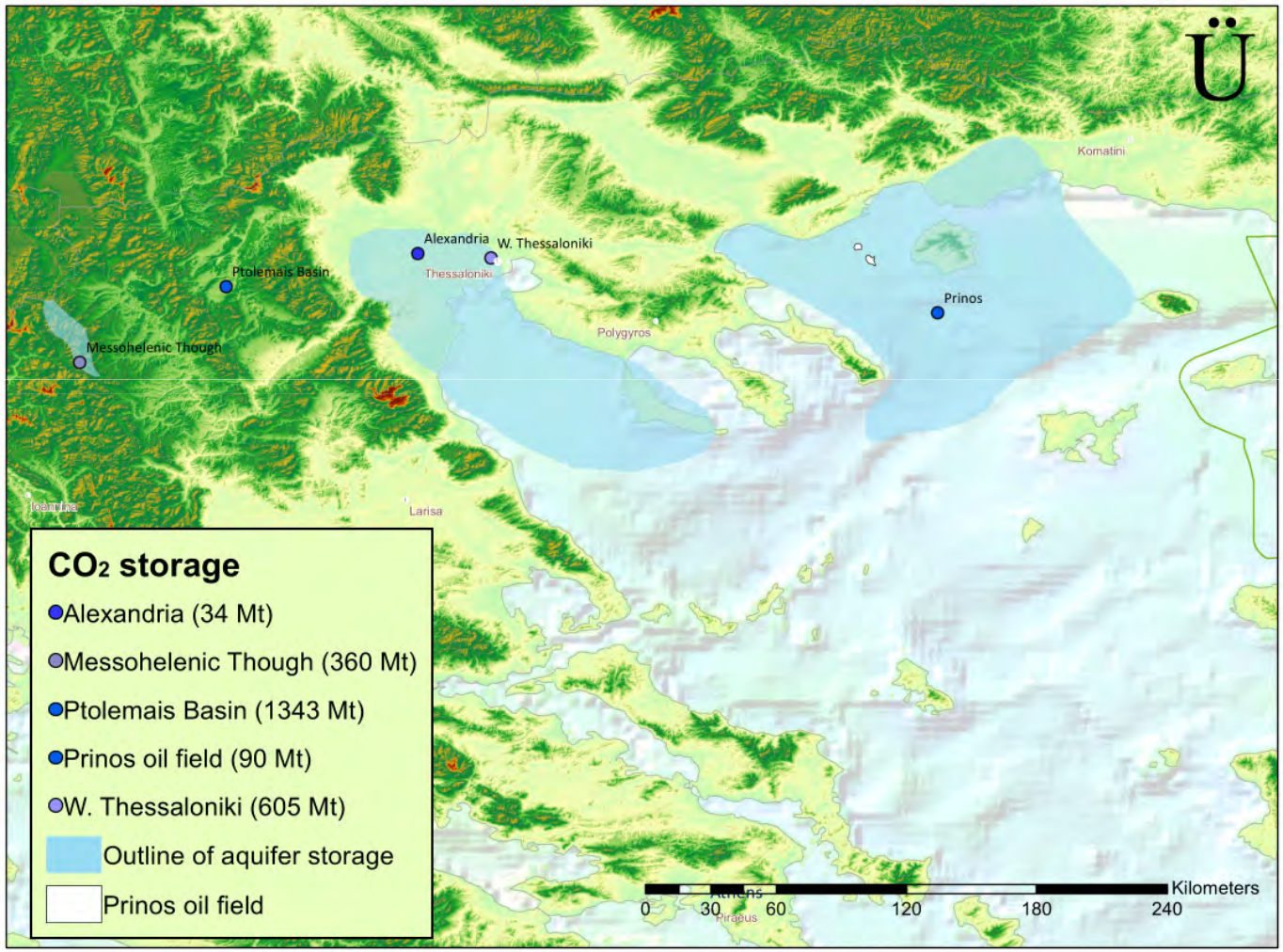
- Executive Summary
  - 1.0 Greece climate change and CCS today
  - 1.1 CCS as a climatic and economic tool
  - 1.2 Energy mix trends
  - 1.3 Emission profile: present and future outlook
- 2.0 CCS deployment scenarios
  - 2.1 Modeling of CCS deployment scenarios
  - 2.2 Applying CCS
  - 2.3 Scenario results
  - 2.4 CO2 storage options
- 3.0 Challenges and recommendations
  - 3.1 Seeing is believing: Making demonstration a reality
  - 3.2 Realizing the potential: Deployment
- 4.0 The bridge to a greener Greece
  - 4.1 Getting started
  - 4.2 Full deployment of CCS
- Annexes

The 'Constrained Deployment' scenario

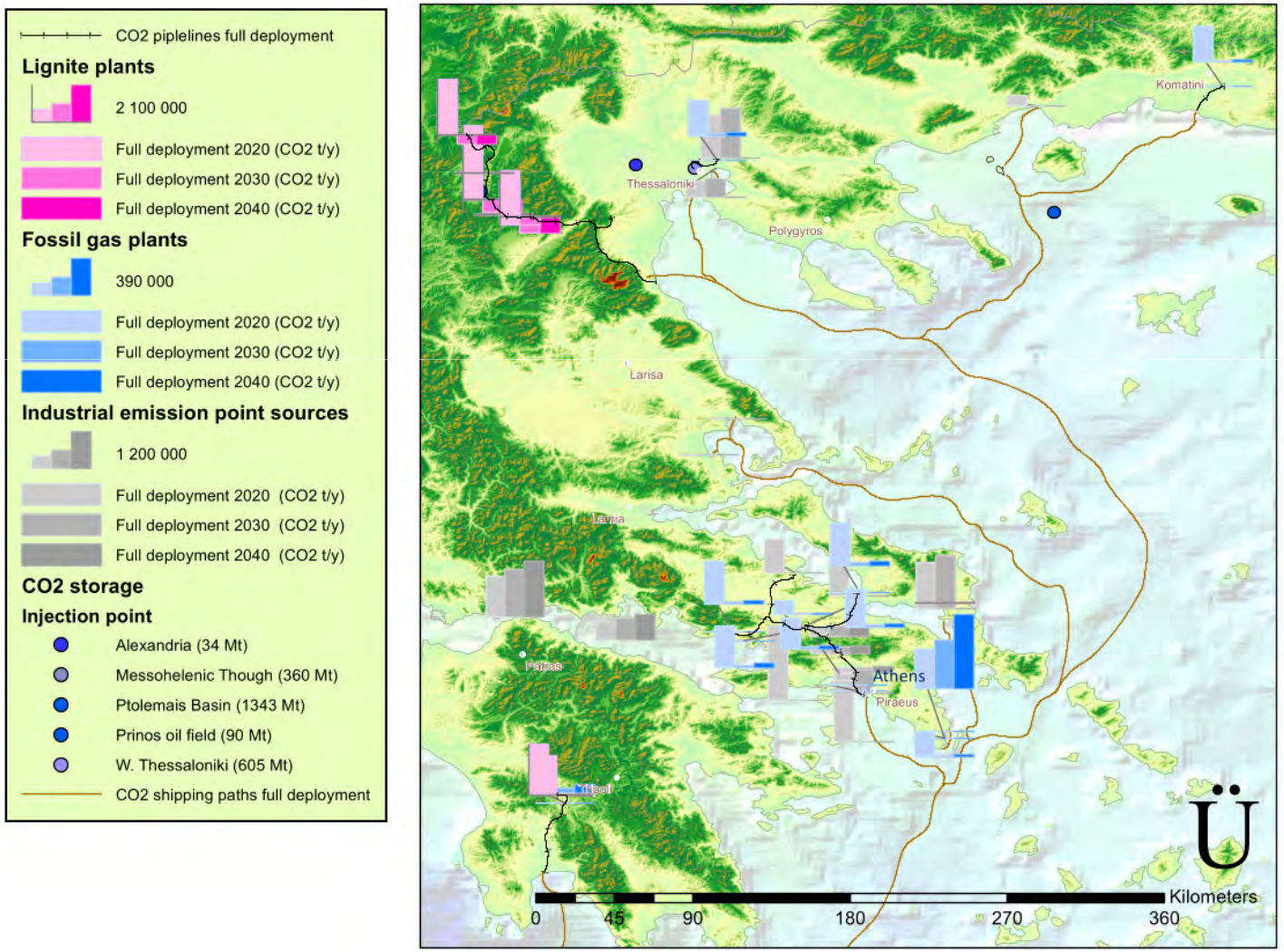




Storage


Ü
Komatini
Alexandria
W. Thessaloniki
Thessaloniki
Ptolemais Basin
Prinos
Polygyros
Messohelenic Though
Larisa
Ioannina
Athens
Piraeus
0
30
60
120
180
240
Kilometers
CO2 storage
Alexandria (34 Mt)
Messohelenic Though (360 Mt)
Ptolemais Basin (1343 Mt)
Prinos oil field (90 Mt)
W. Thessaloniki (605 Mt)
Outline of aquifer storage
Prinos oil field

Transport


CO2 piplelines full deployment
Lignite plants
2 100 000
Full deployment 2020 (CO2 t/y)
Full deployment 2030 (CO2 t/y)
Full deployment 2040 (CO2 t/y)
Fossil gas plants
390 000
Full deployment 2020 (CO2 t/y)
Full deployment 2030 (CO2 t/y)
Full deployment 2040 (CO2 t/y)
Industrial emission point sources
1 200 000
Full deployment 2020 (CO2 t/y)
Full deployment 2030 (CO2 t/y)
Full deployment 2040 (CO2 t/y)
CO2 storage
Injection point
Alexandria (34 Mt)
Messohelenic Though (360 Mt)
Ptolemais Basin (1343 Mt)
Prinos oil field (90 Mt)
W. Thessaloniki (605 Mt)
CO2 shipping paths full deployment
Komatini
Thessaloniki
Polygyros
Larisa
Lamia
Athens
Piraeus
Kilometers
0
45
90
180
270
360

Looking forward for Greece

- Feasibility of CCS in Greece is very good
  - Offshore storage with EOR potential
  - Less an public acceptance issue
  - Strong long term economic benefit
  - Significant Lignite- and Gas-fired power generation

- Policy makers are in disfavour of CCS in Greece
  - Deputy Environment Minister Maniatis:
    "*Projects for carbon capture and storage of CO2, an initiative for which our country retains a very cautious stance for a strong of environmental, earthquake-related, economic, legal and technological reasons*"
  - The CO2 Storage Directive is not being transposed/implemented in order to make CO2 storage legal.

More info

www.bellona.org/ccs