



The Climate Change Agenda

Manthos Kallios Director, Solar Power Division 4th Southeast Europe Energy Dialogue Thessaloniki, 3-4 June 2010

PPC RENEWABLES S.A.



IS CLIMATE CHANGE REAL? The overwhelming majority of the scientific community agrees on two key points:

Climate change is happening now

Human activity is chiefly responsible



Three key scientific findings lead to the first conclusion







The hot summer of 2003 will be the norm by 2030 and seem positively refreshing by 2060





The rise in sea level will have potentially catastrophic results







Glaciers are melting worldwide 1/2

Shepard Glacier



Grinell Glacier



Boulder Glacier







© Glacier National Park Archives





Glaciers are melting worldwide 2/2







So what could be causing this rise in global mean temperature with such dire results?





A rise in solar activity?



- The energy reaching us from the sun has been pretty steady for the past 50 years
- Recent studies have also shown that the solar wind is the lowest it has been in the past 50 years





The natural climatic cycle?



 These cycles do exist but only over periods of millennia, not just the few decades that we are currently experiencing





Accounting only for natural factors (solar activity, volcanoes etc.) leads to a divergence between simulated results and empirical observation...







...whereas incorporating human activity (fossil fuel combustion) corrects the discrepancy







So the Greenhouse Effect is to blame for all this...

The guilty parties: CO₂ and the other bad boys...

...with CO₂ leading the pack



...although, to be fair, the Greenhouse Effect is necessary to a degree for the development and sustainability of life on Earth; without it, the Earth would be 31 °C colder than it is



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Greenhouse Gas (GHG) concentrations are at levels not seen in the past 600.000 years





Unfortunately, over the past 400.000 years, CO₂ concentration and global temperature have been highly correlated







So what does the future hold?



- The best estimate for the Best-Case Scenario (B1) predicts a rise of 1,8 °C with a range of 1,1 °C – 2,9 °C
- The best estimate for the Worst-Case Scenario (A1F1) predicts a rise of 4,0 °C with a range of 2,4 °C – 6,4 °C





A 4°C rise in temperature would result in:

Drought

- Reduction in agricultural production
- Agriculture in Africa reduced by 15%-35%
- Global food production reduced by 10%.

Increased Flooding

- Sea level rises by 59cm.
- Bangladesh & Vietnam threatened as are coastal cities like London, New York, Tokyo, Hong Kong, Kolkata, Karachi
- 1,8MM people threatened in Britain alone

Melting Ice

- Half the Arctic tundra threatened
- Europe loses 80% of its Alpine glaciers
- The Antarctic and Greenland ice sheets begin to melt
- The Arctic icecap melts totally in summer by 2100
- The melting of the Greenland ice sheet will result in a 7m rise in sea level

Increased Disease

- Mosquito populations explode exposing 80MM people in Africa to malaria...
- …and a further 2,5 bn to Dengue Fever
- 20-50% of land-based species threatened with extinction

Lack of drinking water

 The availability of drinking water in Africa and the Med reduced by 50%

Fiercer Hurricanes

- Wind speeds increase by 15-25%.
- Infrastructure destruction
- More frequent occurrences of extreme weather conditions: heat waves, heavy rainfall etc.

Gulf Stream Affected

 It is possible that the thermoregulatory currents of the Atlantic will slow down in the 21st century



EU Response "20-20-20"

- 20% of energy needs from Renewable Energy Sources (RES)
- **20% reduction in energy consumption through energy efficiency**
- 20% reduction in GHG

Greece's Response

- Original EU-mandated target of 18,1% of energy needs from RES by 2020 increased, by law, to 20%
- New laws 3468/2006, 3734/2009, just voted/2010 to facilitate RES penetration
- PPCR's Response...





MILESTONES

- 1973: Geothermal well exploration begins
- 1979: Weather data measurement begins
- 1981: Founding of the Alternative Energy Department (DEME)
- 1982: Construction of the first photovoltaic plant (Kythnos, 100kW)
- 1983: Construction of the first wind farm in Europe (Kythnos, 100 kW)
- 1986: Construction of the first geothermal electric plant on Milos (2 MW)
- 1986-9: Commercial programs HORS QUOTA, MOΠ (Μεσογειακά Ολοκληρωμένα Προγράμματα) and VALOREN for the construction of 25 MW of wind farms in the Aegean, Evia and Crete
- 1998: PPC RENEWABLES S.A. (PPCR) incorporated
- 2006: "Refounding" of PPCR with dedicated staff (4 employees)
- 2007: Transfer of assets, permits, pipeline and PPC staff to PPCR. DEME disbanded

Today, PPCR has 60 employees and is the only Greek company active in all five major RES fields





PPCR has 120 MW of installed capacity in operation



Avaveŵaiµec



RES present a unique opportunity for the PPC Group to capture market share and profitability

Conventional production will be reduced to achieve the target of 20% reduction in CO₂ emissions by 2020

Part of the expected drop in PPC's market share and profits can be recouped by increasing the Group's share of RES production

The cost of CO₂ permits will skyrocket after 2013





In 2009 PPCR added 29 MW to its portfolio of operating assets and is planning to add a further 230 MW over the next 3 years

	Construction completed / Commissioned, 2009	Expected completion of construction or commissioning in 2010	Close to or under construction, 2011-12
WIND	• WF Viotia 38 MW (PPCR share 17,7 MW), joint development with EDF E.N.	 9 Wind Farms Project 12,7 MW Acquisitions 22 MW 	 9 Wind Farms Project 19,7 MW WF Mouzaki 32,2 MW WF Mykonos 1,8 MW WF acquisitions
	• SHPP Smokovo 10 MW • SHPP Ag. Varvara 0,9 MW	 SHPP Papadia 0,5MW Acquisition of SHPP Oinoussa Serron 1,2 MW 	 SHPP Alatopetra 2,3MW SHPP Mesochora 1,6MW SHPP Ilarionas 4,2 MW Ikaria Hybrid 6,5MW Possibly acquisitions in the Balkans
	• 3 x 20kW PV on mass transit rooftops	 PV Atherinolakkos 6 x 80 kW Small-scale PV and PPC rooftops 1,0 MW PV in Industrial Zones 7,4 MW 	 PV Megalopolis I & II 50,0 MW PV Ptolemaida I & II 30,0 MW PV in Industrial Zones 10,0 MW PV Stratos I & II 9,7 MW
			Drilling exploratory wells for • Lesvos 8,0 MW • Methana 4,0 MW • Nisyros 5,0 MW (1 st phase) • Milos 57,5 MW (from 2013+)
Total	29 MW	230	MW ¹
1. Not including Milos's MW			22



PPCR is also expanding into new RES fields:

- Development of a 50 MW biomass plant in depleted lignite mines near Kozani



Biomass plants are especially profitable when located close to the biomass source



PPCR has set 4 priorities for the immediate future

- 1. To review and implement its business plan with over €2 bn of investments by 2015 and which will clearly demonstrate PPC's commitment to RES. Indicative elements include:
 - The development of new wind farms which are expected to contribute decisively to PPCR's development pipeline over the next few years
 - Acquisition and joint development of wind farms which will immediately increase PPCR's installed capacity and increase PPCR's market share in the medium term
 - Significant development of PV over the next few years, starting with the construction of one of the largest PV plants in Europe as well as many others
 - Starting exploitation of high enthalpy geothermal fields
 - Completion of the Ikaria Hybrid and beginning to develop others
 - Development of biomass
 - Gradual expansion into SE Europe and especially the Balkans to diversify our portfolio
- Job creation through new project development and operation which will more than quadruple direct employment at PPCR to ~250 staff by 2015
- 3. Continuing efforts to improve the uptime of existing plants while placing worker safety as a priority
- 4. Commissioning ~1.000 new MW (over 2009) of green energy thus putting the PPC Group once again at the forefront of RES in Greece





Creative use of PPC properties

- Using lignite mines to move to a post-lignite world 1/2

PV Megalopolis, 50 MW – Present and Future





Creative use of PPC properties Using lignite mines to move to a post-lignite world 2/2

Ptolemaida, 2 x 15 MW PV







Creative use of PPC properties

- PV Stratos 10 MW – Exploiting the dam and the area downstream









We are planning to begin the development of all the geothermal fields for which we have permits



TECHNICAL CHARACTERISTICS

- The 2nd largest high enthalpy field in Greece, >350 °C, 18 bar
- Based on feasibility studies, the exploitable geothermal potential of the island is at least 50 MW
- Application for Production Permit for 5 MW at Aghia Irini
- Expected operation: 4Q 2012

NEXT STEPS

Drilling 3 exploratory wells



TECHNICAL CHARACTERISTICS

- The largest high enthalpy geothermal field in Greece, >300°C, 25 bar
- Based on exploratory drilling, the exploitable geothermal potential of Milos alone is at least 120 MW
- Joint development with S&B with a 1st phase target of a 5 MW pilot plant

NEXT STEPS

 Environmental Impact Assessment studies



TECHNICAL CHARACTERISTICS

- Lower enthlapy than the Milos and Nisyros fields
- The goal is to cover the island's baseload power needs (8 MW, for which we have the Production Permit)
- PPC has drilled 22 shallow wells and 4 deep wells (down to 1.410 m).
- Max. geothermal fluid temp. 105 °C

NEXT STEPS

Exploratory wells at Stypsi / Argenos



The medium enthalpy field at Methana is still being explored



Thank you for your attention