Power generation prospects in Greece

E. Spyridonos
PPCR is involved in all RES-related projects, currently realizing an ambitious expansion plan with new and repowering wind projects as well as in Geothermal and Biomass and hybrid power plants pipeline. PPC Renewables generates electricity with no adverse impact on the environment with an overall pipeline of projects in different stages of development amounting some hundreds of MW.
PPC Renewables SA, “PPCR” :

- 100% subsidiary of PPC
- Has inherited the RES portfolio from PPC, including all the know-how and the high expertise in the field of power generation

- Contributes to the energy mix of PPC GROUP with a diversified portfolio of total installed power of **153 MW**: 20 W/F (81,71 MW), 17 SHPP (69,55 MW) and 7 P/V (1,32 MW)

- The overall investments in the Renewable Energy Sector, over the period 2007 – 2017, are about **155 mil €**.


- **Production** (Y2016) was **308,000 MWh**.

- Has **3 pipelines of investment projects**, with different levels of maturity, of about **4000 MW total capacity**.

- Employs **72 persons**.

- Social Acceptability and cooperation with the authorities involved

- Contribution to energy security supply and to the creation of new jobs
Diversified and geographically distributed portfolio of total capacity of 153 MW

Large geographic distribution

Operational portfolio
- 20 Wind Farms
- 17 SHPPPP
- 28 PV Plants
Financials at a glimpse

Production = 308 GWh

Sales of Energy ≈ 30 m€

- **Wind**: 15.4 m€, 142 GWh
- **SHPP**: 14.8 m€, 164 GWh
- **PV**: 0.7 m€, 2 GWh

Production: 308 GWh
Sales of Energy: 30 m€
PPC/PPCR’s Major Geothermal Milestones

- 1973: Beginning of exploratory drilling for Geothermal Fields
- 1986: Construction of the first Geothermal Power Plant in the island of Milos (2 MW)
- 1998: Founding of PPC Renewables S.A.
- 2006: Transfer of all PPC’s RES assets to PPC Renewables S.A.
- 2011: Transfer of geothermal rights from PPC to PPCR

Pic.1: Zefyria 1986
Pic.2: Zefyria 2011
PPCR is expected to play a leading role in the Greek market for geothermal power plants by 2020.
Overview of Kimolos geothermal area (1/2)

Geographic position

Field characteristics

Capacity in MW (based on the relevant Ministerial Decisions)/ Production output

5 MW/ 41,600 MWh

Maximum Temperature

Temperature is expected to be higher than 160°C

Number of deep wells drilled

- 

Shallow exploration wells drilled

PPCR has drilled 8 temperature gradient slimholes and 2 shallow wells to feed desalination facilities (wells’ depth ~200m, max temperature 70 °C) – Temperature for the deep reservoir is estimated to be higher than 160°C

Estimated depth of exploitable fluid

1,200-1,400 m

1) Magnetotellurics’ estimate

Overview

> At this phase a 5 MW power plant will be developed
> PPCR has leased the right to research and develop the field until 2019
> The license can be extended for an additional 20-year period
Overview of Kimolos geothermal area (2/2)

**Current situation**

> Currently the island is under exploration
> Social consensus and positive attitude on Kimolos island
> An application license has been submitted to RAE for a 5MW plant
> An AMT/MT study has been completed in 2010 by “MANVIT S.A.”

**Next steps**

> Construction of deep exploration – production drill holes
Overview of Milos geothermal area (1/2)

Geographic position

Overview

- A 5 MW geothermal plant can alternatively be developed in Milos instead of Kimolos
- With the full field development, and after connecting to Syros, this plant can cover most of the Cyclades’ energy demand
- PPCR has leased the right to explore and develop the field until 2019 – The license can be extended for an additional 20-year period

Field characteristics

Capacity in MW (based on the relevant Ministerial Decisions)/ Production output

5 MW/ 41,600 MWh

Maximum Temperature

323°C

Maximum Depth of wells drilled

1,381 m

Number of deep wells drilled

5

Estimated depth of exploitable fluid\(^1\)

1,000 – 1,500 m

Interconnection infrastructure

Interconnection Milos-Kimolos with aluminum cables 4X50 (max 5MW)

1) Verified by magnetotellurics and production tests
Overview of Milos geothermal area (2/2)

Current situation

> Since 1973, there have been:
  - More than 130 studies performed
  - 5 productive wells of 1,000 – 1,800 m depth were drilled
  - Installation (in 1986) of a 2 MW pilot geothermal unit, which operated for 2 years (generated 6 TWh)
> Over the two years of the plant’s operation, there were no signs of decay in the drillings
> Current activities include:
  - Informing the local community and obtaining formal social consensus
  - Promoting a 5 MW geothermal power unit
> An AMT/MT study has been completed in 2010 by “MANVIT S.A.”

Next steps

> For the full development of the field, connection to the grid of the Cyclades is required
Overview of Nisyros geothermal area (1/2)

**Geographic position**

Overview

- Nisyros has the second largest geothermal field (enthalpy-wise) in Greece
- At this phase, a 5 MW plant will be developed at Aghia Eirini
- PPCR has leased the right to explore and develop the field until 2019 – The license can be extended for an additional 20-year period

**Field characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity in MW (based on the relevant Ministerial Decisions)/ Production output</td>
<td>5 MW/ 41,600 MWh</td>
</tr>
<tr>
<td>Maximum Temperature</td>
<td>350° C</td>
</tr>
<tr>
<td>Depth of wells drilled</td>
<td>1,816 m</td>
</tr>
<tr>
<td>Number of deep wells drilled</td>
<td>2</td>
</tr>
<tr>
<td>Estimated depth of exploitable fluid</td>
<td>1,500 – 2,500 m</td>
</tr>
</tbody>
</table>

**Interconnection infrastructure**

- Interconnection of 9 islands (Lipsi-Leros-Kalimnos-Tenedos-Pserimos-Kos- Giali-Nisyros-Tilos)
- Nisyros-Kos coppers cable 3X 35 (max 10 MW)

1) Verified by geophysical survey and production tests
Overview of Nisyros geothermal area (2/2)

Current situation

- An application license has been submitted to RAE for a 5 MW plant
- The land-owners are in agreement with the idea of long-term lease contract
- The local community could accept a project of this scale
- No social consensus achieved yet
- New wells will be drilled to the known reserve from the projected new plant position

Next steps

- Signing of contracts for the long-term lease of the required land
- 3D geophysical study (MT/AMT)
Overview of Lesvos geothermal area (1/2)

**Geographic position**

**Overview**

> PPCR has leased the right to explore and develop the geothermal potential of the leased area until 2018
> The license can be extended for an additional 20-year period

**Field characteristics**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Capacity in MW (based on the relevant Ministerial Decisions)/ Production output</td>
<td>8 MW/ 66,500 MWh</td>
</tr>
<tr>
<td>Maximum Temperature measured / estimated</td>
<td>105° C / 160° C</td>
</tr>
<tr>
<td>Maximum Depth of wells drilled</td>
<td>1,410 m</td>
</tr>
<tr>
<td>Number of deep wells drilled</td>
<td>2</td>
</tr>
<tr>
<td>Estimated depth of exploitable fluid(^1)</td>
<td>2,500-3,500 m</td>
</tr>
<tr>
<td>Interconnection infrastructure</td>
<td>Not interconnected</td>
</tr>
</tbody>
</table>

\(^1\) Estimate from Magnetotellurics and exploration drilling results
Overview of Lesvos geothermal area (2/2)

Current situation

- An exploration well (Σ-1) of 1,410 m was completed, without detecting satisfactory temperature values
- Approval of environmental terms for exploration drilling works has been granted
- Specifications for exploration drilling works (deep geothermal wells) have been prepared

Next steps

- New additional geophysical survey (MT/AMT, gravity and high-resolution DC-Resistivity)
- Composite tectonic study and 3D modeling with emphasis on tectonic structures, to determine positions of the new exploration wells
- Deep well drilling, selection of contractor
## Overview of Methana geothermal area (1/2)

### Geographic position

![Map of Methana geothermal area]

### Field characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity in MW (based on the relevant Ministerial Decisions)/ Production output</td>
<td>5 MW/ 41,600 MWh</td>
</tr>
<tr>
<td>Maximum Temperature</td>
<td>Temperature is expected to be higher than 150°C</td>
</tr>
<tr>
<td>Number of deep wells drilled</td>
<td>-</td>
</tr>
<tr>
<td>Shallow exploration wells drilled</td>
<td>PPCR has drilled 10 temperature gradient wells (depth approx. 200 – 250 m; temperature of 60 °C)</td>
</tr>
<tr>
<td>Estimated depth of exploitable fluid</td>
<td>2,000-3,000 m</td>
</tr>
<tr>
<td>Interconnection infrastructure</td>
<td>The Geothermal Power Plant can be connected directly with mainland’s grid (400 kV)</td>
</tr>
</tbody>
</table>

### Overview

- The geothermal area of Methana is not yet fully explored – No geothermal field has been proven yet, however there is strong evidence (from geophysical survey) for high geothermal potential.
- PPCR has leased the right to explore and develop the geothermal potential of the area until 2030 which can be extended for additional 20 years.
- PPCR is required to start production until Dec. 2020.

1) Magnetotellurics’ estimate
Overview of Methana geothermal area (2/2)

Current situation

> 8 exploration studies have been conducted since 2000
> PPCR received required approval of environmental terms
> 11 shallow exploratory slimholes (max. depth 250 m) have already been drilled
> 2D magneto telluric (MT) study and Approval of Environmental Terms for drillings up to 300m
> A re-evaluation of the geophysical (AMT / MT) studies by Prof. E. Lagios (Univ. of Athens) was conducted for the precise location of the boreholes
> The Local Authorities are aware of PPCR plans and have a positive attitude
> Characterization as archaeological site has postponed development and additional licenses are required

Next steps

> An exploration well (depth approx. 1,000 m) will be drilled
> Construction of an exploration well of 2,000 m depth will follow
In June 2017 PPCR has published a call (EoI) to find a partner to co-develop the Geothermal Power Plants that will be installed at the leased geothermal areas (Milos-Kimolos-Polyegos, Nisyros, Lesvos and Methana).

The partner selection process promotes the creation of competitive schemes in which strategic investors, consortiums between financial investors and operators with expertise in Geothermal Power Plants etc. will be able to capitalize on their competitive advantages in various capacities.

After the EoI only the pre-qualified parties will have the opportunity to submit a binding offer for becoming PPCR’s partner in the development of Geothermal Power Plants in Greece.

The submission of EoI of Phase A of the selection process of a strategic partners for electricity generation from geothermal power plants had been completed by August 4th, 2017.

Seven (7) Expressions of Interest were submitted, indicating the strong interest of the international and local market to partner with PPC Renewables S.A (PPCR) in this unique project for Greece, one of the few untapped high-enthalpy Geothermal projects in Europe.

Six (6) of the interested parties PPCR meet the pre-qualification criteria and qualify for the Phase B of the Selection Process. During Phase B, eligible partners will be granted access to the terms and conditions of the Selection Process as well as available information about the Geothermal Power Plants Project and the Transaction.

The eligible partners are:

- Storengy
- KS ORKA
- Enel Green Power Hellas
- Terna Energy – Terna AioliKi Xerovouniou
- Helector S.A.
- Zorlu Energy – Turboden
Thank you for your interest

Energy is in our nature