

EAC Research Activities

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1. The electricity sector in Cyprus

Present status

Future plans

2. Research and Development within EAC

Why R&D within EAC

Research projects

Colaborations

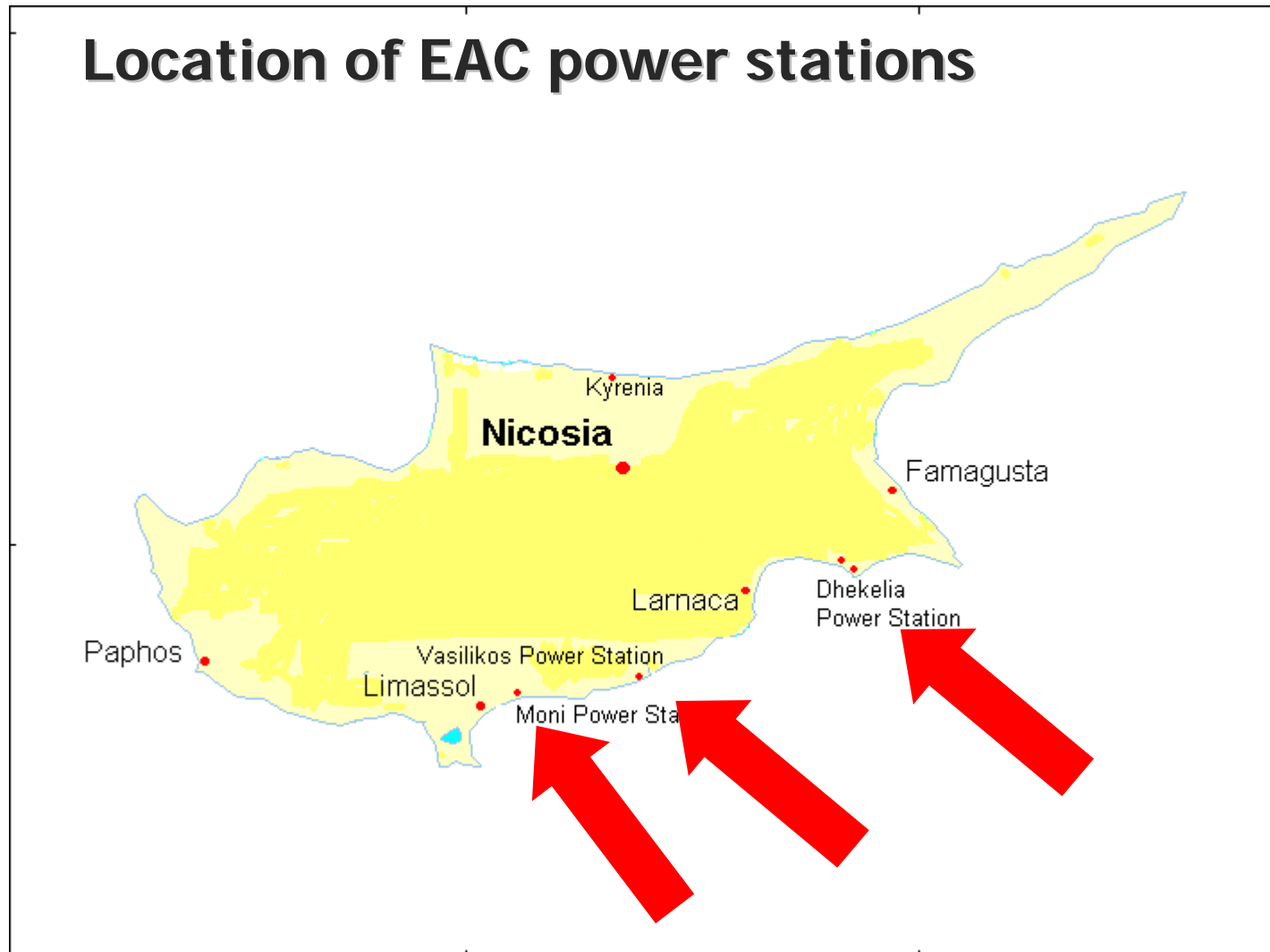
3. Conclusions

1. The electricity sector in Cyprus

Present status

- 1. Small isolated island power system**
- 2. Depend on fossil fuels**
- 3. Installed capacity 988MWe**
- 4. Generation 4.043 million kWh (in 2003)**
- 5. Peak load 776MWe (in 2003)**

Location of EAC power stations



Existing generation system

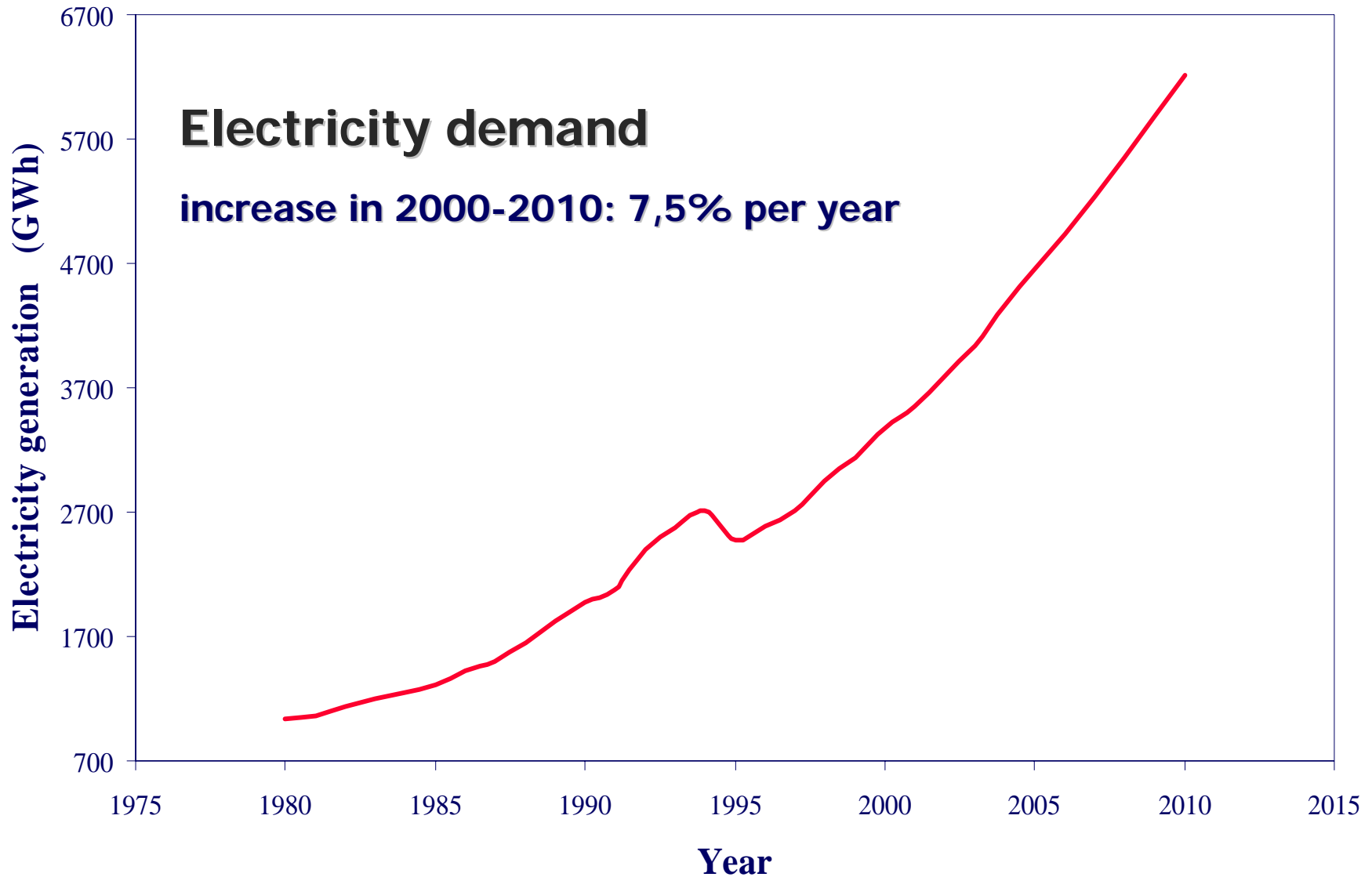
Steam turbine units (HFO)

1. Moni power station 6x30MWe
2. Dhekelia power station 6x60MWe
3. Vasilikos power station 2x130MWe

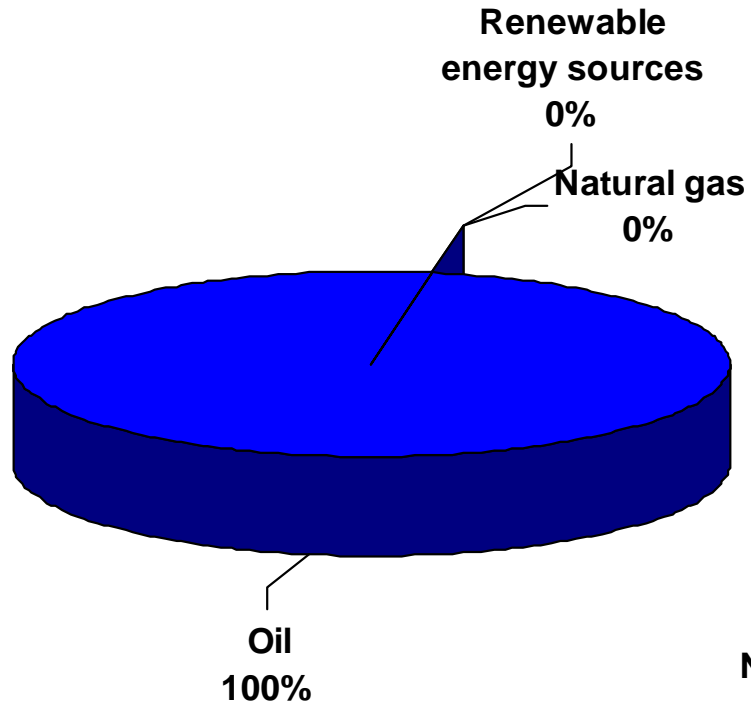
Gas turbine units (Diesel)

1. Moni power station 4x37,5MWe
2. Vasilikos power station 1x38MWe

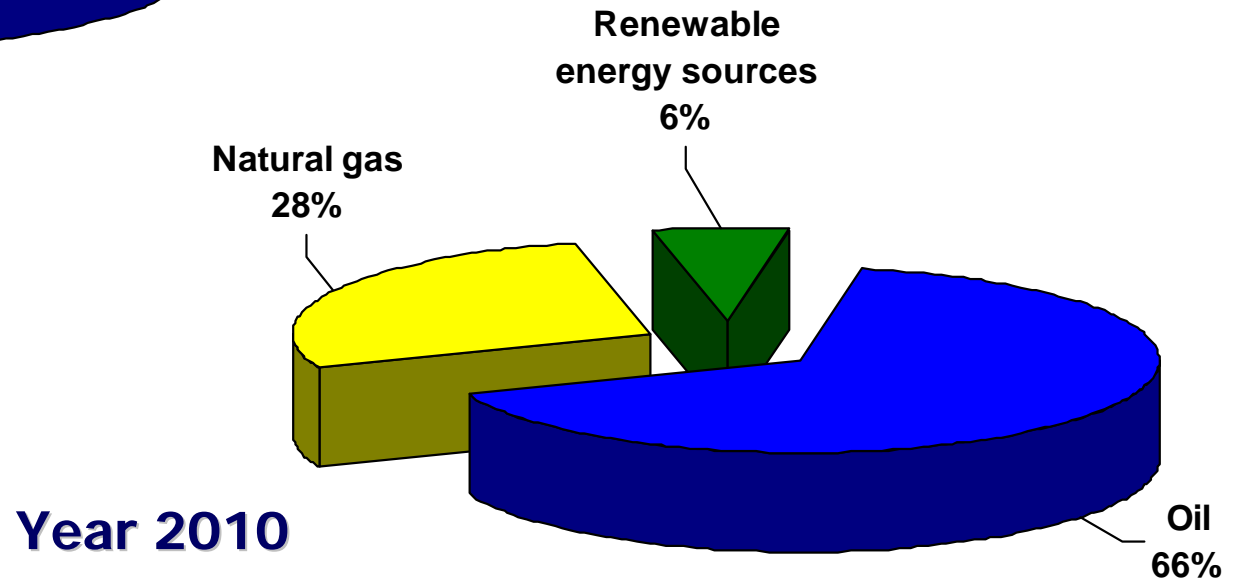
The electricity sector in Cyprus



Cyprus fuel share in electricity



Today



Year 2010

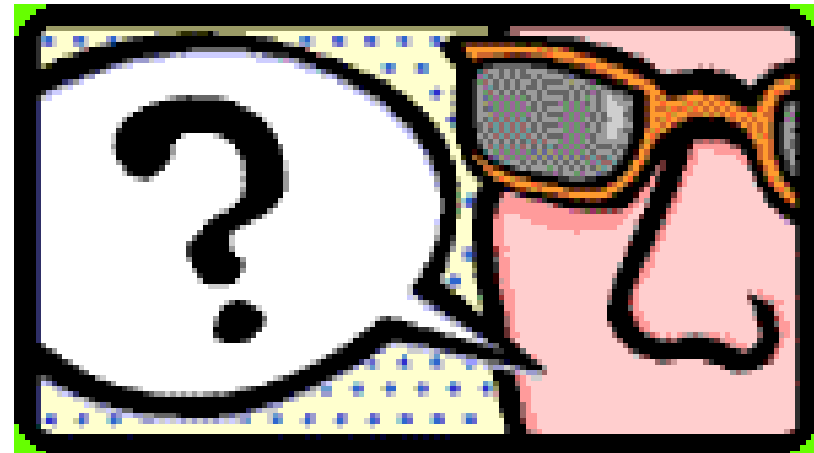
Future plans

- 1. 1x120MWe steam turbine by 2005 (HFO)**
- 2. 1x180MWe combined cycle by 2006 (diesel or natural gas)**
- 3. 2x180MWe combined cycle by 2009 (diesel or natural gas)**
- 4. Renewable Energy Sources:**
Wind energy (6MWe wind park), photovoltaics (80kW)
- 5. RTD (long term planning)**

2. Research and Development within EAC



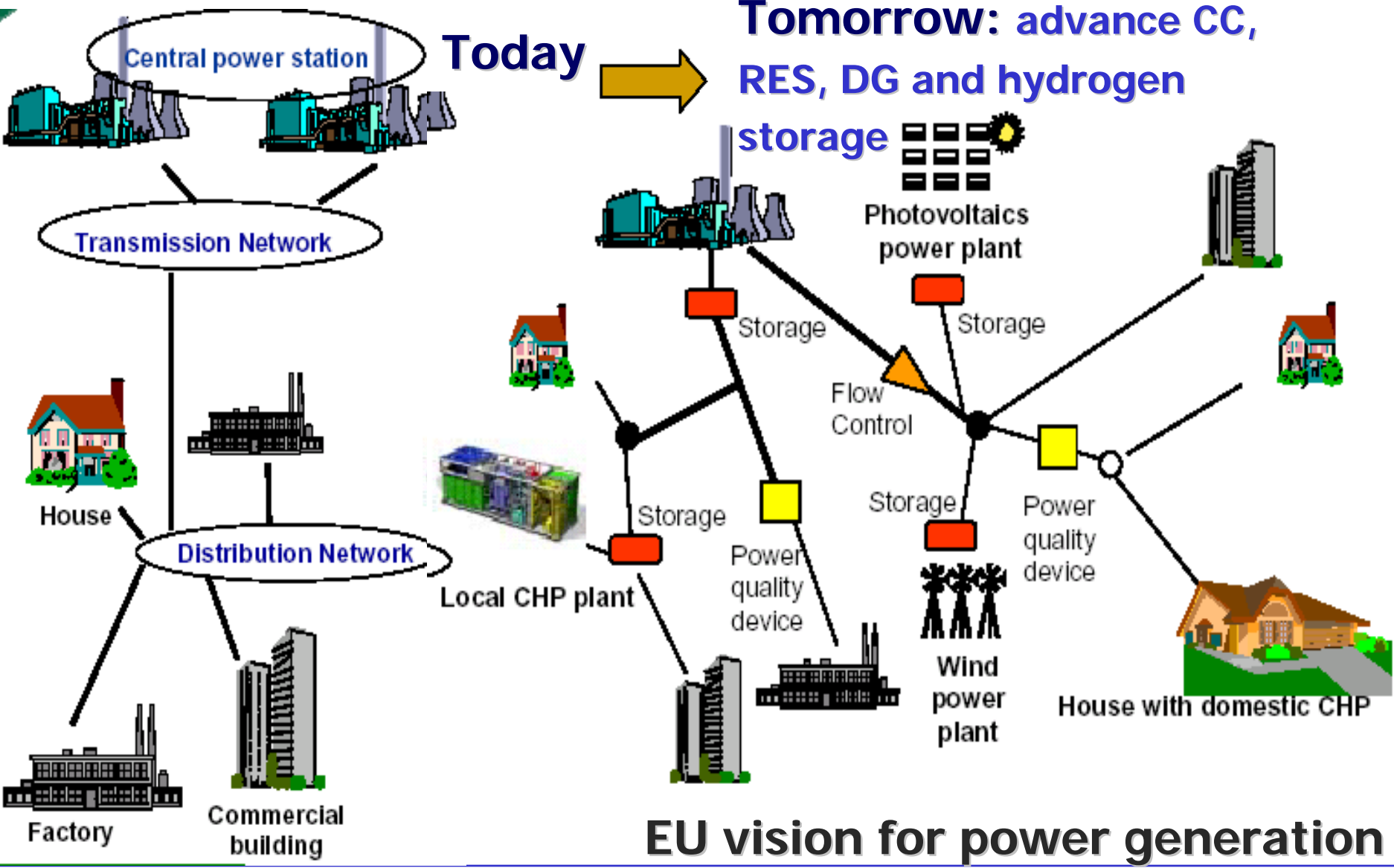
Why R & D at EAC ?





EU targets for power generation

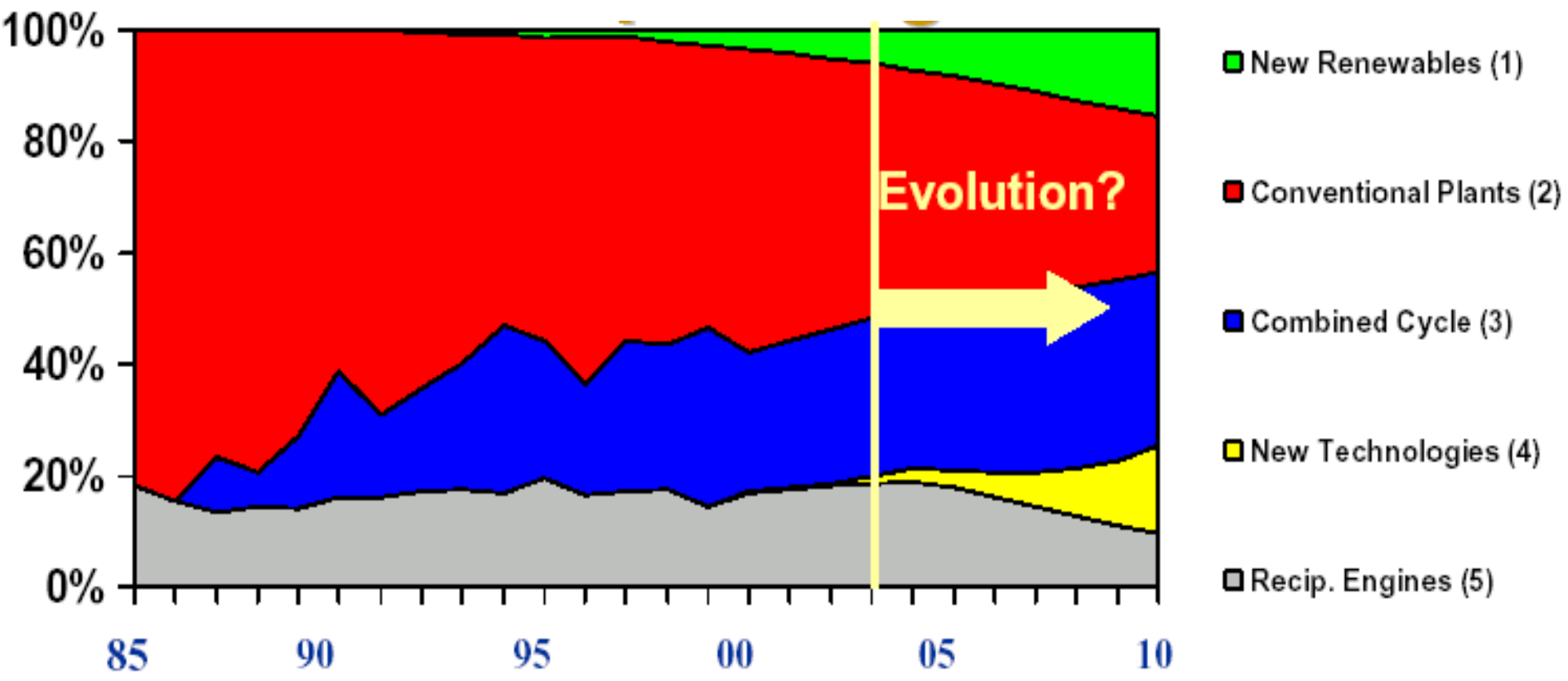
- 1. Kyoto objectives:** reduction of EU greenhouse gases and other emissions
- 2. Improving energy efficiency:** use of advance Combined Cycle technologies
- 3. Increase the share of RES and DG:** cost reduction
- 4. Towards the hydrogen energy economy**



EU vision for power generation

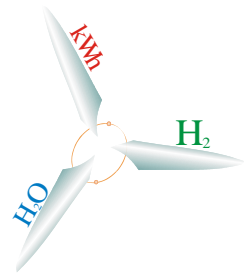


Technological portfolio for power generation within EU



Notes: (1) Wind, Solar, Biomass and hydro, (2) Conventional ST, GT and Nuclear, (3) CC, (4) Small On-site CHP (mini/micro-turbines, fuel cells, ...), (5) Diesel Engines (unit size > 0.5 MW)

1. Seven funded research projects on power generation



Advance GT and CC technologies	(2 projects)
RES - Hydrogen production	(2 projects)
DG	(2 projects)
Emissions abatement technologies	(1 project)

2. EAC input - coordination, WP leader, technical,
economic and environmental studies
(software development)



3. Total funding ~ 1/2 million € - EC and RPF

Research experience on **technical**, **economic** and **enviromental** analysis:

1. Advance gas turbine technologies*, such as,
 - Combined Cycle technologies**
 - Mixed air steam turbine (MAST) technologies***
 - LOTHECO cycle****

- * Poullikkas A., "An overview of current and future sustainable gas turbine technologies", *Renewable and Sustainable Energy Reviews*, to appear, 2004.
- ** Poullikkas A., "Parametric study for the penetration of combined cycle technologies into Cyprus power system", *Applied Thermal Engineering*, 24, 1675-1685, 2004.
- *** Poullikkas A., "Technical and economic analysis for the integration of small reverse osmosis desalination plants into MAST gas turbine cycles for power generation", *Desalination*, to appear (2004)
- **** Poullikkas A., Kellas A., "The use of sustainable combined cycle technologies in Cyprus: A case study for the use of LOTHECO cycle", *Renewable and Sustainable Energy Reviews*, 8, 521-544, 2004.

2. RES and DG technologies, such as,

Fuel cells*

Wind turbines**

Photovoltaics

3. Pilot plants, such as,

Solar (green) hydrogen production and use in fuel cell***

- * Lymberopoulos N., Zoulias E.I., Varkaraki E., Kalyvas E., Christodoulou C., Karageorgis G.N., Stolzenburg K., Poullikkas A., “Hydrogen as an alternative product for wind park developers”, *Proceedings of the 4rd Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion, 2004.*
- ** Christodoulou C., Karageorgis G.N., Menikou M., Karageorgis N., Poullikkas A., Lymberopoulos N., Zoulias E.I., Varkaraki E., Bozukov L., “Hydrogen storage in LaNi₅ metallic hydrates”, *Proceedings of the 1st National Conference on Hydrogen Technologies, 2004.*
- *** Christodoulou C., Karagiorgis G., Menikou M., Karagiorgis N., Poullikkas A., “Green hydrogen production, storage and H₂/fuel cell electricity production: On going projects in the island of Cyprus”, *Proceedings of the International Conference RES for island, 2004.*

Research experience on software development

IPP algorithm*

CAROC algorithm**

Research experience using commercial software

WASP

DEEP

* Poullikkas A., “A technology selection algorithm for independent power producers”, *The Electricity Journal*, 2001.

** Poullikkas A., “Optimisation algorithm for reverse osmosis desalination economics”, *Desalination*, 2001.

IPP technology selection algorithm*

1. Economic model

2. Evaluation of candidate power technologies:

Capital cost

Fuel consumption and cost

Operation and maintenance cost

Plant load factor

Life expectancy etc.

3. Least cost power generation configuration

*Poullikkas A., “A technology selection algorithm for independent power producers”, *The Electricity Journal*, 2001.

Cost function*

$$\text{least cost solution} = \min[c_k] = \min \left[\frac{C_o + \sum_{j=1}^n \frac{C_j}{(1+i)^j}}{P_o + \sum_{j=1}^n \frac{P_j}{(1+i)^j}} \right]_k$$

- c : electricity unit cost for candidate generation technology k in €/kWh
- C_o : production cost of the reference year in €
- C : production cost of year j in €
- P_o : electricity production of the reference year in kWh
- P : electricity production of year j in kWh
- i : discount rate in %

*Poullikkas A., “A technology selection algorithm for independent power producers”, *The Electricity Journal*, 2001.



Research collaborations

University of Cyprus

Imperial College of Science and Technology

University of Twente

National Technical University of Athens

Frederick Research Center

Center of Renewable Energy Sources

Gaz de France

Siemens Sweden

Public Power Corporation

RWE ...

Research and Development within EAC

Advance GT and CC technologies

RES - Hydrogen production

DG

Emissions abatement technologies