ELECTRICITY AUTHORITY OF CYPRUS

NER 300 European Program
2nd call of proposals

Zero Energy Mountains of Cyprus

Green+

Outline

- About NER300 program
- About Green+ Project:
  - Green+ Project - General Overview
  - Green+ Project - Technical overview
  - Green+ Project - Financial Analysis
- Green+ Project - Next steps

About NER300 program (1/8)

General background

- A financing instrument, managed jointly by the EC, EIB and Member States, according to the ETD 2009/29/EC.
- 300 million allowances (rights to emit one tonne of carbon dioxide) in the New Entrants' Reserve (NER) of the European Emissions Trading Scheme will be set aside for subsidizing installations of innovative renewable energy technology and Carbon Capture and Storage (CCS) projects, aiming at low carbon emissions economy.
- The allowances will be sold on the carbon market and the money raised will be made available to projects as they operate.
- A total of 1 billion will be awarded under this 2nd call.

About NER300 program (2/8) - **2nd Call**

- The 2nd call for proposals was released from the EC on 3.4.2013.
- EIB was responsible for the NER 300 process on behalf of and for the account of the EC, for undertaking the Due Diligence assessment on the Proposals submitted by Member States.
- The deadline for the submission by the Member State Authority to the EIB was the 3rd July 2013.

About NER300 program (3/8)-2nd Call

- The Projects are ranked in order of increasing CPUP (Cost Per Unit Performance) score (i.e. those with lowest CPUP are ranked highest).
- CPUP can be seen as the extra funding required for each KWh produced within the Project's context. RES projects are ranked within their respective Sub-category.

About NER300 program (4/8)

Cyprus and the NER300

- Country selection criteria:
  - At least one and no more than three projects shall be funded within one Member State.
- 8 project proposals for 1st call
  - 1 project has been approved
    - CSPe – HeliosPower
- 4 project proposals for 2nd call (out of 32 submitted)
  - 2 projects have been approved:
    - Green+
    - EOS Green Energy

About NER300 program (5/8)

Distributed Renewable Management (Smart grids)

- Renewable energy management and optimisation for small and medium scale Distributed Generators in *rural* environment with predominant *solar* generation: [20MWe] on Low Voltage (LV) network + 50 MW on Medium Voltage (MV) network. [DRMa]
- Same but with *Wind* generartion [DRMb]
- Same but in *urban* environment and irrespective of solar or wind [DRMc]

About NER300 program (6/8)

DRM-Clarifications 1:

- The terms urban (high density population) and rural environment (low density population) are to be determined in the national context.
- The maximum voltage level for LV networks should be of the order of 10kV, and the maximum voltage levels for MV networks should be of the order of 60kV.
- A DRM project should normally include at least 10 independent renewable generators connected to the MV, with a cumulative capacity of at least 50 MW. Furthermore, with reference to the 20 MW capacity threshold for LV networks, at least 2 MW should be produced by generators connected at a voltage level at or below 1 kV.

About NER300 program (7/8)

DRM-Clarifications 2:

- All DRM projects should be such that constraints on the generation operation, or upgrade, replacement or addition of switchgear, transformers, cables or overhead lines to the existing network would be required, if a DRM (smart grid) solution were not used.
- For the purpose of determining the performance of the DRM projects, the project boundary should be interpreted as including all and only those parts of the network whose performance is significantly improved by the adoption of the DRM solution proposed.

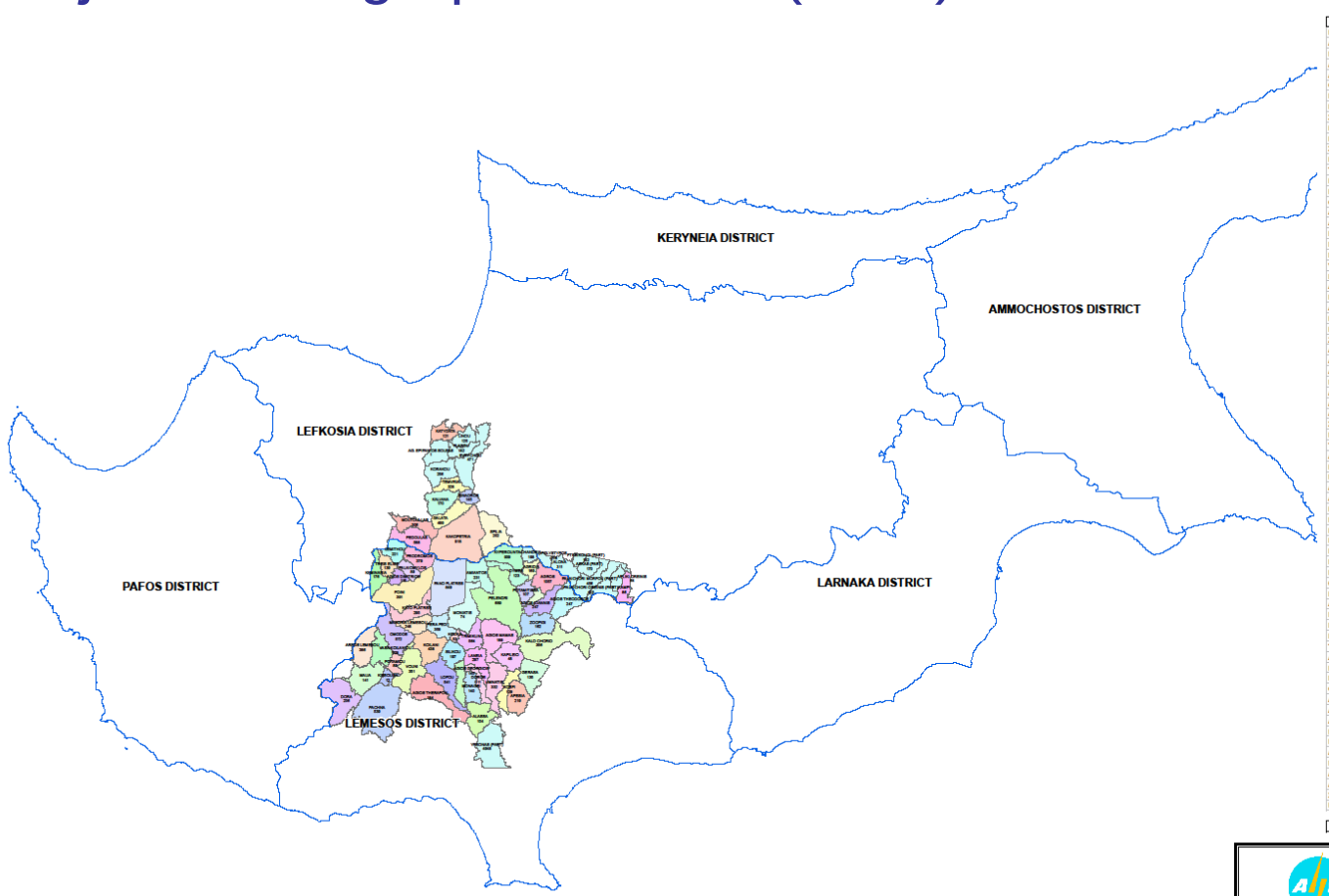
About NER300 program (8/8)

DRM-Clarifications 3

- Performance should be taken to mean the total power produced by all RES generators connected to the network and located within the project boundaries.
- Predominant wind/solar generation should be taken to mean that within the total amount of RES electricity generated within the project boundary, wind/solar generated electricity represents the largest share, and in any case more than 35% (measured in MWh).

Green+ Project Overview

❑ Project's Geographical Area (PGA)



VILLAGE	No. of RESIDENTIAL CONSUMERS
ΚΑΜΠΙ	86
ΑΠΛΙΚΙ ΟΡΕΙΝΗΣ	64
ΠΑΛΑΙΧΩΡΙ ΜΟΡΦΟΥ	456
ΑΣΚΑΣ (ΜΕΡΟΣ)	170
ΑΛΩΝΑ	311
ΦΤΕΡΙΚΟΥΔΙ (ΜΕΡΟΣ)	182
ΠΟΛΥΣΤΥΠΟΣ	218
ΠΑΛΑΙΧΩΡΙ ΟΡΕΙΝΗΣ	403
ΣΤΗΛΙΑ	252
ΚΑΚΟΠΕΤΡΙΑ	918
ΓΑΛΑΤΑ	499
ΣΙΝΑΟΡΟΣ	145
ΚΑΛΙΑΝΑ	170
ΤΕΜΒΡΙΑ	328
ΚΟΡΑΚΟΥ	256
ΕΥΡΥΧΟΥ	471
ΦΛΑΣΟΥ	182
ΑΓ. ΕΠΙΦΑΝΙΟΣ ΣΟΛΕΑΣ	1
ΛΙΝΟΥ	125
ΚΑΤΥΔΑΤΑ	121
ΠΕΔΟΥΛΑΣ	588
ΜΟΥΤΟΥΛΛΑΣ	306
ΥΨΩΝΑΣ (ΜΕΡΟΣ)	4948
ΓΕΡΑΣΑ	135
ΑΠΕΣΙΑ	219
ΚΟΡΦΗ	129
ΛΙΜΝΑΤΗΣ	332
ΚΑΠΗΛΕΙΟ	48
ΚΑΛΟ ΧΩΡΙΟ	356
ΖΩΟΠΗΓΗ	162
ΑΛΑΣΣΑ	104
ΑΓΙΟΣ ΘΕΡΑΠΩΝ	184
ΛΟΦΟΥ	541
ΠΑΧΝΑ	539
ΑΓΙΟΣ ΓΕΩΡΓΙΟΣ	145
ΔΟΡΟΣ	111
ΛΑΝΕΙΑ	297
ΣΙΛΙΚΟΥ	197
ΜΟΝΑΓΡΙ	140
ΤΡΙΜΙΚΛΙΝΗ	564
ΑΓΙΟΣ ΜΑΜΑΣ	189
ΚΟΥΚΑ	53
ΜΟΝΙΑΤΗΣ	74
ΔΟΡΑ	236
ΑΡΓΟΣ ΛΕΜΕΣΟΥ	886
ΚΙΣΣΟΥΣΑ	12
ΜΑΛΙΑ	141
ΒΑΣΑ ΚΟΙΛΑΝΙΟΥ	328
ΒΟΥΝΙ	351
ΠΕΡΑ ΠΕΔΙ	359
ΜΑΝΔΡΙΑ ΛΕΜΕΣΟΥ	248
ΠΟΤΑΜΙΟΥ	89
ΟΜΟΔΟΣ	572
ΚΟΙΛΑΝΙ	438
ΑΓΙΟΣ ΔΗΜΗΤΡΙΟΣ	115
ΠΑΛΑΙΟΜΥΛΟΣ	89
ΠΡΟΔΡΟΜΟΣ	379
ΚΑΜΠΗΔΙΑ	176
ΤΡΕΙΣ ΕΛΙΕΣ	139
ΛΕΜΙΘΟΥ	221
ΚΑΤΩ ΠΛΑΤΡΕΣ	295
ΠΑΝΩ ΠΛΑΤΡΕΣ	849
ΦΟΙΝΙ	391
ΑΜΙΑΝΤΟΣ	231
ΑΓΙΟΣ ΘΕΟΔΩΡΟΣ	247
ΑΓΙΟΣ ΙΩΑΝΝΗΣ	247
ΚΑΤΩ ΜΥΛΟΣ	81
ΠΟΤΑΜΙΤΙΣΣΑ	107
ΔΥΜΕΣ	123
ΠΕΛΕΝΔΡΙ	689
ΑΓΡΟΣ	1057
ΑΓΡΙΔΙΑ	169
ΧΑΝΔΡΙΑ	198
ΚΥΠΕΡΟΥΝΤΑ	939
TOTAL	25621

Αρχή Ηλεκτρισμού Κύπρου
Electricity Authority of Cyprus

Εκτύπωση από: eacgis
Ημερομ. Εκτύπωσης: 4/6/2013

Κλίμακα/Scale 1:350.000

NER300 - DRM PGA No.2.
APPENDIX No.2

Green+ Project Overview (1/10)

PGA characteristics

- Rural mountainous area
- Mostly covered by forests with endemic flora and fauna
- Many small sized villages which are continuously downsized since people are moving to towns
- The most important natural beauty of the country and its mountainous resort (basically in the summer period)

Green+ Project Overview (2/10)

Why Green+:

- Challenge trying to maintain a balance between reliable electricity supply and minimal impact on the sensitive local environment
  - Erection of transmission lines to halt
  - Network is old and its limits
- Renewable energy installations expected to grow in the PGA before economic crisis:
  - tens of projects at licensing phase for wind and PV generation
  - net-metering scheme established
  - existing applications at CERA for >100 MWp of self generation from PV in self supporting their industrial and commercial energy needs.

Green+ Project Overview (3/10)

Options for addressing challenges

- Vast conventional upgrade of the network:
  - new installations and reinforcements of switchgear, cables and overhead lines to anticipate increasing loads and network ageing
  - limitations in RES penetration in PGA or constrained operation

➡ leading to large capital investments and high operational costs.

Options for addressing challenges (1/2)

- Proposed DRM Project-Smart Grid:
  - autonomous power system seen as a hierarchically organized grid, consisted of gradual levels of microgrids
  - monitoring of relevant data acquired from smart equipment, such as smart meters, sensors and weather stations will be integrated in local and central controllers to add smartness and conduct knowledge based decisions by the network's control
  - a core function, besides hierarchical control, will be energy storage that will be installed to backup the system mostly when renewable energy is not adequate for the area's energy demand

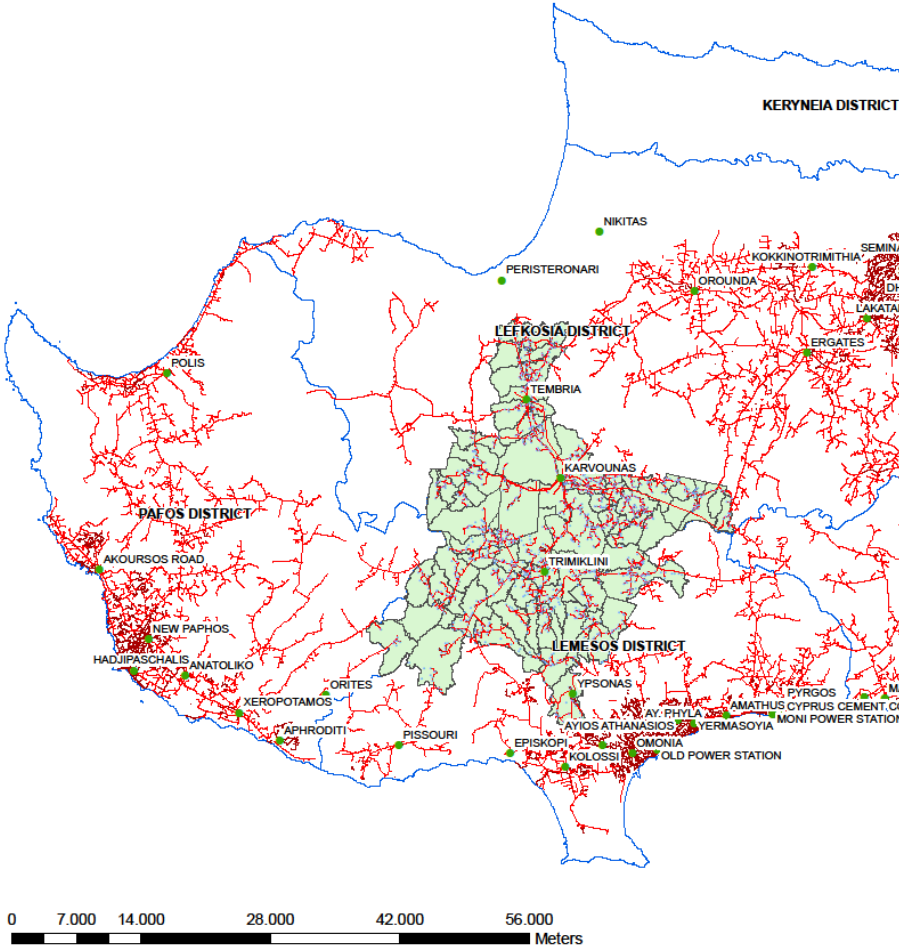
Options for addressing challenges (2/2)

- DRM will allow
  - ✓ efficient integration of RES, enabling the distributed RES generators and the network ability to accommodate it with reduced constraints
  - ✓ reduction of losses in the network

➡ leading to multiple operating benefits with a high return investment.

Green+ Project Overview (6/10)

❑ MV Network in PGA



MV NETWORK	LENGTH
MV Overhead Lines	662 km
MV Underground Cables	38 km

No. of PM & GM TFMRS	kVA	kVA
2	15	30
19	16	304
142	25	3550
516	50	25800
329	100	32900
154	200	30800
3	300	900
12	315	3780
15	400	6000
9	500	4500
5	630	3150
5	800	4000
9	1000	9000
TOTAL	1220	124714

Legend

- Transmission Electric Station
- Pole & Ground Mounted Transformers
- MV Overhead Lines
- MV Underground Cables
- NER Consumers Residential Area

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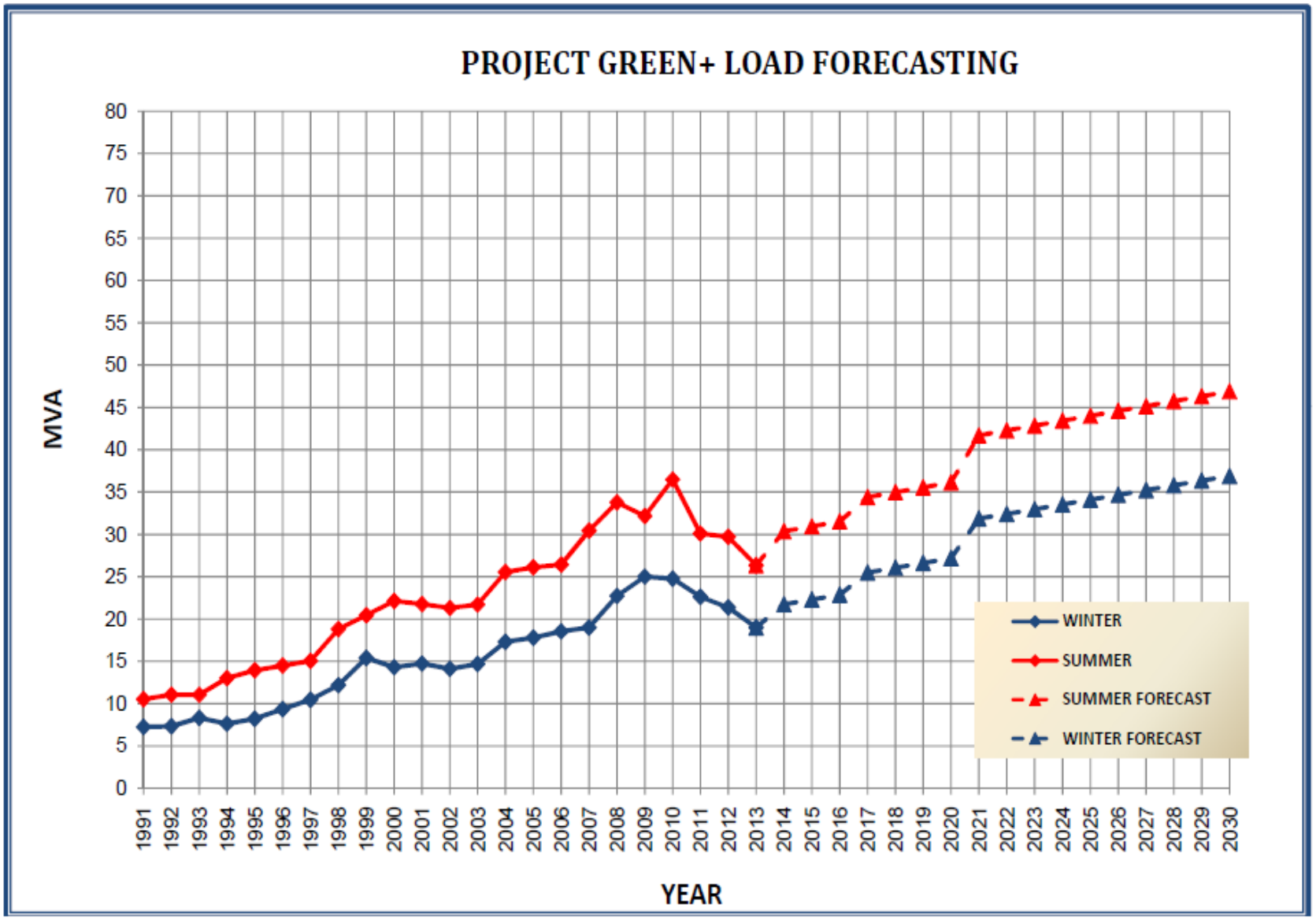
Αρχή Ηλεκτρισμού Κύπρου
Electricity Authority of Cyprus

Εκτύπωση από: eacgis
Ημερομ. Εκτύπωσης: 4/6/2013

Κλίμακα/Scale 1:350.000

NER300
DRM DISTRIBUTION NETWORK No.2
APPENDIX No.4

Green+ Project Overview (7/10)

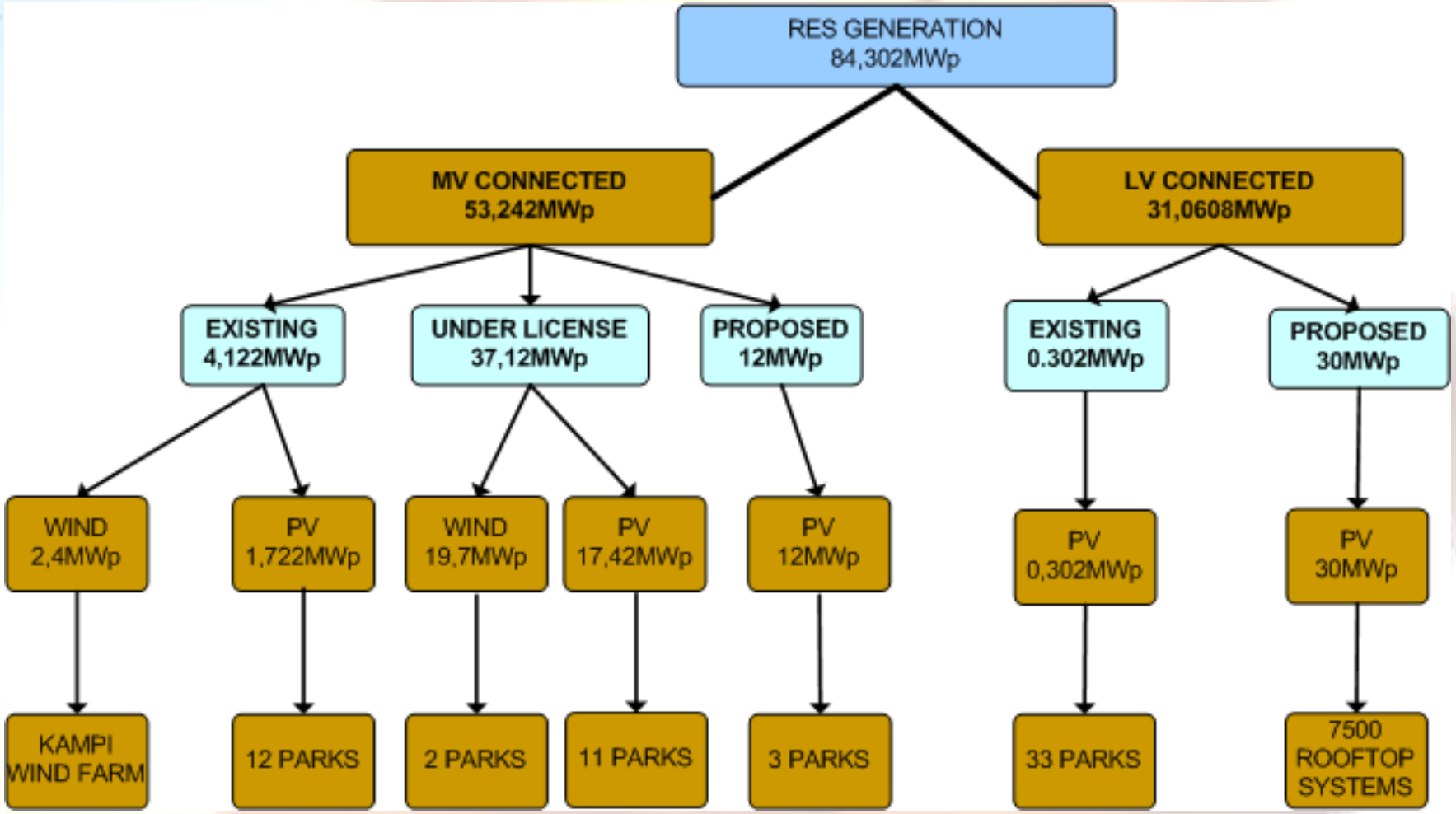


Green+ Project Overview (8/10)

- Expected RES generation in PGA

Generation Technology	Number of units	Unit size range R (kWp/Kwe)	Total capacity (kWp)	Connection voltage (LV, MV)
Photovoltaic	7500	3<R<5kWp	30.000kWp	LV
Photovoltaic	122	0<R<90kWp	1.060kWp	LV
Photovoltaic	26	90<R<10MWp	31.300kWp	MV
Wind	2	9,6 & 12,5MWp	22.100kWp	MV
Biomass	.....	.....	.....	.....
TOTAL	**7650**		**84,46 MWp**	

Green+ Project Overview (9/10)



Green+ Project Overview (10/10)

- EAC Project Structure

CEA: Cyprus Energy Agency

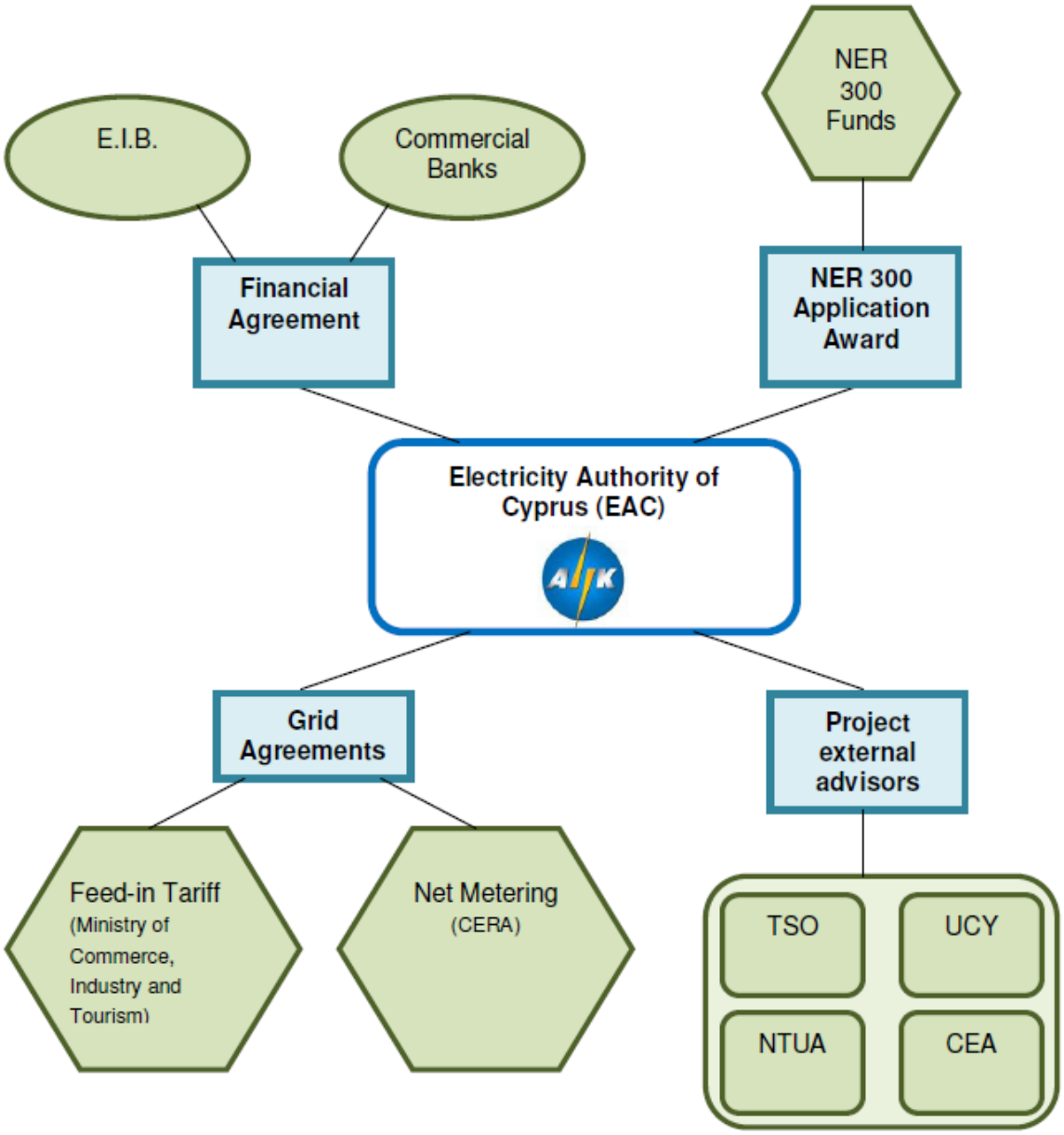
CERA: Cyprus Energy Regulatory Authority

TSO: Transmission System Operator

NTUA: National Technical University of Athens

UCA: University of Cyprus

E.I.B.: European Investment Bank



Technical overview (1/11)

Microgrid particulars

- The installation of 20 MWh energy storage systems at distribution level, mainly in transmission substations and also close to large local renewable generation sites.
- Mass deployment of smart meters in all domestic and commercial establishments that fall within the Project's Geographical Area of deployment which will effectively embed intelligence and offer data collection capabilities.

Microgrid enhancement with active Prosumers

- Adoption of Active Demand Load Management technology through the use of time of use tariffs for peak demand shave off.
- Adoption of new electricity tariffs that will promote passive Demand Load Management.
- Deployment of necessary communication means for the operation of smart grid and microgrid infrastructures to be created within the PGA.

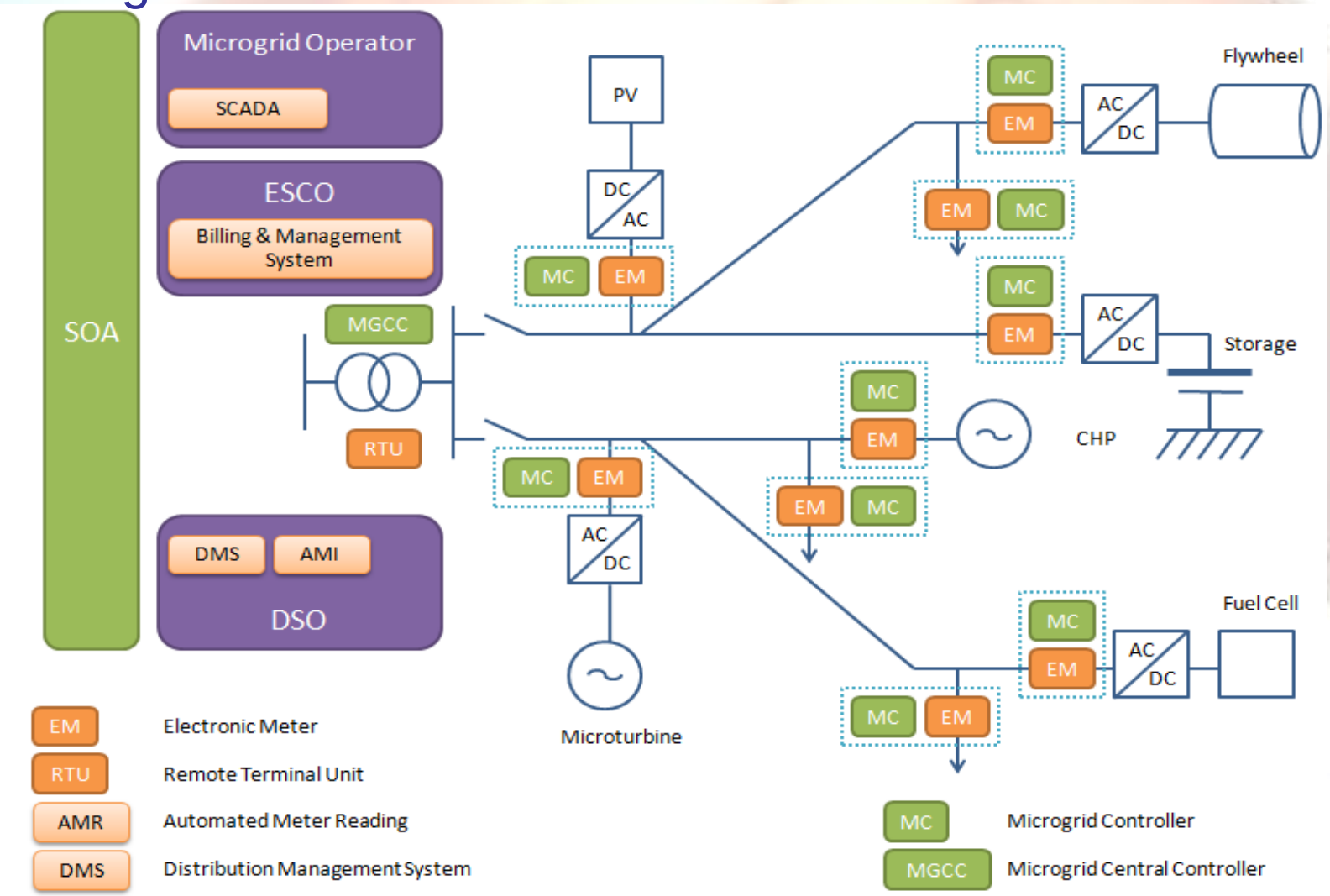
Technical overview (3/11)

Optimal use of grid

- Optimal use of energy sources with minimal need for energy import from sources external to the PGA and hence avoid or minimize the need for erection of additional distribution and transmission network facilities.
- Through optimal use of local generation, local distributed storage and demand side management, the targeted area will be gradually operated as a coordinated Distribution Management System through a hierarchical microgrid infrastructure maximizing the benefits to the participants in the targeted area.
- The distributed generation and storage to be used will depend on strict cost and benefit analysis backed up by supply from the interconnected system.

Technical overview (4/11)

- Microgrid Architecture



Technical overview (6/11)

Demand Response (1/2)

- Shifting demand from one time period to another, with the potential to help smooth the profile of consumption, reducing pressure on prices and system resources during peak periods,
- Reducing demand through more efficient end-use, which can provide a permanent dividend in terms of reducing demand-related pressure on power system capacity.

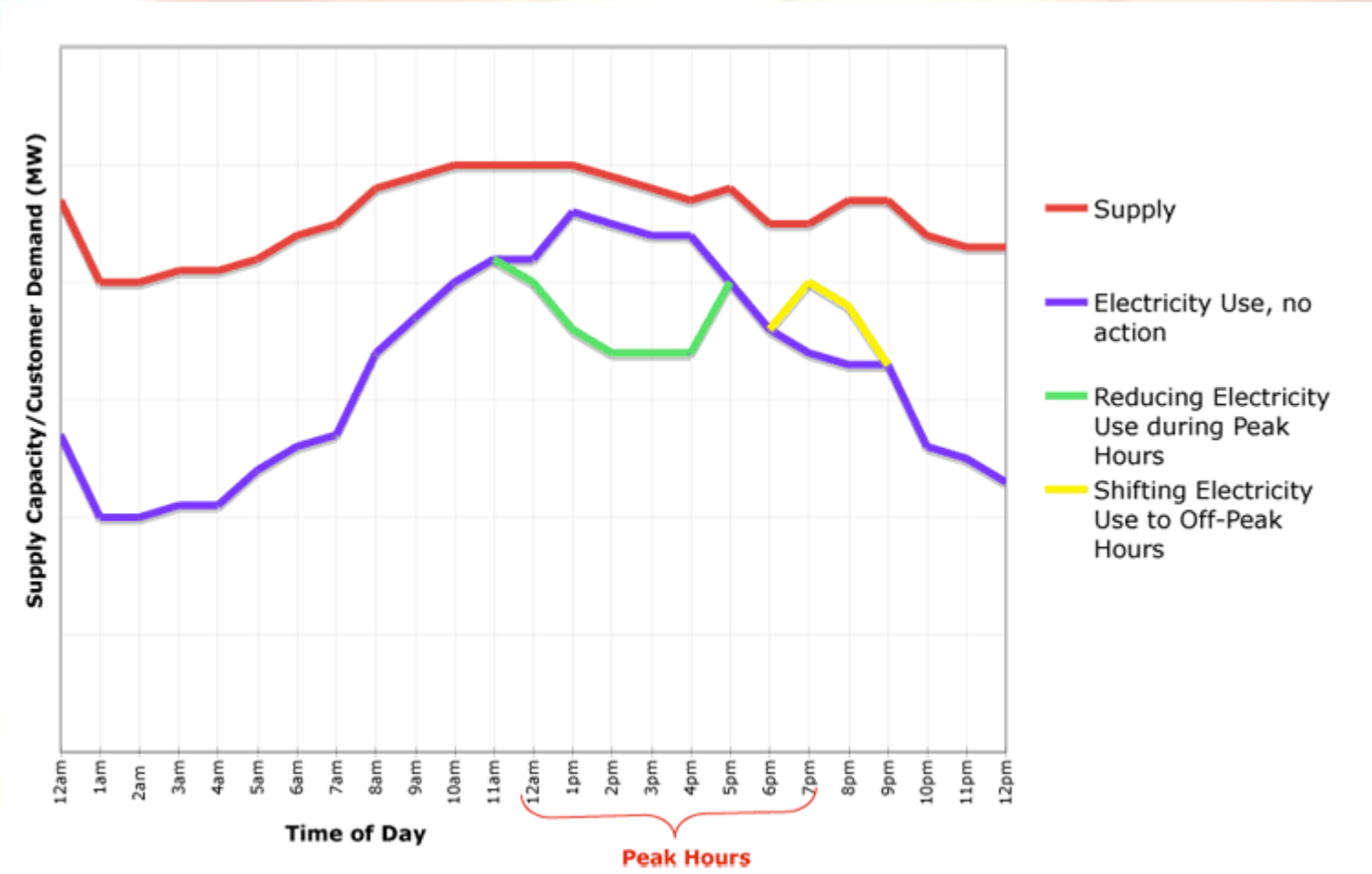
Technical overview (7/11)
Demand Response (2/2)

- Collectively, these DSM responses can:
  - Greatly improve system flexibility and resilience,
  - reduce operating costs and
  - create strong incentives for more efficient upstream investment,

➡ all of which can help deliver more reliable, sustainable and affordable electricity services.

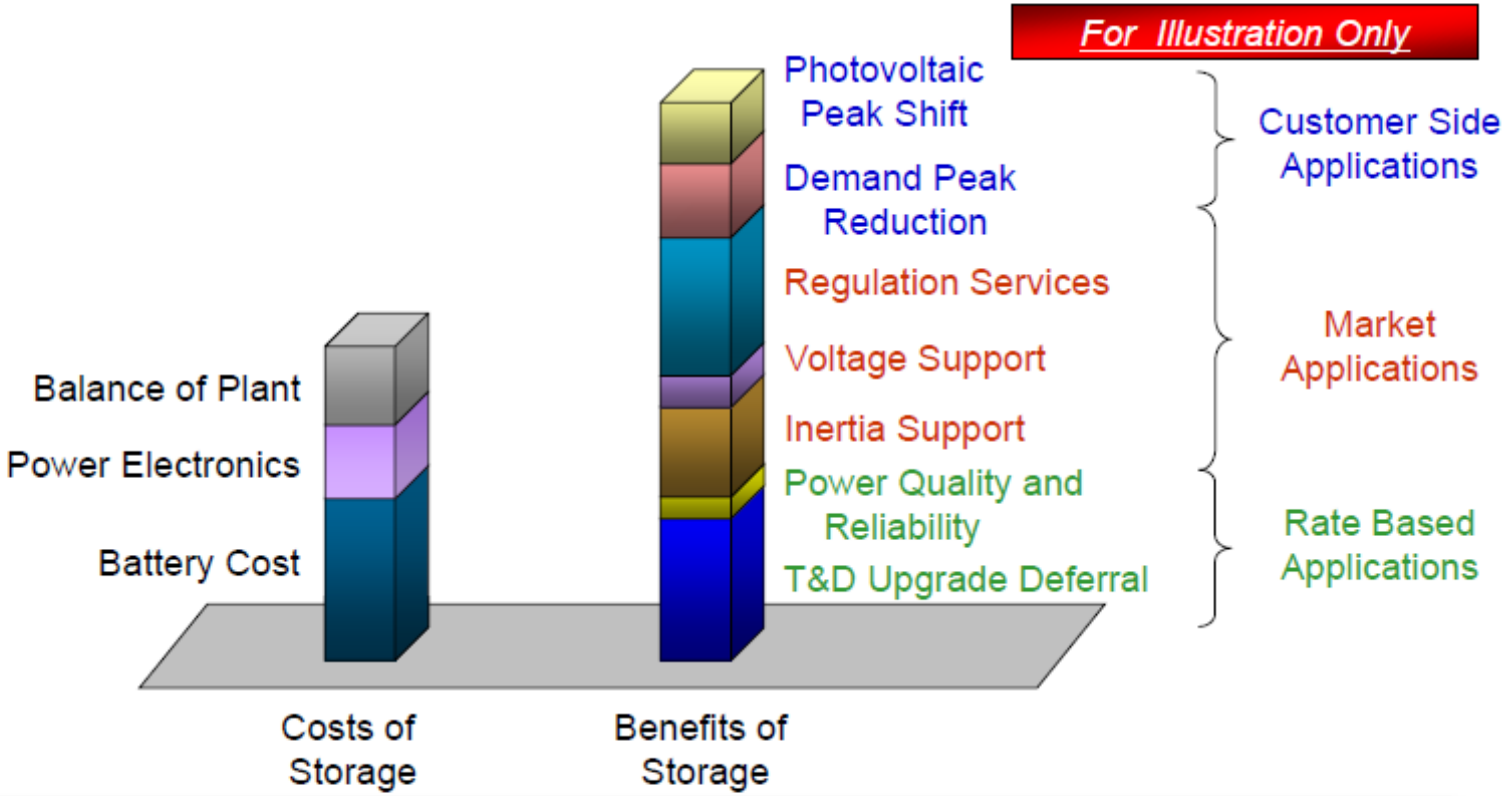
Technical overview (8/11)

- Simple peak shifting through DSM



Green+ Project – Technical overview (9/11)

Analyzing the Value of Storage



Using storage for multiple applications can be effective, but is highly site-dependent

EPRI ELECTRIC POWER RESEARCH INSTITUTE

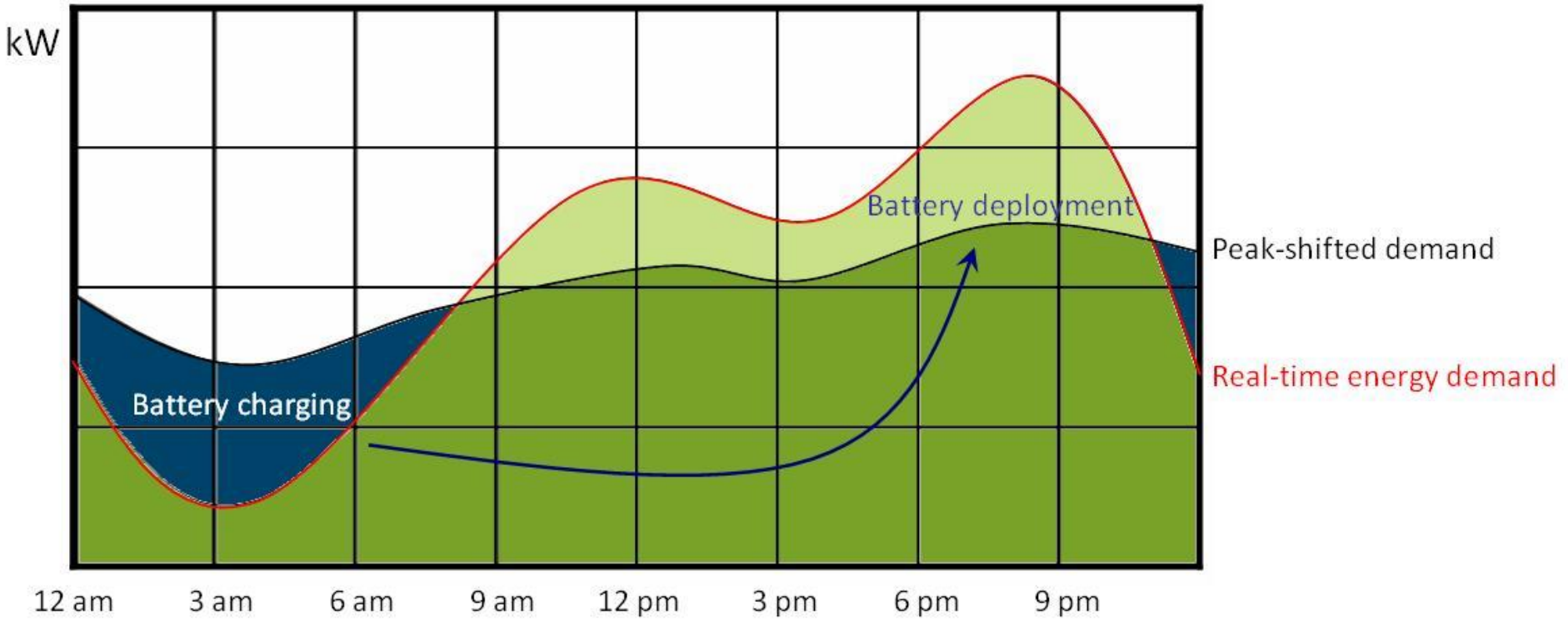
Technical overview (10/11)

The benefits of Storage

- Time shifting: generation cost can be reduced by storing electricity at off-peak times, and discharging it at peak times.
- Power quality: electrical energy storage can provide frequency control functions. But also, electrical energy storage located at the end of a heavily loaded line may improve voltage drops and reduce voltage fluctuations.
- Microgrid essential: generally in the proposed Microgrid architecture, electrical energy storage supports the local grid at steady state when the DGs stall due to technical limitations

Technical overview (11/11)

- Managing demand more efficiently through the use of DSM and storage



Financial Analysis (1/3)

- Overall investment cost: €40,74 mil (IRR= 13 %)
  - AMI: €5,12 mil (1,3 EAC labour)
  - Storage of electrical energy: €24,00 mil
  - Automation of the medium voltage network: €0,64 mil (0,28 EAC labour)
  - Micro-controllers and STS: €1,52 mil
  - Advanced invertors for PV installations: €7,00mil
  - Central controller of DMS: €1,00 mil
  - T & D reinforcement: €0,53 mil
  - Weather stations and forecasting: €0,20 mil
  - Development costs, advisors and support: €0,67 mil

Financial Analysis (2/3)

- Relevant costs

(CAPEX(RES-REF)+NPV5years(Δ(O&M)Benefits–Δ(O&M)Costs)): €22,2 mil

- CAPEX contributions:
  - NER 300: €11,095 mil (maximum)
  - Contribution of Customers (prosumers' SMs) €2,5 mil
  - Storage supplier: (20% of CAPEX) €4,8 mil
  - EAC from own funds or EIB loan €22,35mil

Financial Analysis (3/3)

- But…annual benefits:
  - Storage €1,0 mil
  - AMI €1,42 mil (EAC= €0,52 mil)
  - Use of system charge + Ancillary ~€1,1 mil

    (but with 30MW LV PV)
  - Operational & Maintenance €1,35 mil (EAC= €1,35mil)
  - CO_2 ~€0,15 mil (EAC= €0,15 mil)

Next Steps (1/3)

Milestones

- Final Investment Decision due: 30/06/2018
- Date of entry to operation: 30/06/2020
- Operation period: 2020-2025

Next Steps (2/3)

Overcoming obstacles

- RES penetration at a halt because of economic crisis and fall in conventional generation prices
  - ✓Pushing for individual support measures
  - ✓Searching for and locating available land
- Resistance to innovation and investment
  - ✓Alliances with supporting groups
  - ✓Overcoming RES penetration will help to waive resistance from investment decision makers

Next steps (3/3)

Project Mngt Establishment

- Expanded Project Team
  - EAC core team and supportive teams
  - Other supportive teams including:
    - Green+ partners
    - Green+ Stakeholders
- PM tools such as Gantt chart with time schedule, resources, milestones, deliverables, critical path, etc.
- Establishment of supportive teams
  - Steering Committee
  - Stakeholders/Marketing Committee
  - Financial Team
  - Scientific Team
  - Technical Team
  - Project Officers

Green
+

“It is not the strongest species
that will survive
nor the smartest ,
but those adapting to change”

Charles Darwin