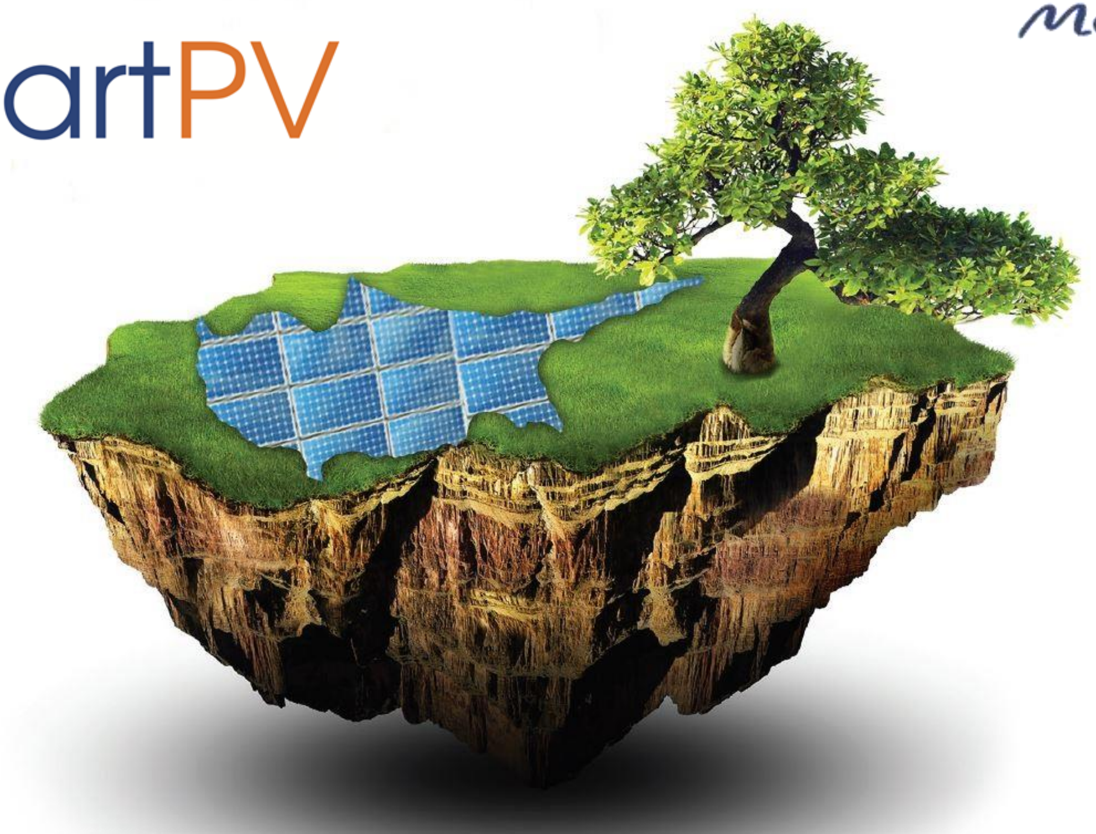

The SmartPV/StoRES Projects (Cyprus)

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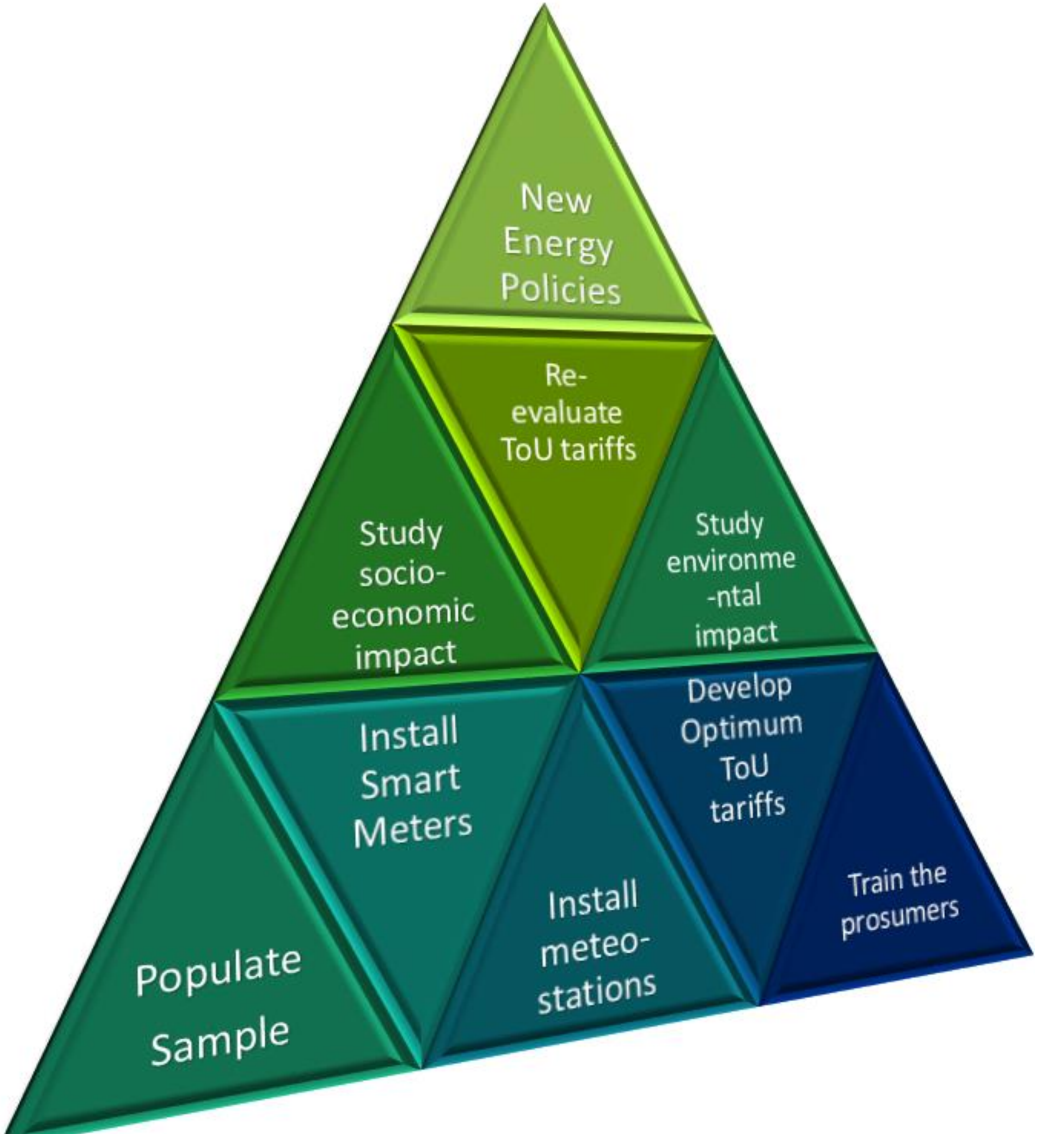
SmartPV

New Energy Policies

- Match consumption with production
- Mitigate PV operational issues
- Fully utilize solar energy by increasing PV integration while maintaining grid stability

Demand Side Management (DSM) + Storage Solutions

SmartPV Three stages for creating effective ToU tariffs



Evaluation Stage - New energy policies

- Promotion of PV integration
- Advantages for both utilities and prosumers

Implementation Stage - One year of ToU application

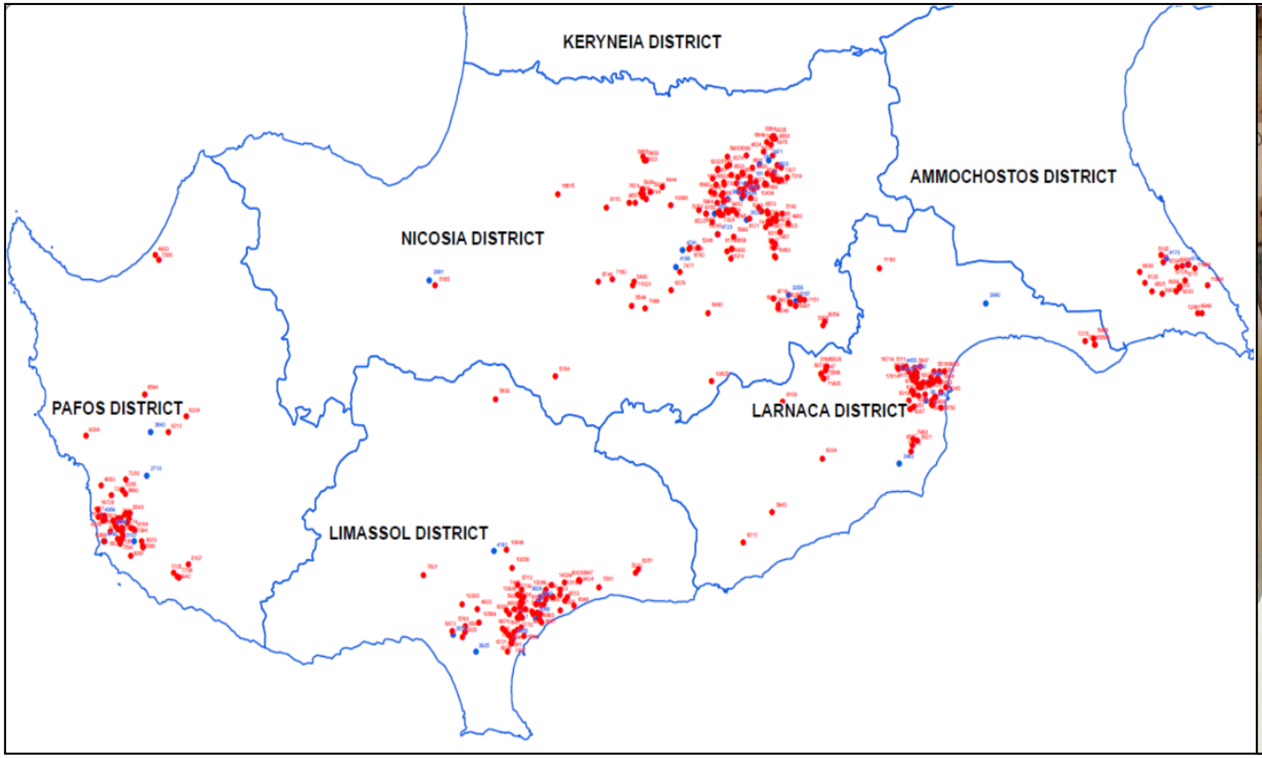
- Data collection for validation
- Feedback provided to the prosumers through web and tablet applications
- ToU tariff re-evaluation

Planning Stage - One year of data collection

- Define initial and baseline scenarios
- Approval of developed ToU tariffs
- Training the prosumers

Planning Stage – Smart Meters (SMs)

- 300 prosumers selected across the island



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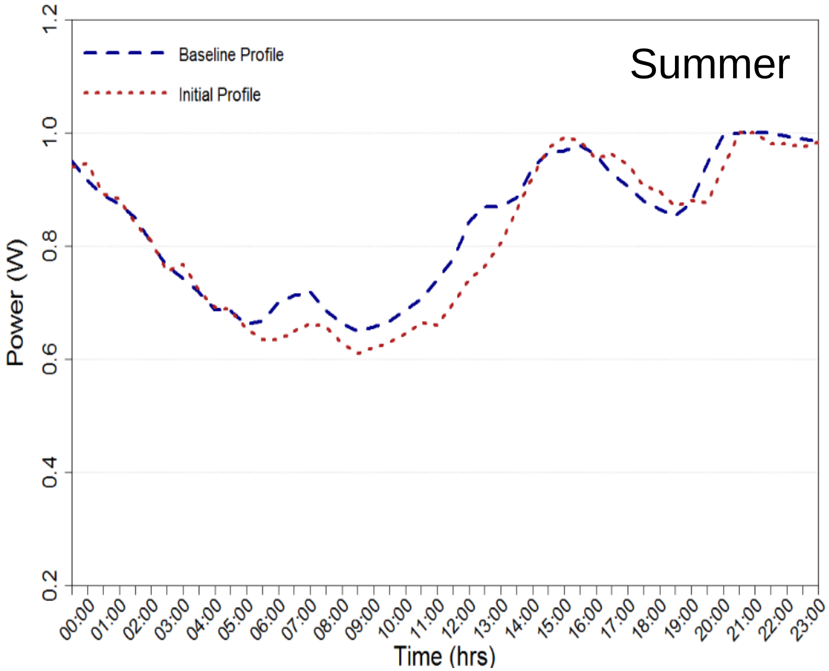
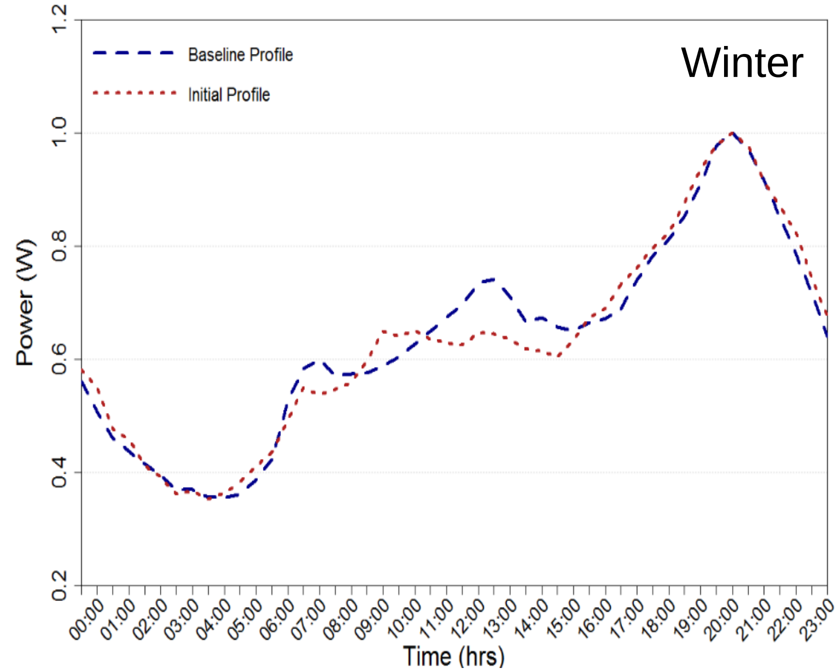
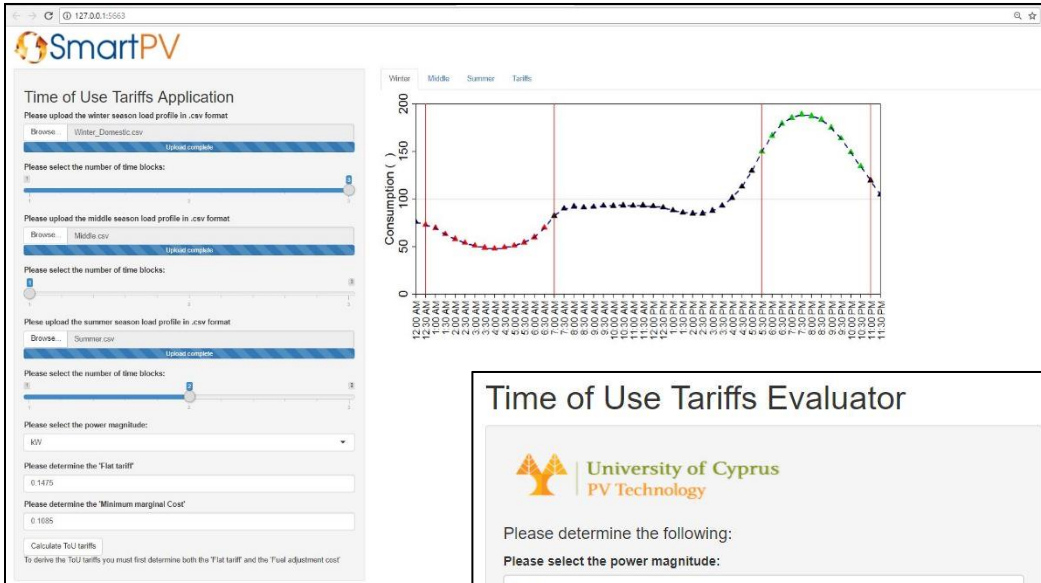
Planning Stage – Initial and baseline

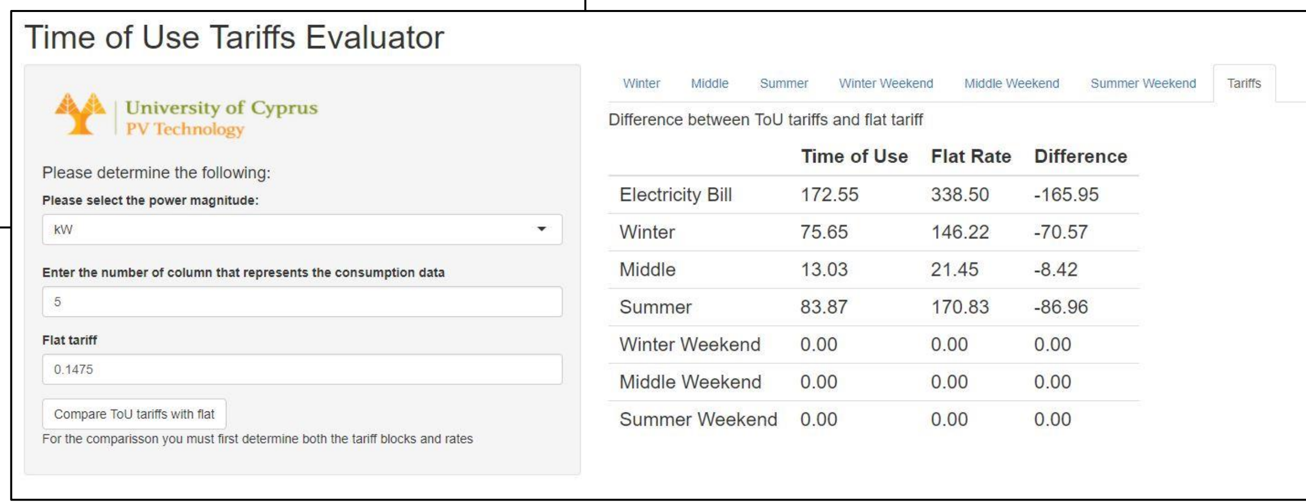
- Each year is divided into three seasons (winter, middle and summer)
- Total Aggregated Consumption → Initial Scenario
- One year of collected data → Baseline Scenario
  - ToU tariffs should be able to reduce the peak demands of the total aggregated consumption
  - Good anchoring point for future evaluations





Planning Stage – ToU tariffs Tools



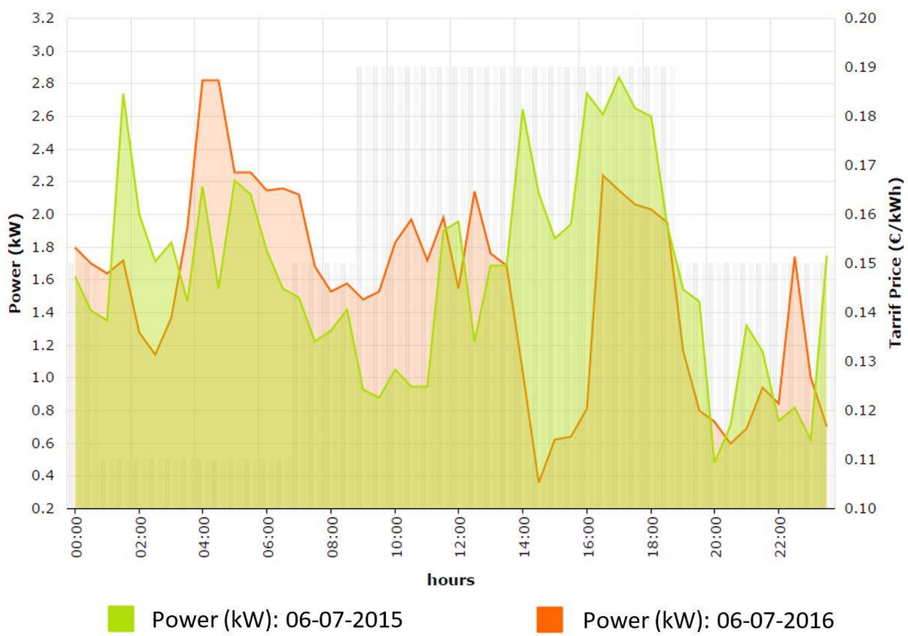


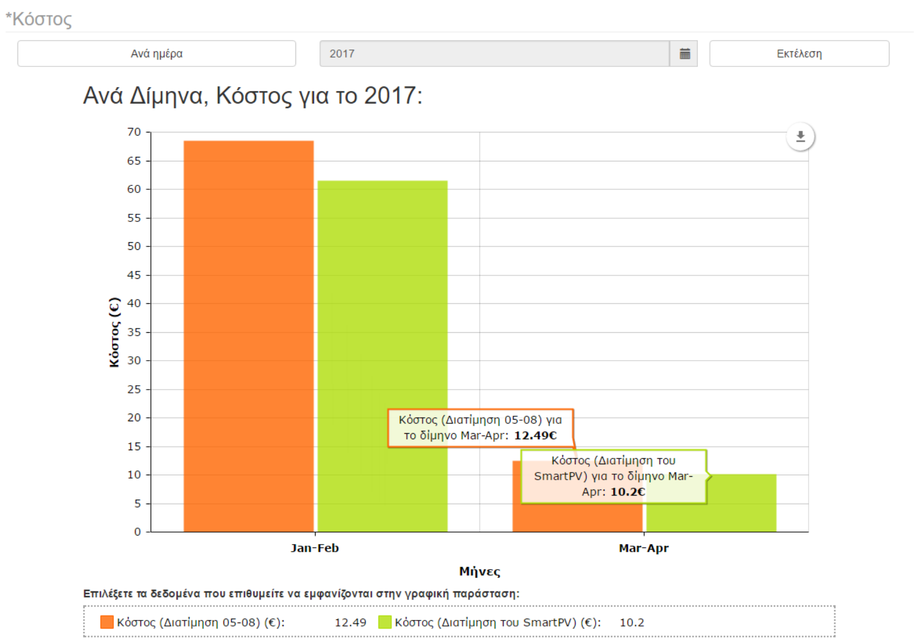
Scientific Approaches

- ❑ Clustering Analysis
- ❑ Optimization Algorithms
- ❑ Changes dynamically

- ❑ Both tools can be utilized by CERA and EAC for developing and evaluating ToU tariffs

Implementation Stage – Web Application





- ❑ Helping participants to easily understand and adopt DSM techniques
- ❑ Observe how their actions change their electricity bill
- ❑ Adjustable to the ToU tariff changes

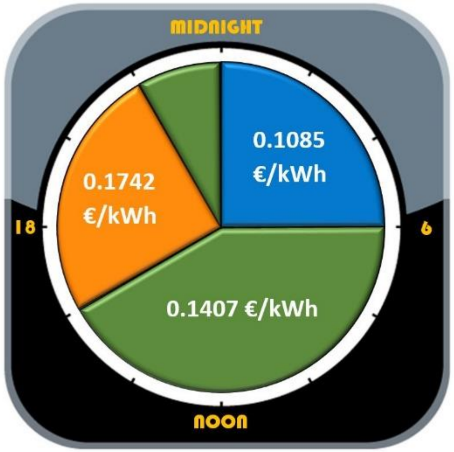
  → Ready for domestic rollout

SmartPV

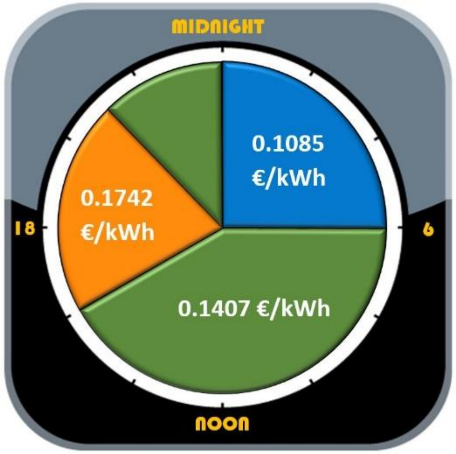
Implementation Stage – ToU tariffs Re-evaluation

- Based on the provided feedback
- ToU tariffs depend on the net-load profiles
- Approved by CERA
- Real implementation on 01/01/2017

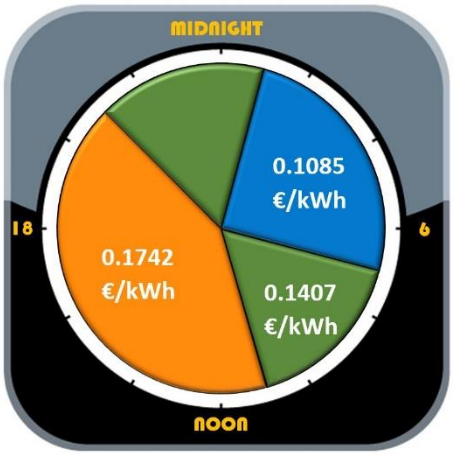
Tariff level	Winter	Summer	Middle	Tariff
Peak	16:00 – 21:59	11:00 – 20:59	16:00 – 20:59	0.1742
Shoulder	06:00 – 15:59 22:00 – 23:59	07:00 – 10:59 21:00 – 00:59	06:00 – 15:59 21:00 – 23:59	0.1407
Off-peak	00:00 – 05:59	01:00 – 06:59	00:00 – 05:59	0.1085



Winter



Middle



Summer

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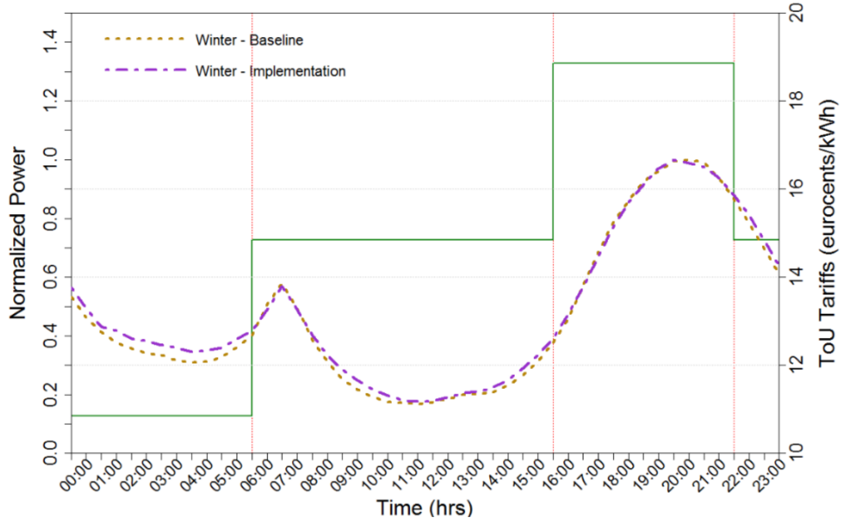
Evaluation Stage – Load Shifting Results



	Summer (%)			Middle (%)			Winter (%)		
Tariff level	2015	2016	Difference	2015	2016	Difference	2015	2016	Difference
Peak	42.70	39.51	- 3.19	36.11	35.08	- 1.03	61.02	59.62	- 1.40
Shoulder	24.01	25.66	1.65	15.12	16.87	1.75	22.89	23.33	0.44
Off - Peak	33.29	34.82	1.53	48.77	48.05	- 0.72	16.08	17.05	0.97

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Evaluation Stage – Impact of ToU tariffs

- After starting the implementation the ToU tariffs, the CO_2 emissions are consistently decreasing (average decrease of 12%).
- An increase of the Load Factor (LF) from 40.65% (baseline year) to 41.43% (implementation year) was observed.
- The energy behaviour change was investigated by comparing the average annual consumption of the smart prosumers with the rest of Cyprus.
  - Rest of Cyprus Sample: Domestic consumers with similar consumption levels with the SmartPV sample

	Average Consumption Baseline Year	Average Consumption Implementation Year	Percentage Increase
SmartPV Sample	6864.11 kWh	7138.98 kWh	4,00
Rest of Cyprus Sample	6785 kWh	7204 kWh	6,18
		SmartPV Savings	-2,18

Benefits for Policy makers / market participants

- The pilot network acts as first class demonstration of the future smart grids.
- Technical know-how on smart meters installation, communication and data acquisition that will enable dynamic tariff structures.
- Experience on developing a time-varying pricing scheme that encourages the end-users to behave in a way that improves the overall efficiency of the energy system while minimizing the total costs → A flexible software tool for developing ToU tariffs
- Prosumers acceptance and responsiveness to time-varying electricity pricing.
- Price-based DSM is the first step towards optimum flexibility that can reduce or postpone investment in infrastructure.
- A well structured ToU tariff scheme is the key to unlocking the potential of battery storage and maximize overall savings.
- The introduction of storage, EVs, aggregators, smart appliances and "active" prosumers will drastically change the energy landscape.

Implementation Stage – THINK BIG, start small

SmartPV

Strategy priority: "Accelerating Clean Energy Innovation"

"More fundamentally, the transition to a low-carbon and climate-resilient economy will require a more decentralised, open system with the involvement of all society. The energy system has traditionally been marked by the dominance of large companies, incumbents and large-scale, centralised technological projects. But in future the consumer has to be at the centre of the energy system: demanding competitive low-carbon solutions; participating as producer and manager of decentralised energy networks; acting as an investor, through decentralised platforms; and driving change through user innovation."

Two important complementary objectives of the StoRES project

Interreg
Mediterranean
StoRES

- Evaluate the optimal size of storage system behind the meter that will maximise the economic benefit of the prosumer by capitalising the possibilities of a dynamic time of use tariff
- Evaluate the optimal size of the socialised storage that will complement the storage behind the meter and offer the local distribution capabilities for 100 % energy generation through local RES penetration by preserving the specified quality of supply (voltage profile, harmonics, thermal loading of equipment etc)

Where is storage best sited

Interreg Mediterranean StoRES

- Energy storage can solve many problems all along the energy supply chain: T&D deferral, demand response, power quality & reliability, frequency control, and mitigation of solar and wind energy intermittency. Because of this, the desired end goal influences where an energy storage technology is best placed.
- Energy storage's value increases as approaches the edge of the grid and the customer's load, with economic benefits accruing to both the utility and the end user.

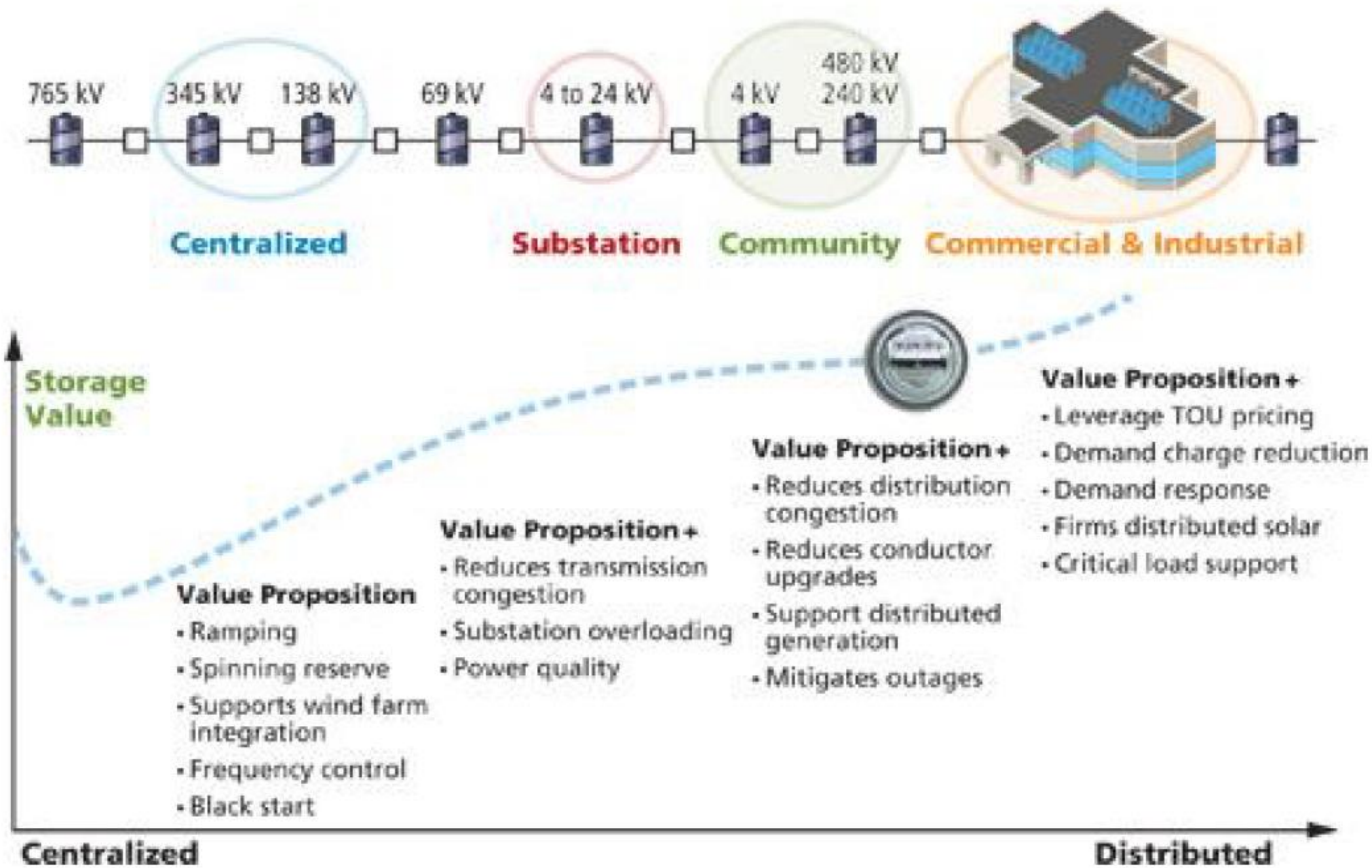
Grid smartness can maximize the benefit of distributed storage

- That terminology, "utilityscale“ and "gridscale,“ illustrates another problem.
- It "is deceiving" and represents "a classic utility mindset" that frames the discussion as a centralized service and thus centralized control. It assumes and creates the persona that it's 100 MWh of storage in one big central location, rather than recognizing how energy is used and where it is located.
- Storage on a distributed basis "can get to grid-scale very quickly" and "is significantly more robust" than upstream centralized grid-scale storage assets.
- It calls for optimisation in siting storage facilities and StoRES is addressing this issue.

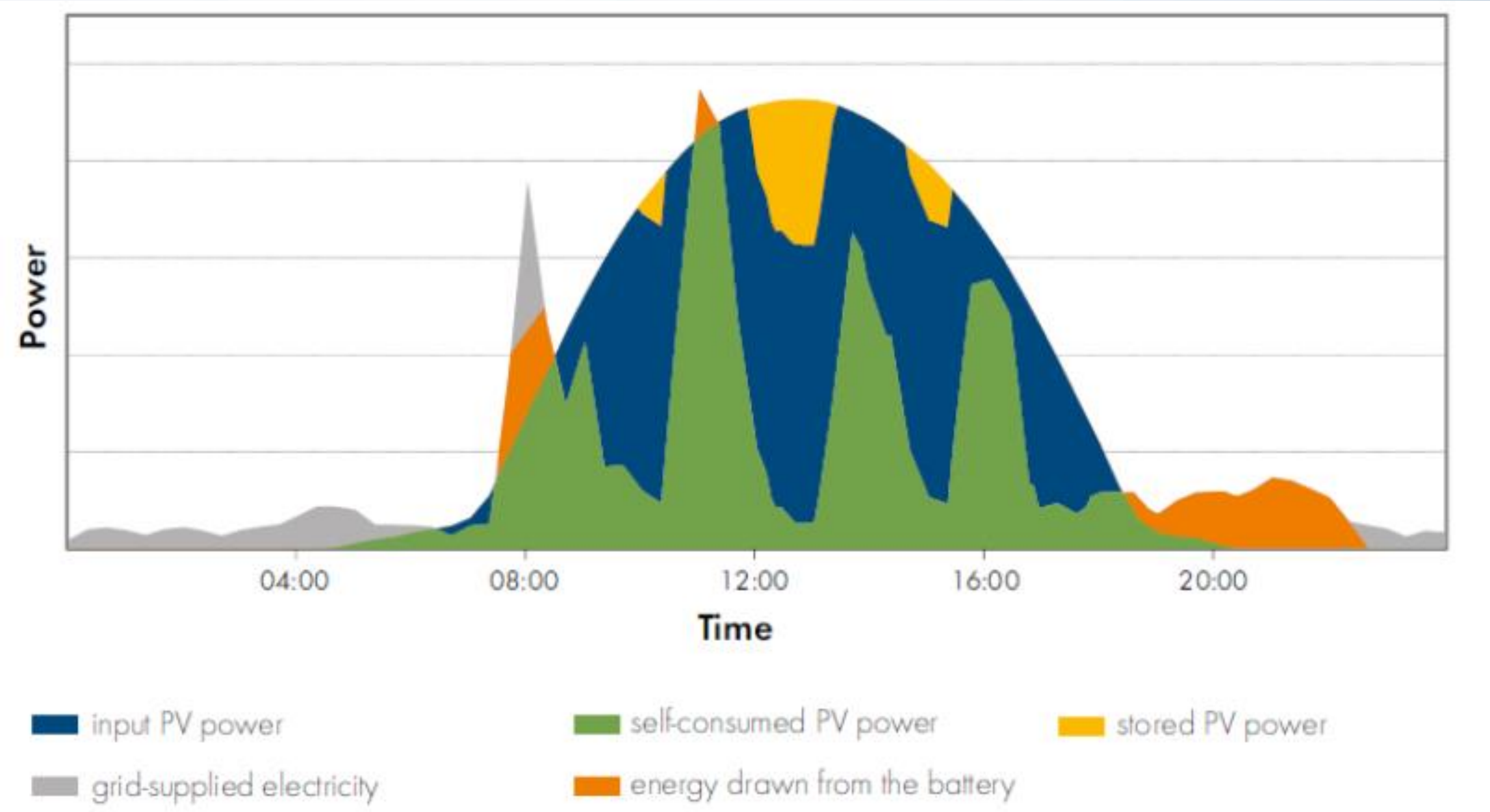
Distributed Energy Storage is vital

Community value proposition:

- Reduces distribution congestion
- Reduces conductor upgrades
- Supports Distributed generation
- Mitigates outages
- Supports quality of supply and voltage profile

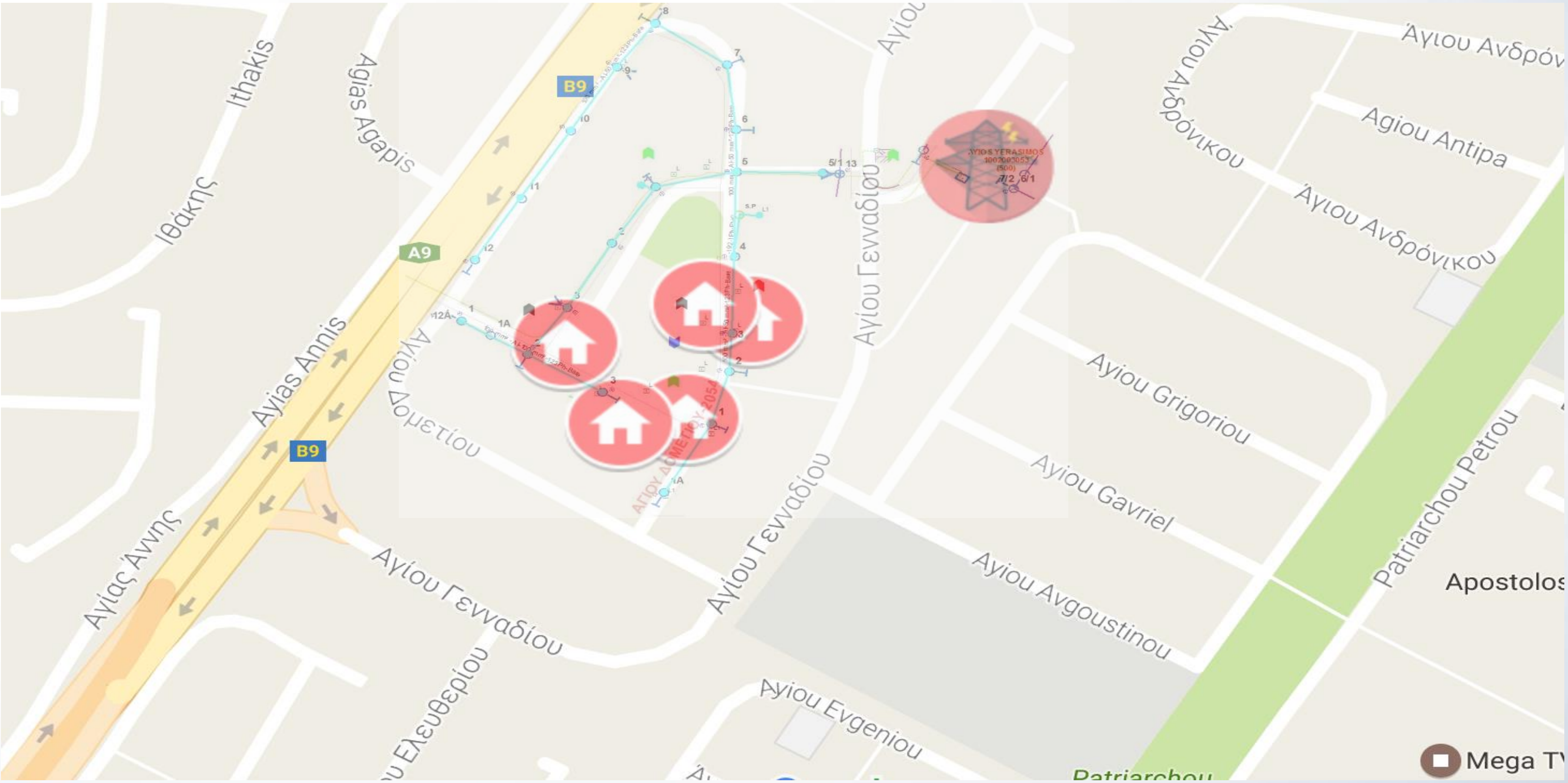


Energy management with smaller size of storage and more social storage

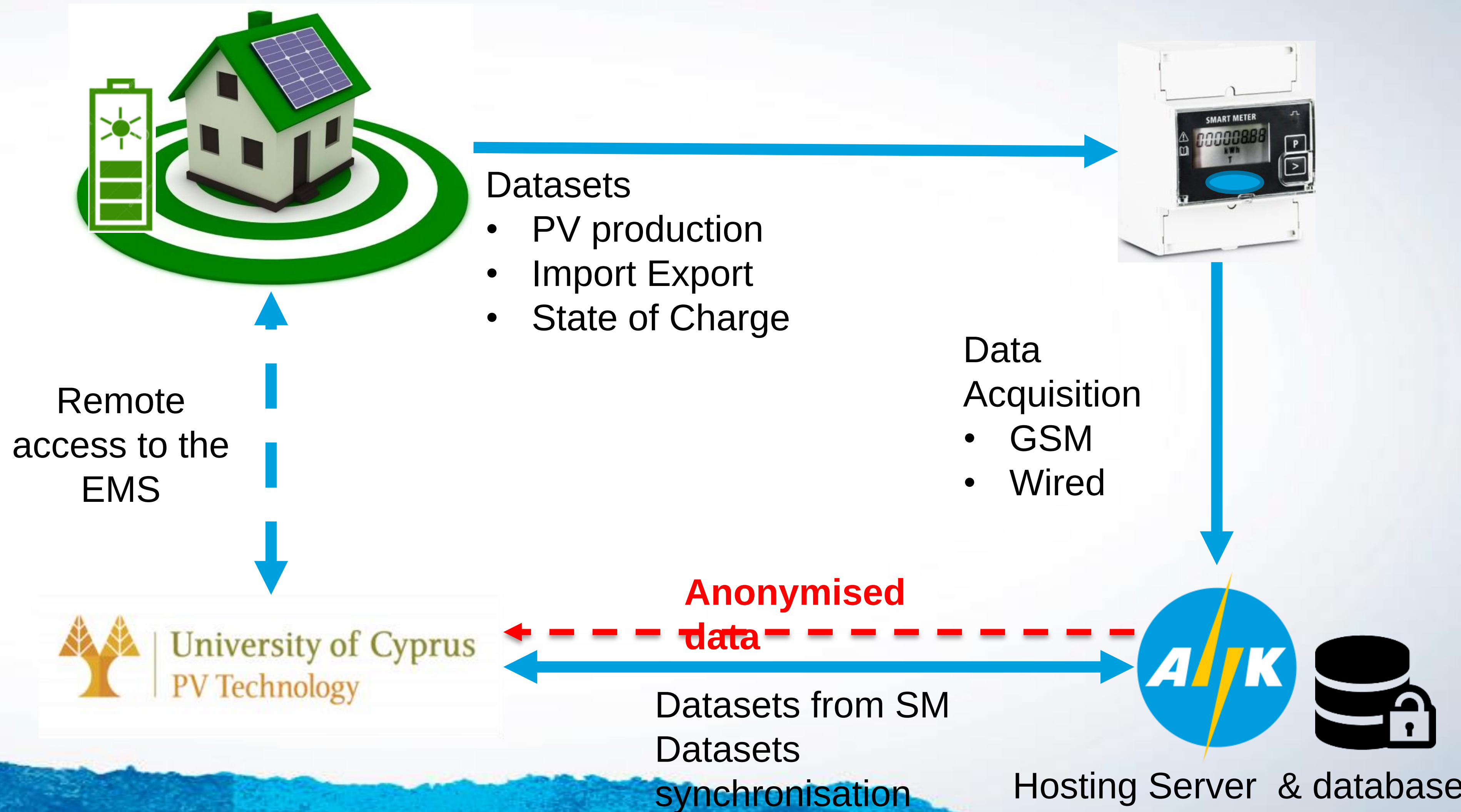


Pilot site in Cyprus – A low voltage feeder in Ayios Dometios

Map Location

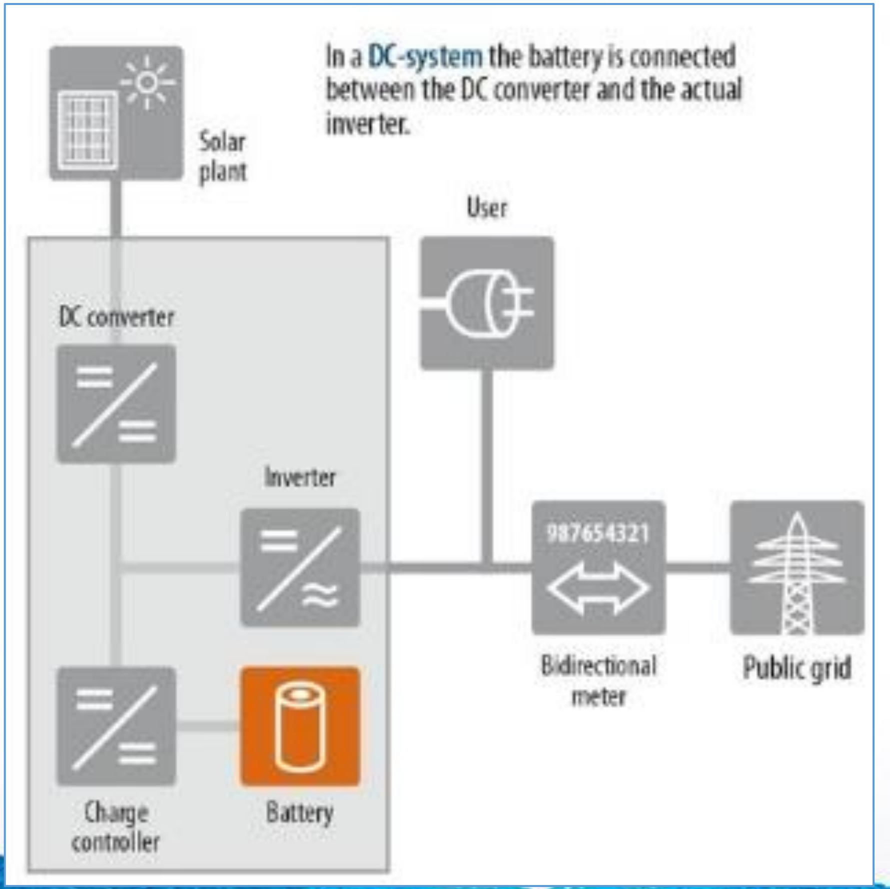


Data Acquisition

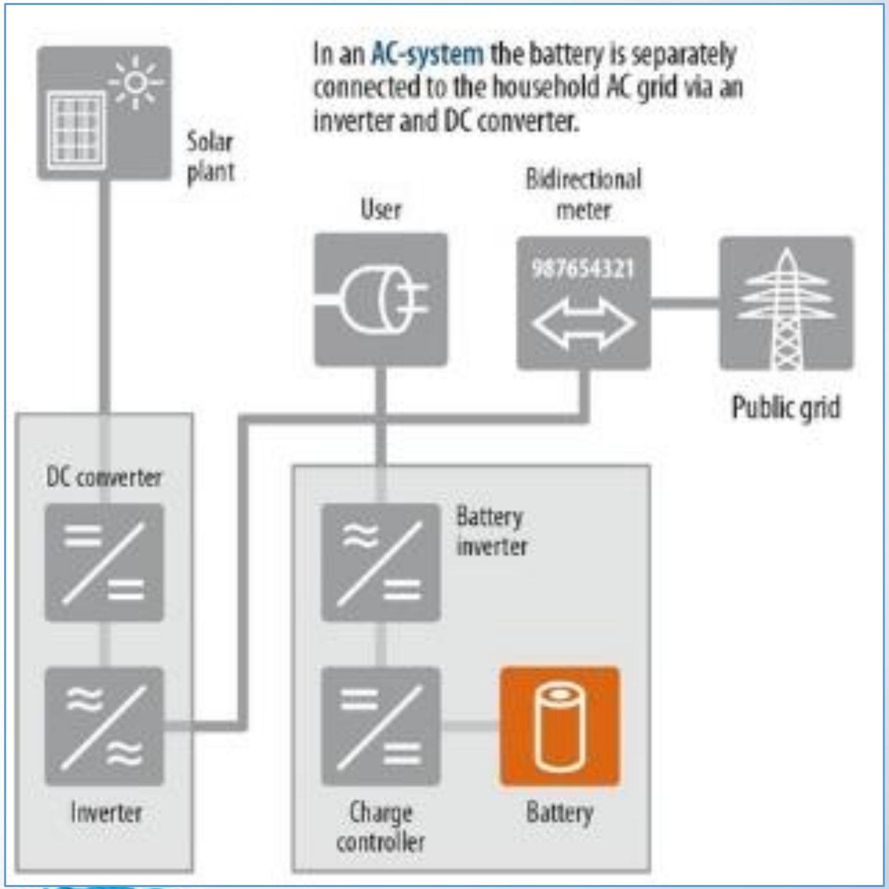


Market Analysis: System Configuration

DC coupled



AC coupled



Storage Implementation: AC vs DC Coupled

AC-Coupled

+ Easily fitted to existing installations

+ Better expandability

- Need of both string & battery inverter

- Same brand for compatibility purposes

DC-Coupled

+ Fewer components

+ Higher round trip efficient

+ Lower unit cost

- Limited Expandability but always expansion can be effected on the AC side

Thank you
for your attention!

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