

Deployment of a partial mesh network for adaption of district level energy optimization schemes

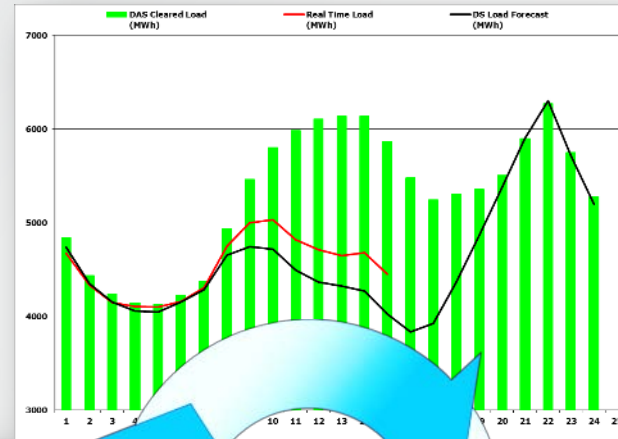
Konstantinos Tsoukalas

School of Mining and Metallurgical Engineering
Laboratory of Metallurgy
National Technical University of Athens
Athens, Greece

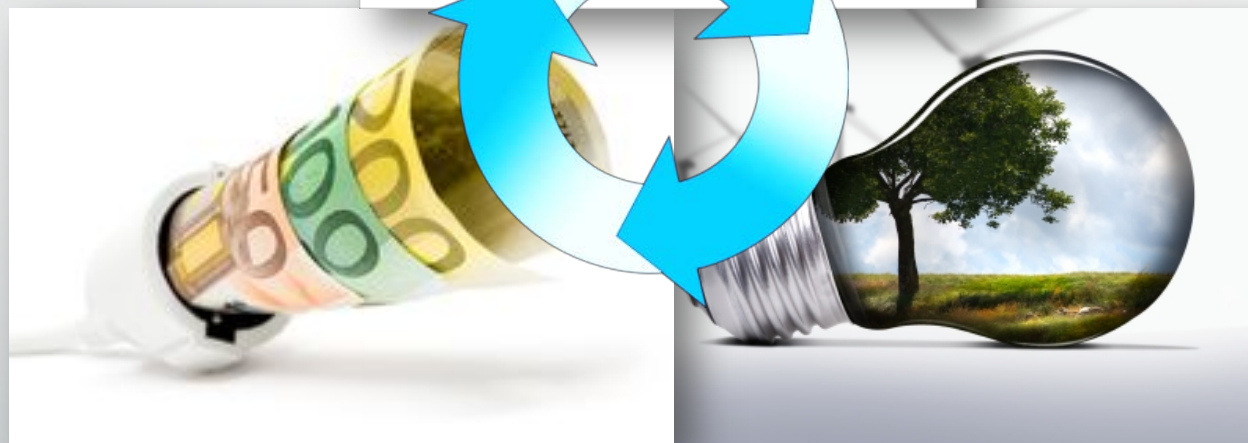


The Challenges

Buildings account for approx.
40% of the total energy
consumed in the EU



Cities cover only 2% of world's
surface – emit almost 75% of
global CO₂ emissions



The pace of urbanization is
increasing exponentially

DSOs in Europe



Energy management at district level

What is the **best strategy** at district level?



How much?



When?



From whom?



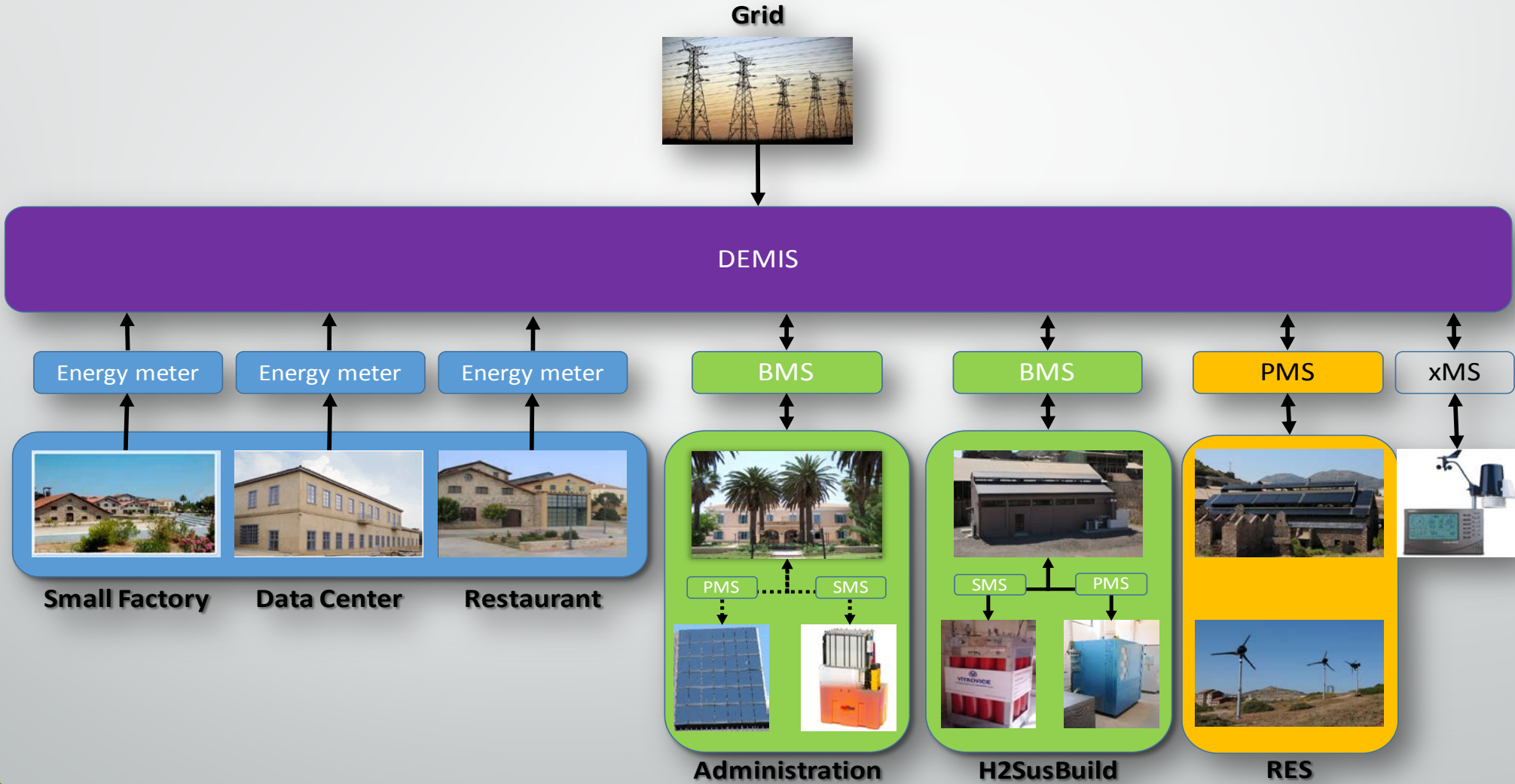
District Energy Management and Information System



LAVRION TECHNOLOGICAL AND CULTURAL PARK (LTCP)

- LTCP is located in Lavrion, in South-eastern Attica, Greece, approximately 50 km from the center of Athens.
- For the purposes of the project, the LTCP demonstration site contains 5 buildings:
 - The administration building (hosts the LTCP managing authority and administrative services)
 - The H2SusBuild building (research installation of NTUA's Laboratory of Metallurgy)
 - A building hosting a data center
 - A building hosting a small industrial company
 - A building hosting a small cafeteria/restaurant

System architecture



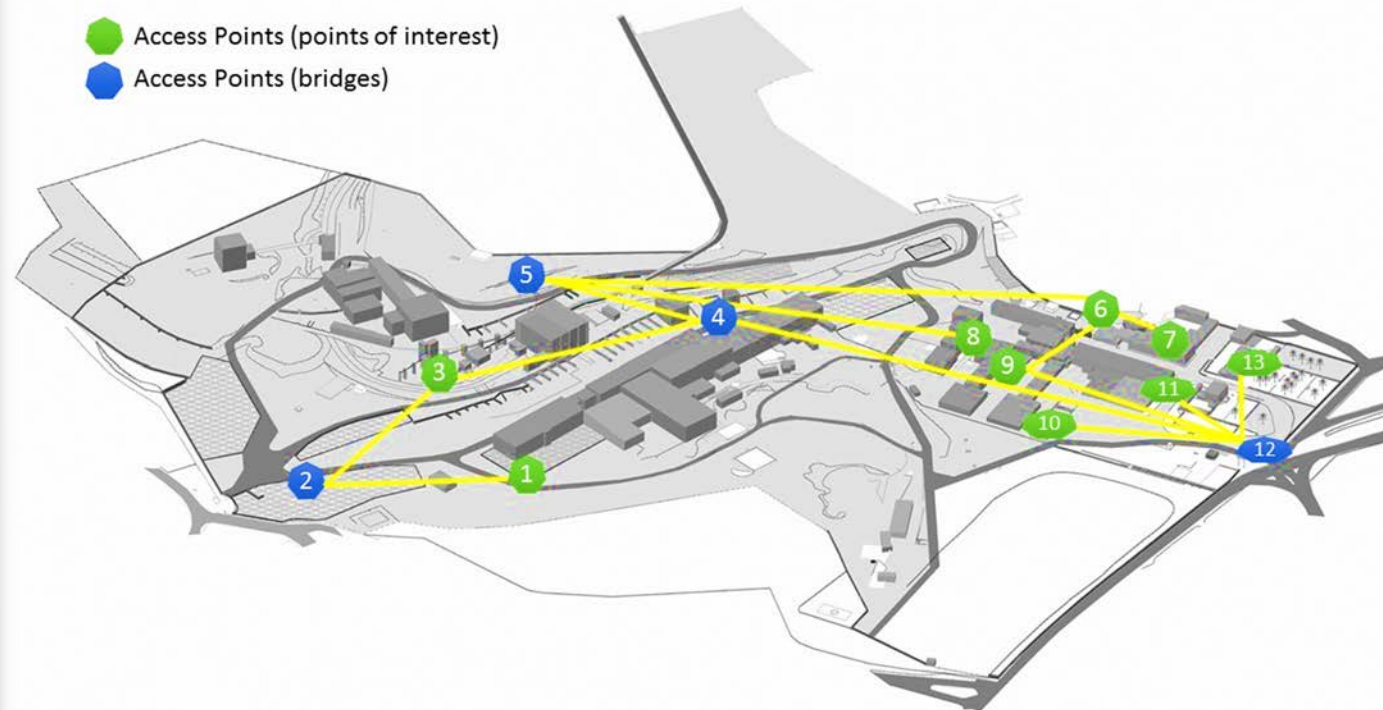
Monitoring requirements

- A total of 34 smart power metering devices have been installed within the Park. The electrical supplies that are measured are:
 - Total electrical consumption of each building
 - Renewable Energy Sources (PV, WT systems and Micro-CHP Fuel Cell separately)
 - Electrical consumption of each building load (lighting, HVAC and other loads separately)
 - Electrical consumption of electrolyser and H₂ compressor
- In addition a total of 62 different sensors/actuators were installed in the five buildings which are measuring:
 - Indoor temperature
 - Relative humidity
 - CO₂ concentration
 - Occupancy
 - Light level
 - Movement sensors
 - Hot & cold water thermostats
 - Meteorological conditions (outdoor air temperature, solar radiation, humidity, barometric pressure, wind speed)

The solution - WLAN

A dedicated **Wireless Local Area Network (WLAN)** was designed, installed and commissioned in the perimeter of the park. A wireless solution was preferred mainly for three reasons:

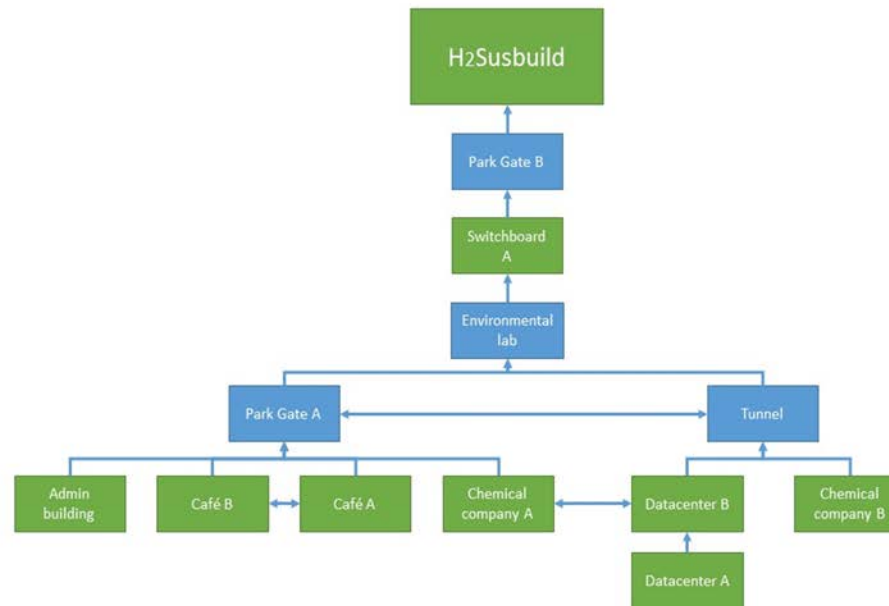
- Considerable cost of Ethernet cabling
- Unreachable areas for cabling routing
- Visual impact of cabling



The solution – Topological structure

A partial MESH topology was selected based on the following criteria:

- The area to be covered (extension, topography, transmission issues –noise, interferences-, etc.)
- The pursued reliability and robustness, expressed by load balance mechanism implementations for data links and routes reconfiguration, due to broken links.
- The bandwidth needed for expected data traffic.
- The maximum data delay allowed.



Testing activities

769,5 GB of data transferred

Uninterrupted operation
of 41 days 17 hours 8
minutes and 1 second

The screenshot displays the RouterOS WinBox interface. At the top right, the system status shows "Uptime: 41d 17:00:32". The left sidebar contains a menu with various configuration options. The main area is divided into two panels for interface configuration: "Interface <wlan1>" and "Interface <ether1>".

Interface <wlan1> Statistics:

General	Wireless	HT	HT MCS	WDS	Nstreme	NV2	Status	Traffic
Tx/Rx Rate:	123.9 kbps	/	2.2 Mbps					
Tx/Rx Packet Rate:	154 p/s	/	207 p/s					
Tx/Rx Bytes:	95.2 GiB	/	667.4 GiB					
Tx/Rx Packets:	506 600 991	/	559 875 075					
Tx/Rx Drops:	0	/	0					
Tx/Rx Errors:	0	/	0					

Interface <ether1> Statistics:

General	Ethernet	Status	Overall Stats	Rx Stats	Tx Stats	Traffic
Tx/Rx Rate:	2.3 Mbps	/	135.9 kbps			
Tx/Rx Packet Rate:	228 p/s	/	161 p/s			
Tx/Rx Bytes:	675.3 GiB	/	94.2 GiB			
Tx/Rx Packets:	591 981 607	/	496 707 424			
Tx/Rx Drops:	0	/	0			
Tx/Rx Errors:	0	/	0			

Below the statistics are two line graphs for each interface. The wlan1 graph shows Tx (blue) at 123.9 kbps and Rx (red) at 2.2 Mbps. The ether1 graph shows Tx (blue) at 2.3 Mbps and Rx (red) at 135.9 kbps. A red box highlights the "Tx/Rx Bytes" field in the ether1 configuration window, which shows 675.3 GiB Tx and 94.2 GiB Rx. A red arrow points from this box to the "769,5 GB of data transferred" text. Another red arrow points from the "Uptime: 41d 17:00:32" text to the ether1 configuration window.

Conclusions

- Testing results showed that implemented partial mesh network achieves stable routes, it has very low packet loss rates, minor delays and more than adequate network throughput
- As the trend of smart cities with advanced interconnection requirements is likely to increase even more in the following years the need for low-cost and reliable communication solutions is more important than ever.

Thank you for your attention

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Konstantinos Tsoukalas
Research Engineer
ktsoukalas@metal.ntua.gr