Photovoltaics in the Energy Transition of Technical Universities: a case study in the Universidad Politécnica de Madrid

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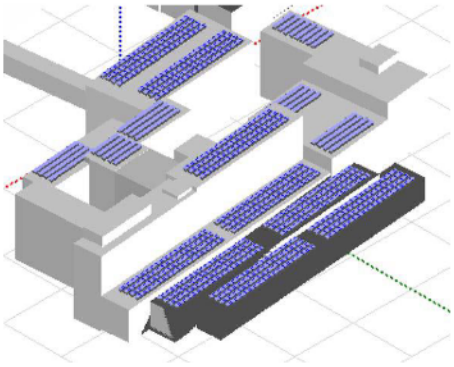
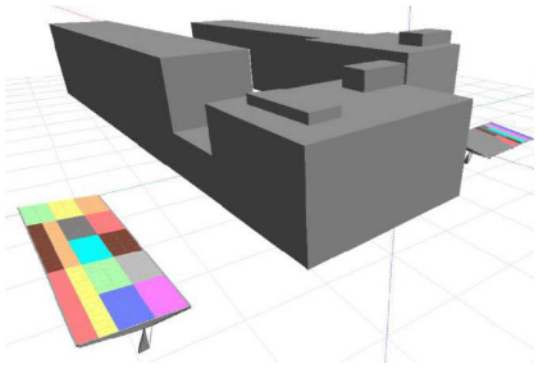
As it is well known, for Europe to become the first climate neutral continent by 2050 an ambitious but reachable Energy Transition is required involving all sectors of the economy. Universities are societal actors that educate professionals and citizens as well as do research and innovation that can enable it, therefore, a reflection seems pertinent on universities' role in the aforementioned transition. Amongst the several disciplines involved, renewable generation and intelligent management of electricity are two particularly interesting fields for technical universities, not only because the technological challenges will demand such professionals but also as users of large amounts of electricity that, in many cases, is also done rather inefficiently. In this context, the "learning by doing" approach can render multiple benefits as a truly Living Labs where technical and non-technical solutions can be tested.

The Universidad Politécnica de Madrid, leader of Spanish universities in the fields of Engineering and Architecture, is exploring such potential. Through several degrees and end-of-degree projects of students of different engineering (Energy and Mines, Telecommunications, Industrial Design) and architecture disciplines the potential of Photovoltaic Distributed Generation (PVDG) of its different campuses has been identified, together with innovative management of renewable electricity applied to Electrical Vehicles charging facilities. The particular case of the Escuela Técnica Superior de Ingenieros de Telecomunicación will be shown, where a comparison between the results of a techno-economic study done in 2019 and actualized ones will demonstrate that it is a key sustainable investment from techno-economic, social and environmental perspectives.



PVDG in ETSIT's main building



PVDG for EV Charging infrastructure

PHOTOVOLTAICS IN THE ENERGY TRANSITION OF TECHNICAL UNIVERSITIES: A CASE STUDY IN THE UNIVERSIDAD POLITÉCNICA DE MADRID

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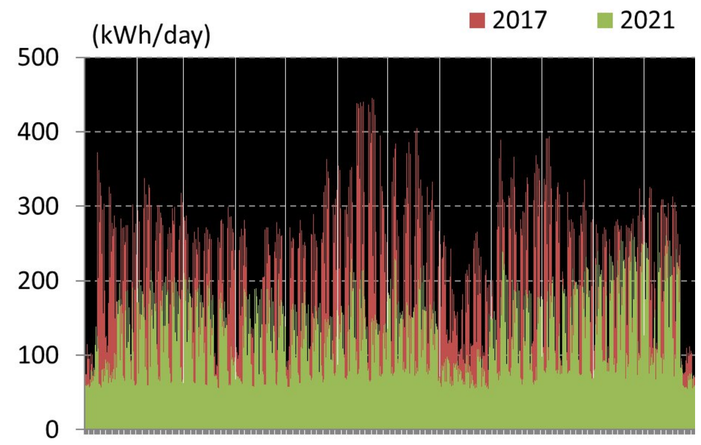
- For Europe to become the first climate neutral continent by 2050 an ambitious but reachable Energy Transition (ET) is required involving all sectors of the economies. As societal actors that educate future professionals and society, universities' role is of outmost importance
- Renewable generation and energy management are relevant fields for technical universities, not only because of the technological challenges, but also as large electricity consumers
- A case study of Telecommunications Engineering School (ETSIT) is presented, where students have demonstrated that Photovoltaic Distributed Generation (PVDG) is a key investment

CASE STUDY BUILDINGS:

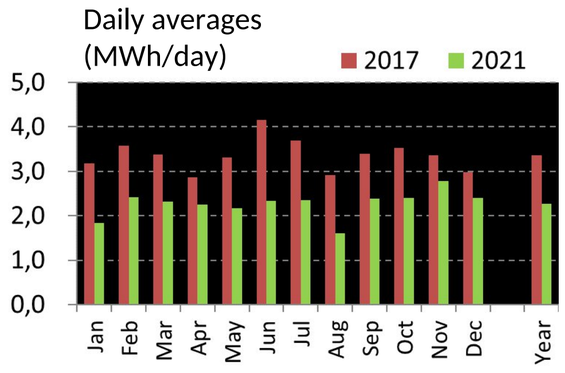
(Uses: training, administrative, library, canteen)

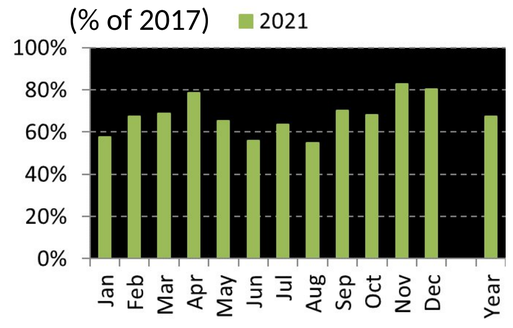
ELECTRICITY CONSUMPTION EVOLUTION



2017: 1225 MWh

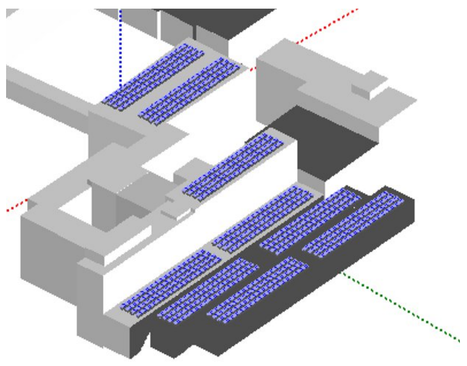
2021: 827 MWh



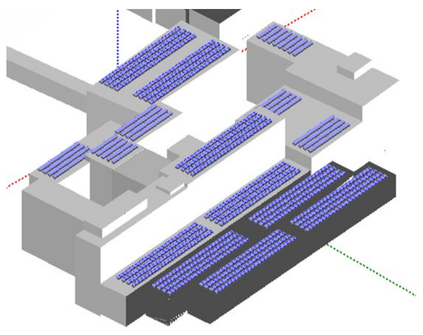


➢ Efficiency investments (LED lighting & control, building envelope improvements) have allowed to decrease consumption

PV INVESTMENTS & SELF-CONSUMPTION REGULATIONS



2017: 310 kW



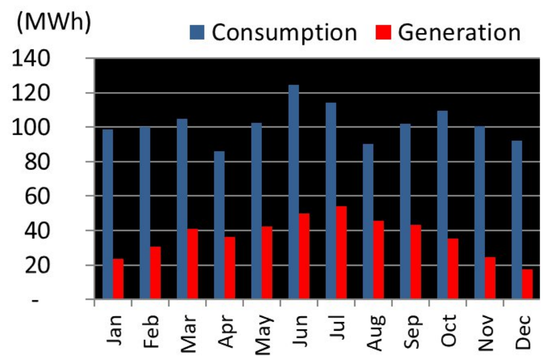
2021: 426 kW

Regulations	Regulations
PV system size ≤ 50% of Transformation Centre (630 kVA)	PV system size ≤ 70% of Transformation Centre (630 kVA)
Only individual self-consumption allowed	Shared self-consumption allowed (nearby buildings)
Surplus electricity* value: Spanish electricity market (hourly, pool)	Surplus electricity value: Electricity hourly prices

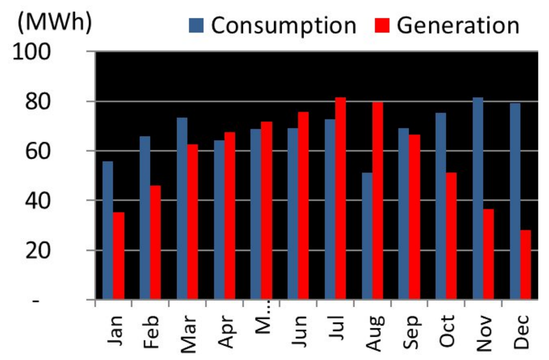
* Surplus electricity: PV electricity locally generated but not locally consumed due to time differences between consumption and PV generation

ELECTRICITY & ECONOMIC BALANCES

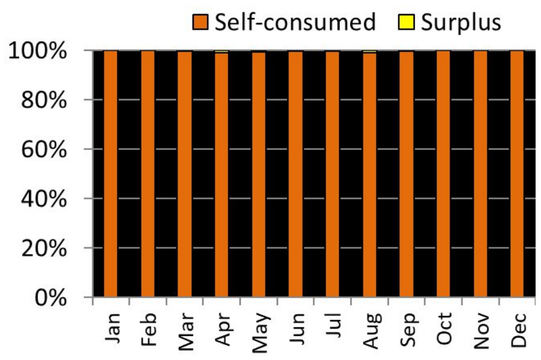
2017

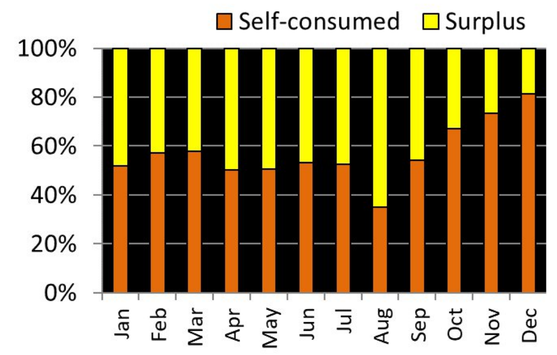


2021

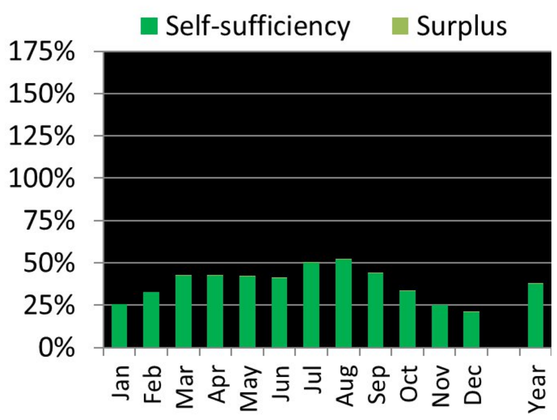


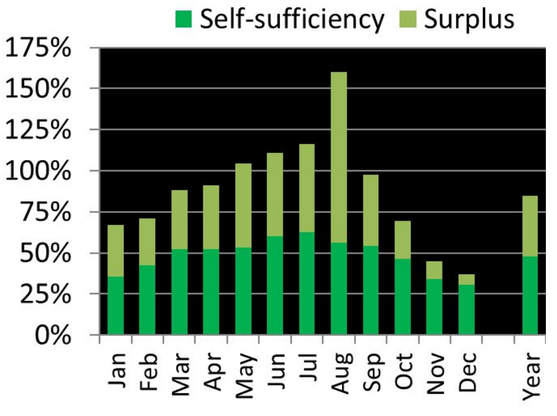
Breakdown of Photovoltaic generation





Breakdown of Economic savings (% of cost without PV)





	2017	2021
PV installation cost (€/kW)	1087	910
Pay-back of investment (years)	10,3	8,9
Internal Rate of Return (%)	13	11

CONCLUSIONS

- Training and End-of-Degree projects from engineering schools can unveil the potential of Renewable energies in buildings and universities campuses ☾ "Learning by doing"
- Green Deal Funding should support universities in the identification and exploitation of projects leading to an Energy Transition that is compatible with European Climate neutrality ambitions
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