Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Sustainability Meets the Campus Data Centre

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Overview

Project Initiation – the idea of an on Campus ‘Green’ Data Centre

Considerations: Requirements, Capacity, Resilience, Reliability, Energy Efficiency, Environmental Impact, Health & Safety, Maintainability, Implementation Costs, Whole Life Cost.

Pros and Cons of a brown field rather than green field

Reasons for ‘on-premise’ rather than satellite site or dedicated commercial site

Planning

Location, Location, Location

On-site # cabinets, loadings, location for external plant

Adjacent to IT Services building

Adjacent to HEAnet PoP

Planning Permission, Alterations, Construction in an occupied building within a busy Capital City centre site.

Award of contract to Future-tech for Design, Build and Maintain

https://www.future-tech.co.uk/

Case Studies

Award-winning data centre delivers flexible, green data centre solution for Trinity College Dublin

Award winning data centre that delivers an ultra-flexible, ultra-green physical infrastructure platform. This new facility will help support Trinity College Dublin for the next 15 – 20 years, delivering reliable uninterrupted IT services to its 20,000 students and staff.

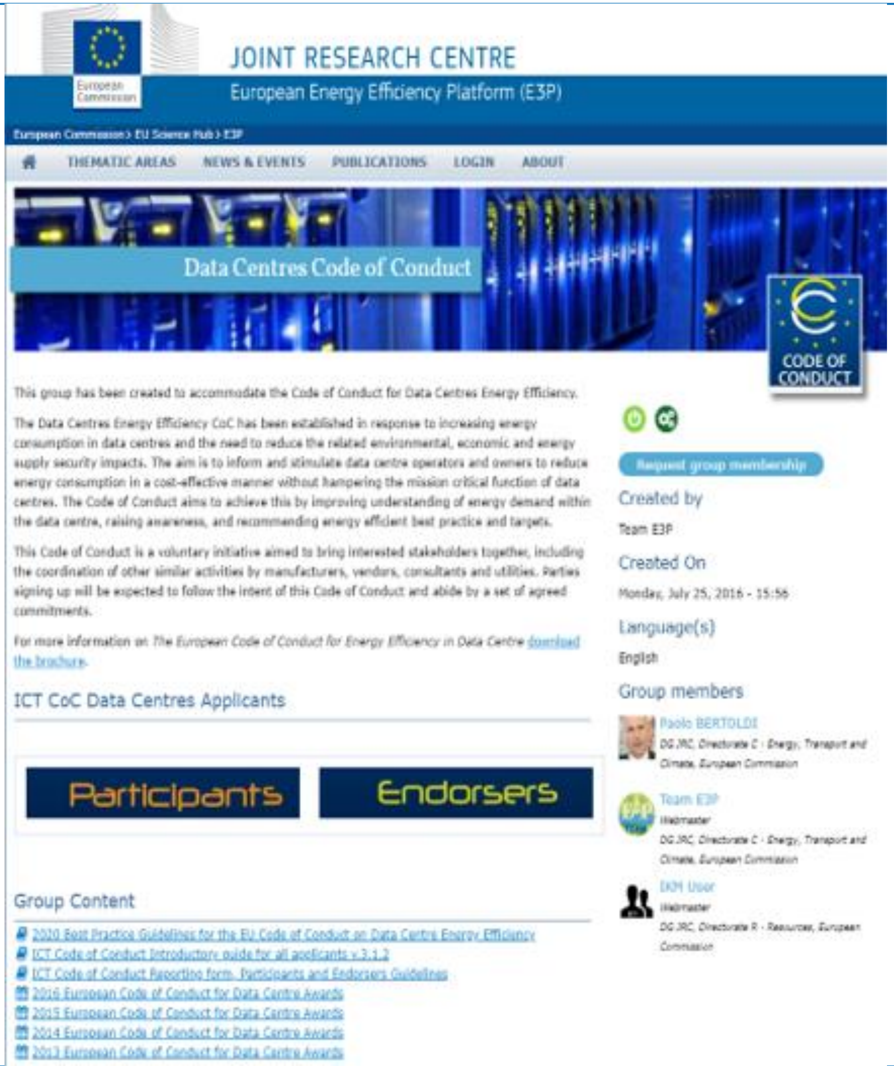
Procurement

EU Code of Conduct for Data Centre Efficiency

- Guidelines
- Recommendations
- Examples of best practice
- Seeking a 20% reduction in energy consumption.
- >3% of electricity use in UK
- 4.7 million tonnes of CO_2 over 6 years – 1 million cars.

https://e3p.jrc.ec.europa.eu/communities/data-centres-code-conduct

- https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/jrc119571_jrc119571_2020_best_practice_guidelines_v11.1.0a_br_ma_21_jan.pdf



Design
Modular Room

- Modular Room inside existing building Firemaster* composite wall – balancing fire performance, cost and weight.
- New clean and sealed environment – protects from water ingress, dust thermal changes.
- Raised floor, Danoline* suspended ceiling
- Roof plant enclosure
- Cooling – Rear Door Heat Exchangers (RDHE) Typically 5- 20kW per rack
- 150kW across 22* racks average 7.1 kW per rack

Life Cycle Assessment	Introduce a plan for Life Cycle Assessment (LCA) in accordance with emerging EU guidelines and internationally standardised methodologies. Examples of which would be *ISO 14040 and ISO 14044*. *EN 15978* 'Sustainability of construction works - assessment of environmental performance of buildings - calculation method' is also a standard that is considered relevant to this Practice. Note: This Practice aims to reduce overall carbon footprint and improve sustainability rather than directly improve energy efficiency.
Environmental Management	Introduce a plan for Environmental Management in accordance with emerging EU guidelines and internationally standardised methodologies. An example of which would be ISO 14001. Consider appointing a cross functional Environmental Sustainability Manager to take responsibility for this initiative.
Energy Management	Introduce a plan for Energy Management in accordance with emerging EU guidelines and internationally standardised methodologies. An example of which would be ISO 50001. Note: The Code of Conduct can be used effectively to underpin the expectations and reporting requirements specifically for data centres in relation to *ISO 50001*. Consider appointing a cross functional Energy Manager to take responsibility for this initiative.
Asset Management	Ensure that Asset Management for both IT and mechanical and electrical assets etc. is implemented and controlled according to a standard and accepted methodology. An example of which would be *ISO 55000*. Understanding the numbers, types and purposes of the assets deployed in a data centre underpins effective energy management.

Build

Sustainability of energy usage

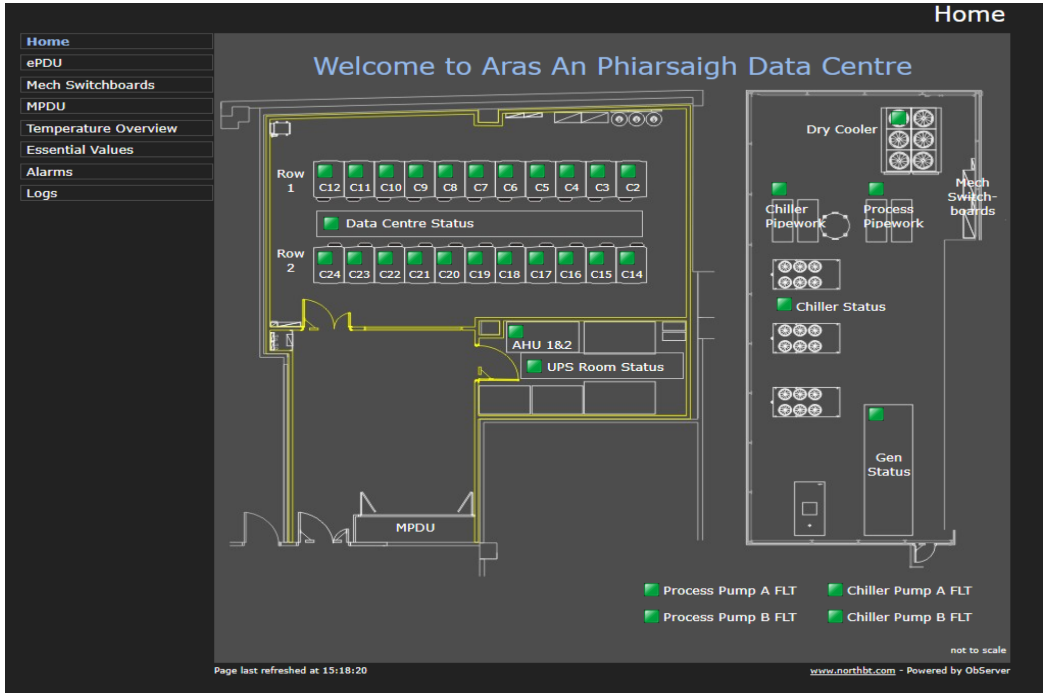
- Guiding Principles for Data Efficiency Metrics
- Calculations to support energy cost estimates
- Power Usage Effectiveness (PUE)
- PUE = Total Data Centre Energy Consumption/ IT Energy Consumption
- ColdLogik* 18°C degree water up to 20kW per cabinet
- Chillers up to 35% less energy consumption
- Dry Air Cooler / Free Cooling module
- Return water temperature of 22-24°C when external ambient air temperature is 20-22°C and 100% free cooling at <15°C

Sustainable energy usage	Consider the proportion of energy used by the data centre that comes from renewable / sustainable sources. Recording and reporting on the proportion of sustainable / renewable energy used against the overall energy consumption is expected to become an expected monitoring and reporting requirement in time. Note: Standardised metrics in this area are available as EN 50600-4-3 or ISO/IEC 30134-3. EN 50600-4-3 "Information technology — Data centre facilities and infrastructures — Part 4-3: Renewable Energy Factor" specifies the "Renewable Energy Factor, REF" as the ratio of the renewable energy (in kWh) to the total energy consumption (in kWh). Note: REF covers all renewable energy purchased from the utility (with guarantee of origin) and produced on-site. However, renewable energy produced on-site, that is not consumed on-site and partly or in total sold to the grid, shall be excluded from REF. Note: CLC/TR 50600-99-1 and CLC/TR 50600-99-2 address Best Practices for Data Centre Energy Efficiency and Environmental Sustainability respectively. Both are a part of the European EN 50600 Standard series. Note: The EN 50600 series has now been adopted by ISO/IEC as ISO/IEC TS 22237. Note: ETSI EN 305 200-3-1 KPIREN KPI excludes both energy from grid and energy not consumed on site, in conformance with net zero initiatives.

Lobby

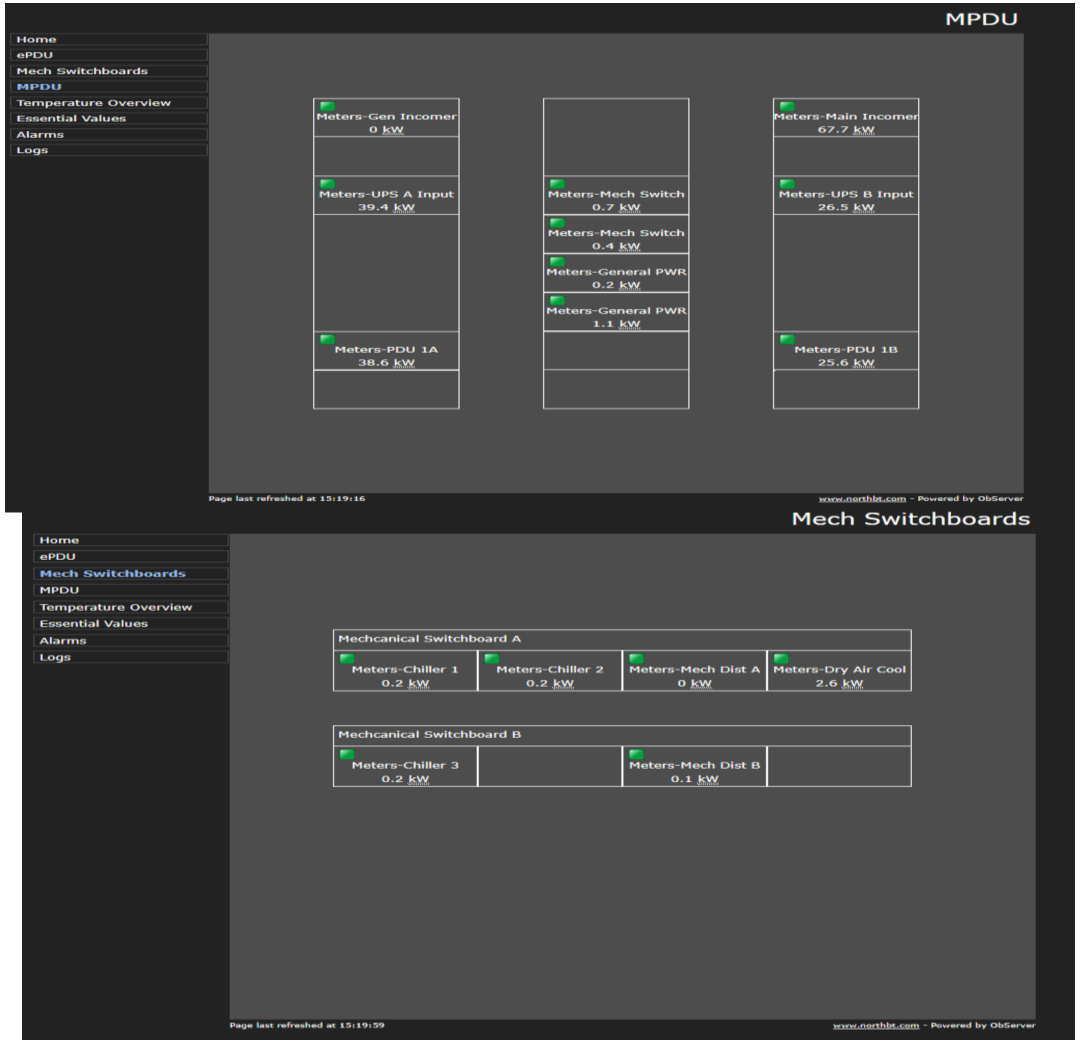
Work area – including flood protection

- PACS,
- CCTV,
- Monitored Intruder Alarm
- Work area and Management console area



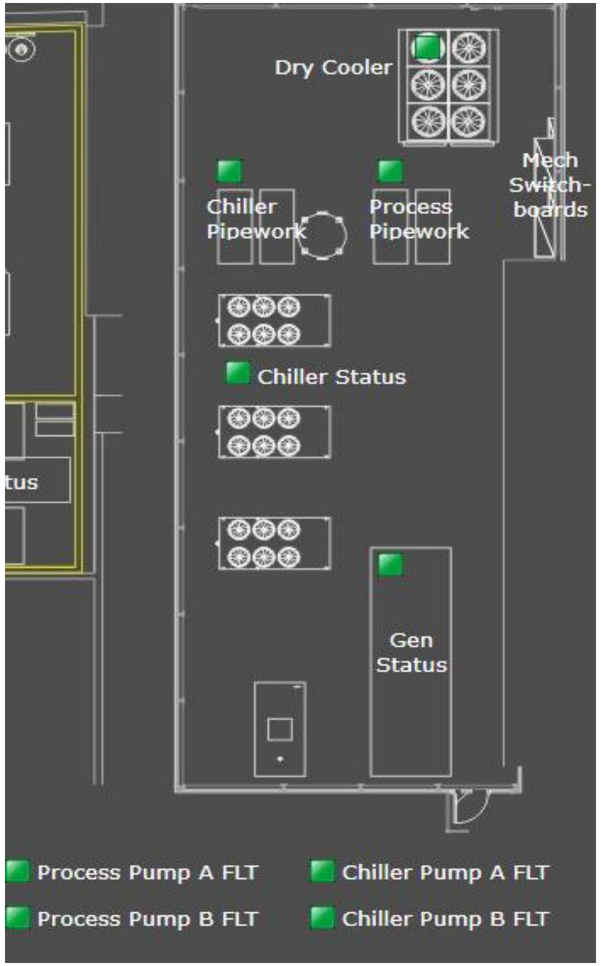
MPDU Switchgear

Physical and 'digital twin'



Rooftop Plant Room

- Process pump pipework
- Chillers
- Generator
- Fuel tank



Rooftop Plant Room

Chillers, process pipework and Free Air / Dry Air Cooling

Roof Top Plant Room

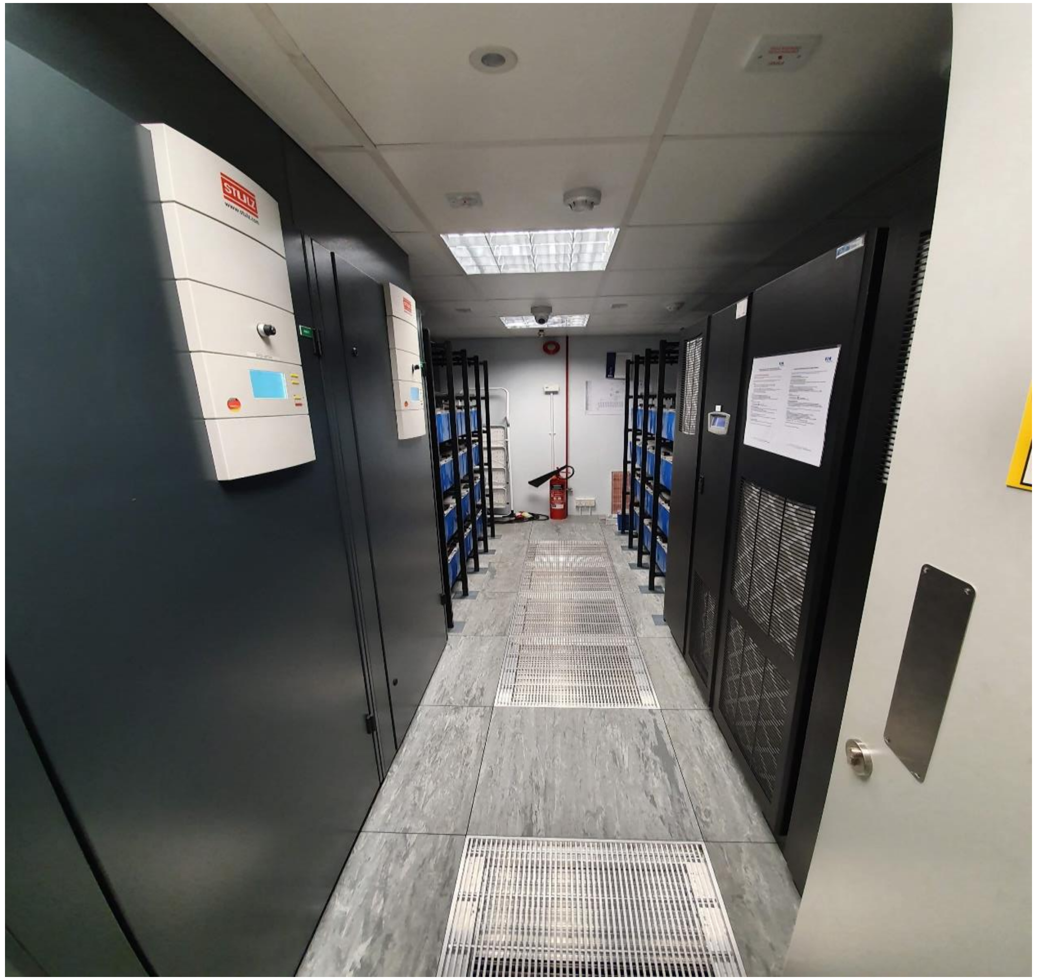
FG Wilson 700kVA Perkins 2806A-E18TAG2

- 700kVA FG Wilson Generator PE700E5
- 800A output @1500rpm
- Located on roof within data centre roof plant area
- Weatherproof and sound attenuated enclosure
- 24 hour fuel 3000L storage tank adjacent
- Emergency 3800L fuel dump tank at ground level
- Automated failover start

UPS Room

AHU & UPS A and UPS B

- Eaton 9395 UPS in 2 modules
- 275kVA / 250kW
- Configured as a single path system
- UPS autonomy @ full load circa 20 minutes per module
- True On Line Operation
- Make before Break Static Bypass
- Power Ramp in Facility for Generator Changeover
- Sophisticated battery monitoring – safe automatic testing



UPS Room

10 year Battery string A & B

- 10 year design life VRLA*
- Note visual inspection highly recommended as actual useful life more like 6-7 years.
- Maintenance phase
- LED lighting
- More energy efficient equipment
- Promoting use of data centre within University

Data Room

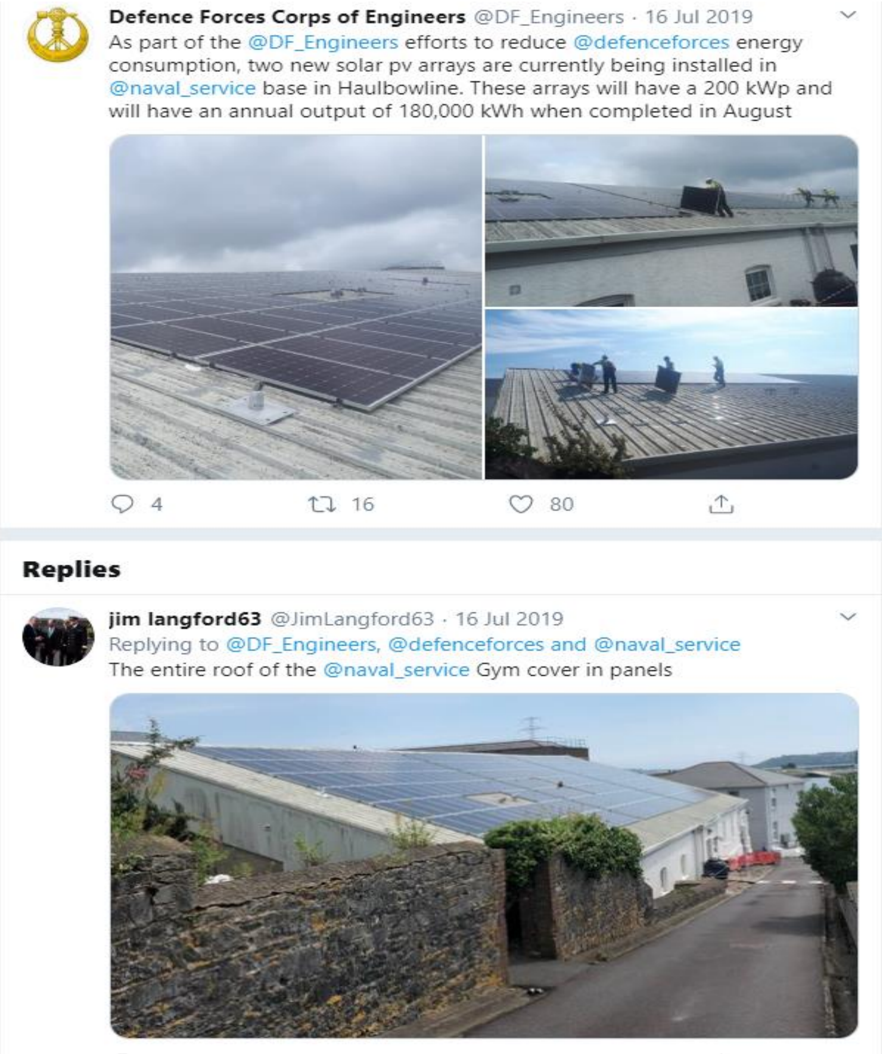
Front Aisle

- 22 x 42U racks with capacity for 2 more
- CAT6A Krone standards
- 120 pair single mode and 120 pair multimode OM3
  20kVA per rack room load not to exceed 150kVA but potential to increase to 250kVA in possible future expansion Phase 2
- BMS – North Extensible Object Model

PV – Irish Defence Forces- Corps of Engineers

Haulbowline Island in Cork

– 200 kWp arrays
– Annual output estimate of 180,000 kWh



Defence Forces Corps of Engineers @DF_Engineers · 16 Jul 2019

As part of the @DF_Engineers efforts to reduce @defenceforces energy consumption, two new solar pv arrays are currently being installed in @naval_service base in Haulbowline. These arrays will have a 200 kWp and will have an annual output of 180,000 kWh when completed in August

4 16 80

Replies

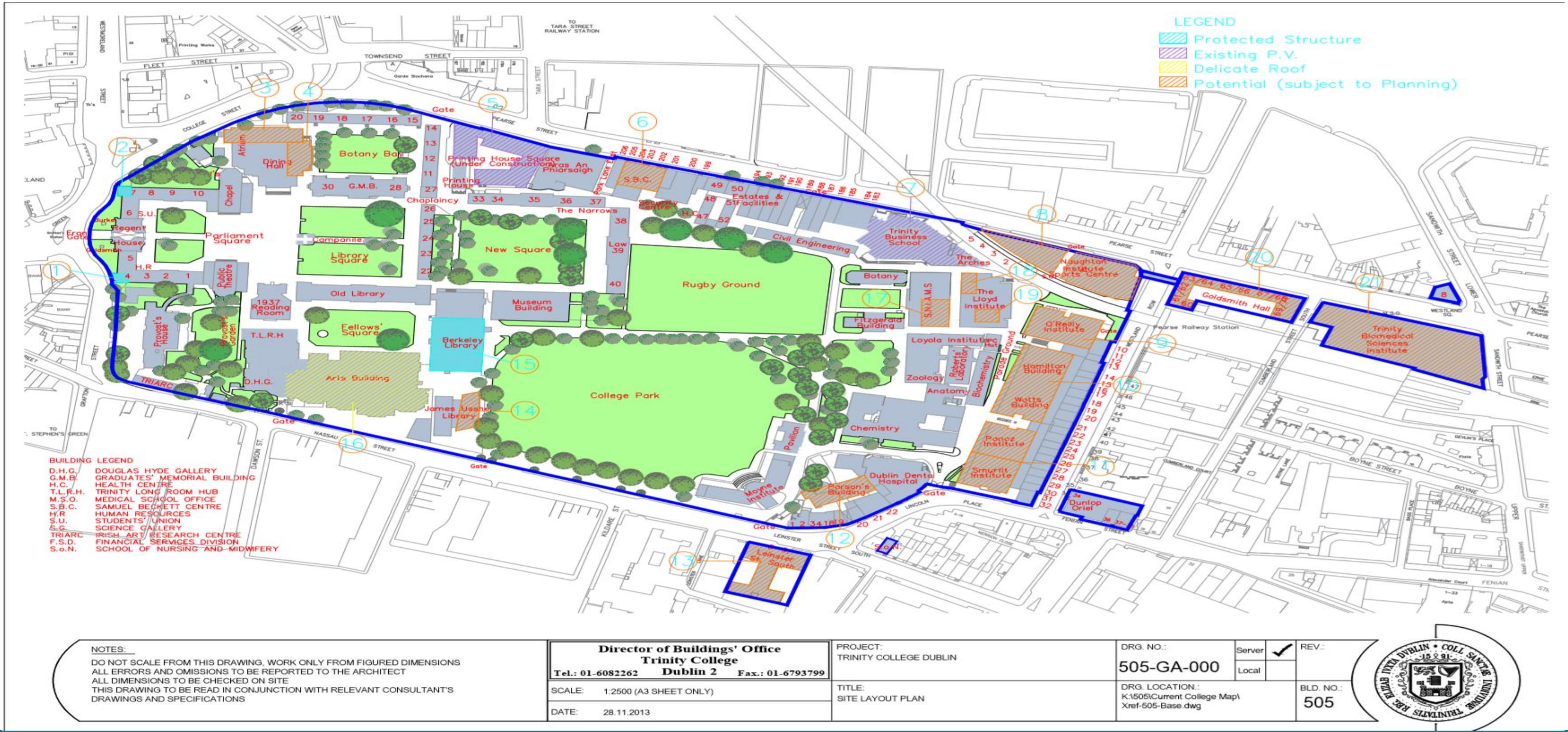
jim langford63 @JimLangford63 · 16 Jul 2019

Replying to @DF_Engineers, @defenceforces and @naval_service

The entire roof of the @naval_service Gym cover in panels

PV Potential in Trinity College Dublin

Main Campus in Dublin City Centre



Calculations of PV around Campus of TCD

Estimation of potential yield of 630,155kWh per annum ~2% overall use

No	Location	Area	Listed Bld	Delicate Roof	Existing PV	Comment	Utilisation Factor	Possible PV area (M2)		kWp/M2	Available kWp	Output PA kWh/kWp	Annual Output (kWh)	Say at 11 cent per kWh	Capital Cost	Payback period
1	House 4	81	Yes			Parapet	40%	33		0.1676647	5	832	4,536	€499	€10,211.09	20.46274038
2	House 7	70	Yes			Parapet	40%	28		0.1676647	5	832	3,884	€427	€8,741.59	20.46274038
3	Catex Kitchen	656				Some plant	30%	197		0.1676647	33	832	27,470	€3,022	€61,831.70	20.46274038
4	East Dining Hall	440					40%	176		0.1676647	30	832	24,551	€2,701	€55,262.95	20.46274038
5	PHS	1,704			Yes		NA			0.1676647	0	832	0	€0	€0.00	#DIV/0!
6	Samuel Beckett Theatre	566				Very clear	40%	226		0.1676647	38	832	31,577	€3,473	€71,075.68	20.46274038
7	TBS	2,081			Yes		NA			0.1676647	0	832	0	€0	€0.00	#DIV/0!
8	Sports & CRANN	2,167				West congested, east saw tooth	20%	433		0.1676647	73	832	60,458	€6,650	€136,085.00	20.46274038
9	ORI	1,170				Roof top plant room and access	20%	234		0.1676647	39	832	32,642	€3,591	€73,474.60	20.46274038
10	Hamilton & Watts Bld	2,108				Very congested	10%	211		0.1676647	35	832	29,406	€3,235	€66,189.94	20.46274038
11	East End 4 & 5	1,892				Very congested	10%	189		0.1676647	32	832	26,393	€2,903	€59,407.67	20.46274038
12	Parsons Building	634				Lot of roof lights	20%	127		0.1676647	21	832	17,688	€1,946	€39,814.44	20.46274038
13	6 - 9 South Leinster Street	1,211				Need edge protection and some plant	20%	242		0.1676647	41	832	33,786	€3,716	€76,049.35	20.46274038
14	Ussher Library East Reader Block	390				Good- possible visible from upper floors	40%	156		0.1676647	26	832	21,762	€2,394	€48,983.07	20.46274038
15	Berkeley Library	1,559				Saw tooth and poor elevation to south	20%	312		0.1676647	52	832	43,495	€4,784	€97,903.33	20.46274038
16	Arts Building L 6	4,091		Yes		Unlikelyto be suitable for PV installation		0		0.1676647	0	832	0	€0	€0.00	#DIV/0!
17	SNIAMS Part	424				Good	40%	170		0.1676647	28	832	23,659	€2,602	€53,253.38	20.46274038
18	Lloyd Part NW	173				Good	40%	69		0.1676647	12	832	9,653	€1,062	€21,728.39	20.46274038
19	Lloyd part south	173				Good	40%	69		0.1676647	12	832	9,653	€1,062	€21,728.39	20.46274038
20	Goldsmith Hall	1,156				Some plant but no parapet	30%	347		0.1676647	58	832	48,378	€5,322	€108,893.12	20.46274038
21	TBSI	4,329				Unusual shape roof laid to falls	30%	1,299		0.1676647	218	832	181,165	€19,928	€407,784.02	20.46274038
22																
23														€69,317	€1,418,417.71	
24																
25																
								4,517	M2		757	kWp	630,155	kWh PA	2.12%	
													29,706,299			
											kWp		€/kWp			
	Approx Cost										50		€2,340		€117,000	
													€1,873			

Conclusions

PV or not PV………..perchance to Dream aye there's the rub

"If all the available and suitable roofs were used on campus it would only provide about 2% of Trinity's annual energy consumption. So likely to be a better outcome if the money was invested in better energy efficiency measures like LED lighting or aged boiler plant replacement.

This said there is a national, strategic and University imperative to use more on-site renewables. There exists a large impetus to completely move away from burning any on site fossil fuels both for new buildings and removal of gas from many of the existing buildings. Simply on basis that the national electricity will become progressively less and less carbon intensive.

Noted that now the cost of PV is now €1.1 per PV watt (Peak) which is much lower that the figure we have used (€1.873 per PV watt peak). "

*Special thanks to Kieron McGovern M&E, Estates and Facilities for use of PV data and assistance with feasibility study and Michele Hallahan LEED, Sustainability Advisor to Trinity College Dublin.

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Thank You