

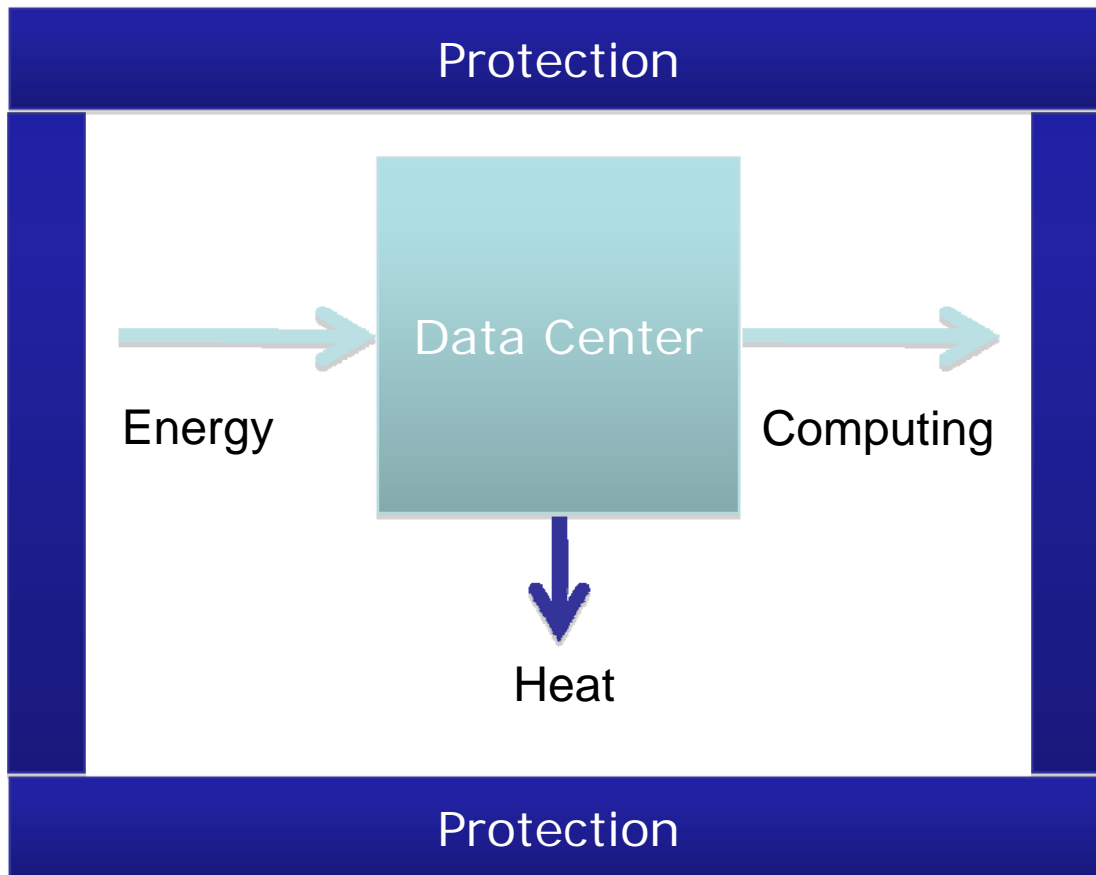


How innovation can make Data Centers green

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What's a Data Center



Energy density 500 times higher than a refinery (at 30MW)

- ❑ DC designed more than 10 years ago: P.U.E. > 3.0
- ❑ DC designed about 5 years ago: P.U.E. $1.8 \div 2.0$
- ❑ Best in class today – Google: P.U.E. $= 1.28$
- ❑ Target for new DC (e.g. Eni): P.U.E. $1.14 \div 1.18$

Energy savings & CO2 reduction

			Annual saving		
	P.U.E	gCO2/KW h	Gw/h	Kton CO2	M€
Conventional	3.3	550			
Green today	1.4	550	500	275	25.0
Target	1.2	180	550	420	27.8

Assumptions

Energy cost

100€MW/h

CO2 conversion

0.550 Kg * kW/h: Italian average

CO2 conversion

0.180 Kg * kW/h: gas power generation



CO2 production by power generation and Green DC contribution

Italian power consumption in 2008	320	TWh
Average CO2 emission	550	g/KWh
CO2 target reduction (20%)	35.200	Kton/CO2
Eni Green DC saving	420	Kton/CO2
Contribution	1,2%	

How?

- Transportation: gas co-generation in site
- Transformation: high efficiency transformers along the complete chain 380kV->132kV->15kV->400V
- Continuity:
 - purposely designed 200kW off-line UPS, >99% efficiency
 - carbon, magnetically suspended, 3^o generation flywheels
 - (Compressed Air Turbines – CAES)
- Distribution: 23kV close to the DC distribution network (saving: tons of copper less)
- Cooling – air movement:
 - Direct free cooling (only computers own vents)
 - Aggressive 27° working temperature
- Cooling – heat removal:
 - Direct free cooling
 - Condensation chillers
 - High efficiency electric chillers
- Energy re-use:
 - Stirling engines (30°, low enthalpy)
 - Ready for next generation liquid cooled computers (60°, higher enthalpy)
 - Experimental solar field, geothermal storage, refinery heat waste



Back up



P.U.E. components

	Google vs Eni
1) Transportation	-5,60%
2) Transformation	0,00%
3) Continuity	-1,50%
4) Distribution	0,00%
5) Cooling	
a. Air movement	-2,00%
b. Heat removal	-6,00%
6) Energy reuse	-1,00%
Total	-16,10%



- CAES
 - 10.000 m³ of compressed air @ 15MPA
- Batteries figures
 - 12.821 batteries
 - 4.436.000 kg
 - 2.208 m³