



# Eni Green Data Center

Eccellere nell'efficienza energetica in campo informatico

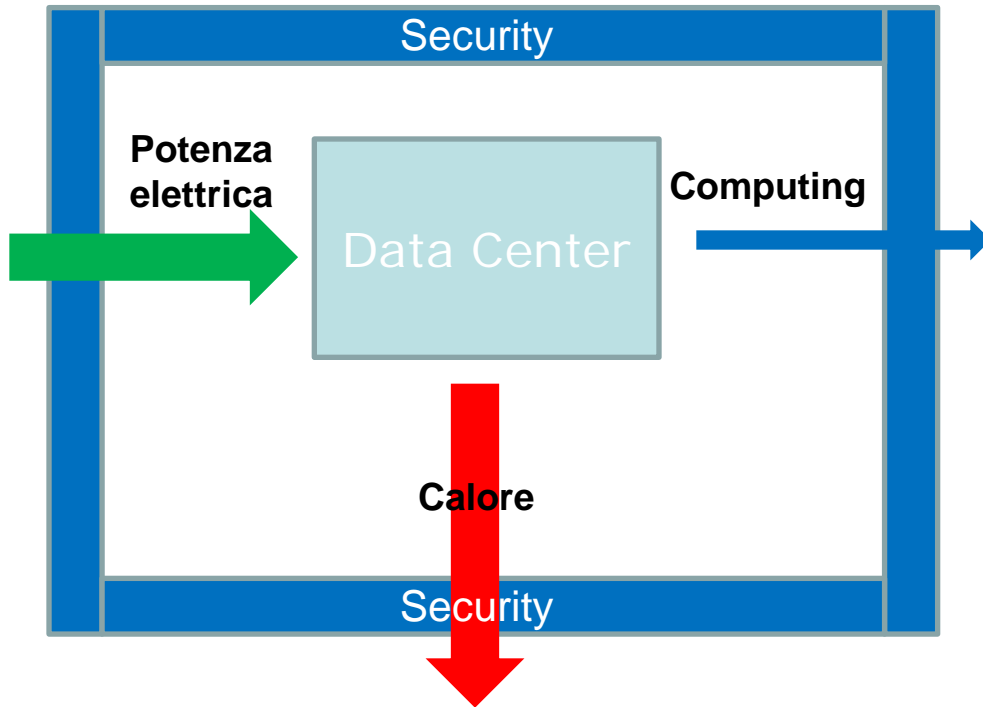
Gianluigi Castelli, Executive VP & CIO

Gionata della Terra

Roma, 27 Novembre 2013

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# Che cos'è un data center?



- È un **impianto industriale specifico...**
- Che trasforma **energia elettrica** in capacità di calcolo e **calore...**
- ...con valori elevati di **densità di energia e di calore da dissipare....**
- I parametri chiave sono **l'energia totale disponibile** e il **calore da dissipare....**
- ... tutto il resto è una conseguenza un limite, un costo...

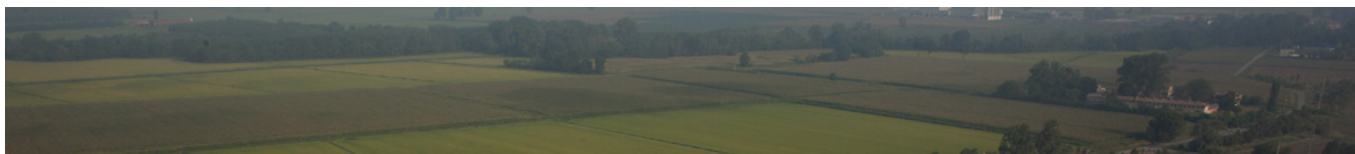


- ✓ **Multipurpose IT DC (conventionale e HPC)**
- ✓ **PUE < 1,2 (media, a ogni carico)**
- ✓ **30MW max IT power**
- ✓ **5.200m<sup>2</sup> in 6 sale macchine**
- ✓ **45.000m<sup>2</sup> di area totale**
- ✓ **Densità elettrica 50 kw/m<sup>2</sup>**
- ✓ **TIER IV**



# Il più grande DC italiano, diversi record....

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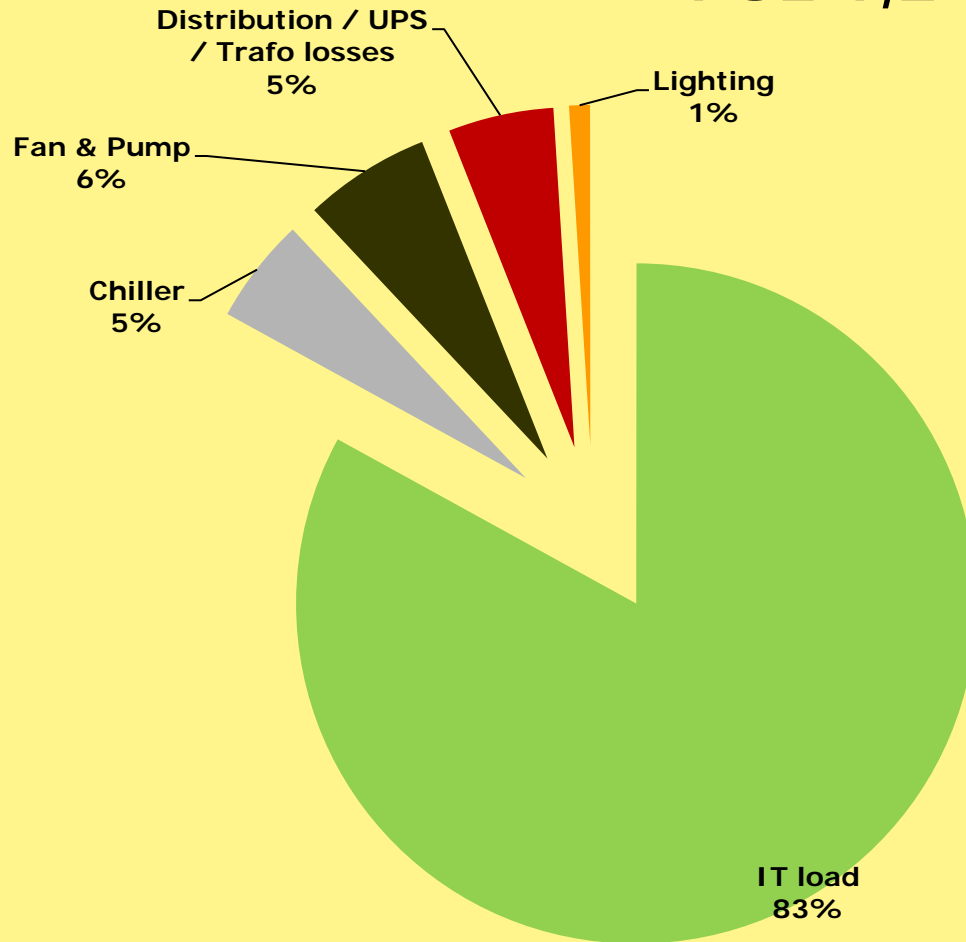


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# Capire per agire: dove si consuma energia in un data center?

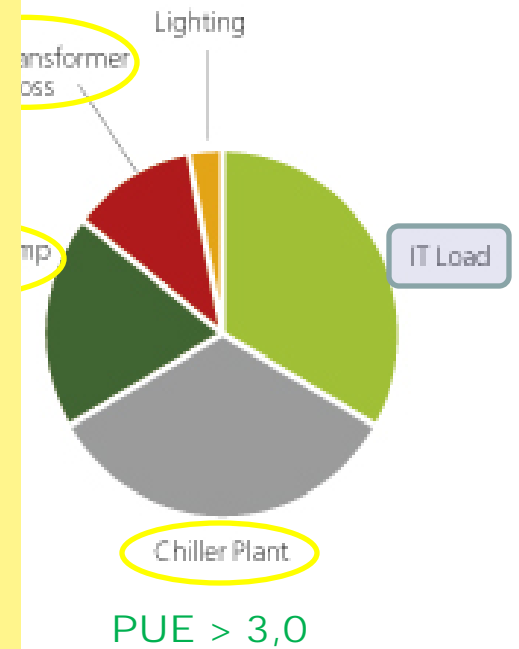
$PUE = \text{Power Usage Effectiveness} = \text{Total Facility Power} / \text{IT Equipment Power}$

## PUE 1,2



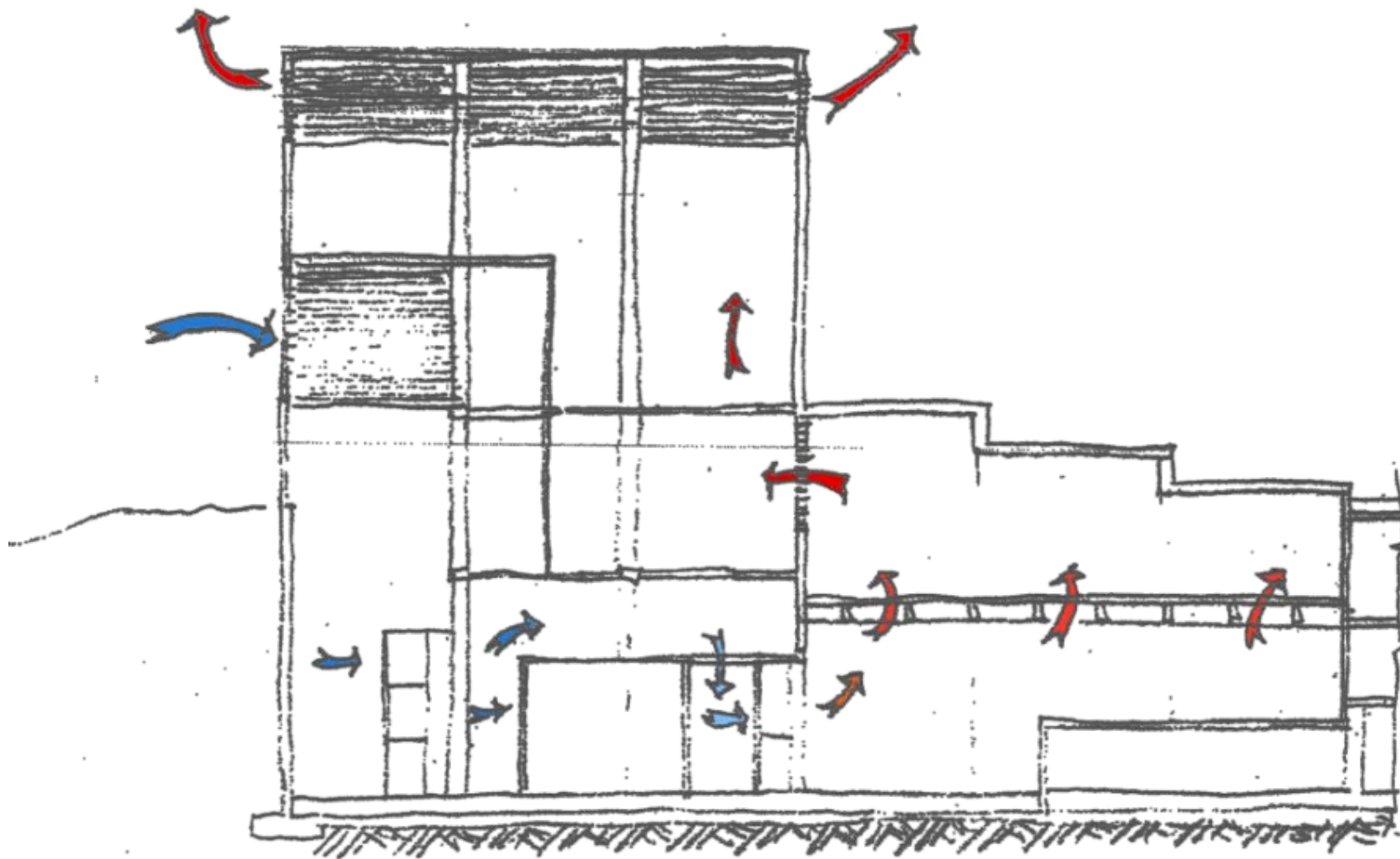
$\text{Total Facility Power} / \text{Total Facility Power}$

## Standard



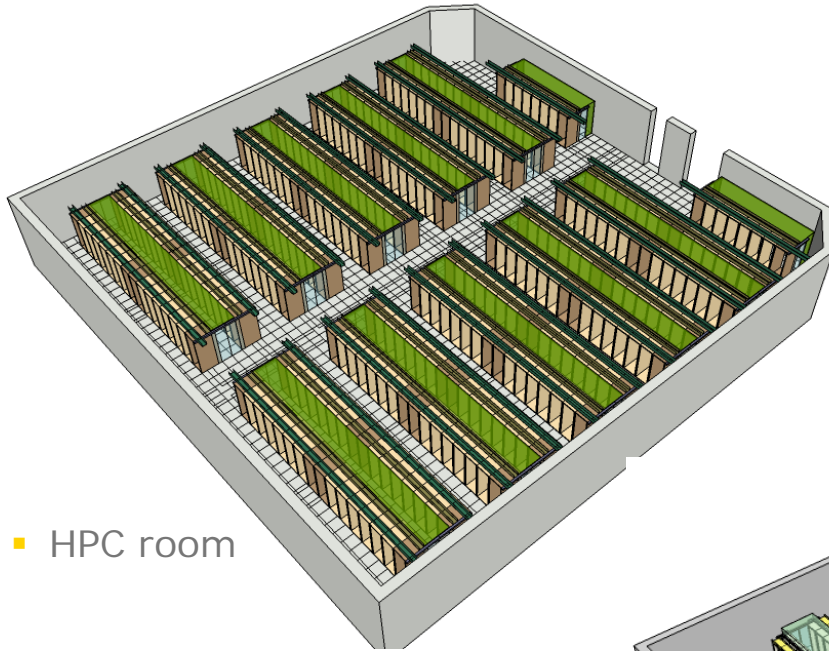
# Free Cooling: non siamo al Polo Nord, ma.....

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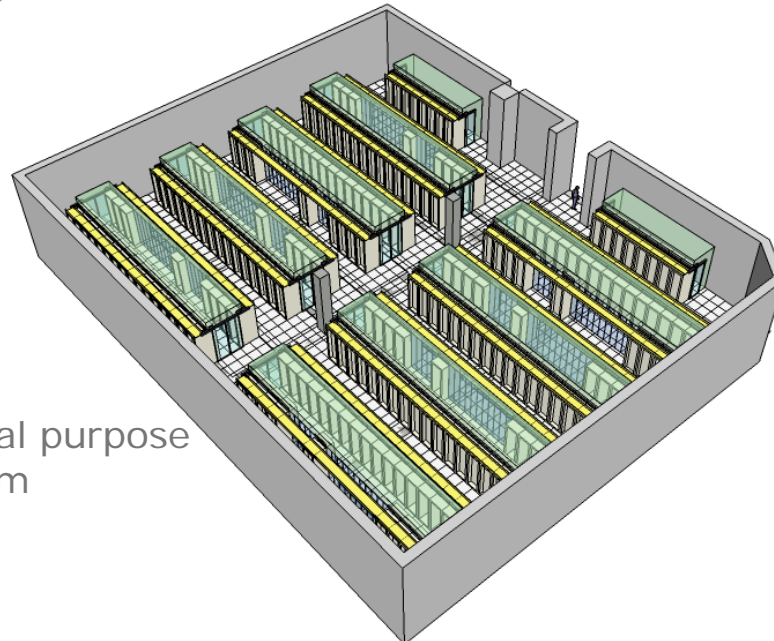


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# Segregazione dell'aria fredda/calda - CAGE



■ HPC room



■ General purpose  
IT room

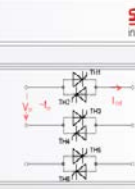


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# Se non esiste, lo inventiamo: UPS off-line, 200 kVA, eff. = 99,40%

**SEMISEL™** **SEMİKRON**  
Innovation + Service

Project:  
Topology: AC/AC  
Circuit: IABC



Circuit:  
 $V_{in}$ : 400 V  
 $I_{rated}$ : 144/330 A  
 $P_{out}$ : 100 kW  
 $f_n$ : 50 Hz  
 Overload factor: 2  
 Overload duration: 1000sec

Overload characteristic graph:  
 X-axis: time/s (0 to 2k)  
 Y-axis: Overload factor (1 to 2)

Device:  
 Product line: Semipack  
 Device: SKET800  
 Recommended voltage: 1400V  
 Max. junction temperature: 130 °C  
 Use maximum values: Yes

$V_{R_{DS(on)}}$ = 0.93V	$V_{R_{CE(sat)}}$ = 0.03V
$r_{DS(on)}$ = 0.20 mOhm	$r_{CE(sat)}$ = 0.25 mOhm
$R_{th(jc)}$ = 0.051 K/W	

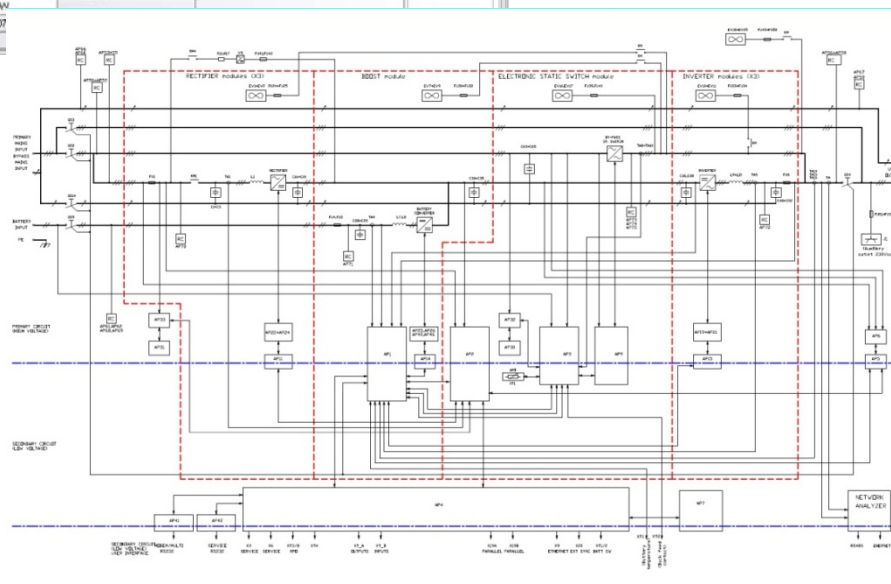
Data set from: 2AF52007

Cooling:  
 Ambient temperature: 40 °C  
 Number of switches per heat sink: 6  
 Number of parallel devices on the same heat sink: 1  
 Additional power source at this heat sink: 0 W  
 Max. heat sink temperature: 60 °C

Losses and temperatures:

	Steady State	Overload
Losses <sub>device</sub>	61 W	126 W
Losses <sub>tot</sub>	<b>366 W</b>	757 W
Heat Sink Temperature	60 °C	60 °C
Junction Temperature	63 °C	66 °C

Temperature characteristic overload current graph:  
 X-axis: time/s (0 to 2k)  
 Y-axis: T<sub>S</sub>/°C (60 to 66)  
 Legend: T<sub>S</sub>/°C (red line), T<sub>J</sub>/°C (black 'x' markers)



Losses estimation at load supplied by reserve and inverter in stand by

	@Tamb = 25 C	@200kW	@100kW
SCR (1)		757W	<b>366W</b>
Power cable (2)		185W	41W
Firing SCR		25W	25W
Fan		45W	45W
Control		80W	80W
Other (3)		10W	10W
Total		1102W	567W
		$\eta_{AC/AC} = 99.45\%$	$\eta_{AC/AC} = 99.44\%$

(1) 6x SKET800, worse case, see annex

(2) Total power cable length = 9m, AWG 3/0, (@200kW, R eq. = 2.18mΩ, @100kW, R eq. = 1.94mΩ)

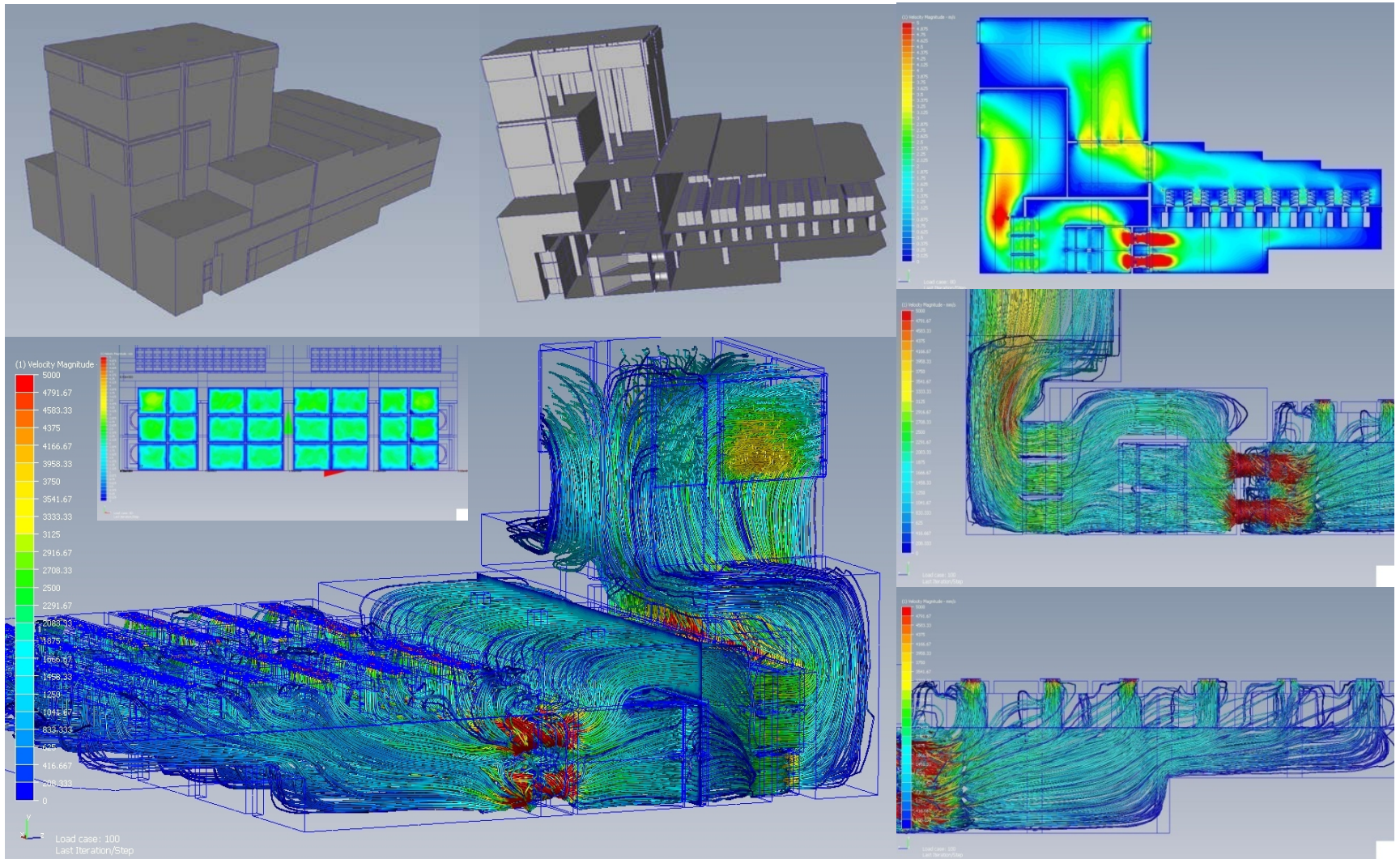
(3) Network analyzer, CT,....



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# Metodi avanzati di progettazione: CFD Analysis



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## La riduzione delle emissioni di CO2

	MW	P.U.E.	gCO2 /KWh	Year Kton CO2 emission	Year Kton CO2 saving
<b>Traditional</b>	30	3,3	550	477	--
<b>Eni Green Data Center</b>	<b>30</b>	<b>1,2</b>	<b>449</b>	<b>141,6</b>	<b>335,4</b>

**1% of Italy target vs Kyoto 20-20-20**

CO2 Conversion factor 0.550 Kg \* kW/h standard power

CO2 Conversion factor 0.449 Kg \* kW/h methane gas power



## Tante soluzioni, una sola visione: l'energia è preziosa

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- ...
- CAGE (segregazione aria fredda/calda),
- Direct FreeCooling, senza ventilatori di aspirazione,
- Anti incendio (sprinkler, no gas),
- chiller (temp. vs dehumidif. systems),
- UPS off-line, standby,
- Condizioni operative (26° , 60%)
- Controllo umidità,
- Soluzioni architettoniche,
- Simulazione SW dell'energia da dissipare,**
- Simulazione SW del filtraggio,**
- Monitoraggio integrato dei parametri ambientali,**



## Condivisione e cultura

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- [www.eni.com](http://www.eni.com)
- Presto disponibile la progettazione esecutiva per Università e enti non-profit
- Progetto didattico in corso di realizzazione con MIT – Harvard - Berkeley

