WP4 – Determination of standard system applications and most promising markets detailed work programme

Task 1 – Standard system configurations

(task coordinator: University of Bergamo)

Solar Combi+ Project meeting

Bergamo, 3rd - 4th March 2009

Giuseppe Franchini, UNIBG

Task 1 – Standard system configurations

→ Objective

Standard system configurations, independent of specific product, to be communicated and promoted towards a **wide audience**

→ Task

Definition of a reduced number of "standard system configurations" which can be promoted and applied **similarly to the standard systems for DHW** with **reasonably good results** in **typical/average cases** (mostly technology independent)

→ Outcome

Standard system configurations (3 to 5), which are independent of specific product and work best under different circumstances

Role & contribution of each partner

	Task 1	Task 2	Task 3	Task 4	Task 5	∑ hours
EURAC	contribution	with CW	X	X	X	860
CRES	contribution			X		110
ISE	contribution	with SorTech		X		220
AEE INTEC	contribution	with SOLution				200
UNIBG	coordination					200
TECSOL	contribution	with EURAC				220
IKERLAN	contribution	with ROTARTICA				150
ROTARTICA		with IKERLAN				160
CW		with EURAC				160
SorTech		with ISE				160
SOLution		with AEE INTEC				50
SK		with TECSOL				50
estimated ∑hrs.	470	1200	320	470	80	2540

Task 1 – Standard system configurations

Twofold Goal

→ **Synthetic** representation (as much as possible)

→ **Complete** information (as much as possible)

Task 1 – Standard system configurations

Targets

→ engineers/HVAC planners/installers looking for an **easy** wayfor sizing SC+ systems

→ engineers/HVAC planners interested in a **deeper** comprehension of SC+ technology (*WP5 Training on package solutions*)

Task 1 – Standard system configurations

Starting Point

The results of simulation runs have to be collected from partners involved in WP3 and organised in a suitable way (MACROS implemented by EURAC).

Some filters are needed (e.g. Stagnation time < upper limit) ?

P3 =('Energetic Results'!P3/('User Parameters'!C

	A	B	C	D	E	F	
1	Code	Code	ΔPE_{fossil}	$\Delta PE_{electricity}$	PE_{save}	PE_{ref}	Relativ
2			[kWh_{PE}]	[kWh_{PE}]	[kWh_{PE}]	[kWh_{PE}]	[%
3	1	C-ROT-TOU-CC-ET-DC-R10	4997.83	186.48	5184.31	19752.72	0.
4	2	C-ROT-TOU-CC-ET-DC-R10	5449.35	178.95	5628.29	19793.86	0.
5	3	C-ROT-TOU-CC-ET-DC-R10	5607.99	179.59	5787.58	19797.60	0.
6	4	C-ROT-TOU-CC-ET-DC-R10	5797.61	213.27	6010.88	19804.27	0.
7	5	C-ROT-TOU-CC-ET-DC-R10	6146.48	200.13	6346.61	19818.94	0.
8	6	C-ROT-TOU-CC-ET-DC-R10	6297.94	197.55	6495.48	19822.00	0.
9	7	C-ROT-TOU-CC-ET-DC-R10	6457.46	225.72	6683.17	19822.36	0.
10	8	C-ROT-TOU-CC-ET-DC-R10	6858.37	222.41	7080.77	19840.19	0.
11	9	C-ROT-TOU-CC-ET-DC-R10	7026.44	238.79	7265.23	19840.25	0.
12	10	C-ROT-TOU-CC-ET-DC-R10	7019.66	247.33	7266.99	19834.32	0.
13	11	C-ROT-TOU-CC-ET-DC-R10	7493.16	256.64	7749.80	19853.93	0.
14	12	C-ROT-TOU-CC-ET-DC-R10	7710.42	242.69	7953.11	19859.88	0.
15	13	C-ROT-TOU-CC-ET-DC-R10	7609.62	257.95	7867.57	19847.12	0.
16	14	C-ROT-TOU-CC-ET-DC-R10	8113.49	276.42	8389.91	19866.59	0.
17	15	C-ROT-TOU-CC-ET-DC-R10	8333.43	266.27	8599.70	19871.58	0.

Task 1 – Standard system configurations

Configurations

Configuration = a combination of different items:

ROT-TOU-CC-ET-DC-R10

- chiller
- location
- application
- distribution system
- solar collectors type
- heat rejection type
- collectors area
- storage volume

Task 1 – Standard system configurations

Configurations

- location
- building/application
- chiller

} ***"fixed"*** parameters

- distribution system
- solar collectors type
- heat rejection type

} ***"semi-fixed"*** parameters

- collectors area
- storage volume

} ***"free"*** parameters

Task 1 – Standard system configurations

Methods

As suggested by WP4 leader (EURAC) at Athens meeting, methods which could be applied are:

→ Graphical representation

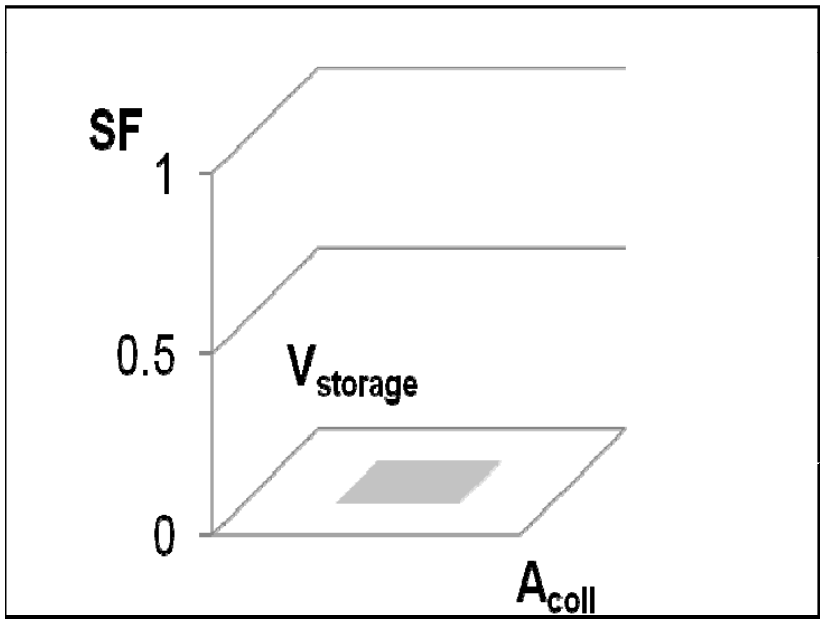
→ Optimisation functions

→ Sensitivity analysis

Task 1 – Standard system configurations

Graphical representation

For every “fixed” configuration (climate, building, chiller) ***performance*** illustration can be given in a 3D graph in dependence on collectors area and storage volume, in order to get an idea on range of obtainable values.



Task 1 – Standard system configurations

Graphical representation

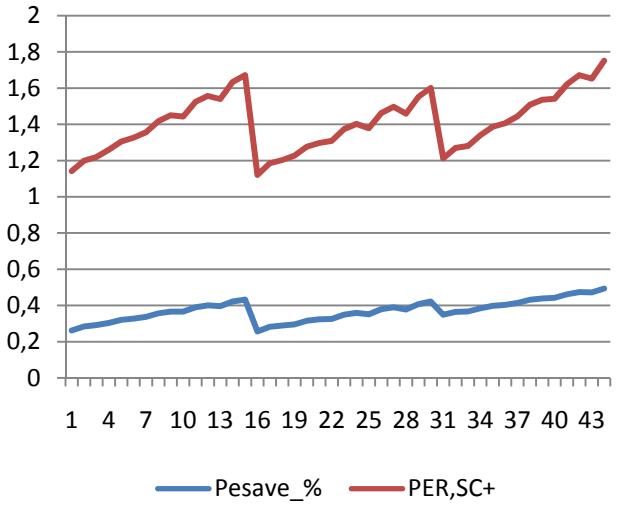
Performance…
in terms of:

→ (Total) Solar Fraction

→ Primary Energy Ratio (or PE_{save}% ?)

→ C_{PE} (Cost per saved PE kWh)

→ others...?



in dependance on:

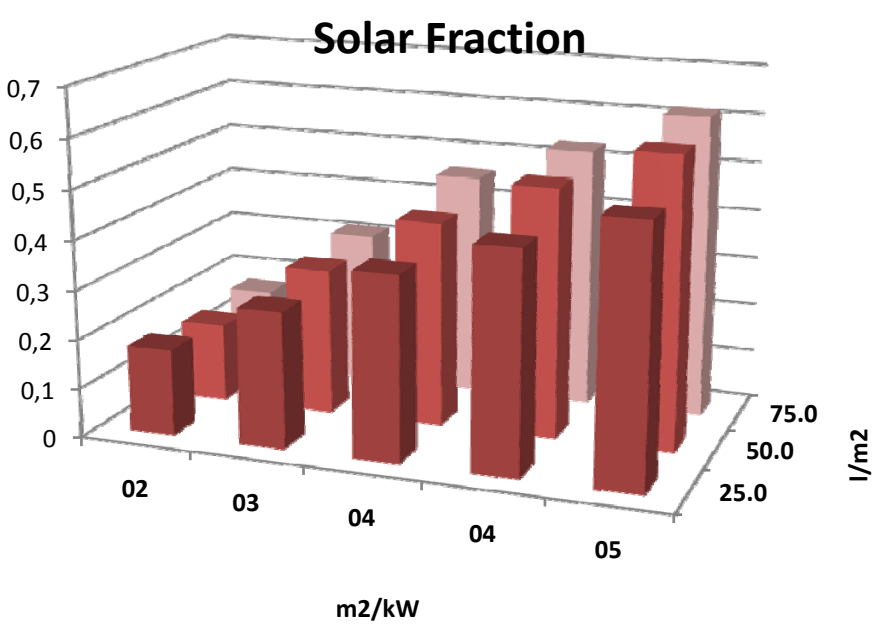
→ A_{coll} rated with $Q_{chiller}$ (const.)(m^2/kW_{cool})

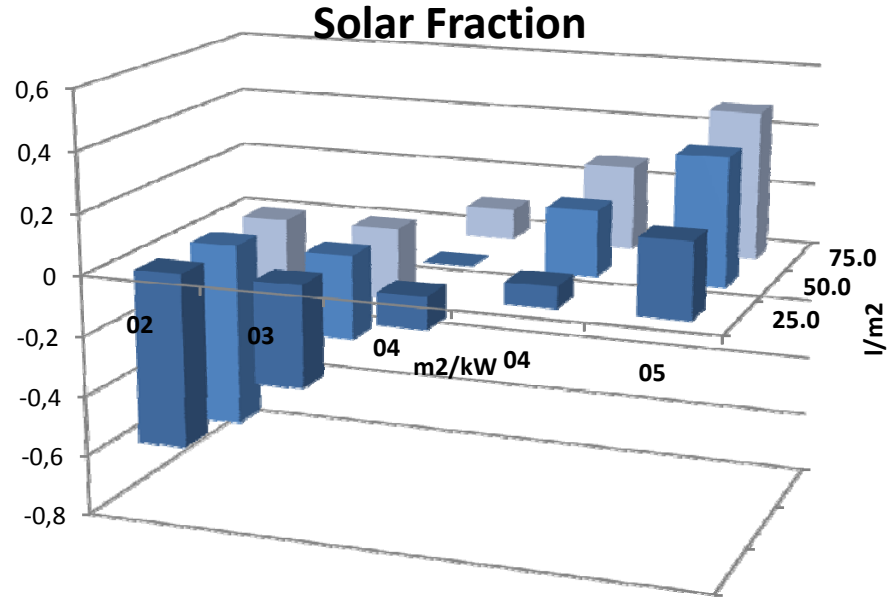
→ $V_{storage}$ rated with A_{coll} (l/m^2)

Task 1 – Standard system configurations

Graphical representation

Absolute or Relative representation?





Task 1 – Standard system configurations

Optimisation functions

Proposed optimisation functions:

→ (Total) Solar Fraction

→ Primary Energy ratio [or PE_{save}%]

→ C_{PE} (Cost per saved PE kWh) [or Cost/Benefit ratio (according Haberl et.al. 2008)]

$$\text{objective} = \min \frac{\text{additional costs}}{\text{primary energy savings}} = \min \frac{a * I_0 + B_{MaxLean} - B_{ref}}{E_{prim,sav}}$$

a	annuity factor
I_0	total investment costs of the solar thermal system
$B_{MaxLean}$	annual operation costs of the MaxLean system concept (including the heating circuit)
B_{ref}	annual operation costs of the conventional reference system
$E_{prim,sav}$	primary energy savings

Task 1 – Standard system configurations

Optimisation functions

For every "fixed" configuration (climate, building, chiller) ***3 best configurations*** will be identified.

→ The highest Solar Fraction
→ The highest Primary Energy Ratio [PE_{save}%]
→ The lowest Cost/Benefit Ratio

Task 1 – Standard system configurations

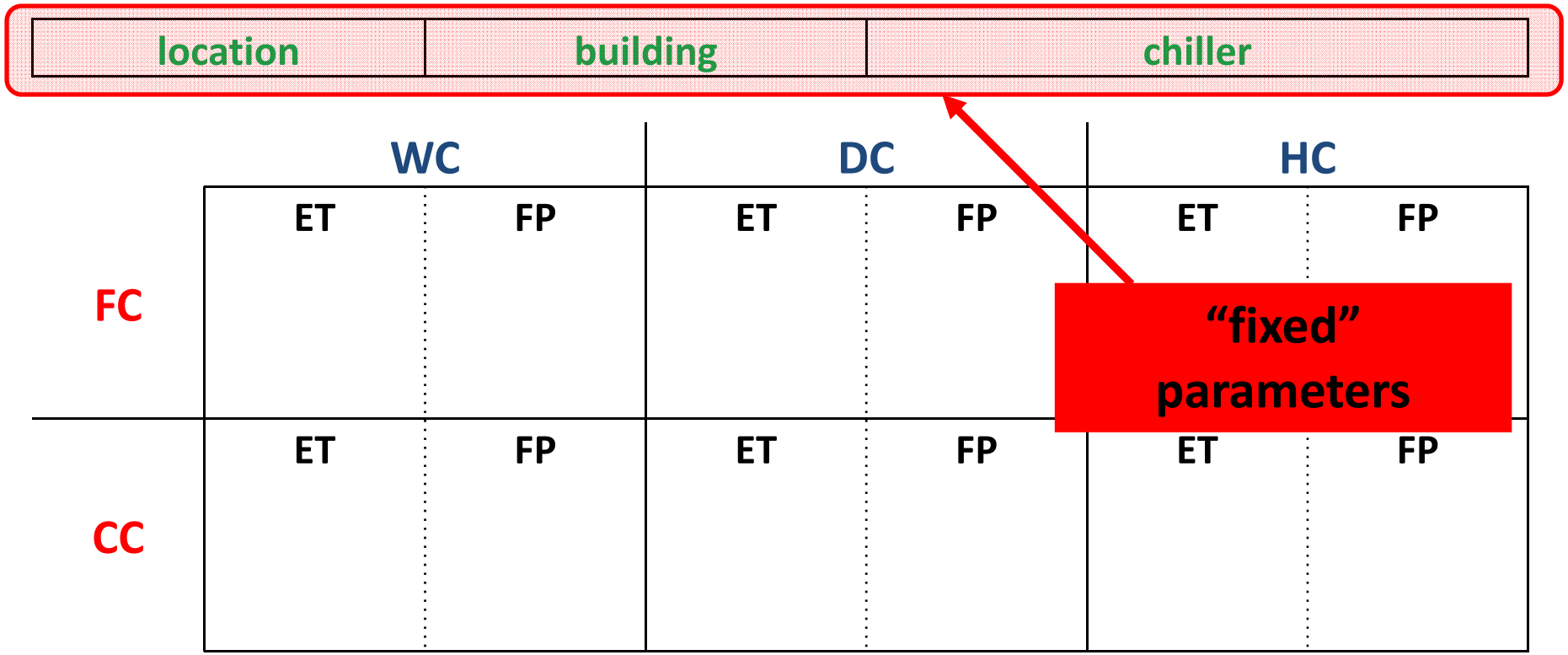
Synthesis

location	building	chiller

	WC		DC		HC	
	ET	FP	ET	FP	ET	FP
FC						
	ET	FP	ET	FP	ET	FP
CC						

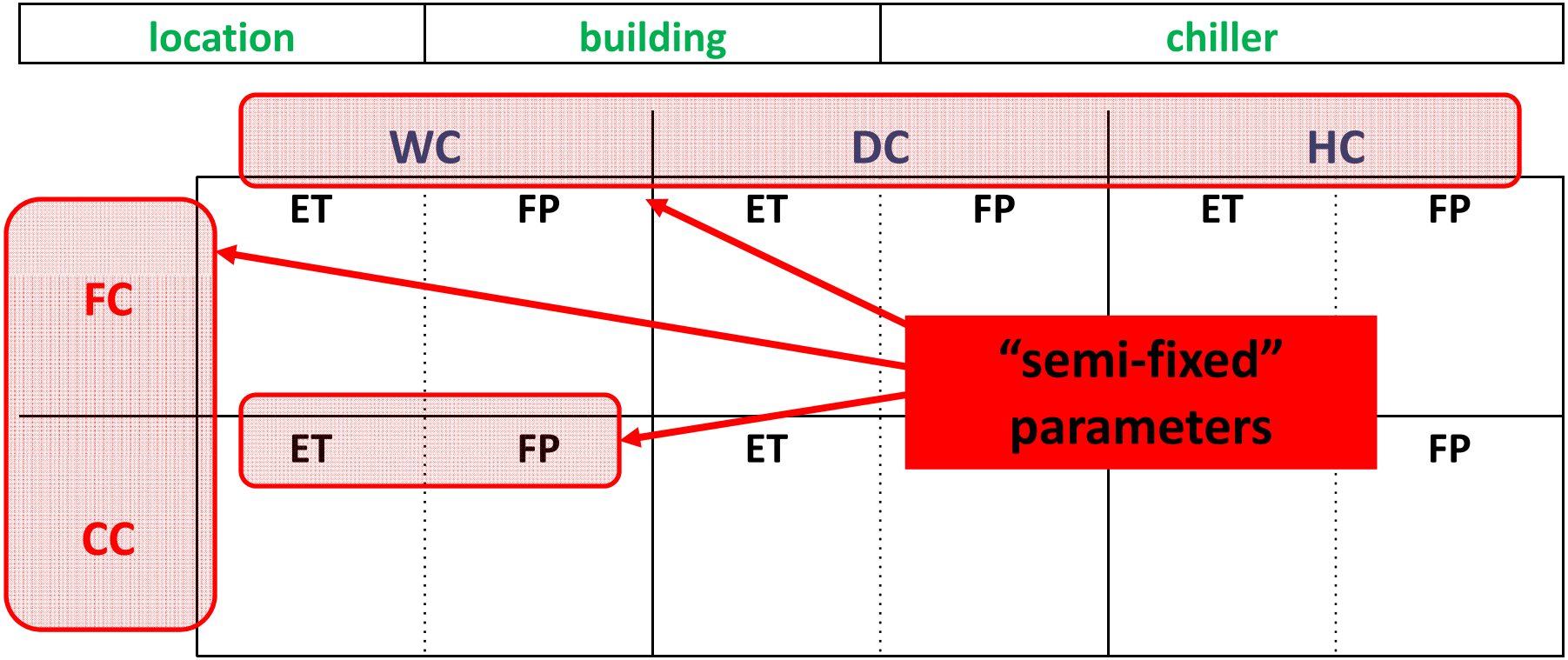
Task 1 – Standard system configurations

Synthesis



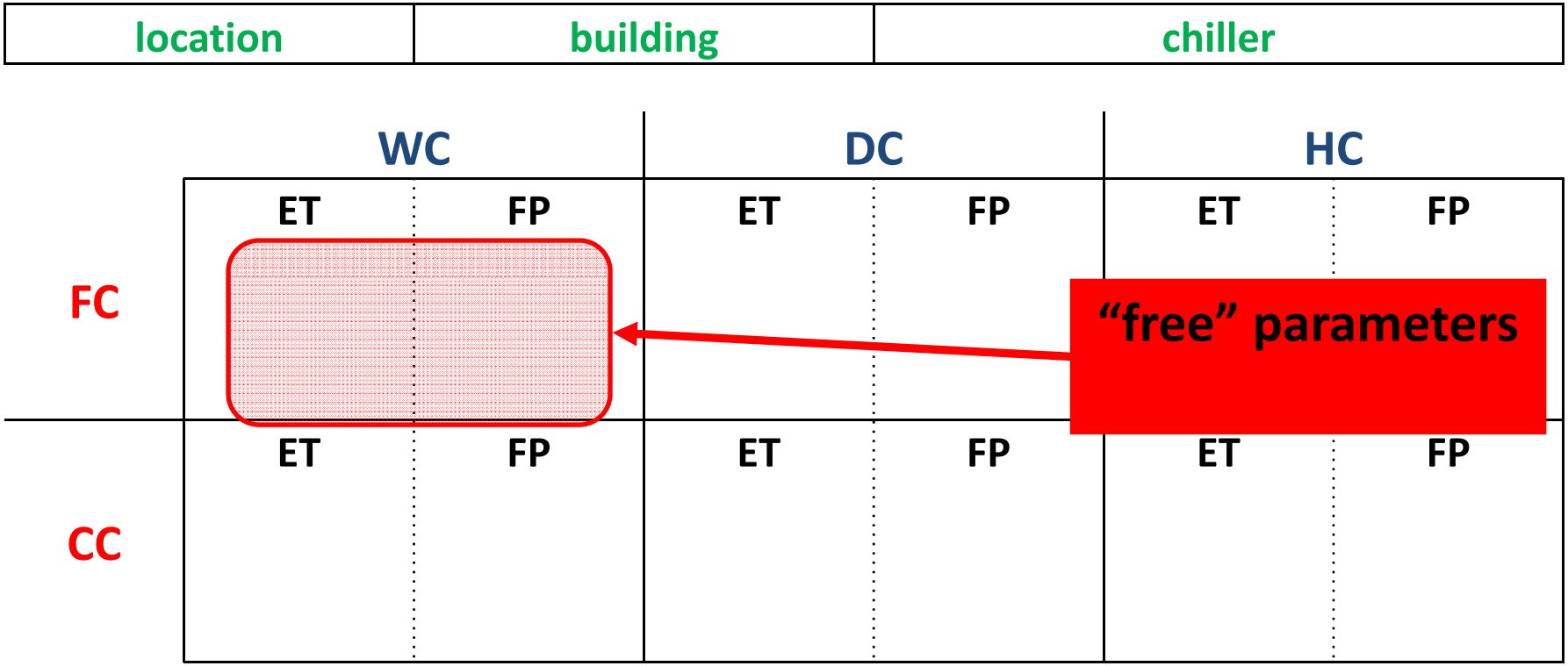
Task 1 – Standard system configurations

Synthesis



Task 1 – Standard system configurations

Synthesis



Task 1 – Standard system configurations

Synthesis

NAPLES	OFFICE	ROTARTICA

	WC		DC		HC	
	ET	FP	ET	FP	ET	FP
FC	_ m^2/kW _ l/m^2					
CC						

Task 1 – Standard system configurations

Synthesis

NAPLES	OFFICE	ROTARTICA

	WC		DC		HC	
	ET	FP	ET	FP	ET	FP
FC	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2
	ET	FP	ET	FP	ET	FP
CC	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2	_ m^2/kW _ l/m^2

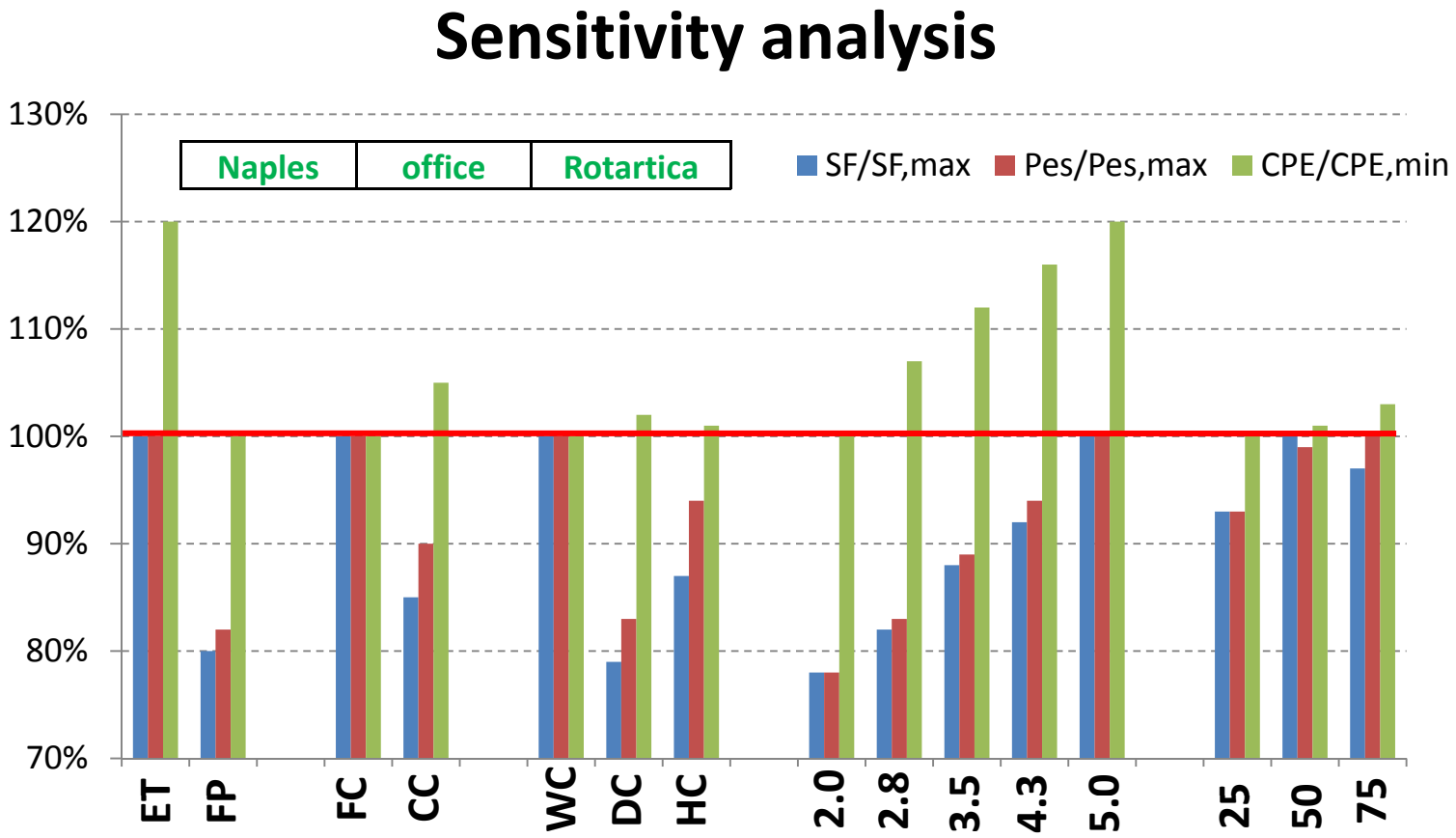
Task 1 – Standard system configurations

Sensitivity analysis

For each best configuration (max SF, max PE_{save}, min C_{PE}) a parametric analysis can be carried out, varying – *ceteris paribus* – the following parameters (one at a time):

1) A_{coll} (from MIN to MAX)
2) $V_{storage}$ (from MIN to MAX)
3) ET <-> FP collectors
4) FC <-> CC
5) WC <-> DC (<-> HC)

Task 1 – Standard system configurations

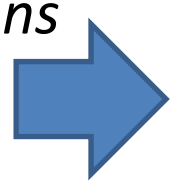


Task 1 – Standard system configurations

Technology independent Results

Definition of a reduced number of "standard system configurations" which can be promoted with **reasonably good results** in **typical/average cases** (mostly technology independent).

*From the **BEST** configurations (chiller by chiller)*



*To **GOOD** configurations (chiller independent)*

Task 1 – Standard system configurations

Technology independent Results

Lucky case: all simulated SC+ systems (based on different chillers) give the same best configurations

→ Standard system configurations are immediately determined

Unlucky (real!) case: simulated SC+ systems (based on different chillers) give different best configurations

→ How determine Standard system configurations?

Task 1 – Standard system configurations

Technology independent Results

Unlucky (real!) case: How determine Standard system configurations?

→ If differences are in optimal area collectors or optimal storage volume: *take AVERAGE values?*

→ If differences are in "semi-fixed" parameters: *take the most common configurations?*

Comments on the general approach?

Questions?

Answers?