Minimising AHU energy- and water-related costs through controls

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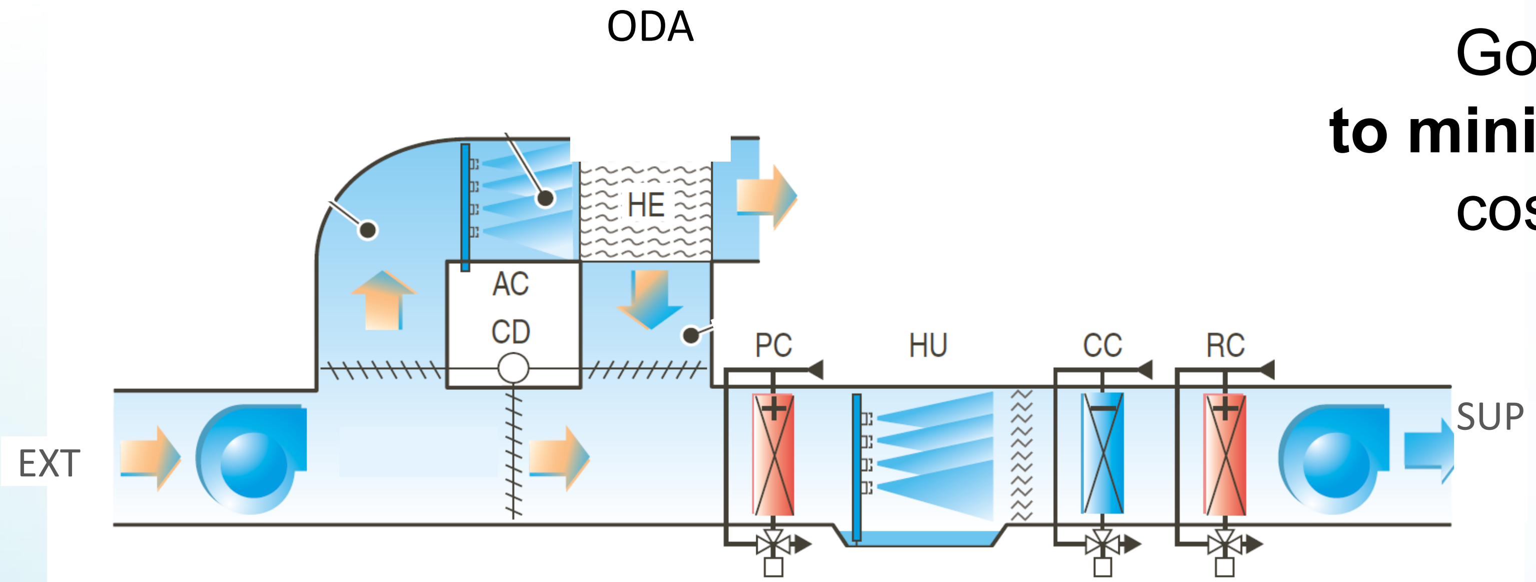
Reference AHU & Goal of the simulation



Goal of the simulation:
to minimise the AHU's running costs (energy + water)

CD	Combined dampers
PC	Preheating coil
HU	Humidifier (steam/adiabatic)
CC	Cooling coil
RC	Post-heating coil
IEC	Indirect evaporative cooler

HE	Heat exchanger
OD	Outdoor air
SUP	Supply air
EXT	Extraction air

Simulation input data

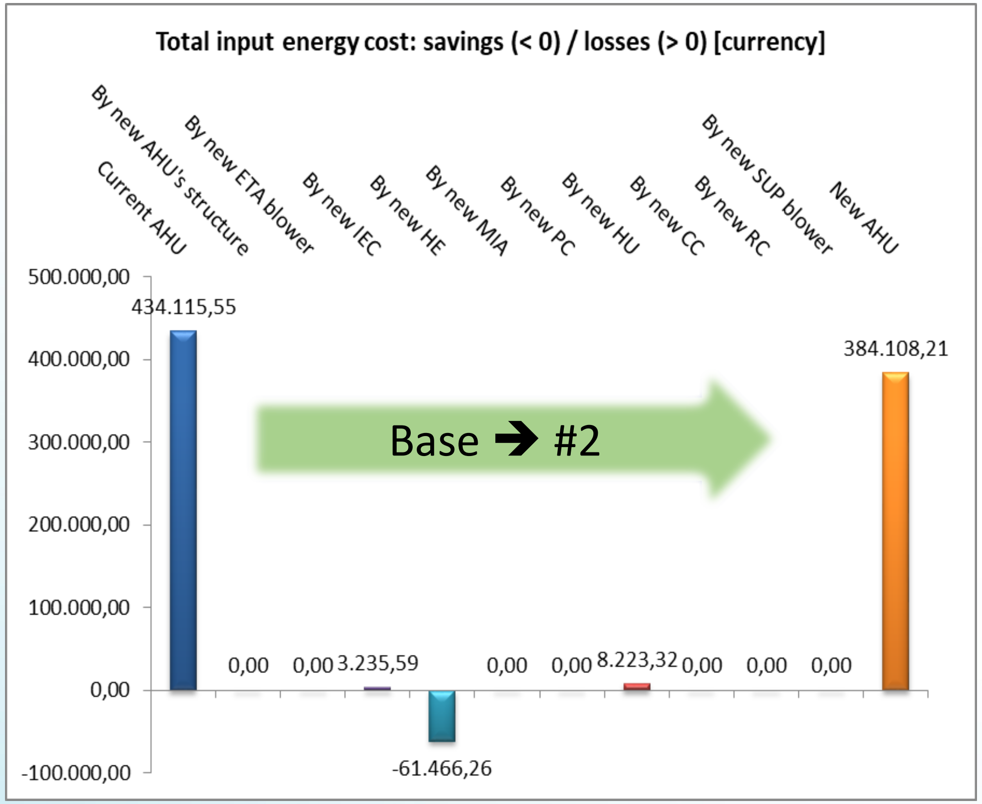
- Localities: Atlanta (GA), Chicago (IL), Denver (CO)
- Climatic conditions: ASHRAE’s TRY
- Space set point: 23.5 °C / 74 °F; 50 %rh
- Supply/extraction flows: 120,000 m^3/h – 70,629 cfm
- Persons: 1,000, duty: 24/7/365
- Costs (see slide «Bibliography»):
  - Electricity: US Energy Information Administration
  - Gas: US Energy Information Administration
  - Water: Utilities’ data
- Coils sizes: automatically calculated based on set points and internal loads
- Humidifier sizes: idem
- Pressure drops considered for: humidifiers, heat exchanger

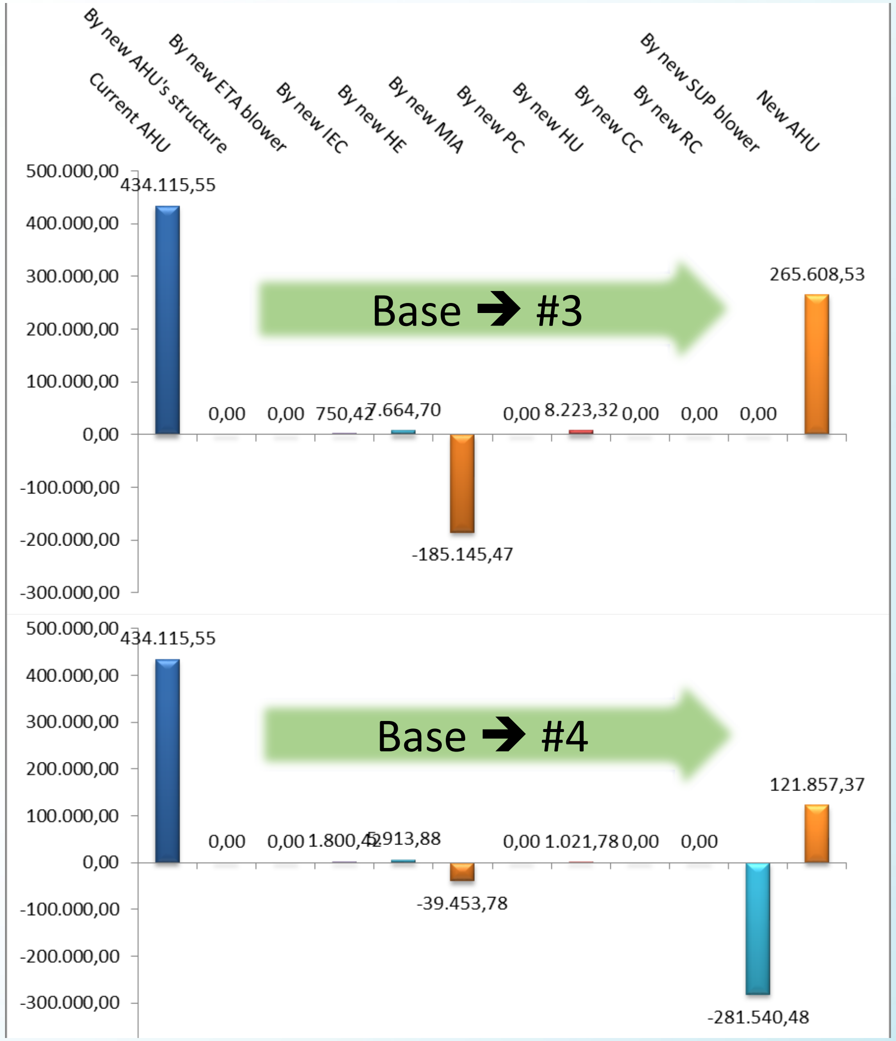
Cases

#	ODA	HU	HE	IEC	BLOWERS
1 (BASE)	100% fixed	Gas-driven	NONE	NONE	FIXED SPEED (CAV)
2	100% fixed	High-pressure water, modul. step 10 L/h – 2.64 gal/h	73%/0% sens./lat. eff., 0%-100% bypass (step 33%)	High-pressure water, modul. step 10 L/h – 2.64 gal/h	FIXED SPEED (CAV)
3	20%-100%, step 33%	High-pressure water, modul. step 10 L/h – 2.64 gal/h	73%/0% sens./lat. eff., 0%-100% bypass (step 33%)	High-pressure water, modul. step 10 L/h – 2.64 gal/h	FIXED SPEED (CAV)
4	20%-100%, step 33%	High-pressure water, modul. step 10 L/h – 2.64 gal/h	73%/0% sens./lat. eff., 0%-100% bypass (step 33%)	High-pressure water, modul. step 10 L/h – 2.64 gal/h	0%-100%, step 33% (VAV)

Yellow: changes vs. previous case

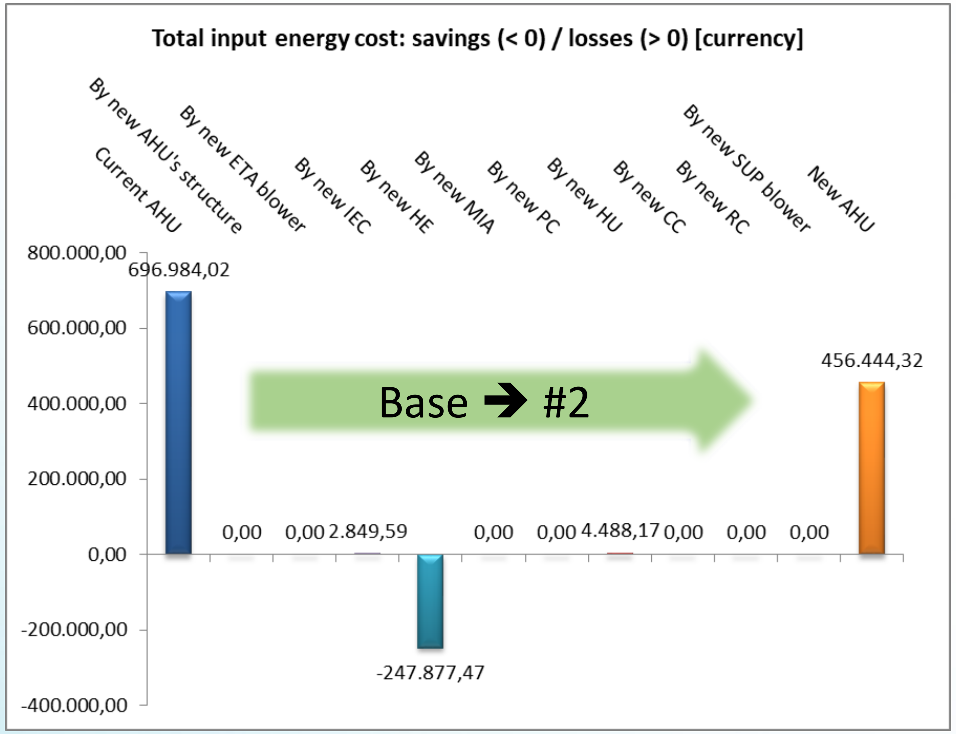
Atlanta, GA





HE's savings @ 100% ODA & CAV (#2) is replaced by bigger savings when modulating ODA @ CAV (#3), both being surpassed by VAV's savings @ modul. ODA (#4): **modulation of both SUP and ODA % gives the best result because it adapts the AHU to the need**.

Chicago, IL



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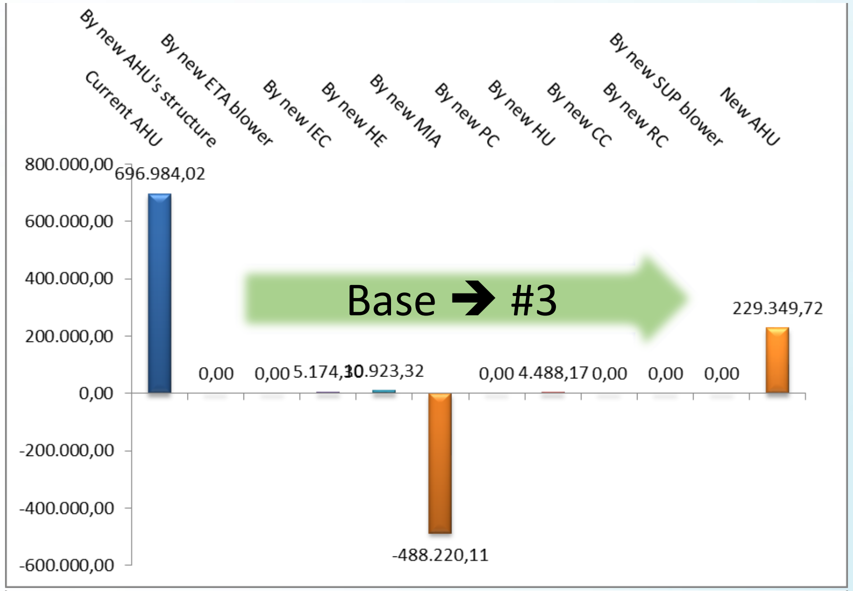
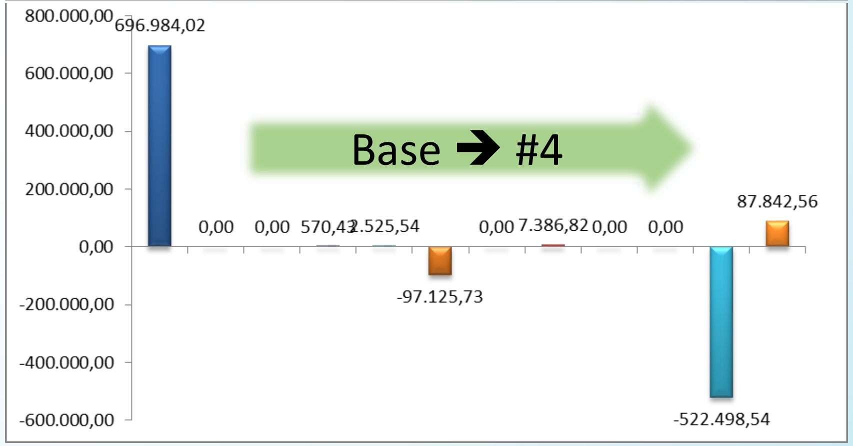
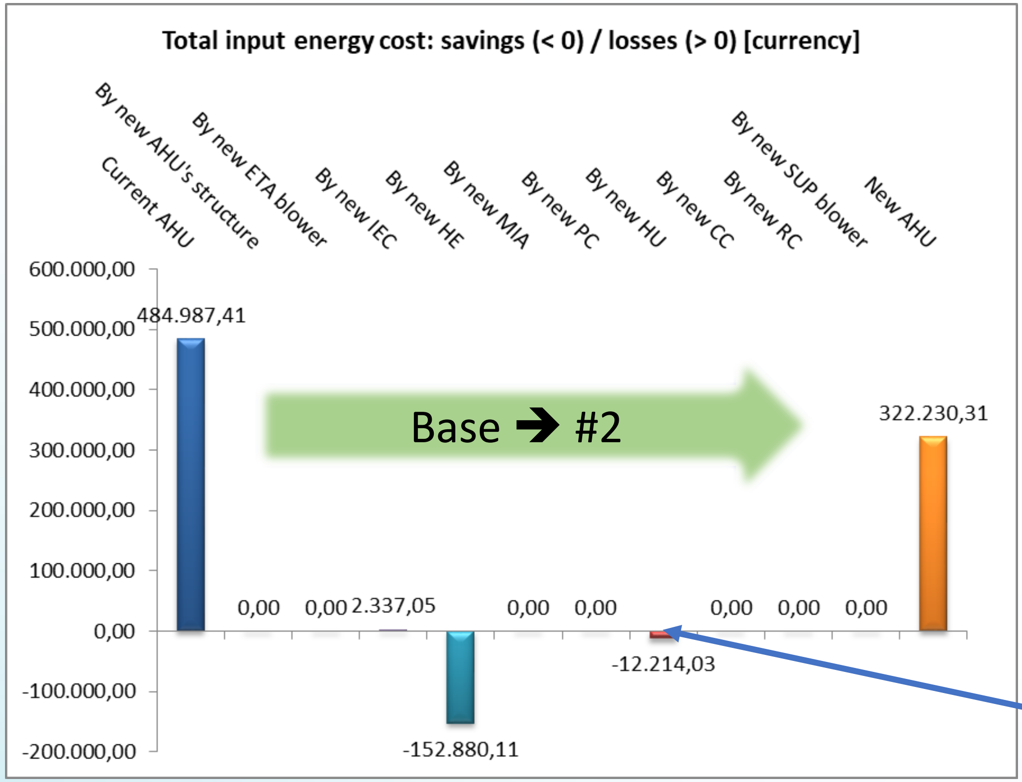
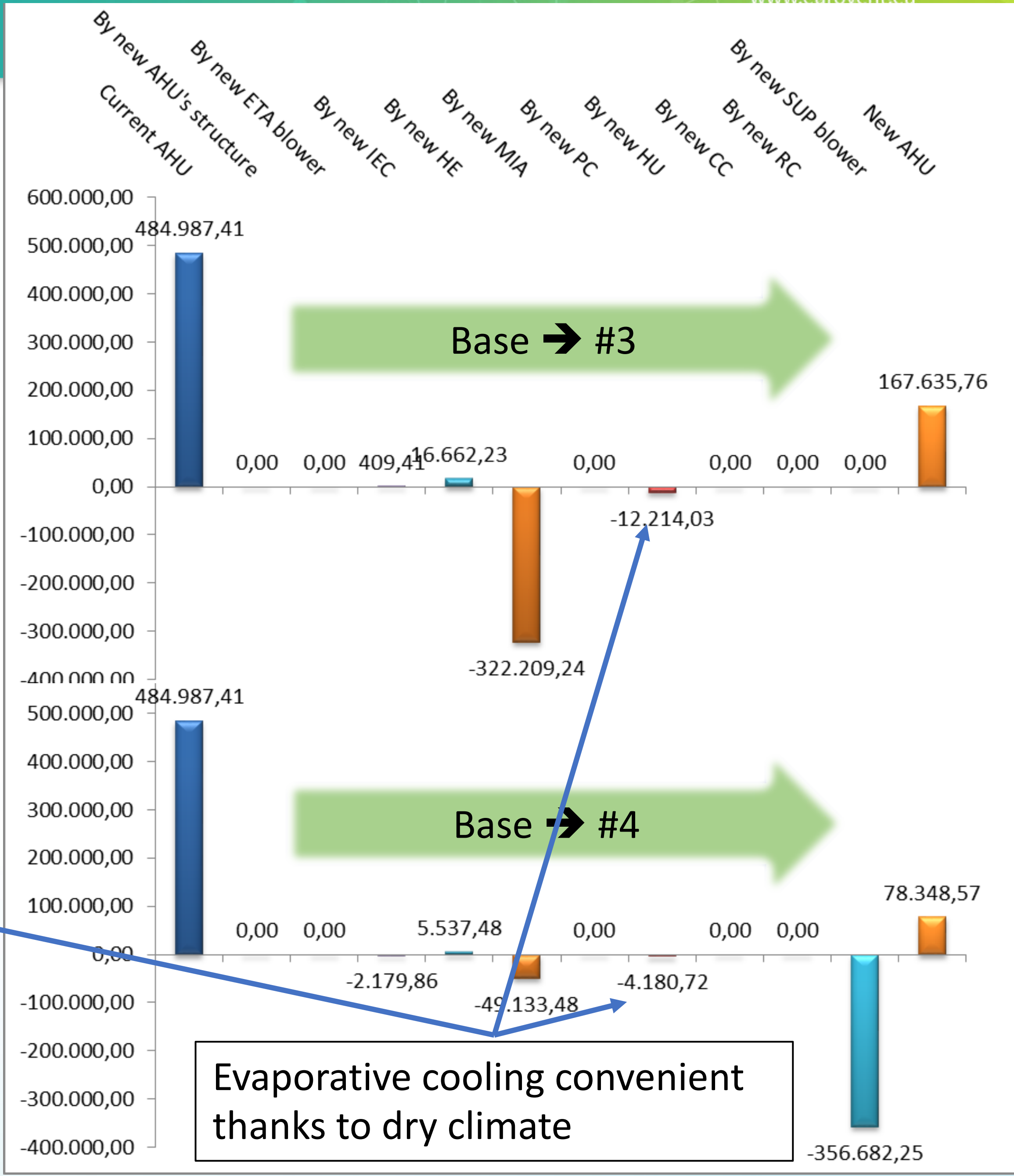




Denver, CO





HE's savings @ 100% ODA & CAV (#2) is replaced by bigger savings when modulating ODA @ CAV (#3), both being surpassed by VAV's savings @ modul. ODA (#4): **modulation of both SUP and ODA % gives the best result because it adapts the AHU to the need.**

Conclusion

- VAV systems save the most because they adapt the supply air flow to the needs, which implies additional savings across the AHU because the output of AHU’s devices (coils, humidifiers, etc.) is proportional to the supply air flow.
- Use control systems (controllers + sensors + actuators) that can modulate at best all devices inside the AHU.
- Use evaporative cooling systems whenever convenient (simulations) and allowed, always considering any associated water stress.

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