An interview with
Prof. Livio Mazzarella

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Q.1) It is well known that worldwide there is an increasing need for an energy transition. Let us focus on the HVAC and building sector. Since nowadays it consumes more than 40% of final energy consumption and causes 36% of the total energy-related CO_2 emissions, it will play a crucial role in the realization of such transition. In your opinion, which could be the solutions or actions that could help the achievement of a low-carbon built environment?

Prof. Livio Mazzarella: There are several actions that can be pursued to achieve a low carbon built environment. Before to focus on HVAC systems, the first step is to reduce as much as possible the buildings energy requirements lowering the loads and growing up the users' consciousness on the environmental impact of their actions. Nowadays, for instance, the plug-load energy use is often greater than the energy needs for heating and cooling. A second step is continuing improving the building envelope performance, but, personally, I believe that in new buildings, they are already close to cost effective solutions and further improvements would have very high marginal costs. Thus, coming to the HVAC, the main point is how to foster renewable energy source exploitation while increasing the overall system efficiency. The use of RES alone is not a solution, because we do not have to confuse energy availability with its potential: the second for RES is finite and then using RES with low efficiency systems is a wrong solution. Thus, the first action is to push for high efficiency emission, distribution and air treatment systems (for instance, low and very low temperature systems, possible only if coupled with high performance envelope). This can be achieved through setting up legal requirements on both components and system efficiencies. A second action is to facilitate a transition to RES exploitation without imposing too ambitious levels of coverage: a not economic or technical feasible requirement (i.e. RES share) could result in a very low real exploitation. There are two levels of intervention: on-site use of RES and a full electric scenario where RES are used to feed the grid. At the first level, the building heat and cold generators technology is involved plus on-site PV systems, while at the second level the use of power station feed with RES or anyhow no carbon combustion based. These two actions have very different time scale and thus have to be pursued in parallel.

Q.2) The European building stock is characterized by high percentages of buildings built before 1980, when energy efficiency requirements were not in place. In your opinion, which could be the opportunities for improving the energy behaviour of these buildings? Which will be their role in the transition of the building sector and more specifically of HVAC technologies?

Prof. Livio Mazzarella: This is the main problem. The yearly renewal ratio of the existing building stock

is very low (few percent); thus, any action on that is not giving any important result in the short time. For instance, the Italian plan to NZEB transition in ten years of existing building estimates a fuel saving (natural gas) that corresponds to switching off for two days a gas power station of 1 TW. Then, in Italy, we have another problem: the culture of conservation. We are used to rehabilitate building more than rebuilt them from the scratch. That means that the economically achievable energy saving, and the CO_2 saving, is lower, and some time, much lower, than what is possible with a complete replacement, and it is very difficult to push for complete replacement. When an important envelope rehabilitation in not possible or feasible (historic buildings or just landscape fashion conservation), the only way is again to improve as much as possible systems efficiencies and to use RES. The problem is that in such cases low temperature emission systems are probably not able to guaranty the required comfort temperatures and landscape reasons may limit the installation of PV system on the buildings themselves. Thus, the most feasible way, which can be applied on large scale, is a transition to a full electricity scenario or RES driven scenario, where several not mutually exclusive options are possible: direct electric heating or electric heat pump heating and cooling with RES produced electricity, low district heating and cooling system feed by RES driven generators (solar, biomass, etc.) with water-to-water heat pumps to rise up the temperature level when needed. The first step in such direction is very easy to be implemented in Mediterranean countries, where the need of cooling is fast growing. It would be enough to oblige to install reversible heat pump systems, when a cooling system is going to be installed, replacing in such way also the convention gas boiler for heating, if any exists.

Q.3) To meet the climate change ambitions, there is the need for a stronger effort from policy makers and stakeholders. In your opinion, which are the barriers, economic and social, that they should overcome in order to accelerate a transition toward "high energy performing and environmental friendly" buildings? And, thus, which are the investment needs, strategies and policies that could stimulate a cost-effective renovation of buildings towards decarbonization?

Prof. Livio Mazzarella: The main barrier toward high energy perform buildings is the actual structure of the buildings market, at least in Italy. Only few buildings are designed, built, owned and used by the same subject: usually companies are designing, building and then selling out buildings, apartments or houses to future owners, who have not been involved in the previous building life cycle stages. These owners are just operating the building as it is. The company convenience is just to maximise their income lowering the production costs as much as possible until this does not affect the customers' perceived quality of the building. Thus, for new constructions, or the final owner is always involved in all stages (I do not see the way), or a more stringent quality check has to be introduced by law as commissioning to assure high quality performing buildings in practice. For the existing buildings stock, if we like to maintain how landscape and cultural heritage (not demolition and reconstruction), the only way is to force for centralised heating and cooling systems (district heating and cooling systems), combined or not combined with water-to-water heat pump systems at the single building level, together with electric power generation via RES. The centralised H&C systems can be realised in modular way (i.e. step by step) and at the beginning may use high efficiency conventional generators with a limited fraction covered by RES generators to move later to full RES use. In this way, the investment cost may be more affordable for the communities.

Q.4) Smart buildings and city are recognized concept, but still few examples of smart buildings/cities are available worldwide. Which will be the role of HVAC sector in the realization of a smart building and city? Considering the current situation of Italian cities, which could be the barriers for the implementation of a smart energy city and the benefits that this could create for the society?

Prof. Livio Mazzarella: As said before, our culture of conservation is somehow a barrier to "smart" buildings and cities as they are usually thought today: new building, new futuristic landscape, etc. Land availability is also a barrier for new constructions. We have to reuse all in a "smart way", this our challenge for Italian smart buildings and cities. That means that, if we cannot lower to much the energy needs (because interventions on the envelope are limited), the provided energy carriers have to be as much possible CO_2 free and all CO_2 non-free generators have to be moved outside of the towns, in centralised systems where CO_2 emissions can be better managed, dispersed or reduced via sequestration, and so on. The role of HVAC systems in this scenario is then to be very high efficient and to be able to work effectively with low temperature for heating and high temperature for cooling while assuring the required IEQ (indoor environmental quality). In this way, less power and energy has to be provided at "lower quality" lowering the installation and running cost of the district heating and cooling systems. ■