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Cities need to modify and/or adapt their urban form, the distribution and location of services and learn how to handle the increasing complexity to face the most pressing challenges of this century. The scientific community is working in order to minimise negative effects on the environment, social and economic issues and people's health. The three issues of the 14th volume will collect articles concerning the topics addressed in 2020 and also the effects on the urban areas related to the spread Covid-19 pandemic.

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Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

The cover image is a train passes a rail road crossing that is surrounded by flooding caused by rain and melting snow in Nidderau near Frankfurt, Germany, Wednesday, Feb. 3, 2021. (AP Photo/Michael Probst)

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REVIEW NOTES – Economy, business and land use

Environmental, social and economic sustainability in urban areas: a cool materials' perspective

Federica Rosso [a b], Stefano Franco [c*]

[a] Department of Civil and Environmental Engineering, University of Perugia, Perugia, Italy

[b] Department of Civil, Construction and Environmental Engineering, Sapienza University of Rome, Roma, Italy
e-mail: federica.rosso@uniroma1.it
ORCID: https://orcid.org/0000-0003-2151-3780

[c] Luiss Business School, LUISS Guido Carli University, Rome, Italy
e-mail: sfranco@luiss.it
ORCID: https://orcid.org/0000-0001-7341-8318
* Corresponding author

Abstract
Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always following a rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is the expression of a continuous updating of emerging topics concerning relationships among urban planning, mobility and environment, through a collection of short scientific papers. The Review Notes are made of four parts. Each section examines a specific aspect of the broader information storage within the main interests of TeMA Journal. In particular, the Economy, business and land use section aims at presenting recent advancements on relevant topics that underlie socio-economic relationships between firms and territories. The present note tackles the topic of cool materials for urban areas, as a mitigation strategy to counteract climate-change related issues. The most recent developments about cool materials demonstrate how they can boost environmental, social and economic sustainability and resilience in urban areas.

Keywords
Urban areas; Sustainability; Comfort; Cool materials; High-albedo materials.

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1. Introduction

Nowadays, urban areas are subject to increasing challenges, due to different contributing factors, which are all expected to be further exacerbated in the next future.

The first crucial factor is the increase in urban population, as assessed in the United Nations Report "World Urbanization Prospect" (United Nations, 2018). Indeed, as of today, in the entire world, the 55% of the total population lives in cities, while considering only more developed regions, the 78% of population lives in cities – the vast majority of it. Moreover, while today the world urban population is 4.5 billion citizens, projections state that by 2050 such number will be as high as 6.7 billion citizens in urban areas (United Nations, 2018), continuing the unprecedented growth and aggravating the pressure on urban areas. What is even more impressive is the growth of land consumption, which largely outpaces population growth: within 2100 it is expected that 1.1-3.6 million km^2 of land will be added to urban areas and consumed by urban surfaces, depending on different consumptions scenarios (Gao & O'Neill, 2020). The middle scenario assesses 1.6 million km^2 more of land consumption due to cities' growth, a dimension which is almost 5 times the dimension of Germany (Gao & O'Neill, 2020). As of today, cities are responsible for the majority of global energy consumptions and emissions, thus calling decision makers to undertake policies in line with such challenges (Tira, 2020).

Another factor challenging cities is due to climate-change related hazards (Moglia et al., 2018; Moriarty & Honnery, 2015; Shirgir et al., 2019). Climate change leads to more intense and more frequent extreme climate conditions, which are further exacerbated in cities due to the different hygro-thermal equilibrium of urban surfaces with respect to natural land. For example, more intense and frequent heatwaves are expected in the next future and are currently being experienced (Hatvani-Kovacs et al., 2016). In cities, heatwaves are exacerbated by Urban Heat Island (UHI) effect, which entails higher temperatures in cities than in surrounding suburban areas, up to 10°C more (Oke, 1982). Therefore, urban citizens are more at risk of suffering heat-related issues. This factor is considered as one of the main public health threats globally, as it is responsible of increased mortality rates in urban areas, with the 2003 European heatwave resulting in 71,000 excess deaths (Mayrhuber et al., 2018; Xu & Tong, 2017). It also implies higher energy consumptions for cooling and higher costs for energy production and consumptions, as well as a tremendous increase in peak electricity demand, which often leads to interruptions in the service (Hatvani-Kovacs et al.,2016; Santamouris & Kolokotsa, 2015) and thus to environmental problems as well as social and economic ones (Pham et al., 2021).

In this panorama, mitigation strategies that could help to face such issues are analyzed by the scientific community and by policymakers. Some of the strategies are strictly linked to the urban surface and the construction materials composing it. These strategies have the advantage of being "passive" in their functioning, as intrinsic properties of the urban surface itself: indeed, certain materials and construction elements allow modifying the hygro-thermal equilibrium of consumed land due to their intrinsic thermal and optic properties. Such passive strategies have the advantage of not requiring energy or control to work. Some examples are green strategies (AboElata, 2017; Lobaccaro & Acero, 2015), that can be inserted in cities under the form of green patches, parks, trees, vegetation, but also green facades and green roofs. Such measures regards the built environment and entails interventions for housings, firms and infrastructures, (Bianconi et al., 2018; Koppelaar et al., 2021), and may bring benefits both to the environment, society and local economies. In addition to technical factors, indeed, people perceptions towards urban green solutions is positive and may generate virtuous behaviors (Berman et al., 2008). Recently, it has been found that nature-based solutions and green strategies may lead firms to increase their revenues while bringing a positive impact on urban environment (Koppelaar et al., 2021). In the case of hotels, for example, several studies have found that being green increases customers positive feelings, in turn increasing economic performance (Franco et al., 2021; Lee et al., 2010). However, green strategies

generally require higher installation and maintenance costs. In this review note, the focus is on another passive strategy to counteract UHI and heatwaves, namely cool materials (also named high-albedo or high-reflective materials). They are materials with specific thermal and optic properties, that allow to them to maintain cooler temperatures than traditional materials, thus contributing to alleviate extreme heat in cities. Cool materials are generally easy to apply and have low maintenance. While their application on a single building implies a reduction of the energy demand for cooling during the hot season (Rosso et al., 2014), their scaling up to an entire neighborhood and city amplifies their positive effects and mitigation potential, towards environmental, social and economic sustainability and resilience of urban areas.
The aim of this review note is to shed lights on recent advancements in literature about the use of high-albedo materials, their latest developments in cities and their benefits to environment, economy and society. The next section illustrates their functioning, and highlights research and practical cases of cool materials in urban areas. The last section provides discussions and concluding remarks.

2. The application of cool materials in urban contexts

Cool materials come in a wide variety of typologies, and can be composed to form construction elements for both vertical urban surfaces, such as buildings' facades, and horizontal ones, such as buildings' roofs and urban paving (Doya et al., 2012; Santamouris, 2015). Their "coolness" defines the ability to maintain low surface and air temperatures due to their thermal and optic characteristics. Indeed, they have intrinsic high thermal emissivity, meaning their property of re-emitting the absorbed heat, and high solar reflectance and albedo, meaning their property to reflect the majority of the incident solar radiation on their surface (Falasca et al., 2019). On the other hand, conventional materials with low albedo and low solar reflectance absorb solar radiation, thus heating up and contributing to UHI, whilst aggravating heatwaves during the hot season. The lighter and smoother a material is (think about white marble (Rosso et al., 2017)), the cooler (Doulos et al., 2004), while dark and rough materials (for example asphalt (Rosso et al., 2016)) on the contrary absorb solar radiation and heat up during summer.
High-albedo materials can be applied in cities under the form of simple light-colored plaster on facades, or facades' panels (they can be cool stone panels, or light-colored cement-based panels); or as roof finishing material (cool membranes, clay tiles, paving); or else, as urban pavement (cool cement- or asphalt-based paving, tiles, stone paving) (Akbari & Matthews, 2012; C40 Cities, 2016; Kandya & Mohan, 2018; Rosso et al., 2014; Rosso et al., 2018; Synnefa et al., 2006). With reference to the above-cited studies, when such construction elements are applied on a building (as cool façade and roof), they contribute at lowering energy demand for cooling by at least 6%, improving indoor thermal comfort and also contribute to UHI and heatwaves mitigation, by reducing by 20-35°C surface temperatures. Additionally, they help maintaining the façade/roof, as there are lower temperature variations, benefiting the durability of the system.
It is worth considering that urban surfaces are composed by 60% of roof (20%) and pavements (40%) and absorb more than the 80% of incident solar radiation, converting it into heat (C40 Cities, 2016). Therefore, such generally easy-to-apply and non-expensive cool solutions can have a significant effect if extensively applied on the available urban surfaces, at the city-scale. Survey conducted in U.S.A. cities demonstrated that the installation of cool roofs and pavements (together with green strategies such as trees) are able to reduce air temperature by up to 4°C at the city scale during summer (C40 Cities, 2016; Falasca et al., 2019), thus effectively mitigating UHI. Such a large-scale application of cool materials is also able to improve air quality, as ozone-smog is more abundant in hot days. Additionally, the reduction of energy consumptions and related emissions for air conditioning, considering the contribution of many buildings in the city is even more impactful due to the large-scale application of such solutions. A direct consequence of this benefit is the reduced peak electricity demand, which was estimated as 1.6 GW for a reduction of 3°C in Los Angeles,

corresponding to $175 million savings each year. Below, in the boxes, some successful cases of cool material strategies applied at the city-scale are reported.

Tokyo - Thermal barriers coating with cool materials on urban paving

Tokyo Metropolitan Government (TMG) promoted cool pavements, by employing high-reflective materials as barriers to solar radiation, defined in the project "thermal barrier coating" (C40 Cities, n.d.; Japan for Sustainability, n.d.). The interventions on streets are part of the construction works for the Olympic Games (2020). 136 km of pavements are implemented, which were able to reduce surface temperatures by 8°C. In this case, the economic burden of converting the paving in cool paving was reduced as the maintenance works were already deemed necessary by the TMG. This case study is relevant to highlight the efficacy and opportunity to include cool strategies during common maintenance works on buildings and other urban surfaces.

New York City - NYC °Cool Roofs Programme

Launched in 2009, the Programme has contributed to implement cool roofs on 530,000 m^2 of rooftops in 625 buildings (C40 Cities, 2016; NYC, n.d.). To-date, it demonstrated to provide a 10 to 30% cost reductions in air conditioning costs. The Programme offers no- or low-cost cool roof installations, depending on the type of buildings. No-cost installations are offered for free to low-income houses, community centers, schools, hospitals museums, while all other buildings can have it at a discounted rate through vendors that participate to the initiative: NYC Cool Roofs will provide the labor and technical assistance at no charge if the building owner pays for the coating. Only determined types of roofs are eligible, in that they have to be flat and in good conditions, accessible and free of dangerous equipment, they should have parapet. The Programme involves local property owners, community partners, workforce training organizations, and volunteers throughout the process. The case study is relevant as it offers financial incentives and provides educational and workforce training to increase population awareness on the topic.

3. Discussion and conclusions

While the above-mentioned benefits clearly demonstrate the contribution of cool materials to environmental sustainability when applied at the city scale, they entail crucial consequences for social and economic sustainability and resilience, too. With respect to social sustainability and resilience, the reduction in temperatures helps mitigating the impact of heatwaves on heat-related death toll, as it was evaluated that a 6% reduction in the number of heat-related deaths during a heatwave could be achieved by increasing the solar reflectance of urban surfaces by 10% at the city-scale. Moreover, the reduction in temperatures aid in safer and more comfortable indoors during the summer months for unprivileged neighborhoods that cannot rely on air conditioning to achieve comfortable conditions during summer (Fuller et al., 2019; Harlan et al., 2006). Indeed, such a solution contributes at reducing energy poverty, as it entails lower expenditures for energy for cooling in the long run. In other words, such kind of materials allow to reduce energy consumptions thus reducing the carbon footprint of the buildings that adopt them (Gargiulo & Russo, 2017). In turn, they bring economic benefits due to two main effects: on one side they cut energy costs, and on the other they allow to implement strategies that may be rewarded by stakeholders. In the case of local businesses, for example, the involvement in green activities signals positive feelings to customers (Koppelaar et al., 2021). Lower expenditures and reduced energy poverty deal also with economic sustainability. As mentioned above, cost savings for citizens and for the operations of large public or commercial buildings can be achieved by means of the application of high-albedo materials. This note tries to shed light on the benefits that such materials can bring to the sustainable development of cities and its components. It adopts a multi-disciplinary perspective embracing engineering and management that is needed to tackle urban grand challenges that involve diverse but interconnected factors. Future studies may further investigate synergies between economy and urban planning in the study of green measures to mitigate climate risks in cities, underlining related benefits and drawbacks.

Author Contributions

The work, although the result of a common reflection, was divided as follows: Federica Rosso, paragraphs 1, 2 and 3; Stefano Franco, paragraphs 1 and 3.

References

AboElata, A. A. A. (2017). Study the Vegetation as Urban Strategy to Mitigate Urban Heat Island in Mega City Cairo. *Procedia Environmental Sciences*, *37*, 386–395. https://doi.org/10.1016/j.proenv.2017.03.004

Akbari, H., & Matthews, H. D. (2012). Global cooling updates: Reflective roofs and pavements. *Energy and Buildings*, *55*, 2–6. https://doi.org/10.1016/j.enbuild.2012.02.055

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, *19*(12), 1207–1212. https://doi.org/10.1111/j.1467-9280.2008.02225.x

Bianconi, F., Clemente, M., Filippucci, M., & Salvati, L. (2018). Regenerating Urban Spaces: A Brief Commentary on Green Infrastructures for Landscape Conservation. *TeMA Journal of Land Use, Mobility and Environment*, *11*(1), 107–118. https://doi.org/10.6092/1970-9870/5216

C40 Cities. (n.d.). C40 Good Practice Guides: Tokyo - Thermal-barrier Coating and Water-retentive Pavement.

C40 Cities. (2016). Good Practice Guide: Cool Cities. *C40 Cities Climate Leadership Group*, 1–17.

Doulos, L., Santamouris, M., & Livada, I. (2004). Passive cooling of outdoor urban spaces. The role of materials. *Solar Energy*, *77*(2), 231–249. https://doi.org/10.1016/j.solener.2004.04.005

Doya, M., Bozonnet, E., & Allard, F. (2012). Experimental measurement of cool facades' performance in a dense urban environment. *Energy and Buildings*, *55*, 42–50. https://doi.org/10.1016/j.enbuild.2011.11.001

Falasca S., Ciancio V., Salata F., Golasi I., Rosso F., C. G. (2019). High albedo materials to counteract heat waves in cities: An assessment of meteorology, buildings energy needs and pedestrian thermal comfort. *Building and Environment*. https://doi.org/10.1016/j.buildenv.2019.106242

Falasca, S., Ciancio, V., Salata, F., Golasi, I., Rosso, F., & Curci, G. (2019). High albedo materials to counteract heat waves in cities: An assessment of meteorology, buildings energy needs and pedestrian thermal comfort. *Building and Environment*, *163* (May), 106242. https://doi.org/10.1016/j.buildenv.2019.106242

Franco, S., Caroli, M. G., & Del Chiappa, G. (2021). The impact of hotel sustainability practices on tourist intentions to book hotel rooms. *Sinergie Italian Journal of Management*, *39* (1), 21–35. https://doi.org/10.7433/s114.2021.03

Fuller, S., Barber, L. B., & Mah, D. N. yin. (2019). Narratives of energy poverty in Hong Kong. *Energy and Buildings*, *191*, 52–58. https://doi.org/10.1016/j.enbuild.2019.03.015

Gao, J., & O'Neill, B. C. (2020). Mapping global urban land for the 21st century with data-driven simulations and Shared Socioeconomic Pathways. *Nature Communications*, *11* (1), 1–12. https://doi.org/10.1038/s41467-020-15788-7

Gargiulo, C., & Russo, L. (2017). Cities and Energy Consumption: a Critical review. *TeMA Journal of Land Use, Mobility and Environment*, *10* (3), 259–278. https://doi.org/10.6092/1970-9870/5182

Harlan, S. L., Brazel, A. J., Prashad, L., Stefanov, W. L., & Larsen, L. (2006). Neighborhood microclimates and vulnerability to heat stress. *Social Science and Medicine*, *63* (11), 2847–2863. https://doi.org/10.1016/j.socscimed.2006.07.030

Hatvani-Kovacs, G., Belusko, M., Pockett, J., & Boland, J. (2016). Assessment of Heatwave Impacts. *Procedia Engineering*, *169*, 316–323. https://doi.org/10.1016/j.proeng.2016.10.039

Hatvani-Kovacs, G., Belusko, M., Skinner, N., Pockett, J., & Boland, J. (2016). Heat stress risk and resilience in the urban environment. *Sustainable Cities and Society*, *26*, 278–288. https://doi.org/10.1016/j.scs.2016.06.019

Japan for Sustainability. (n.d.). Thermal Barrier Coating Found Effective as Global Warming Countermeasure.

Kandya, A., & Mohan, M. (2018). Mitigating the Urban Heat Island effect through building envelope modifications. *Energy and Buildings*, *164*, 266–277. https://doi.org/10.1016/j.enbuild.2018.01.014

Koppelaar, R., Marvuglia, A., Havinga, L., Brajkovi, J., & Rugani, B. (2021). *Is Agent-Based Simulation a Valid Tool for Studying the Impact of Nature-Based Solutions on Local Economy? A Case Study of Four European Cities*. 1–17.

Lee, J. S., Hsu, L. T., Han, H., & Kim, Y. (2010). Understanding how consumers view green hotels: How a hotel's green image can influence behavioural intentions. *Journal of Sustainable Tourism*, *18* (7), 901–914. https://doi.org/10.1080/09669581003777747

Lobaccaro, G., & Acero, J. A. (2015). Comparative analysis of green actions to improve outdoor thermal comfort inside typical urban street canyons. *Urban Climate*, *14*, 251–267. https://doi.org/10.1016/j.uclim.2015.10.002

Mayrhuber, E. A. S., Dückers, M. L. A., Wallner, P., Arnberger, A., Allex, B., Wiesböck, L., … Kutalek, R. (2018). Vulnerability to heatwaves and implications for public health interventions – A scoping review. *Environmental Research*, *166* (May), 42–54. https://doi.org/10.1016/j.envres.2018.05.021

Moglia, M., Cork, S. J., Boschetti, F., Cook, S., Bohensky, E., Muster, T., & Page, D. (2018). Urban transformation stories for the 21st century: Insights from strategic conversations. *Global Environmental Change*, *50* (January), 222–237. https://doi.org/10.1016/j.gloenvcha.2018.04.009

Moriarty, P., & Honnery, D. (2015). Future cities in a warming world. *Futures*, *66*, 45–53. https://doi.org/10.1016/j.futures.2014.12.009

NYC. (n.d.). NYC CoolRoofs.

Oke, T. R. (1982). The energetic basis of the urban heat island. *Quarterly Journal of the Royal Meteorological Society*, *108*(455), 1–24. https://doi.org/10.1002/qj.49710845502

Pham, Y., Reardon-Smith, K., & Deo, R. C. (2021). Evaluating management strategies for sustainable crop production under changing climate conditions: A system dynamics approach. *Journal of Environmental Management*, *292*(May), 112790. https://doi.org/10.1016/j.jenvman.2021.112790

Rosso, F., Pisello, A. L., Cotana, F., & Ferrero, M. (2014). Integrated thermal-energy analysis of innovative translucent white marble for building envelope application. *Sustainability (Switzerland)*, *6*(8). https://doi.org/10.3390/su6085439

Rosso, F., Pisello, A. L., Cotana, F., & Ferrero, M. (2016). On the thermal and visual pedestrians' perception about cool natural stones for urban paving: A field survey in summer conditions. *Building and Environment*, *107*. https://doi.org/10.1016/j.buildenv.2016.07.028

Rosso, F., Golasi, I., Castaldo, V. L., Piselli, C., Pisello, A. L., Salata, F., … de Lieto Vollaro, A. (2018). On the impact of innovative materials on outdoor thermal comfort of pedestrians in historical urban canyons. *Renewable Energy*, *118*, 825–839. https://doi.org/10.1016/j.renene.2017.11.074

Rosso, F., Pisello, A., Cotana, F., & Ferrero, M. (2014). Integrated Thermal-Energy Analysis of Innovative Translucent White Marble for Building Envelope Application. *Sustainability*, *6* (8), 5439–5462. https://doi.org/10.3390/su6085439

Rosso, F., Pisello, A. L., Cotana, F., & Ferrero, M. (2017). Cool, Translucent Natural Envelope: Thermal-optics Characteristics Experimental Assessment and Thermal-energy and Day Lighting Analysis. *Energy Procedia*, *111*, 578–587. https://doi.org/10.1016/j.egypro.2017.03.220

Santamouris, M. (2015). Regulating the damaged thermostat of the cities - Status, impacts and mitigation challenges. *Energy and Buildings*, *91*, 43–56. https://doi.org/10.1016/j.enbuild.2015.01.027

Santamouris, M., & Kolokotsa, D. (2015). On the impact of urban overheating and extreme climatic conditions on housing, energy, comfort and environmental quality of vulnerable population in Europe. *Energy and Buildings*. https://doi.org/10.1016/j.enbuild.2014.08.050

Shirgir, E., Kheyroddin, R., & Behzadfar, M. (2019). Defining urban green infrastructure role in analysis of climate resilience in cities based on landscape ecology principles. *TeMA Journal of Land Use, Mobility and Environment*, *12*(3), 227–247. https://doi.org/10.6092/1970-9870/6250

Synnefa, A., Santamouris, M., & Livada, I. (2006). A study of the thermal performance of reflective coatings for the urban environment. *Solar Energy*, *80* (8), 968–981. https://doi.org/10.1016/j.solener.2005.08.005

Tira, M. (2020). About the Sustainability of Urban Settlements. *TeMA Journal of Land Use, Mobility and Environment*, 361–371. https://doi.org/10.6092/1970-9870/6984

United Nations. (2018). *World Urbanization Prospect*.

Xu, Z., & Tong, S. (2017). Decompose the association between heatwave and mortality: Which type of heatwave is more detrimental? *Environmental Research*, *156*(March), 770–774. https://doi.org/10.1016/j.envres.2017.05.005

Authors' profiles

Federica Rosso

PhD in Architectural and Urban Engineering at Sapienza University of Rome (Italy). She is postdoctoral research fellow at University of Perugia (Perugia, Italy) and lecturer at Sapienza University of Rome (Rome, Italy). She has been a visiting researcher at the New York University Tandon School of Engineering (New York, USA) and Pace University Seidenberg School of Computer Science (New York, USA). Her main research interests are focused on built environment sustainability and resilience. Her works on these topics are published in international scientific journals, such as *Journal of Environmental Management, Journal of Cleaner Production, Applied Energy, Energy and Buildings, Building and Environment, Construction and Building Materials journals, Buildings, Sustainability.*

Stefano Franco

PhD in Management from LUISS Guido Carli University in Rome. He has been visiting researcher at Rey Juan Carlos University, Madrid. His main research interests are in the areas of sustainability and entrepreneurship. His papers have appeared in international refereed journals, among others *IEEE Transactions on Engineering Management, International Journal of Hospitality Management, Journal of Cleaner Production.*