



Jul 13th, 11:10 AM - 11:30 AM

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Cremades, Roger, "Challenges and opportunities for urban decarbonization at the global scale" (2016). *International Congress on Environmental Modelling and Software*. 89.

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Challenges and opportunities for urban decarbonization at the global scale

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Abstract: Urban areas emit roughly three quarters of global carbon emissions. Cities are crucial elements for a decarbonized society, however, there is not a framework to analyse cities at the global scale. Supervised machine learning from remote sensing provides information about human settlements from 4 dates (1974, 1990, 2000 and 2014), allowing the creation of the Global Human Settlement Layer (GHSL) which jointly with the Gridded Population of the World (GPW) provides the basis for this study. This dynamic evolution of 250 metre sided cells and its population at the global scale gives an unprecedented opportunity to analyse a backbone of urban sustainability: density. Density is one of the most decisive parameters of urban sustainability; it influences energy consumption through its impact on transportation needs. Density, together with technology adoption (including transport), institutional governance and citizen behaviour, determines most of the opportunities for climate change mitigation at the urban scale; based on these variables, I present the first results of the Integrated Global Urban Complexity (IGUC) Model, a system dynamics model. The novelty of IGUC relies on considering the dynamic links of decarbonization and its economic implications in an urban assessment framework at the global scale. The analyses show that there are substantial opportunities for intervention to avoid irreversible lock-in effects in growing urban spaces of the global south. Existing urban developments with substantial lock-in appear to show opportunities under high citizen implication assumptions, but negative feedbacks related to low density would disrupt opportunities for transformation, especially in regard to mass transportation needs, leaving urban services only easily accessible to the affluent fraction of the population. Plenty of opportunities are observed when technology, institutions and citizen behaviour work together, but institutional barriers emerge as the most challenging factor of avalanche effects on the adoption of technologies. Our results are crucial for the Agenda 2030 at the urban scale.

Keywords: Decarbonization, Cities, Sustainable Development Goals, System Dynamics.