ETH zürich

URBAN SOLUTIONS AND SUSTAINABILITY
R&D CONGRESS 2023
BUILDING SUSTAINABLE, RESILIENT, AND LIVEABLE CITIES OF TOMORROW
4TH - 5TH OCTOBER 2023

Design to Decarbonise: Effective Tools to Reduce Urban Building Emissions

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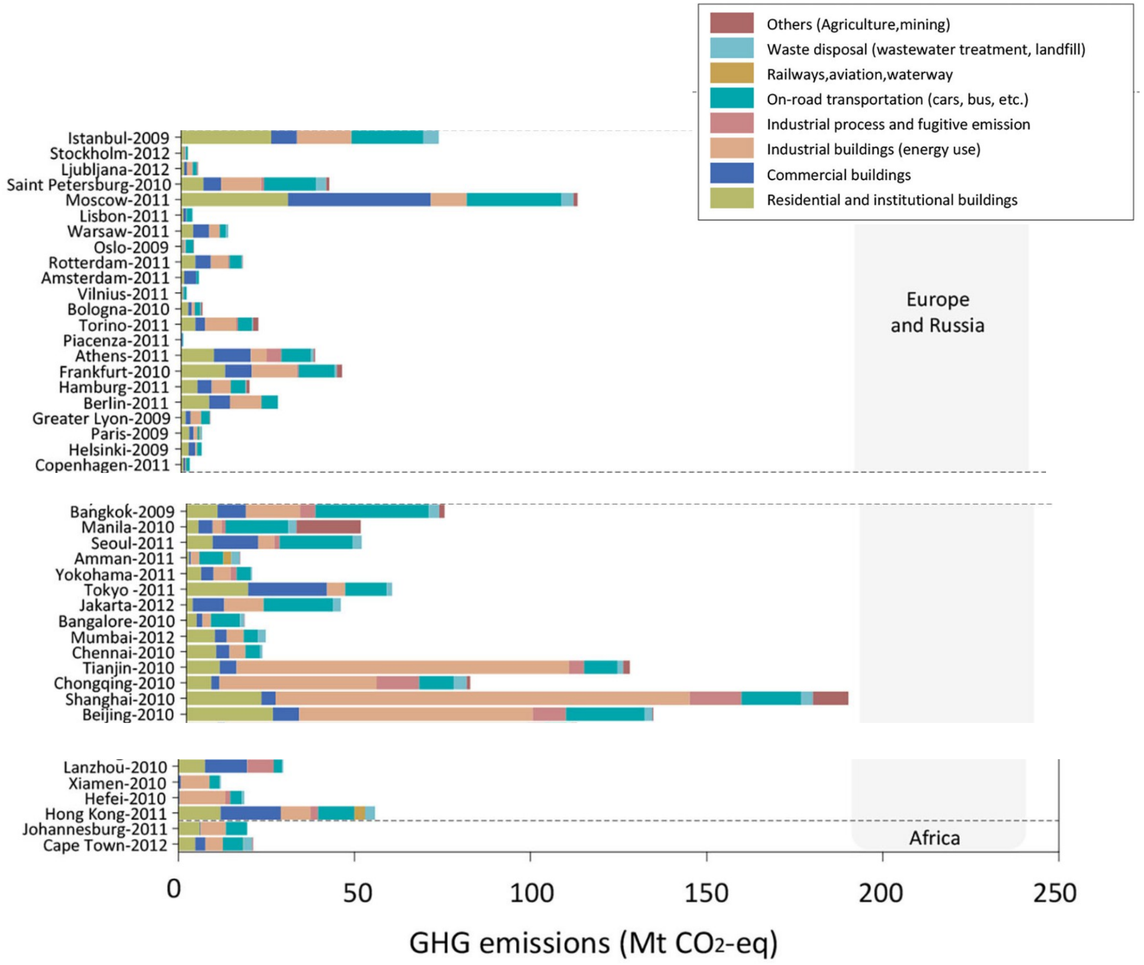
Architecture and Building Systems Group

The Ambigous Role of Buildings

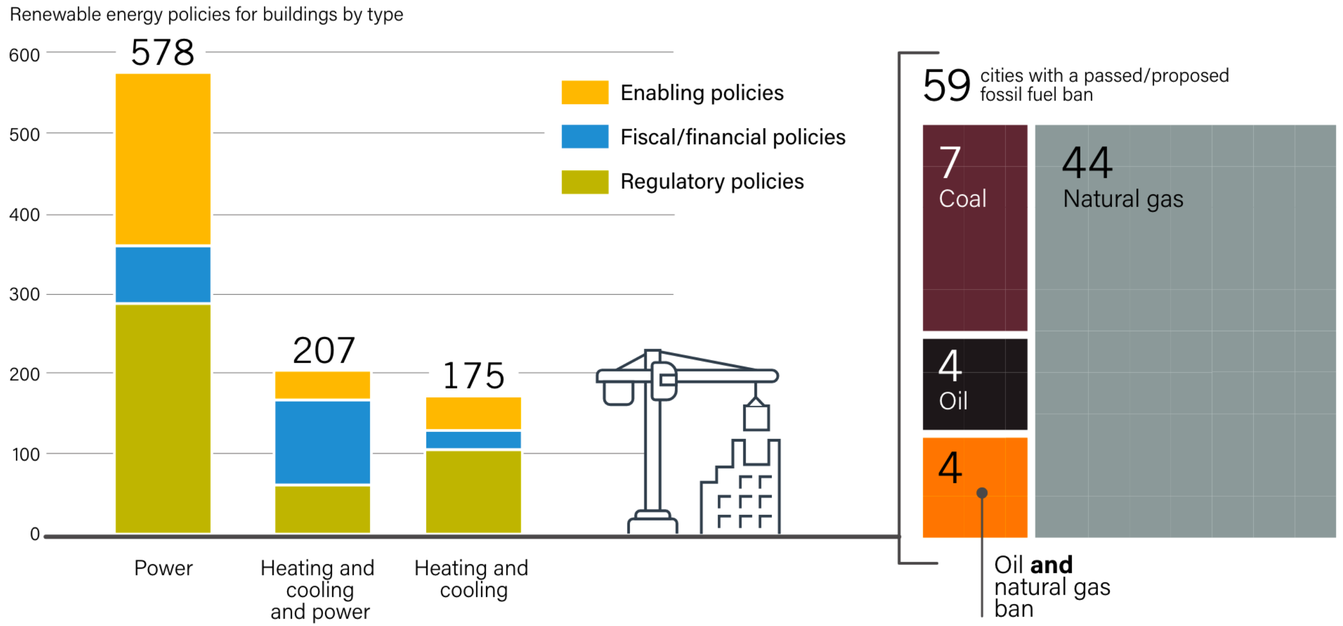


Wei, Ting, Junliang Wu, and Shaoqing Chen. 'Keeping Track of Greenhouse Gas Emission Reduction Progress and Targets in 167 Cities Worldwide'. *Frontiers in Sustainable Cities* 3 (2021).

Solar Retrofit in Basel, Switzerland (image: Aeppli AG)

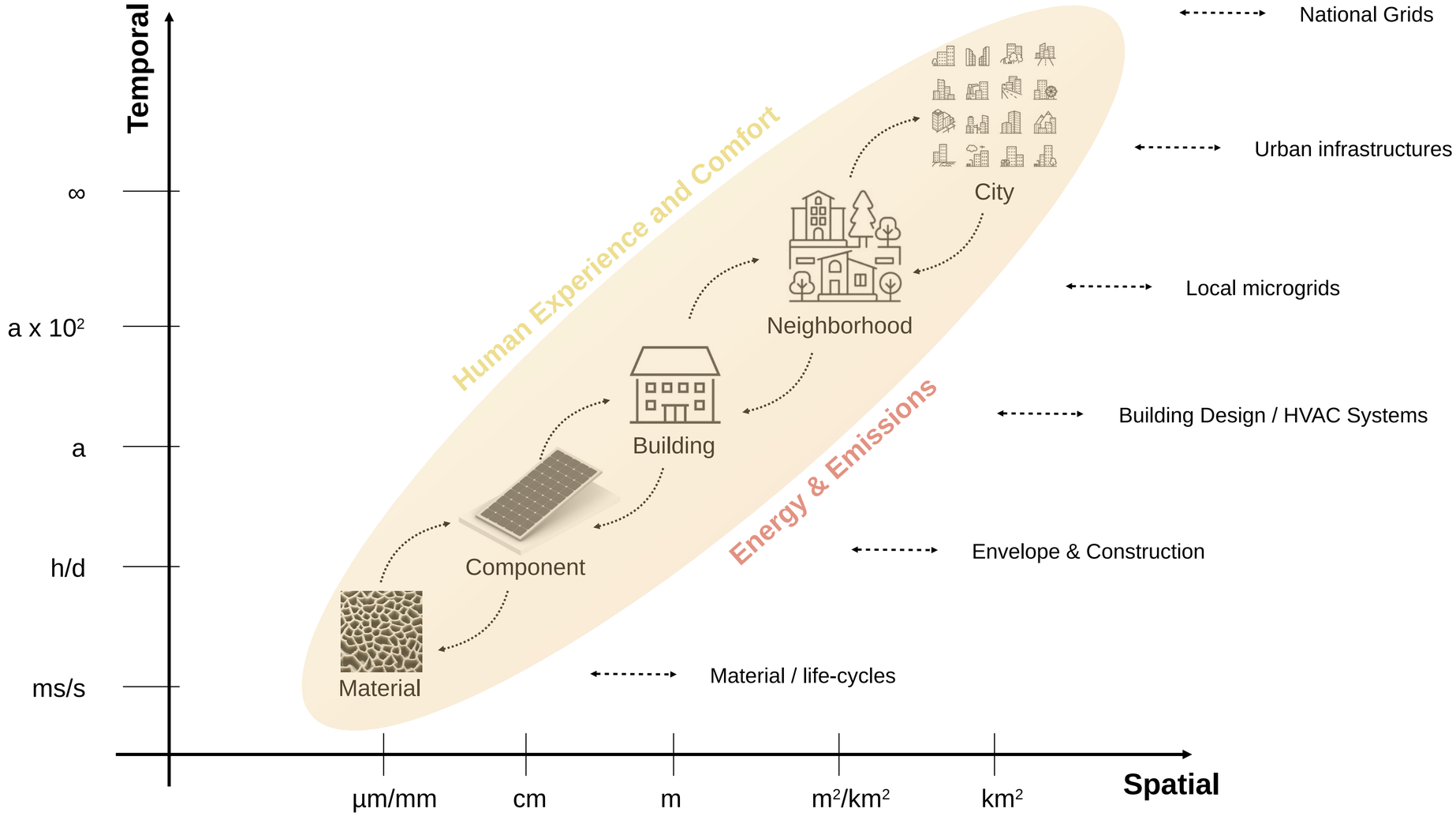
Policies towards Decarbonizing Buildings in Cities

" By the end of 2021, over 920 municipal governments had implemented direct regulatory policies, financial and fiscal incentives, and indirect support policies aimed at ***decarbonising buildings through renewable power*** *and/or renewable heating"*

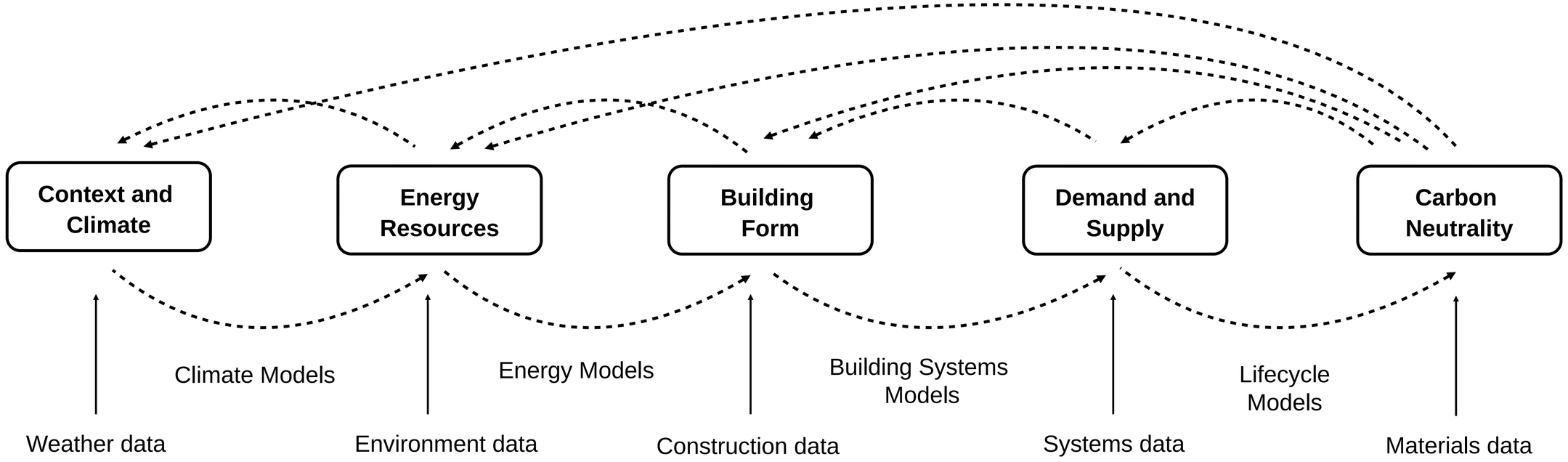


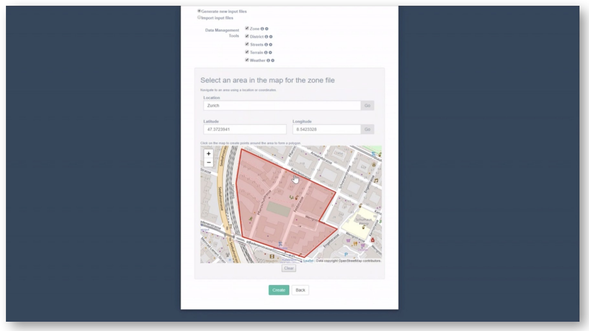
REN21. 'RENEWABLES 2022 GLOBAL STATUS REPORT'. Accessed 20 September 2023. https://www.ren21.net/gsr-2022.

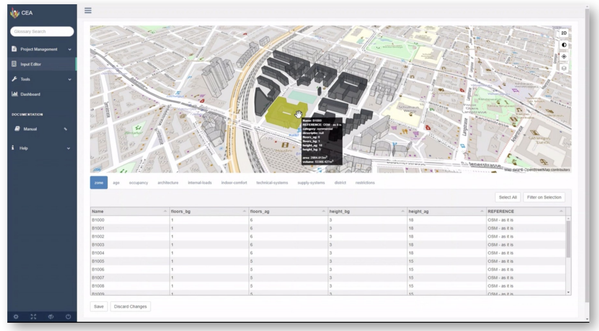
Decarbonization through Solar PV: Temporal and Spatial Dependencies

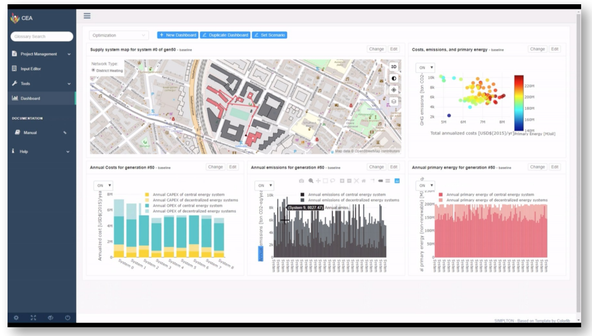


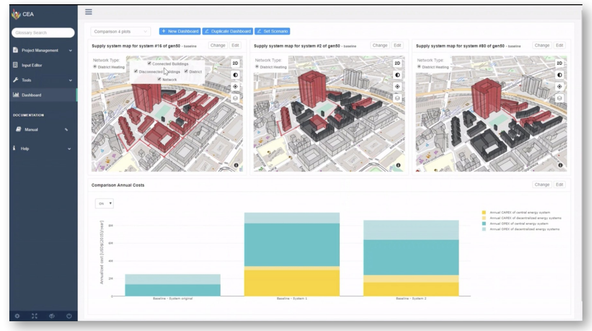
Capture Interdependencies through Computational Analytical Toolsets











CO_2 Mitigation Potential through Solar PV in SEA

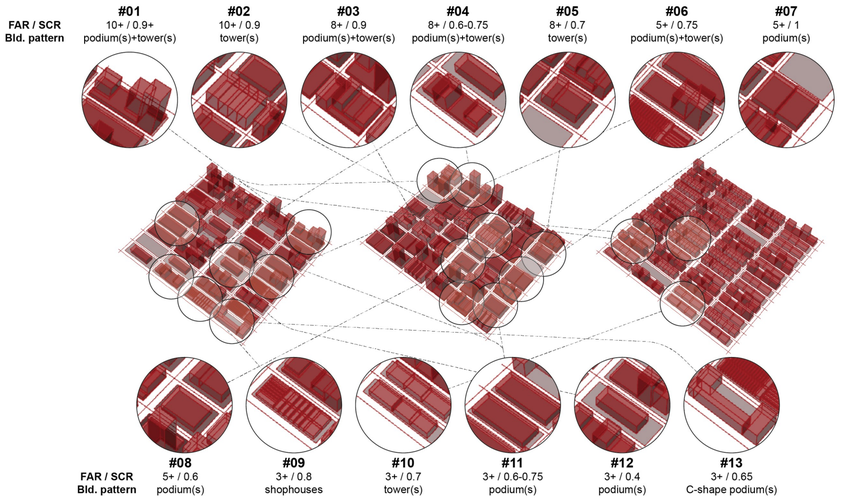
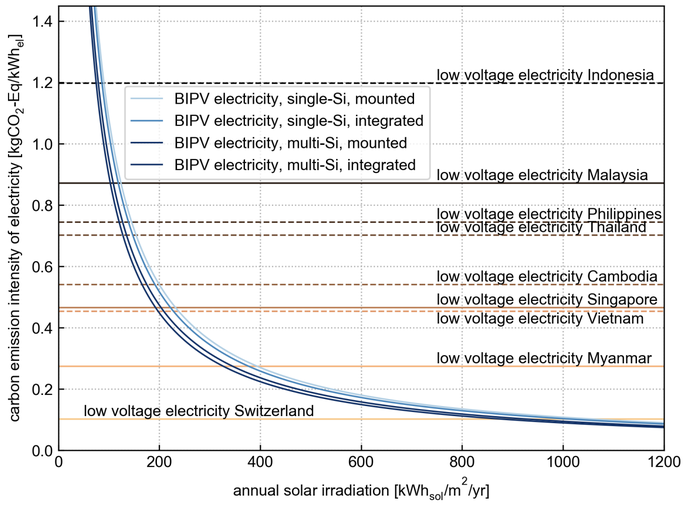
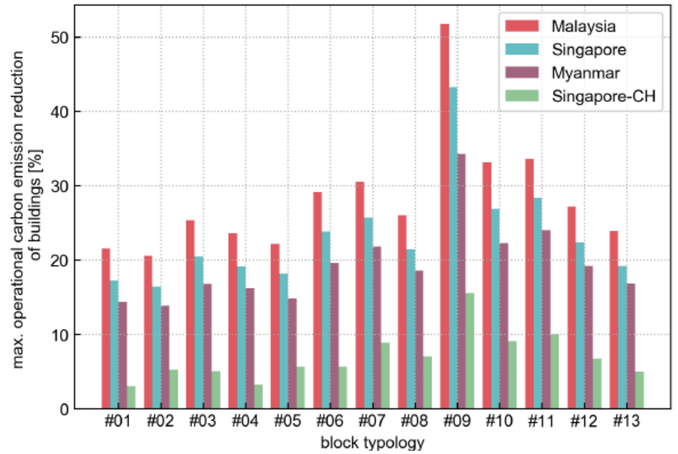
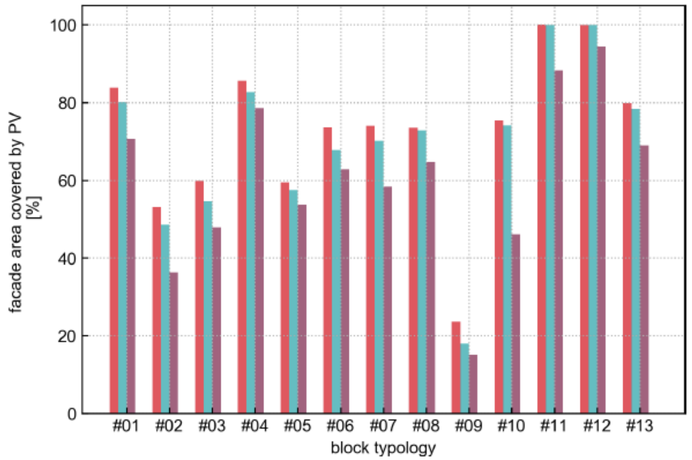


Image: Zhongming Shi

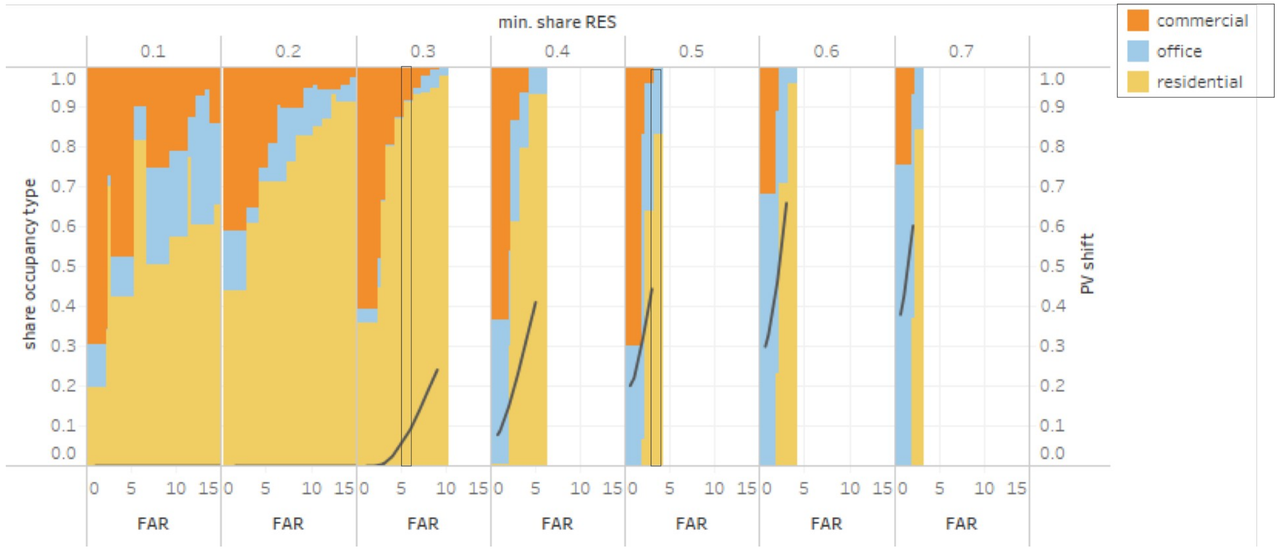




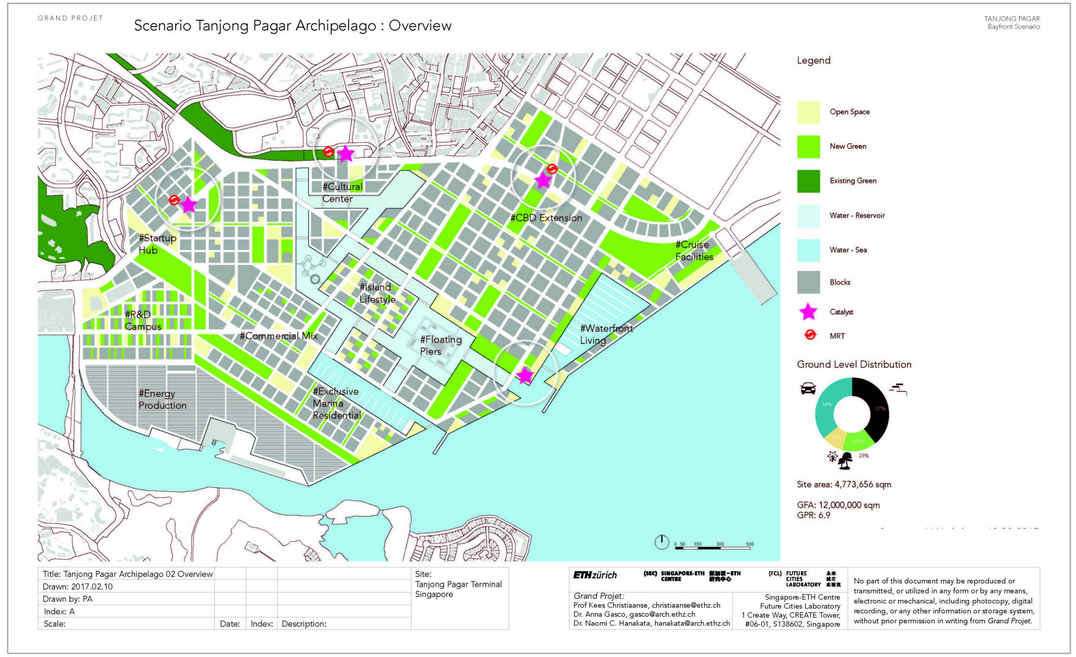


G. Happle, Z. Shi, S. Hsieh, B. Ong, J. A. Fonseca, F. Maréchal, A. Schlueter; Identifying carbon emission reduction potentials of BIPV in high-density cities in Southeast Asia, CISBAT 2019, Lausanne

Density and Urban Program Influence Renewable Energy Utilization

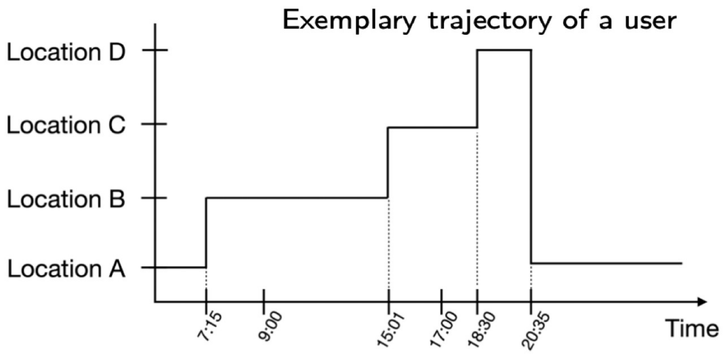


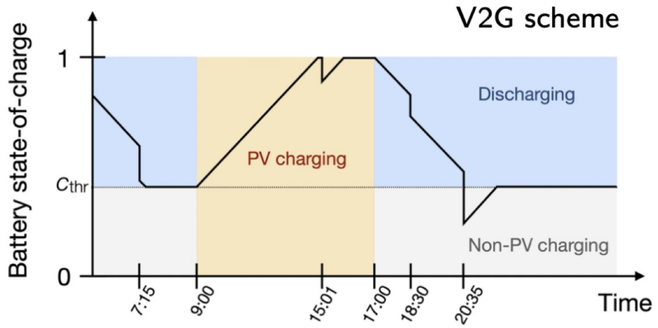
S. Hsieh, N. Schüler, Z. Shi, J. A. Fonseca, F. Maréchal, A. Schlueter; Defining density and land uses under energy performance targets at the early stage of urban planning processes, CISBAT 2017, Lausanne

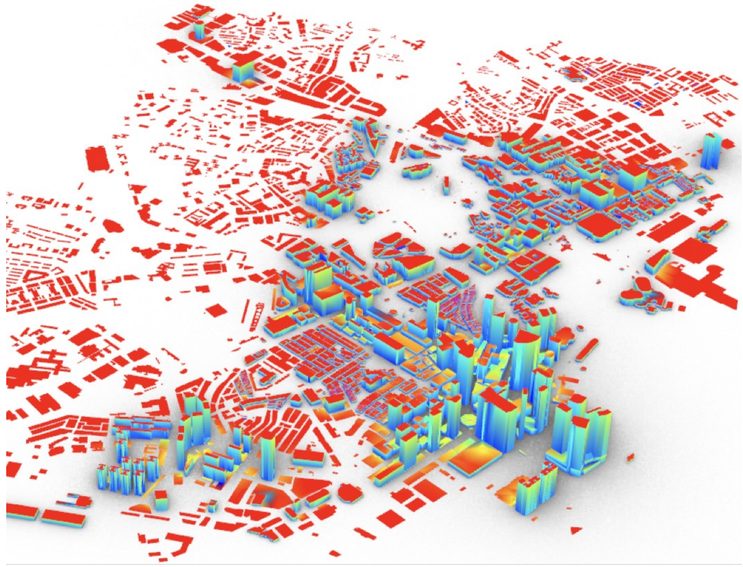


Images: SEC Future Cities Lab, *Grand Projet,* K. Christiaanse

Linking BIPV Generation to Electric Vehicle Storage







Estimation of Solar Yield (Christoph Waibel)

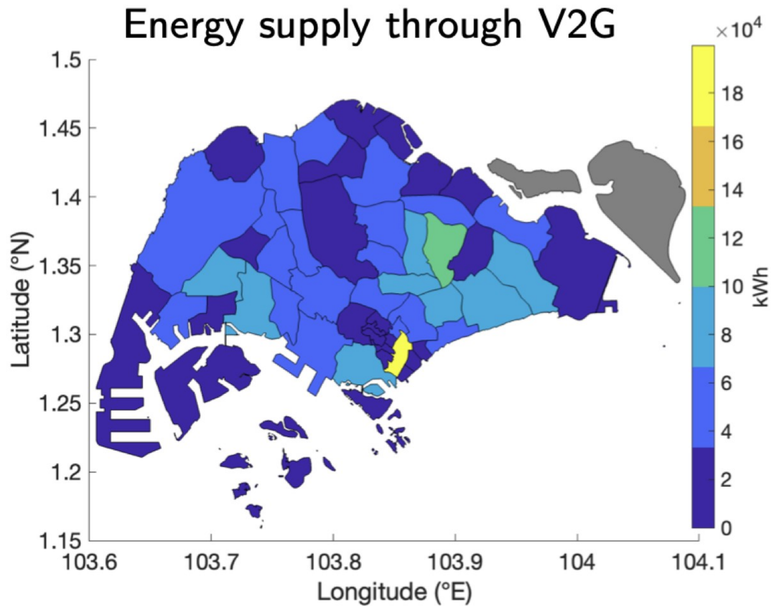
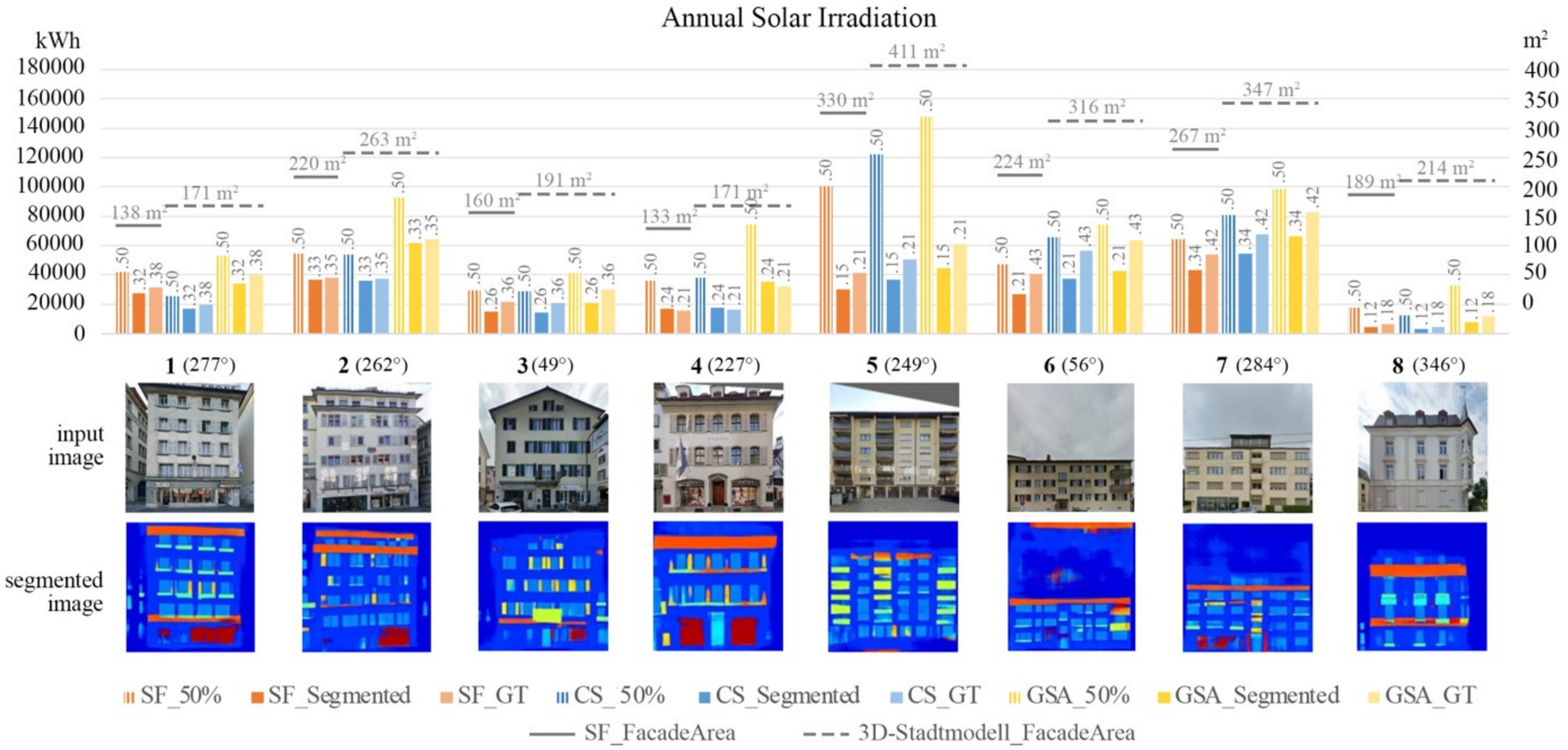


Fig. 2. Estimated local energy supply, Eev, through V2G in each planning area of Singapore for a typical day. Values correspond to a low EV penetration rate of 3% (δ = 0.03).

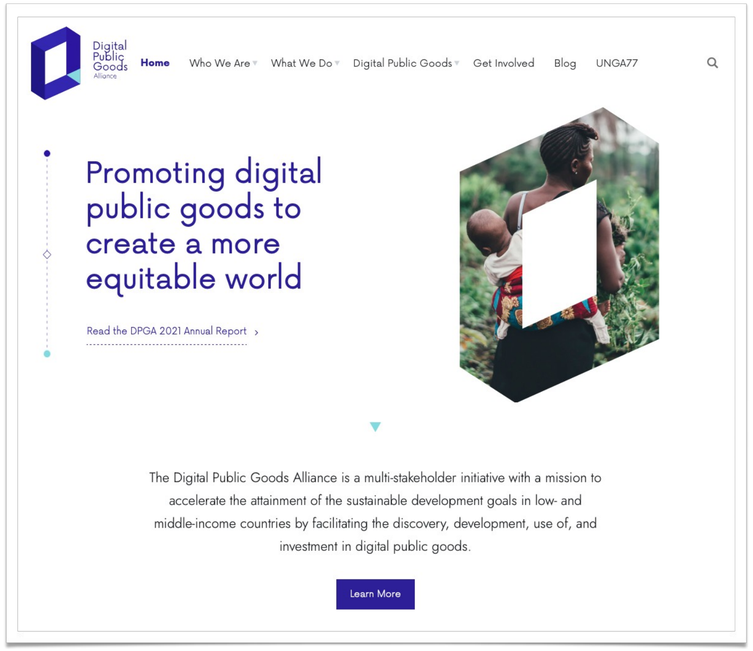
Using mobility patterns for the planning of vehicle-to-grid systems that support the deployment of photovoltaics
Schläpfer et al., arXiv: 2112.15006, 2021

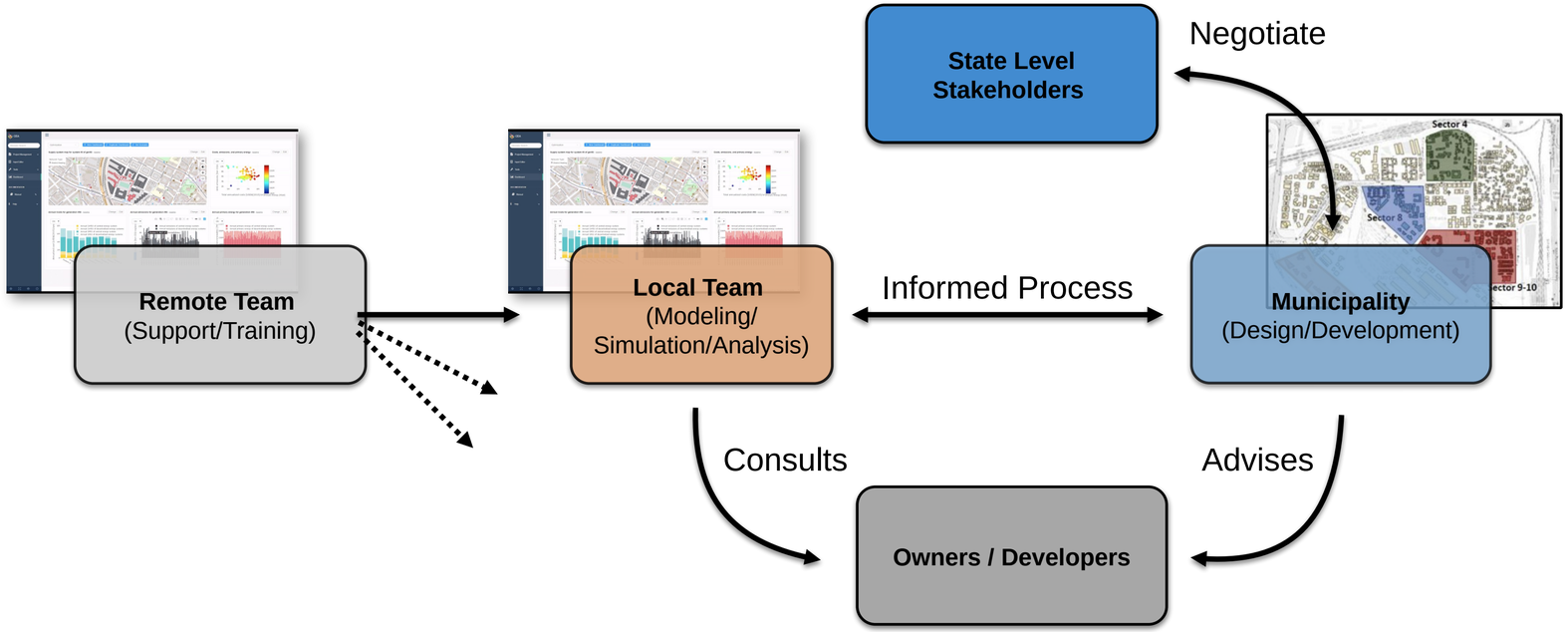
Data-Driven Methods: Facade Images + GAN for Identification of BIPV Potentials



An image-based approach for estimating solar potential of building facades,
A. Duran, C. Waibel. and A. Schlueter, CISBAT 2023, Lausanne

Local Stakeholders Empower Evidence-based Design Processes





Design to Decarbonize - Action is needed!

- **Analytical methods** allow for identifying cost- and emission optional measures to decarbonize – increasingly fast!
- No silos – we need **systemic and integrated** approaches
- **New processes**: towards evidence-based urban design and development using life-cycle metrics
- **Speed matters** – we have to act fast to reach climatic goals