# Dynamic Energy Mapping Project Outline

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**Abstract**

This document provides an approach of adding the "time" dimension to an Energy Map. The approach is demonstrated with a model of a conceptual urban setting created in CityEngine based on the extracted topological and density pattern from an existing urban design project. The buildings in the conceptual model is then assigned an energy profile of certain DOE Commercial Benchmark Building Reference model based on its building type. Hourly energy demand profile of heating and cooling end use is then obtained from the EnergyPlus Reference models. The energy consumption data is classified into groups with consideration of building energy design context and the data distribution properties. A corresponding color coded energy profile is then generated and imported to CityEngine. 8760 color coded 3D map images was then extracted from CityEngine with Python script. A data reading, ploting, color-coding calculation and a user interface for visualizing the images and dynamic data plot with sliders is implemented using Python and related packages. The tool is anticipated to provide decision support for community energy management and planning, demand-side strategy design and district system sizing.

The document will also briefly discuss one of the testbed for data classification and visualization.

# 1   General Introduction

## 1.1   Definition of Energy Map: energy related geo-database

## 1.2   Why "time" dimension is important for an Energy Map

1. Development of supply side requires better understanding of the demand side

2. Community Energy Planning and District system design requires a more detailed picture of the energy temporal behavior on community level

## 1.3   General Description of Dynamic Energy Map

1. Dynamic Map holds 8760-hour meta data of energy demand and supply

2. Dynamic Map has multi-dimensional graphical display of the meta data in conveying spatial-temporal pattern

   2.1. 1D: data plot for providing quantitative information
   2.2. 2D/3D: graphical display of spatial relationship of energy data
   2.3. 1D + 2D/3D: interactive graphical display of spatial-temporal pattern of energy data

# 2 Related Works

## 2.1 Energy Map (without temporal dimension) (grouped with field of application)

1. Supply side: Assessing renewable energy potential

    1.1. "Evaluation of Renewable Energy potential using a GIS decision support system", Voivontas et al., 1998

    1.2. "Spatial mapping of renewable energy potential", Ramachandra and Shruthi, 2007

    1.3. "Energy Potential Mapping: Visualizing Energy Characteristics", Dobbelsteen et al. , 2013

    1.4. "NYC City Solar Map": present solar energy potential for buildings across the city. Information presented include: solar energy generation curve, estimated solar system installation area, finantial incentive and payback etc`http://www.nycsolarmap.com/`.

2. Supply and Demand Side: Analysis or design support of existing energy infrastructures

    2.1. "Developments to an existing city-wide district energy network  Part I: Identification of potential expansions using heat mapping", Finney et al. , 2012

    2.2. National Heat Map, `http://tools.decc.gov.uk/nationalheatmap/`

3. Smart Management of Urban Energy System

    3.1. "Smart Urban Services for Higher Energy Efficiency"(SUNSHINE) project (2013): energy consumption map, automatic alerts, remote control of public building lighting system.