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# HONMA LAB.

# [Management of Urban Environmental Systems]

## International Center for Urban Safety Engineering

http://www.honma-lab.iis.u-tokyo.ac.jp/

### Urban Environmental Mathematical Engineering
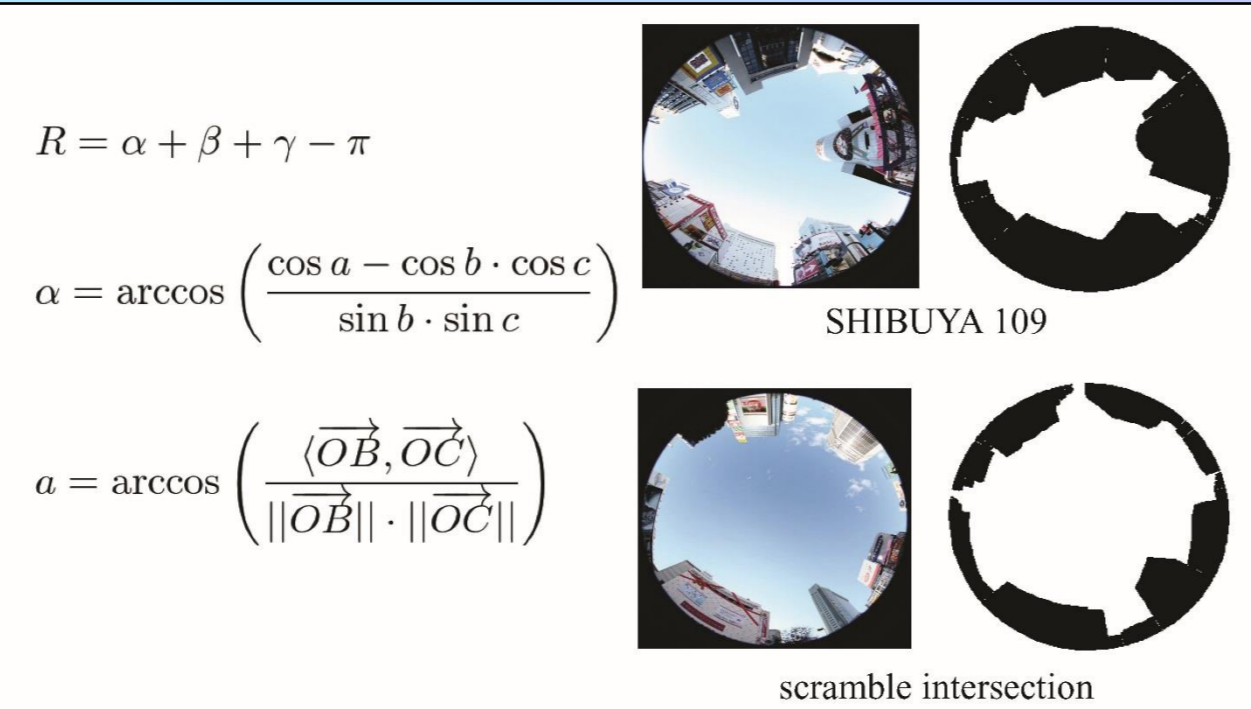
Department of Architecture

# Management of Urban Environmental Systems

## Mathematical Engineering for Sustainable Society

Urban environmental systems in present society have become large and complicated. In our laboratory, we have proposed to manage the above systems and grasp the basic structures using the "mathematical model".
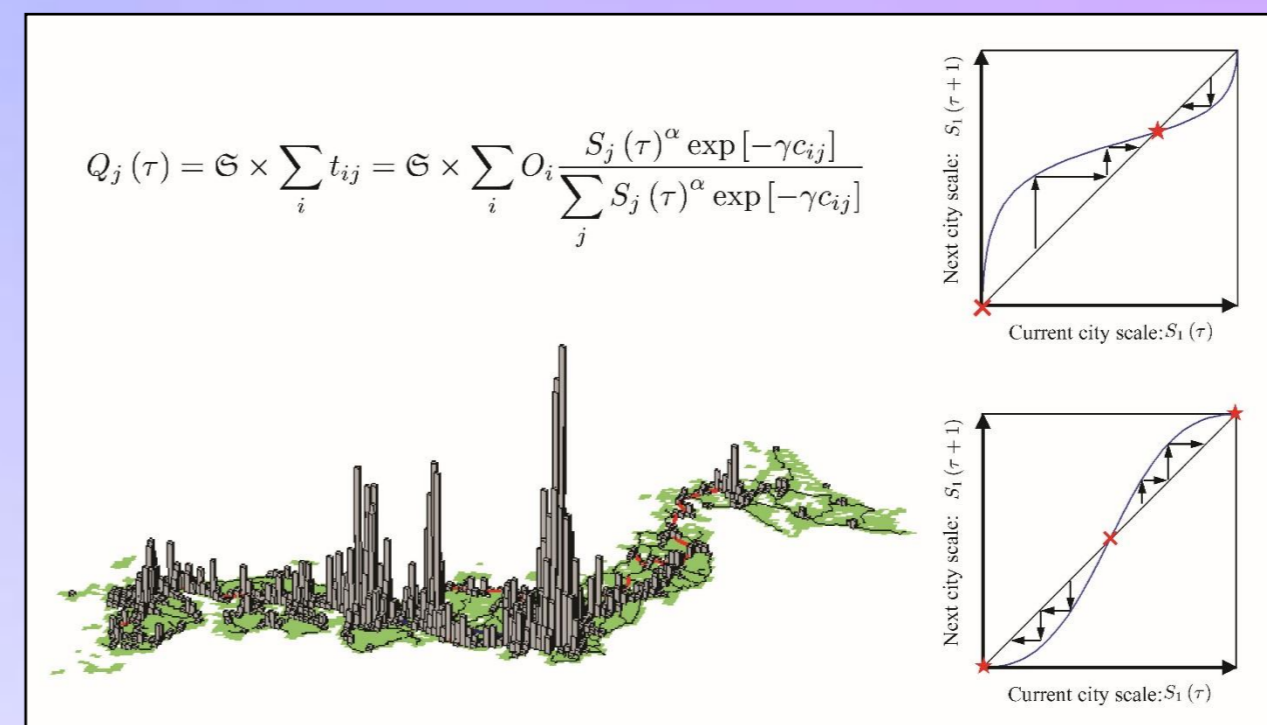
◆ **Analysis of Landscapes by Computational Geometry**

The solid angle, which is closely related to the sky factor, has been used to assess urban landscapes. In this study, we propose a new algorithm to calculate the solid angles of urban landscapes.
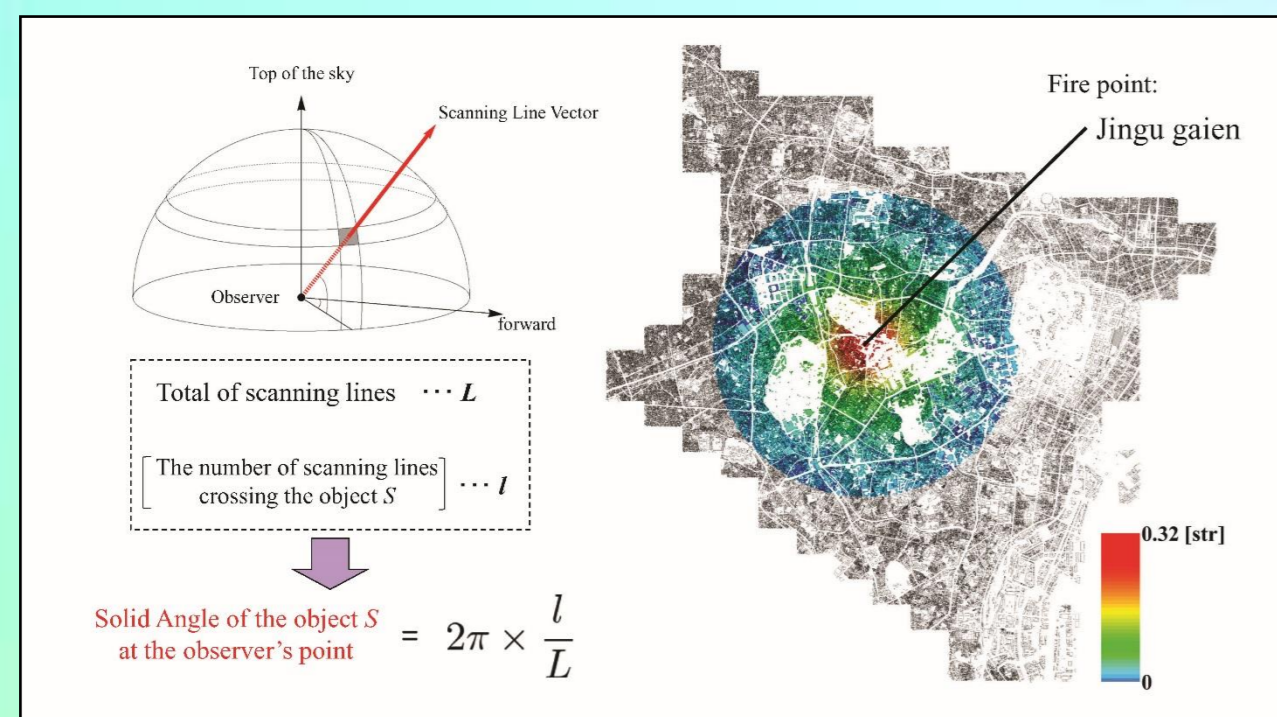
$$R = \alpha + \beta + \gamma - \pi$$
$$\alpha = \arccos\left(\frac{\cos a - \cos b \cdot \cos c}{\sin b \cdot \sin c}\right)$$
$$a = \arccos\left(\frac{\langle \overrightarrow{OB}, \overrightarrow{OC} \rangle}{||\overrightarrow{OB}|| \cdot ||\overrightarrow{OC}||}\right)$$

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scramble intersection

◆ **Analysis of Fireworks Using Building Data**

Fireworks displays are typical features of summer in Japan. In this study, we propose a mathematical model to evaluate the optimal view points for fireworks displays.

**Urban**

◆ **Urban Concentrations by Japanese Railway Networks**

$$Q_j(\tau) = \mathfrak{S} \times \sum_i t_{ij} = \mathfrak{S} \times \sum_i O_i \frac{S_j(\tau)^\alpha \exp[-\gamma c_{ij}]}{\sum_j S_j(\tau)^\alpha \exp[-\gamma c_{ij}]}$$

In this study, we analyze the dynamics of urban activity distribution In particular, we examine how the construction of Shinkansen bullet train affects the developments of cities in Japan.
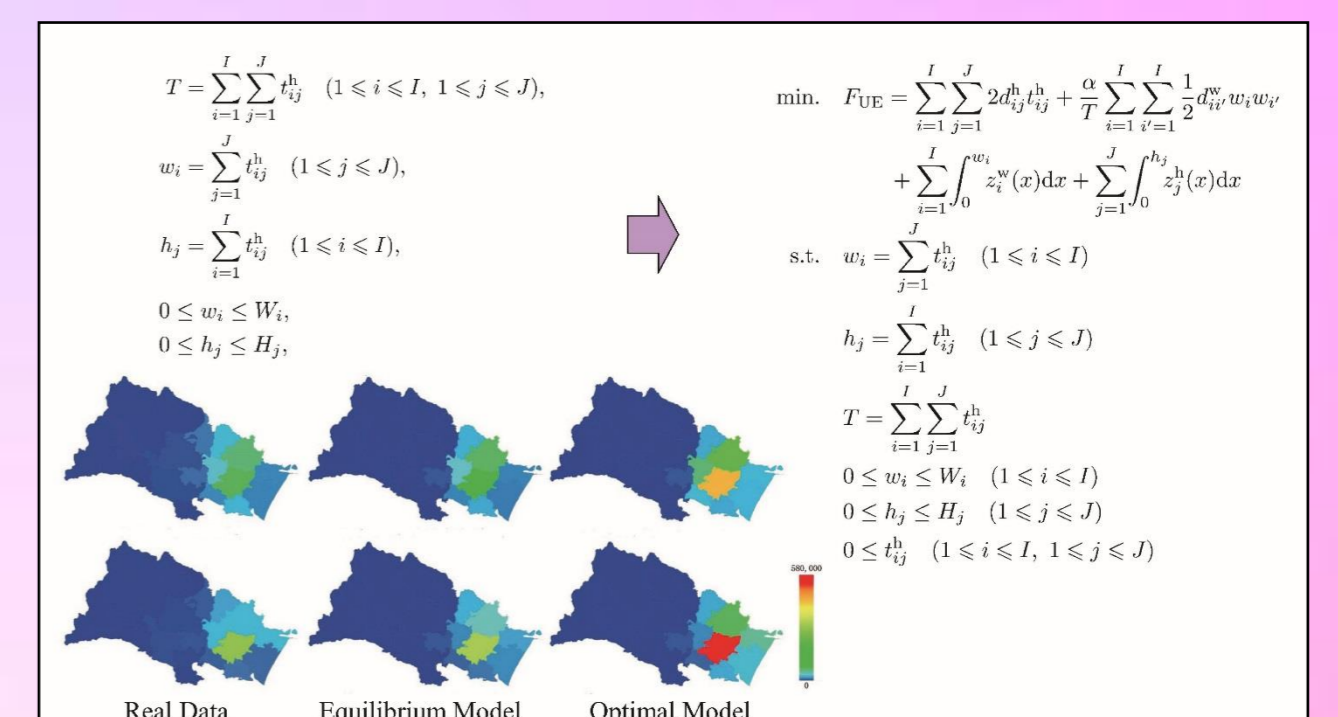
◆ **Equilibrium and Optimum Location of Housings and Jobs**

In this study, we propose a new calculation method of equilibrium and optimum distribution of housings and jobs. The model will be used for discussion of compact-city.
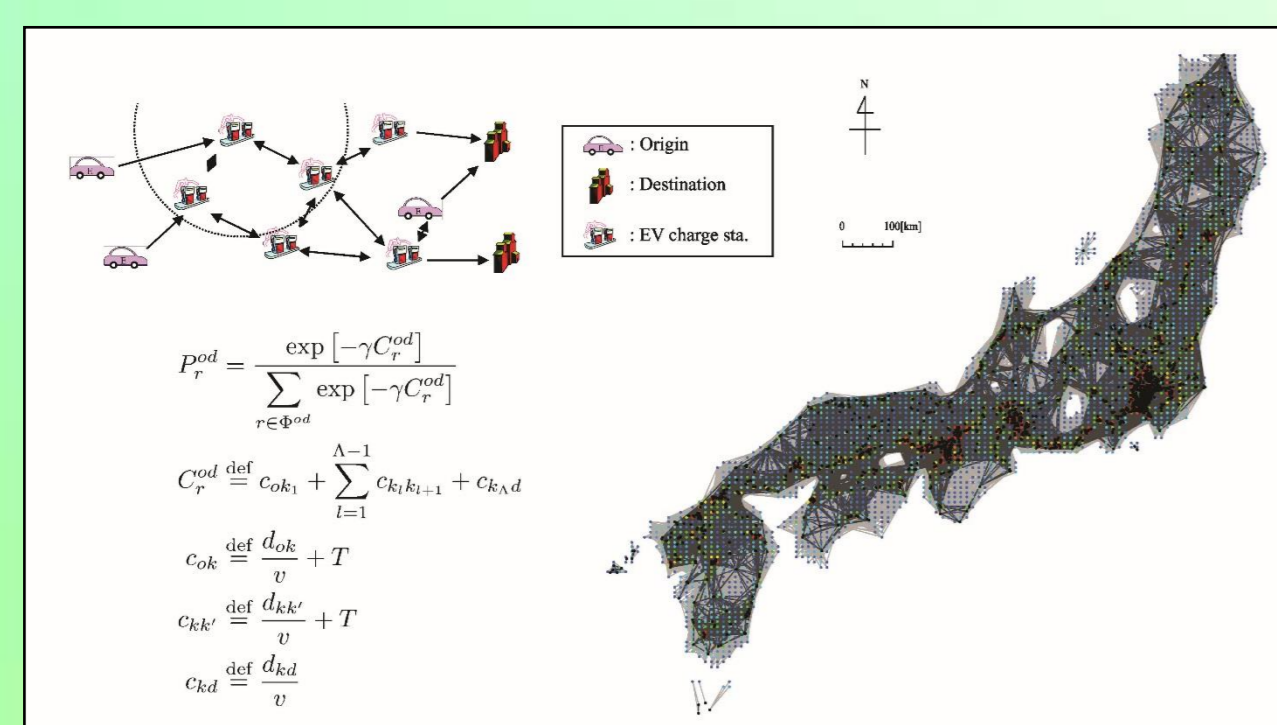
Real Data    Equilibrium Model    Optimal Model

**Simulation**    **Mathematical Modelling**    **Optimization**

◆ **Analysis of EV Movement Using Japanese Road Network**

EV have attracted an increasing amount of attention, but the cruising distance is insufficient. In this study, a mathematical model based on the supporting infrastructure is proposed.

◆ **Information Network for Sustainable Environment**

We present a new multi-path routing -MLB-routing-. Since MLB-routing is pure multi-path routing, it reduces the convergence on some links and increases bandwidth utilization in the network.

$$p_{j|i} = \exp[-\gamma c_{ij}] \frac{W_{j|D}}{W_{i|D}}$$
$$W_{j|D} = \sum_{l_j \in \phi_{j|D}} \exp[-\gamma C_{lj}^{j|D}] + \delta_{jd}$$

Server
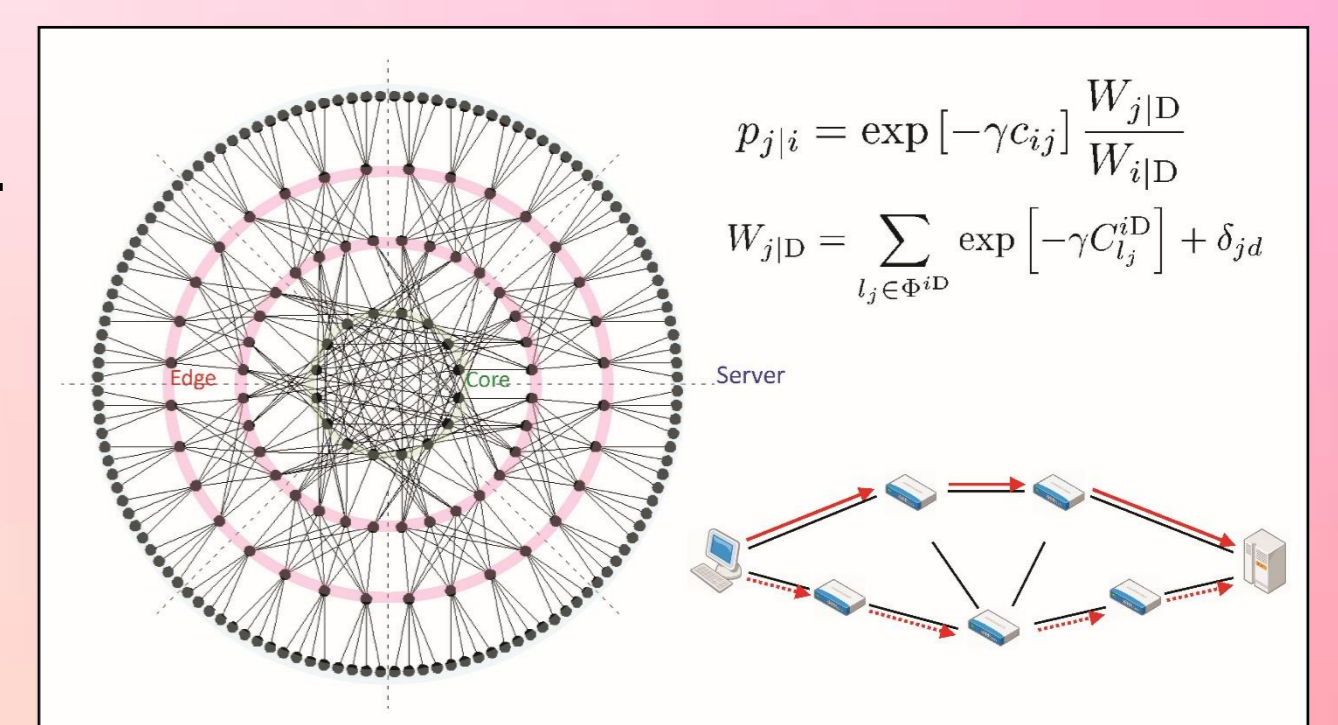
◆ **Sight-seeing Behavior Focused on Trip-chain**

Analyzing sight-seeing behaviors are important for sustainable development of each region. In this study, focusing on the trip-chaining behavior in Japan, and estimate the number of Tourists.
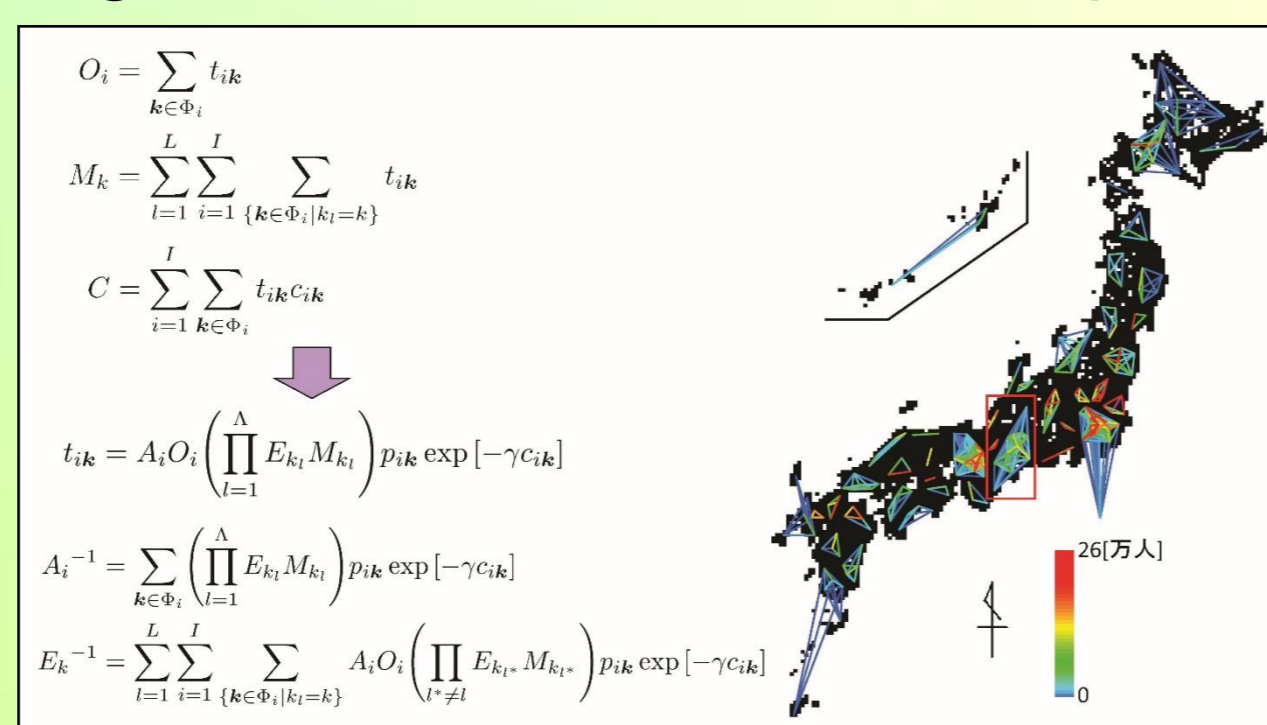
**Human**

◆ **Safety Stock in EV Battery Switch Stations**

Arrival of EVs (replacement)    Waited    Recharged    Full charged
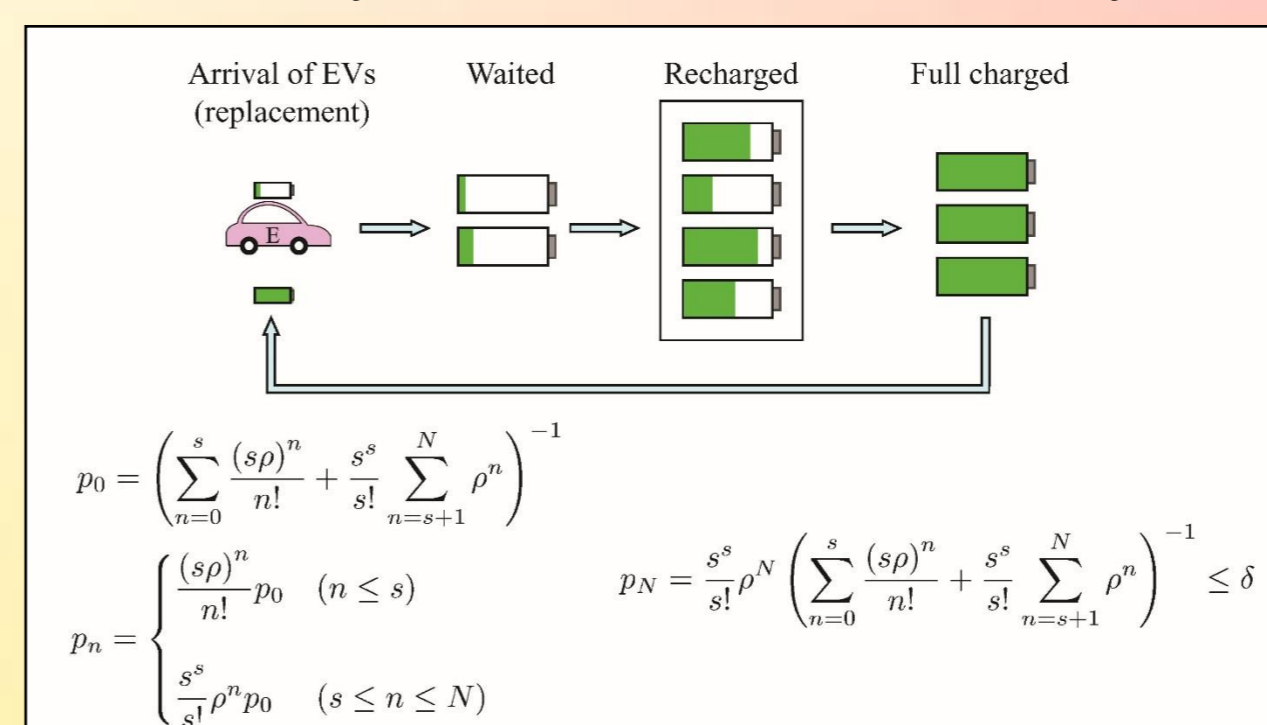
Some company has proposed an EV operations system called ``battery switch system". In this study, we focus on the infra-structure required to support the operation of battery switching system.