

# Converting Disused Lots to Housing

Equitable locations for new housing



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D2P SP-2023

# The Problem in Numbers

Figure 1: Housing supply and prices

Percent Change



Source: Federal Reserve Economic Data; National Association of Realtors Monthly Supply Data

Housing Supply and Prices. FRED

"In the Denver metro area, the deficit ranges between 14,604 and 62,606 units"

- commonsenseinstituteco.org

"According to findings from Housing Colorado, there is a shortfall of over 100,000 homes priced at an affordable level for households making less than \$20,000/year, representing over 16 percent of the entire rental stock in Colorado. It is a gap that, at current rates of affordable rental housing construction of 823 homes per year, will take over 100 years to eliminate."

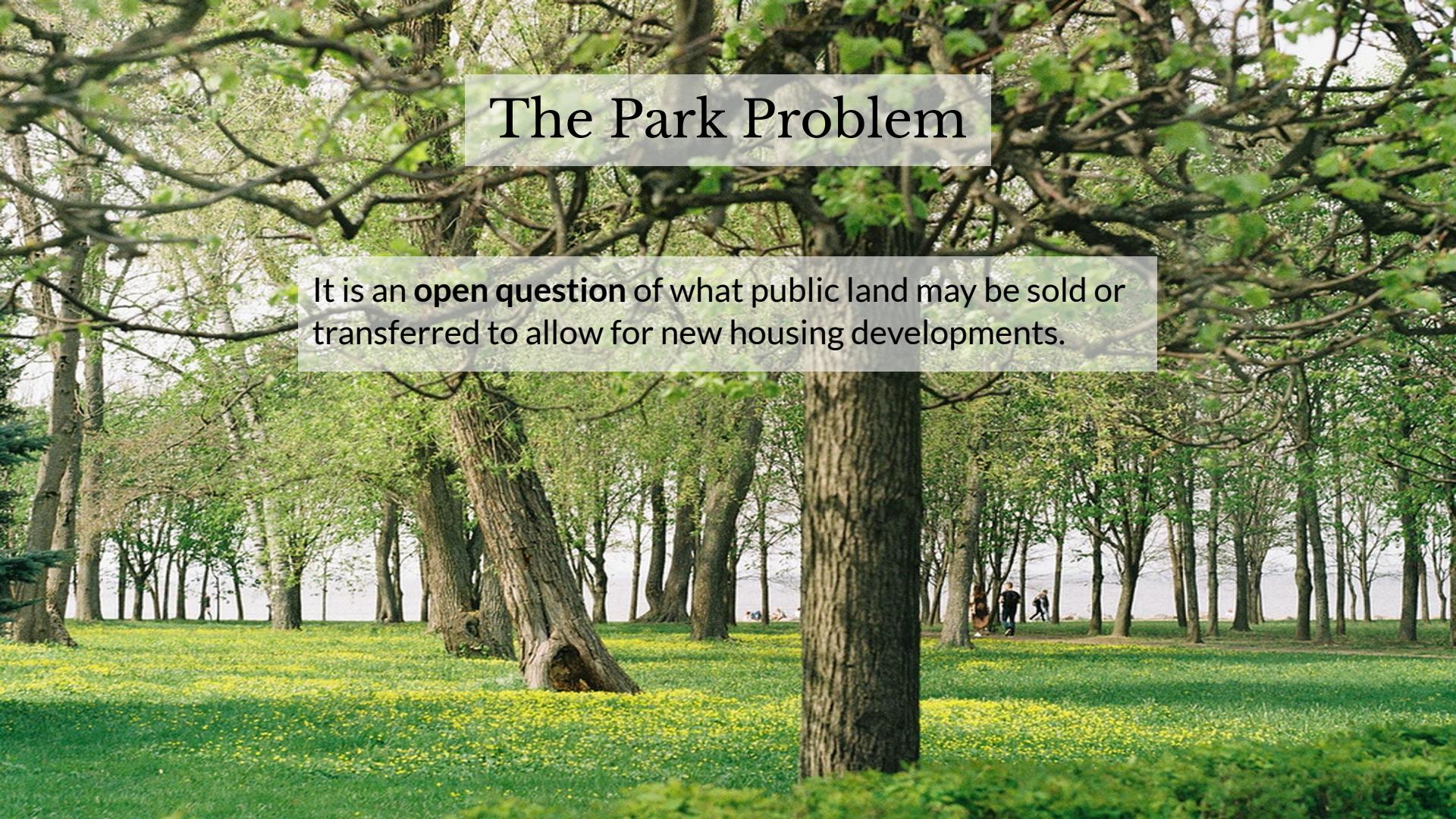
- denverchamber.org

# Unused Lots & Housing



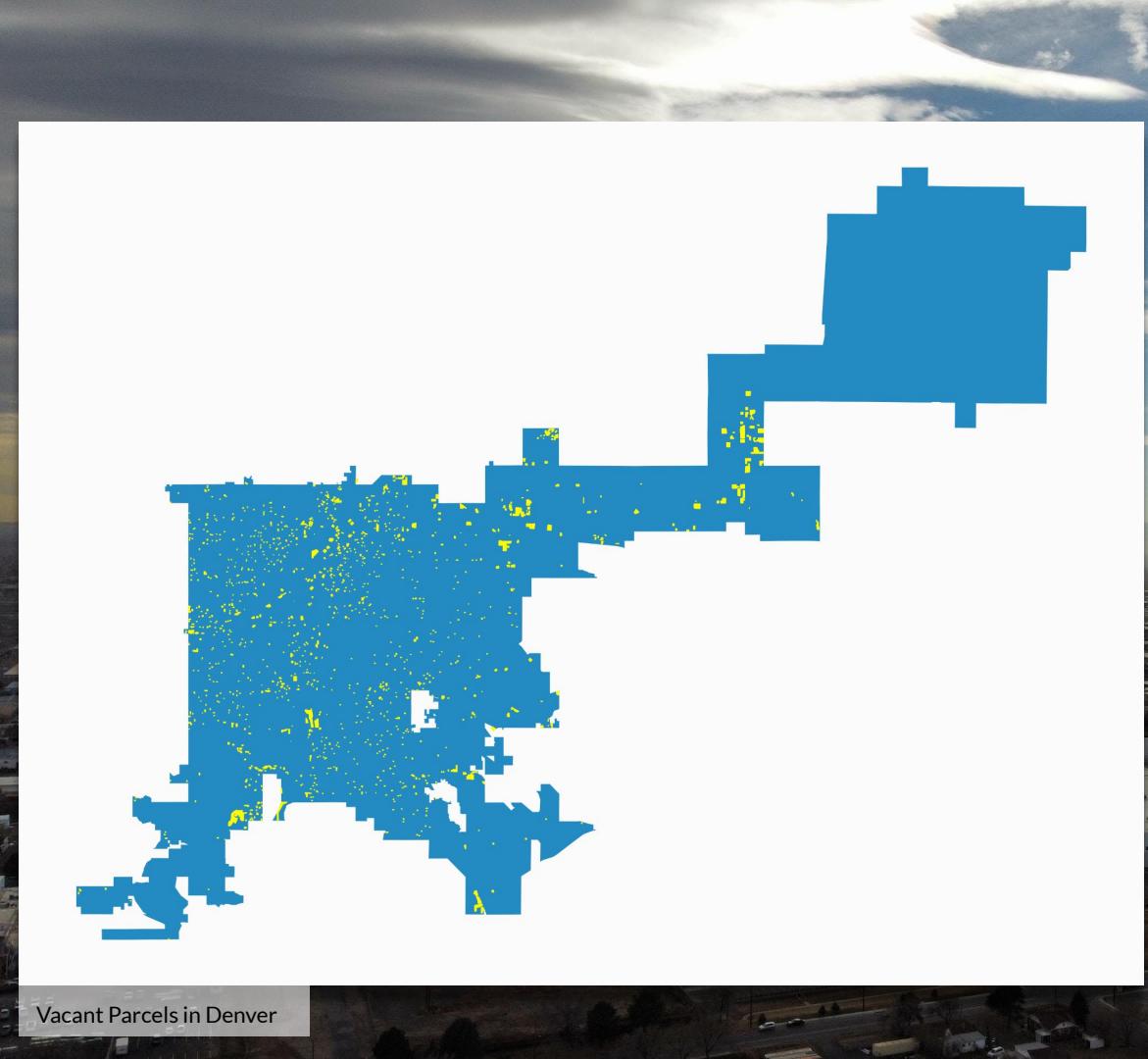
Credit: PBS12

Nearly every candidate for the Spring 2023 mayoral election recommended using vacant / underutilized land in the city's possession to create affordable housing.

A wide-angle photograph of a park. In the foreground, there's a field of green grass dotted with small yellow flowers. A dense line of tall, thin trees stands in the middle ground, their trunks leading towards a body of water. The sky is overcast. Overlaid on the upper portion of the image is a semi-transparent white box containing the title.

# The Park Problem

It is an **open question** of what public land may be sold or transferred to allow for new housing developments.



# A Problem We Can Solve

Denver has ~900 Acres of  
“vacant”, private land.

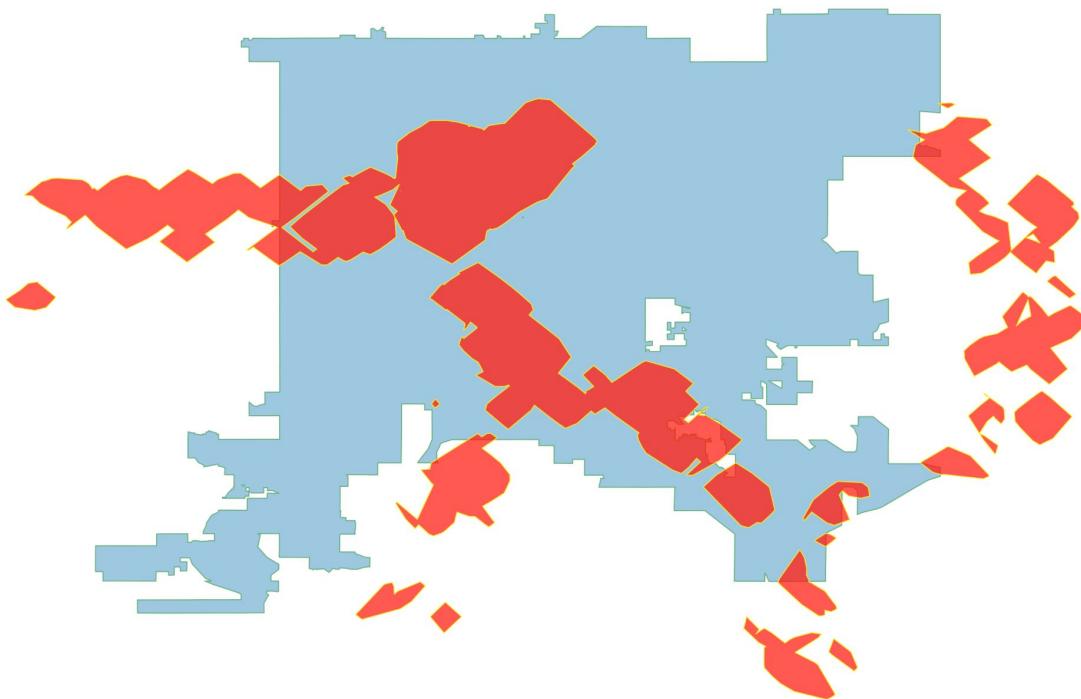
- Some land is temporarily vacant
- Many plots have been vacant for a decade or more

# Walking Disks



# Finding Equitable Locations

Areas within 20 min walk of a LightRail, a Supermarket, and a School



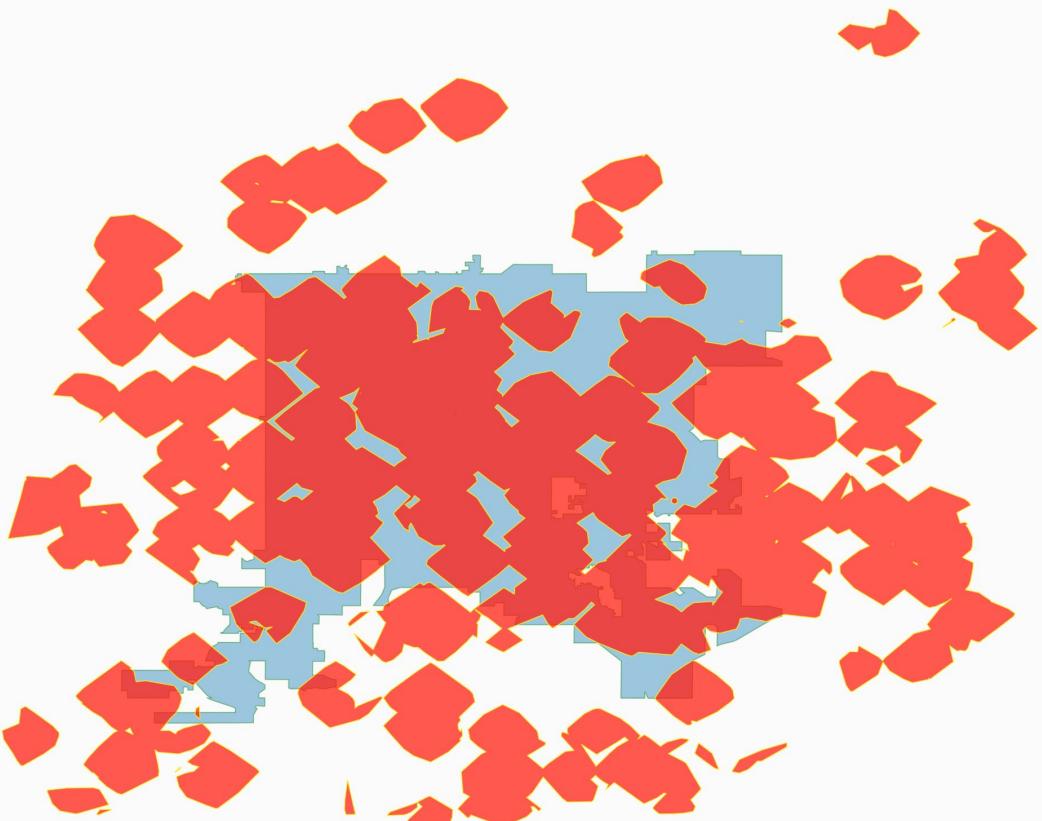
Areas within 20 min walk of amenities

To allow for equitable access to homes, only parcels with **20 minute** walking access to each

- Schools
- Light Rail Station
- Supermarkets

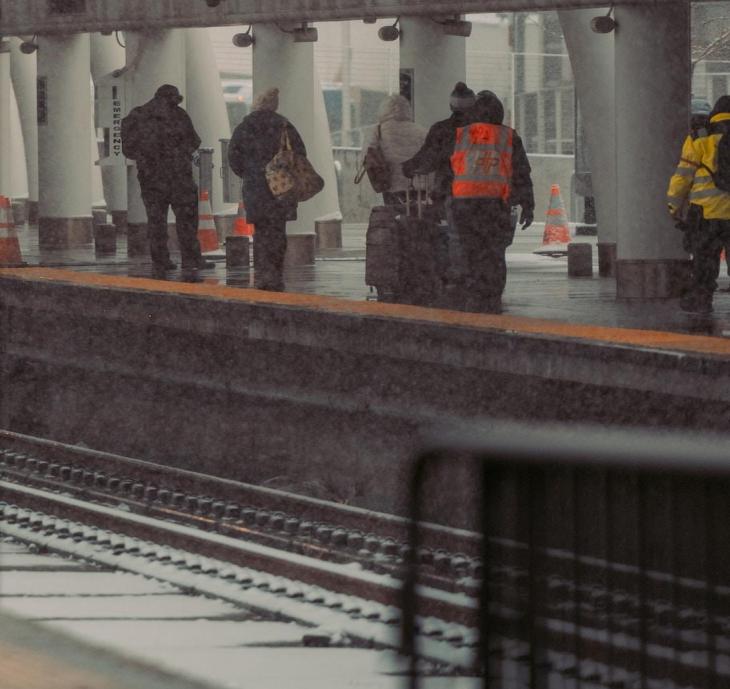
are considered.

Areas within 20 min walk of a Supermarket and a School



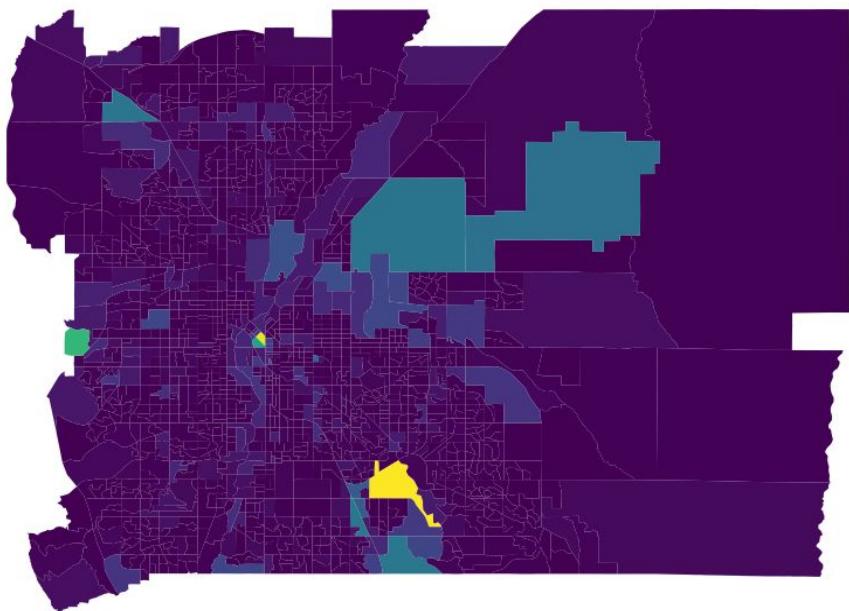
20 Minute Access to Schools and Supermarkets

Access without  
Light Rail  
Requirement

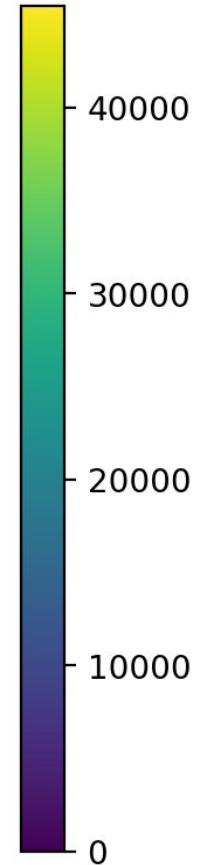


# Parcels for Consideration

Parcels after filtering on amenities



EPA Job Density (total jobs per census tract)



## Deciding Which Parcels to Use

- Employment access should be maximized.
- Total Cost should be minimized.

# Model A

$P$  :Set of parcels

$x_p$  :Indicator variables for parcel  $p$ . Selects whether the parcel is selected or not.

$c_p$  :Cost of parcel  $p$

$v_p$  :Capacity, in units, of a parcel  $p$

$e_p$  :Employment Coverage of parcel  $p$

$D$  :Total demand in terms of units

$\alpha, \beta > 0$  :Weights for cost vs employment coverage

$$\begin{aligned} \min \quad & \sum_{p \in P} \alpha x_p \cdot c_p - \beta x_p \cdot e_p \\ \text{s.t.} \quad & \sum_{p \in P} x_p \geq D \end{aligned}$$



# Suggested Parcels

In these parcels, about 1000 homes could be build with  
**20 min or less access to**

- Schools
- Supermarkets
- Light Rail
- A total of 14k local jobs

for a total estimated cost of  
\$13 mil (for land).

# Model B

$P$  :Set of parcels

$x_p$  :Indicator variables for parcel  $p$ . Selects whether the parcel is selected or not.

$c_p$  :Cost of parcel  $p$

$v_p$  :Capacity, in units, of a parcel  $p$

$\theta_{jk}$  :Overlap of walking disks for parcels  $j$  and  $k$

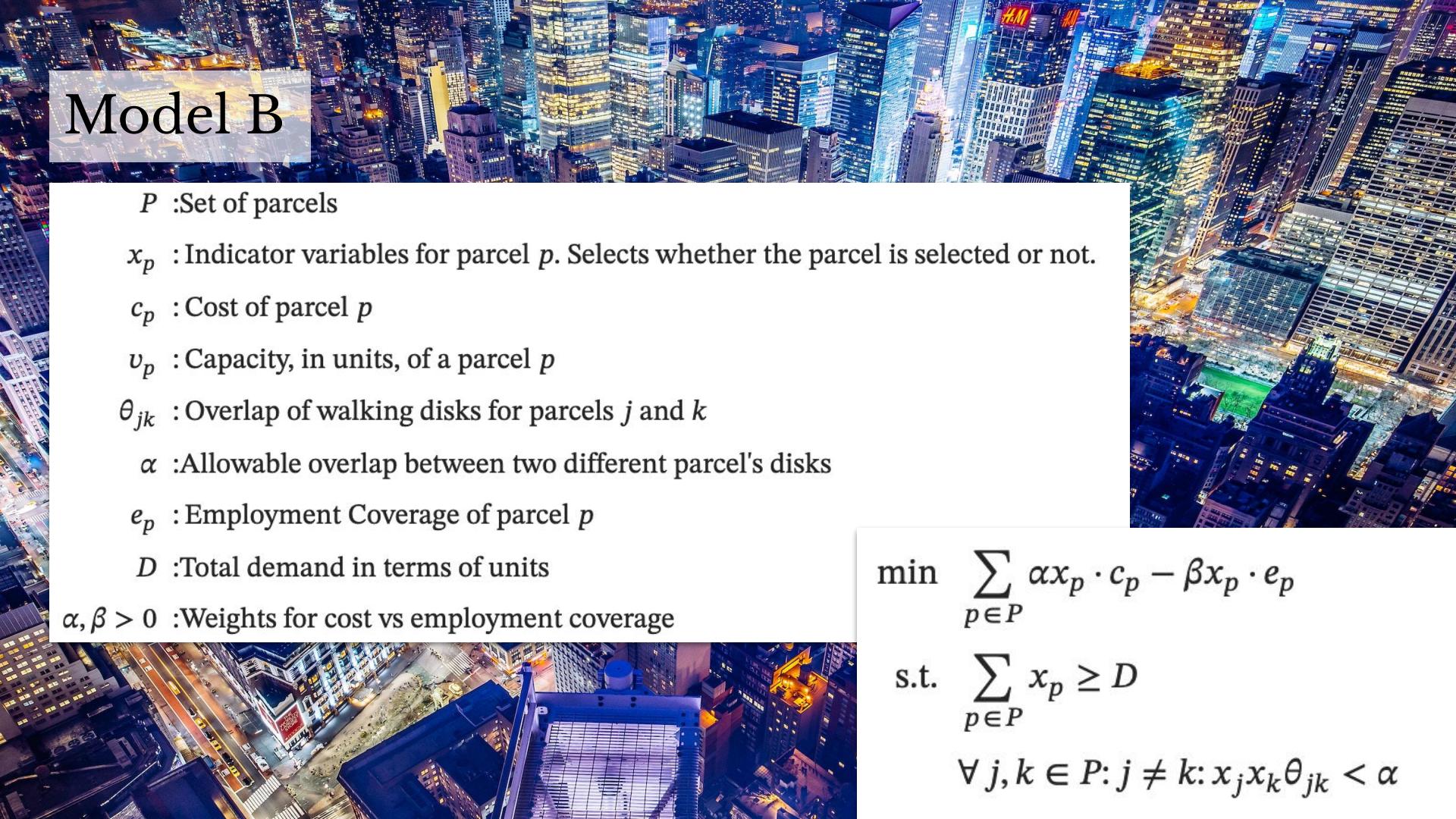
$\alpha$  :Allowable overlap between two different parcel's disks

$e_p$  :Employment Coverage of parcel  $p$

$D$  :Total demand in terms of units

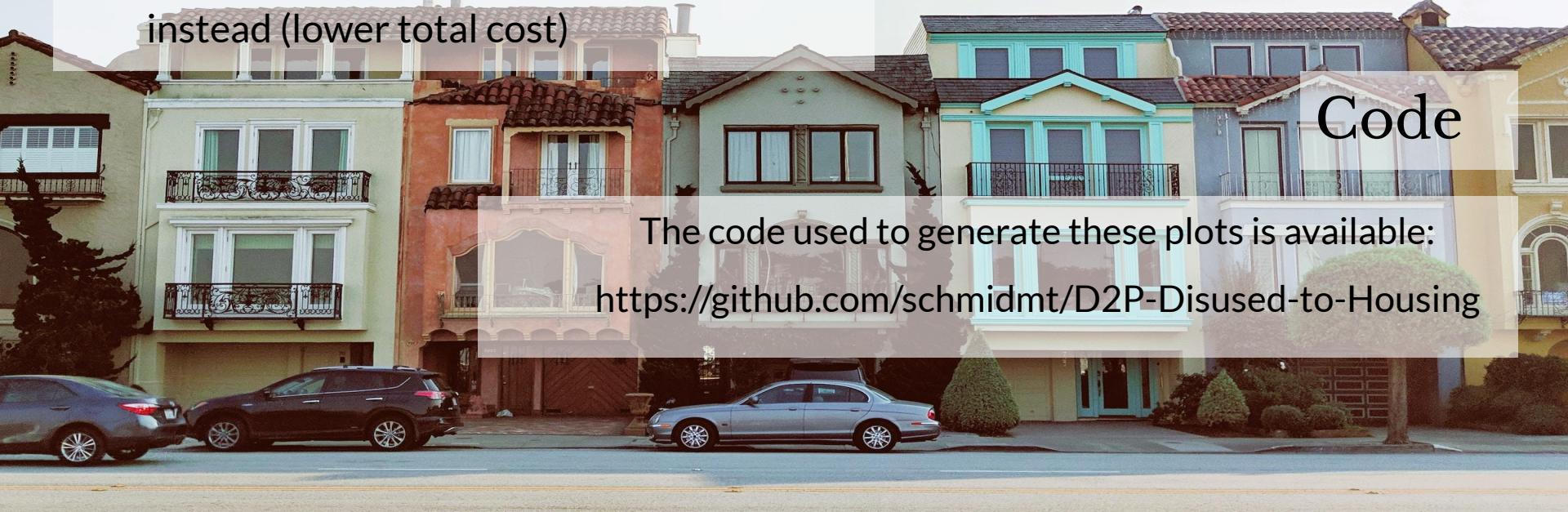
$\alpha, \beta > 0$  :Weights for cost vs employment coverage

$$\begin{aligned} & \min \sum_{p \in P} \alpha x_p \cdot c_p - \beta x_p \cdot e_p \\ \text{s.t. } & \sum_{p \in P} x_p \geq D \\ & \forall j, k \in P: j \neq k: x_j x_k \theta_{jk} < \alpha \end{aligned}$$



# Future Work

- Better data on disused instead of vacant
- More advanced model of transportation
- Which plots of public land could be used instead (lower total cost)



Code

The code used to generate these plots is available:  
<https://github.com/schmidmt/D2P-Disused-to-Housing>

# References

- [Parcels | City and County of Denver / Department of Finance / Assessment Division / GIS Section | Denver OpenData](#)
- [Colorado Housing Affordability Update: November 2022 | Common Sense Institute](#)
- [Alleviating Supply Constraints in the Housing Market | CEA](#)
- [Policy: Housing White Paper - Denver Metro Chamber of Commerce](#)
- [Employment Density | EnviroAtlas](#)
- [Gentle Density can save our neighborhoods | Brooking](#)

Photo Credits

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