

# The Value of Daylight In Office Buildings

Christoph Reinhart

Velux Symposium Paris | Oct 9 2019



# Benefits of Daylight

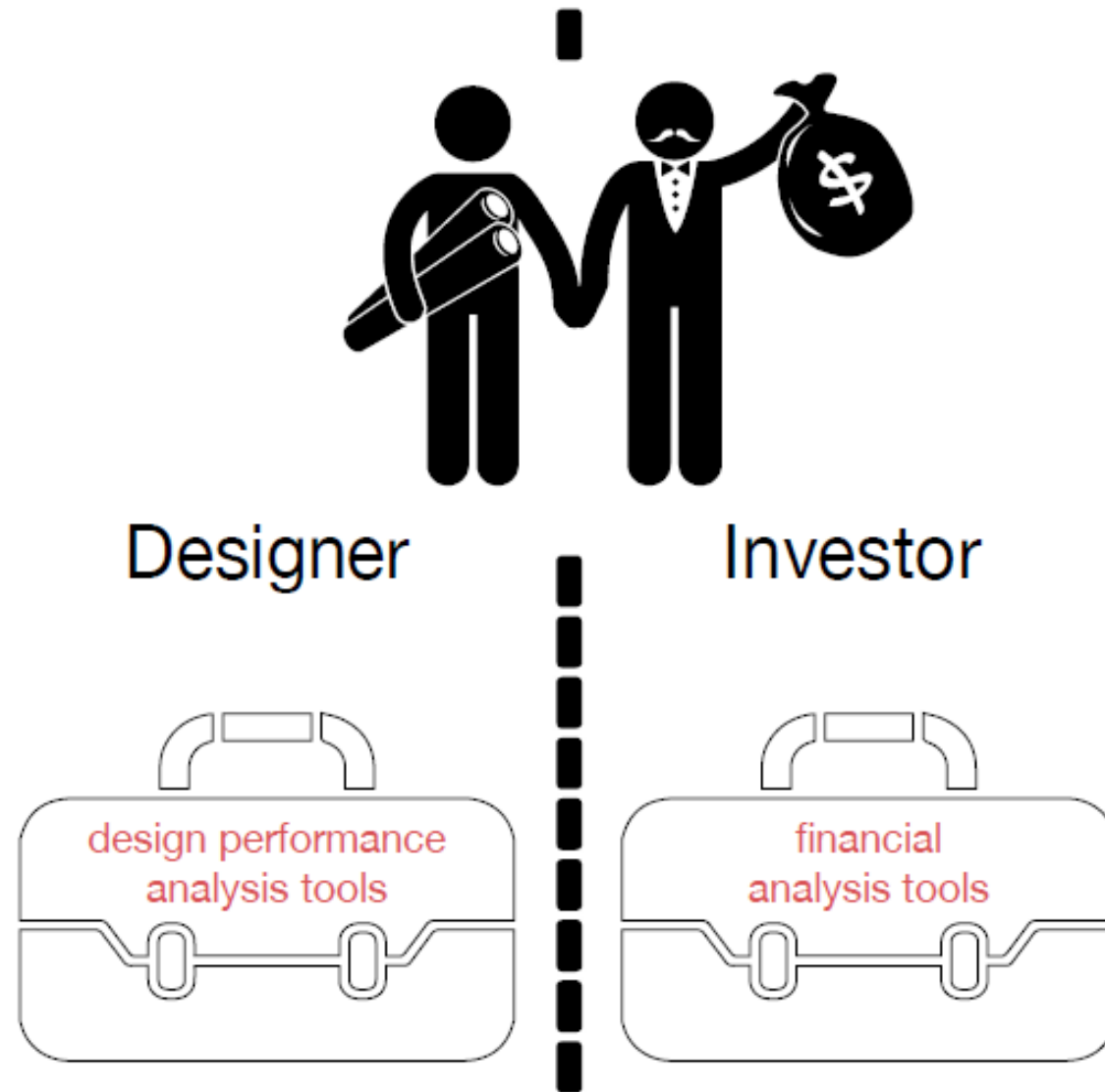
- ❑ Enhanced indoor environmental satisfaction
- ❑ Greater workplace productivity
- ❑ Decreased stress
- ❑ Connection to the outside
- ❑ Higher prestige
- ❑ Energy savings

⇒ These are all tenant benefits.

⇒ The question remains whether social value translates into economic value measured by what tenants are willing to pay?

# During early design

Image: I Turan



# Research Question

Image: I Turan



I Turan



C Reinhart

MIT Sustainable Design Lab



A Chegut



D Fink

MIT Real Estate Innovation Lab

What is the financial value of **daylight** in commercial spaces in Manhattan?

# Anecdotal Evidence

**150 Wooster St. Loft 6, New York, NY 10012**  
\$14,850,000  
In Contract

**Description:** Loft (ex. of 100 Wooster) is a full floor, 4 bedroom, 4.5 bath and 4,271 square foot residence **flooded with natural light**. The interior was designed with wide-open spaces and large-scale windows as an homage to the original Soho artists' residences of the 60s and 70s, incorporating exquisite detailing and modern conveniences, including 18 millibuck baseboards and large plank fumed white oak floors as a fully integrated Luxon lighting system and a 184 square foot private balcony. As an added bonus, this residence has been pre-wired with smart home automation system and Lutron motorized shades.

The keyed elevator opens directly into the private entry gallery leading to the generous living and dining areas, elegantly separated by sculptural gas fireplace. The chef's kitchen consists of Danby marble island, countertops, and cabinet faces, state-of-the-art appliances, large walk-in pantry. The master bathroom is complete with a custom Danby marble island, vanity, Danby marble mosaic floors, walls, 6-foot soaking tub and separate water closet. A laundry room with full sized washer and dryer and three additional bedrooms & bathrooms complete the living quarters.

foot residence **flooded with natural light**. The interior was the original Soho artists' residences of the 60s and 70s, while work baseboards and large-plank fumed white oak floors, as well

**212 West 18th St. PENTHOUSE 1, New York, NY 10011**  
\$46,000,000

**550 WEST 29TH STREET**  
A NEW BUILDING BY Tamarkin Co.

**Key Features:** Penthouse, 20' Double Height, Private, Gym, Elevator, Pet-Friendly, Parking

**Description:** Incredible Penthouse One at 550 West 29th, widely considered to be the best penthouse apartment in the city, is now available with 3 bedrooms, 3.5 bathrooms and 3,500 square feet of outdoor space on a private terrace.

house One offers unrivaled luxury and **360-degree views** of the Hudson River, the city's most significant building.

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**RESIDENCES**  
Solid 4-inch wide rift and quarter sawn white oak floors with natural finish.  
20' double height apartment entry doors in elevated European architectural chrome hardware.  
Energy efficient, individually controlled multi-zone heating and cooling.  
Washer and dryer.  
Stainless feature private rear terraces.  
Duplexes feature 20'-0" double height living spaces, ornamental steel and white oak stairs and handrail.  
South-facing 40-plus feature private balconies.  
Penthouses feature private keyed entry from elevator, gas fireplace, 20'-0" double height living spaces and **special terraces with river views**.

**AMENITIES**  
24-hour attended lobby.  
Full-time building superintendent.  
Fitness room and spa.  
State-of-the-art recreation and video security system.  
Laundry room with commercial-grade machines for coin and home.  
Private storage rooms for each residence.  
Bicycle room.

glass offering abundant natural light. The majority of the residences feature **panoramic views of the High Line, Hudson River or the architecture of West Chelsea, and**

Penthouses feature private keyed entry from elevator, gas fireplaces, 20'-0" double-height living spaces and **spacious terraces with river views**

□ Ads praising the daylight in apartments abound

# Anecdotal Evidence

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## REAL ESTATE

### Will the Loss of a View Lead to Lower Maintenance Costs?

Ask Real Estate By RONDA KAYSEN NOV. 25, 2017

Nadia Pillon

**Q.** I live in a Manhattan co-op with open East River views. But a building will soon rise next door, abutting much of our 20-story building and obstructing most river views, including mine. The value of my apartment and others will certainly take a hit, yet our maintenance costs, which include property taxes, are high. Might the city take this change into account and reassess our property? Or, could other maintenance costs be reduced? I am concerned that when I go to sell my apartment without the coveted views, the high maintenance will be an instant deal breaker.

**A.** "In New York, the first thing buyers do is they walk to the window," said Tony Sargent, an associate broker with CORE. "They want to see what's outside."

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So yes, a river view matters. Mr. Sargent estimates that waterfront apartments that have a river view fetch around \$300 more per square foot than those without.

Once that building goes up, your property value might take a hit. Could you get a discount on your maintenance just because your apartment has lost some value? No. Maintenance pays for common costs like the building's property taxes, fuel and labor. Unless those costs fall, your maintenance will not change.

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How much you pay in maintenance is determined by how many shares of the corporation are allocated to

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So yes, a river view matters. Mr. Sargent estimates that waterfront apartments that have a river view fetch around \$300 more per square foot than those without.

"Will the Loss of a View Lead to Lower Maintenance Costs?"  
New York Times, November 2017

Kaysen, R. (2017) 'Will the Loss of a View Lead to Lower Maintenance Costs?', The New York Times, 25 November, p. RE2.

□ Including rough estimates that are being used in industry

# Catch That Moment



Signing of the rental contract

# Hedonic Pricing Model

Revealed preference model that identifies the factors that influence the price of a good, assuming that the price is based on both intrinsic characteristics and external factors.

$$\log P_i = \alpha + \beta X_i + \delta g_i + \varepsilon_i$$

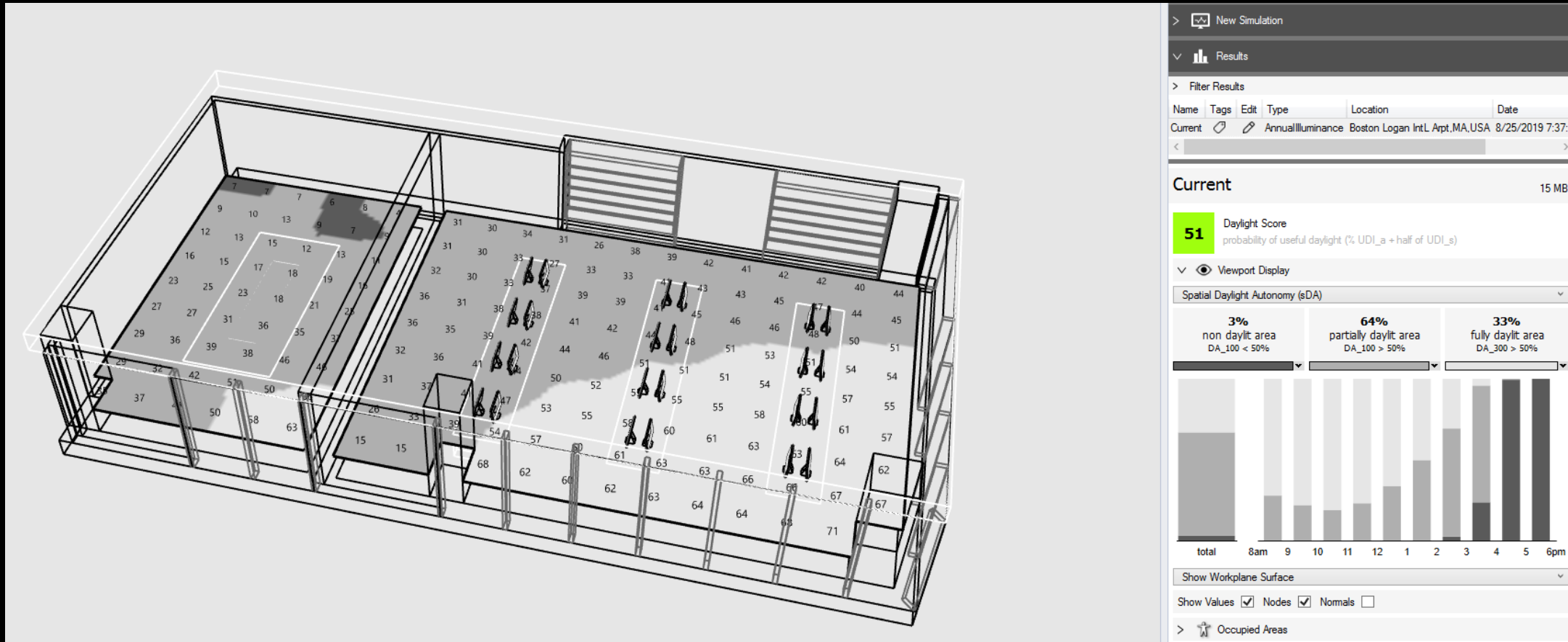
Price

Add daylight availability

Hedonic characteristics include:  
property type; age; building class; number of floors;  
renovations; amenities; transportation accessibility;  
investor type



# Metric: Spatial Daylight Autonomy

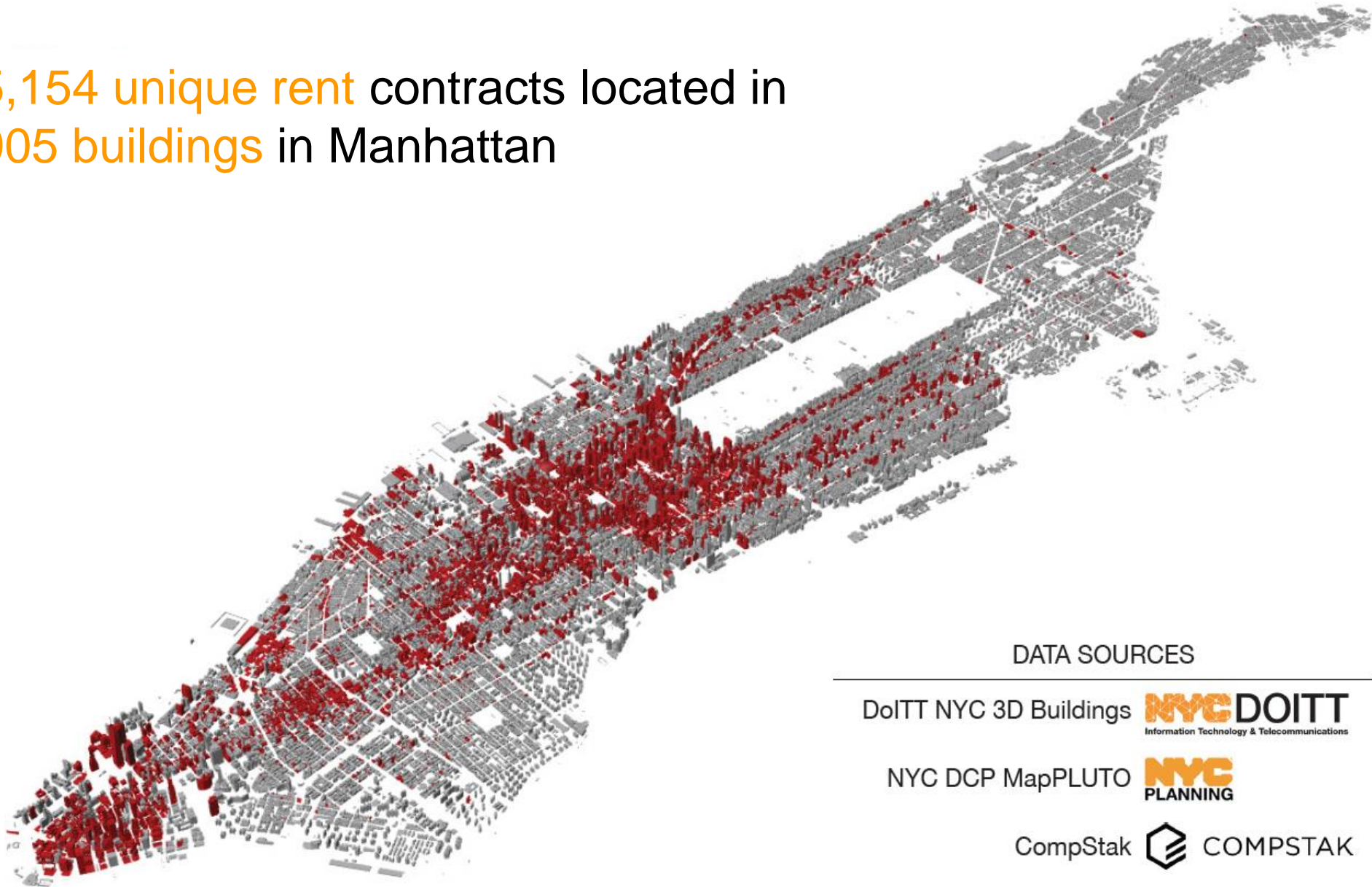


Source: Solemma LLC

- ❑ High-level metric to evaluate whether a space is daylit
- ❑  $sDA_{300lux}[50\%]$  has been linked to occupant evaluations during one time space visits

# The Data

5,154 unique rent contracts located in  
905 buildings in Manhattan



## DATA SOURCES

DoITT NYC 3D Buildings **NYC DOITT**  
Information Technology & Telecommunications

NYC DCP MapPLUTO **NYC**  
PLANNING

CompStak  **COMPSTAK**

Source, I Turan, A Chegut, D Fink & C Reinhart

# The Workflow

Compstak  
Data



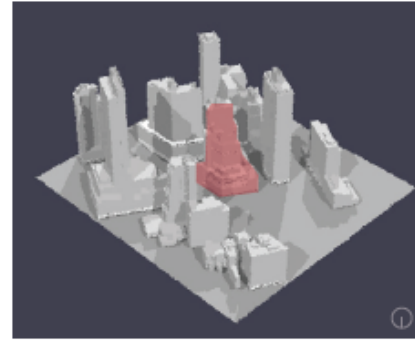
3D Model of  
Manhattan



+



Create a Model for  
Each Building



Climate-Based  
Daylighting Simulations

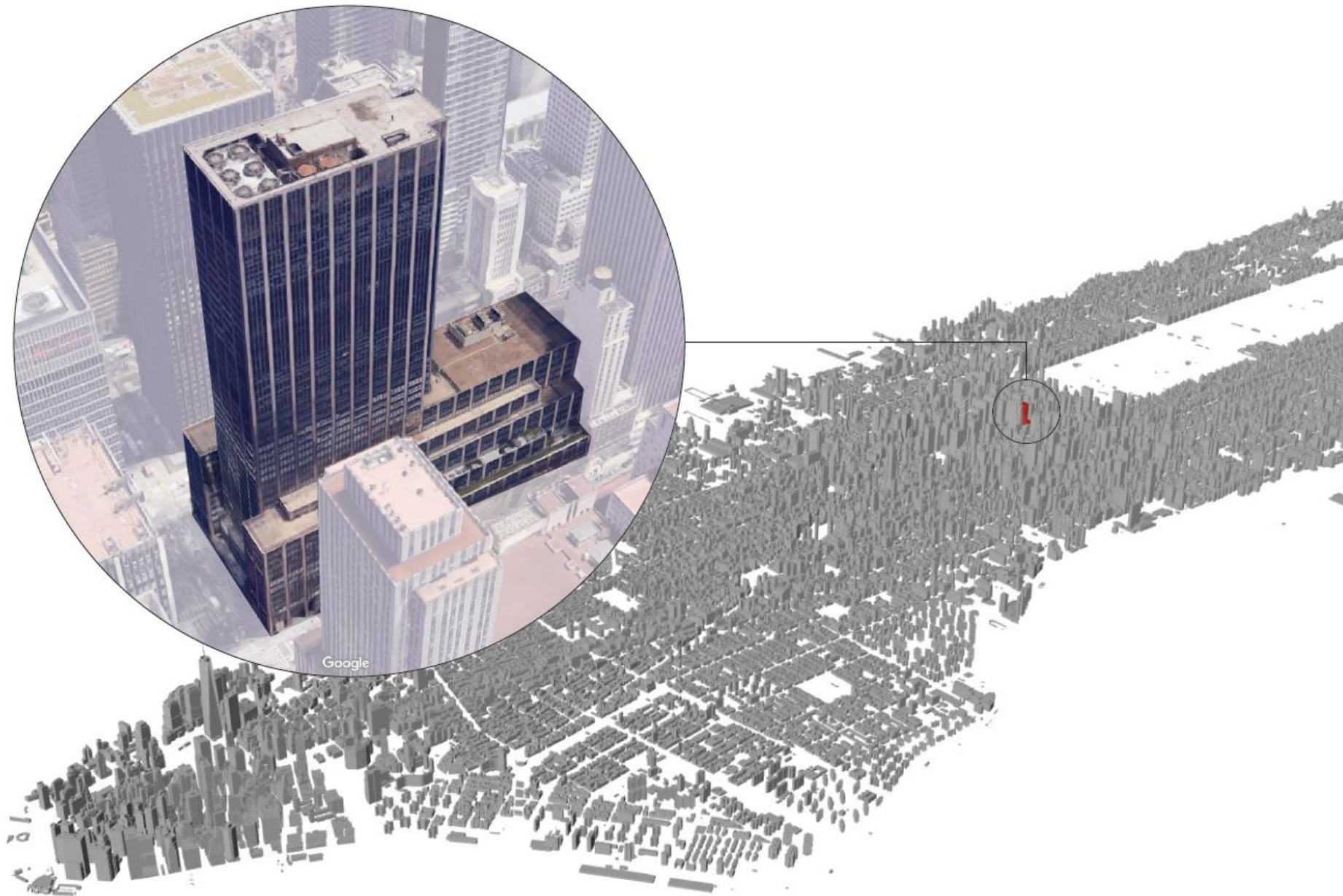
spatial Daylight Autonomy  
(sDA) and view results  
for all office spaces

Hedonic Pricing Model

$$\log P_i = \alpha + \beta X_i + \delta g_i + \varepsilon_i$$

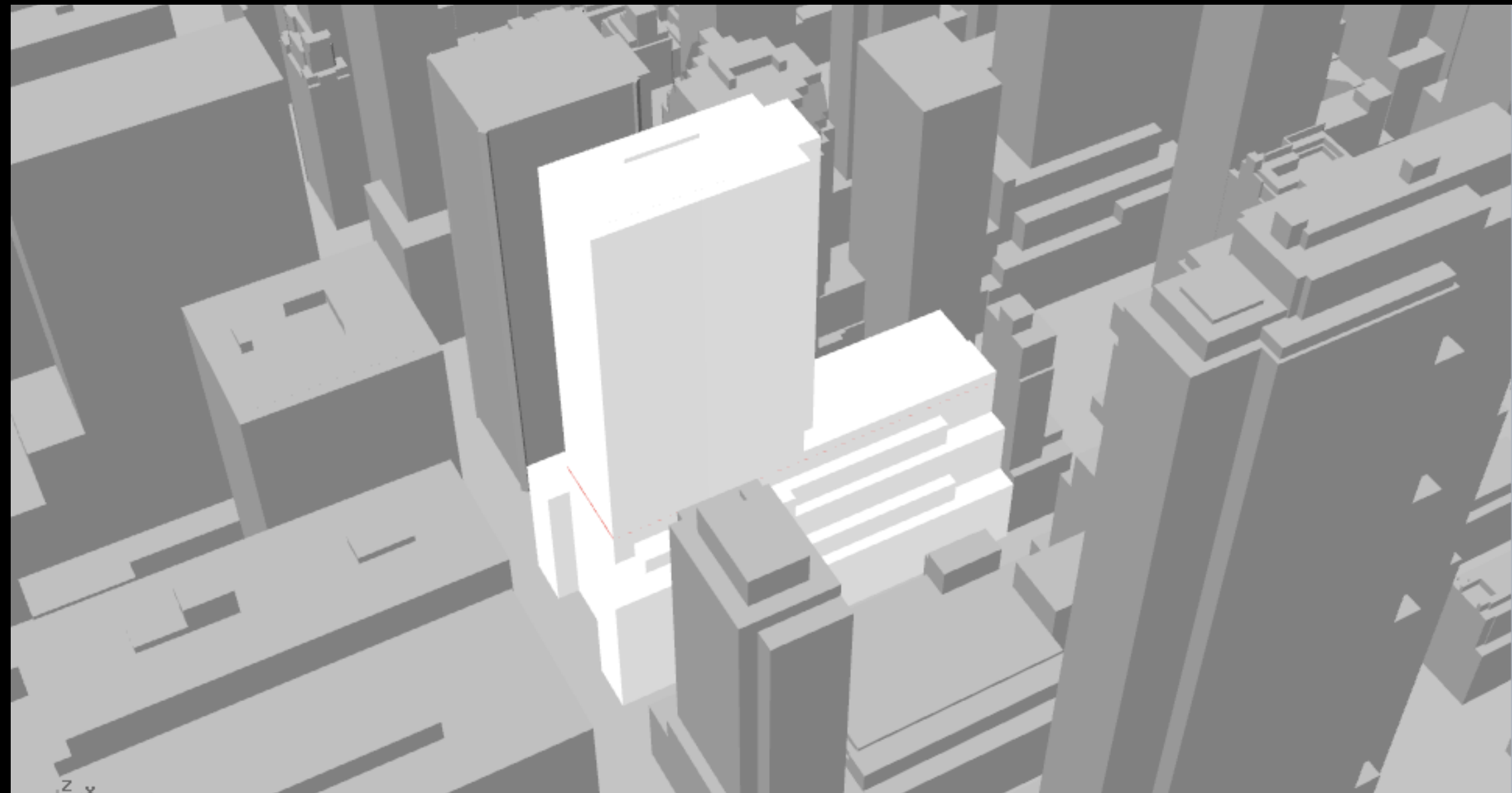
Source, I Turan, A Chegut, D Fink & C Reinhart

# Sample Building



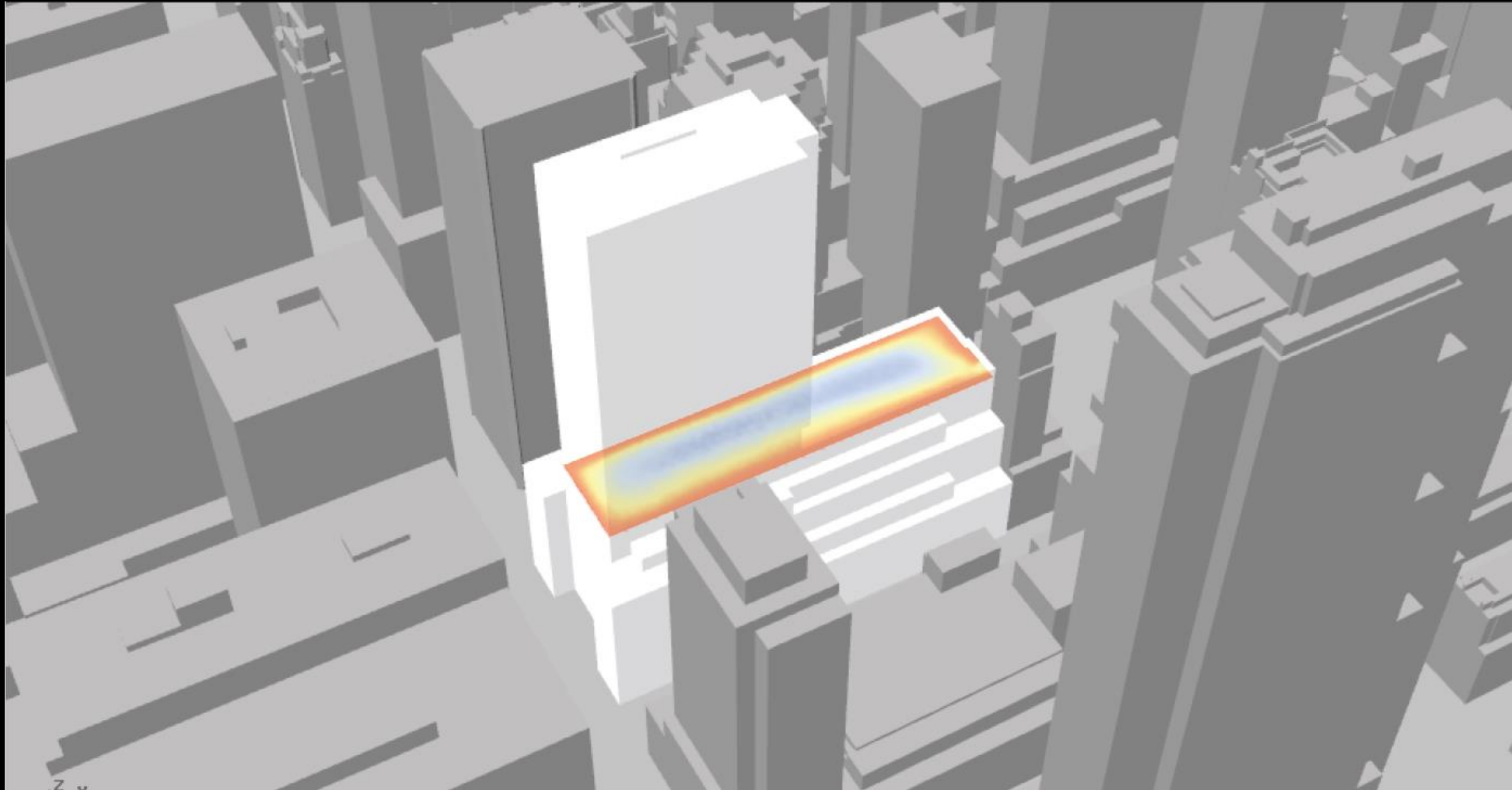
Source, I Turan, A Chegut, D Fink & C Reinhart

# 3D Model in Rhino



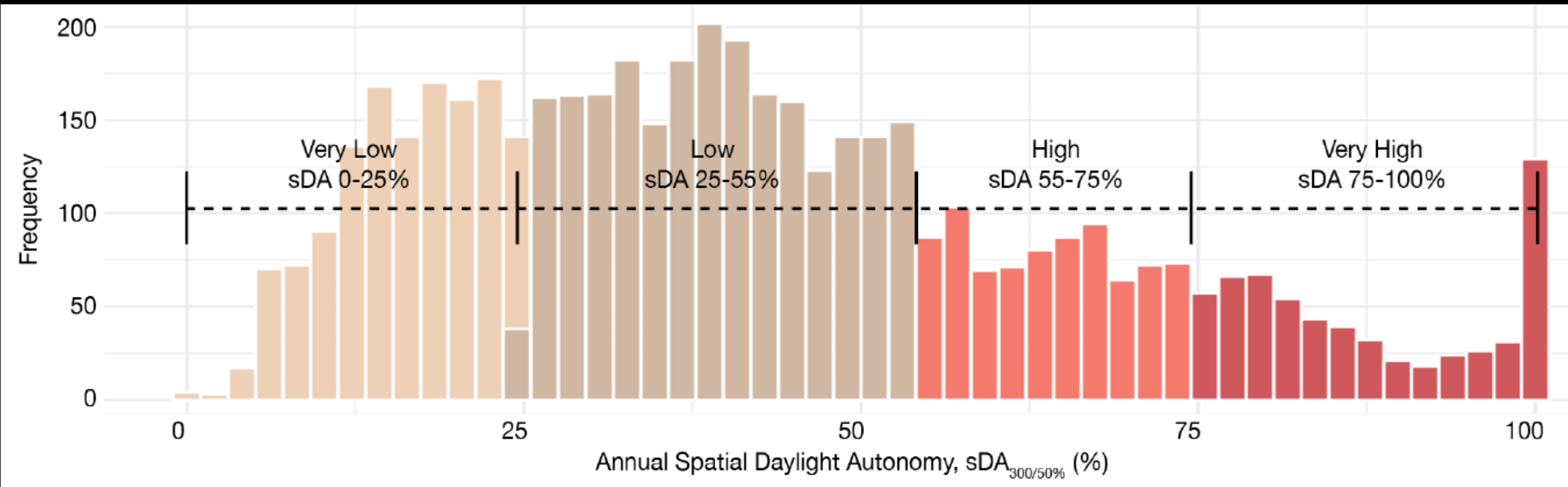
Source, I Turan, A Chegut, D Fink & C Reinhart

# Simulation Result sDA=46%



# Results

# sDA Distribution in Manhattan

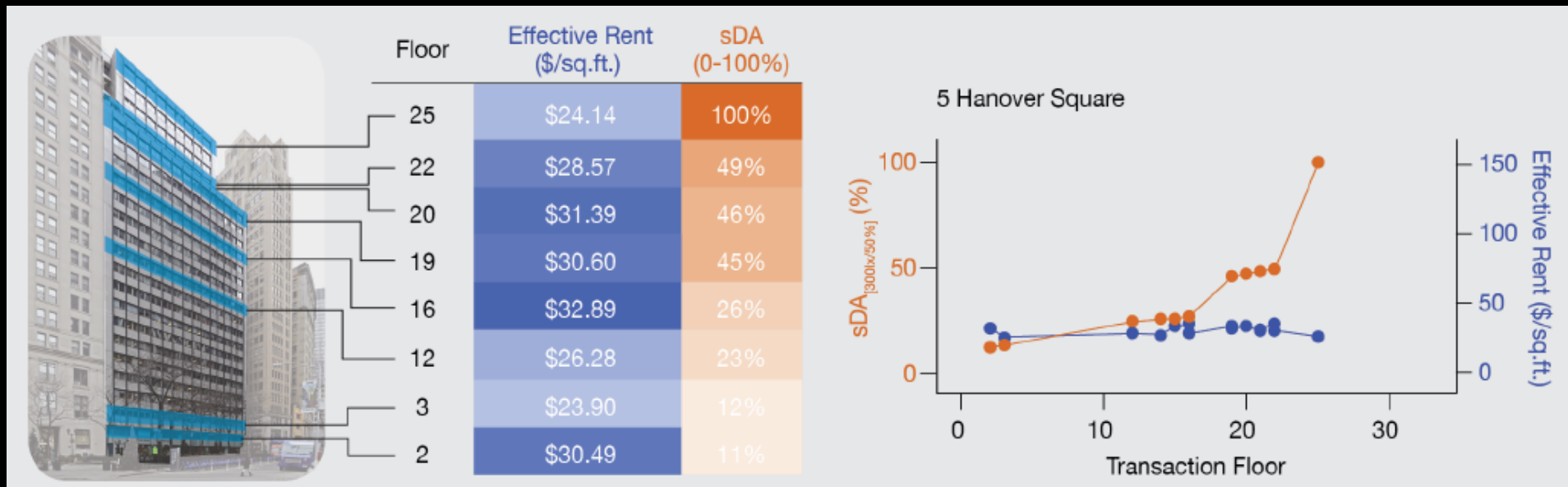
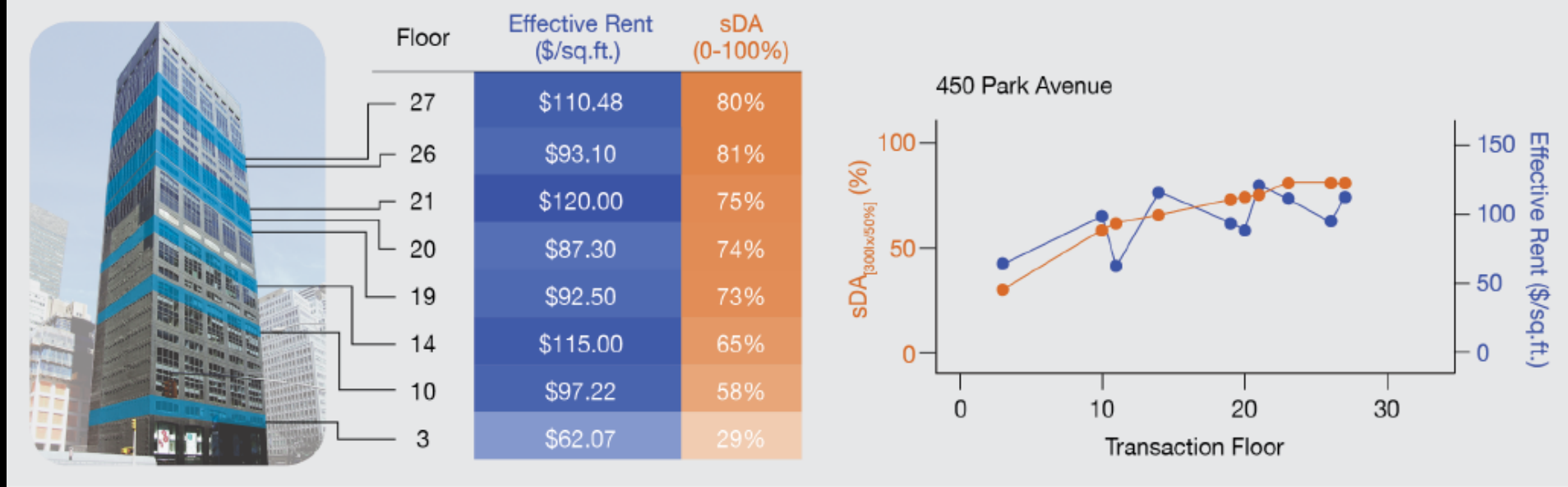


Source, I Turan, A Chegut, D Fink & C Reinhart

- ❑ Range from 0% to 100%; mean sDA = 43%; standard deviation 23%; median 39%;
- ❑ 74% of the spaces have very low to low daylight levels (0-55% sDA)
- ❑ Access to daylight is a **meaningful discriminator**



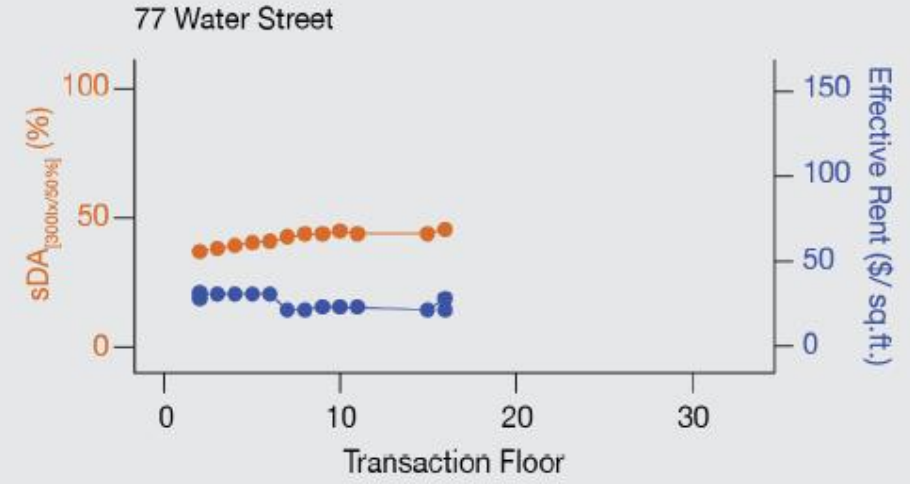
# sDA, Rent Prices and Floors



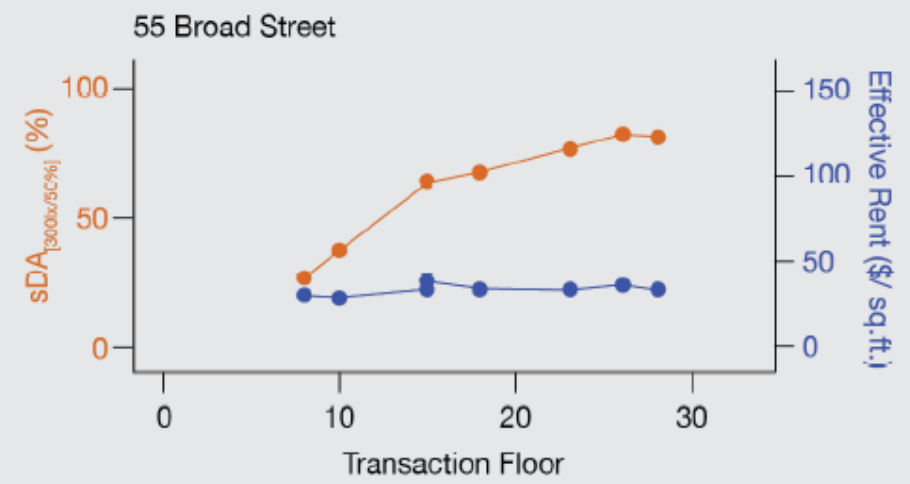
# sDA, Rent Prices and Floors



Floor	Effective Rent (\$/sq.ft.)	sDA (0-100%)
16	\$27.14	45%
15	\$20.24	43%
11	\$21.41	43%
9	\$22.25	43%
7	\$20.15	42%
5	\$29.31	40%
3	\$29.31	38%
2	\$26.26	36%

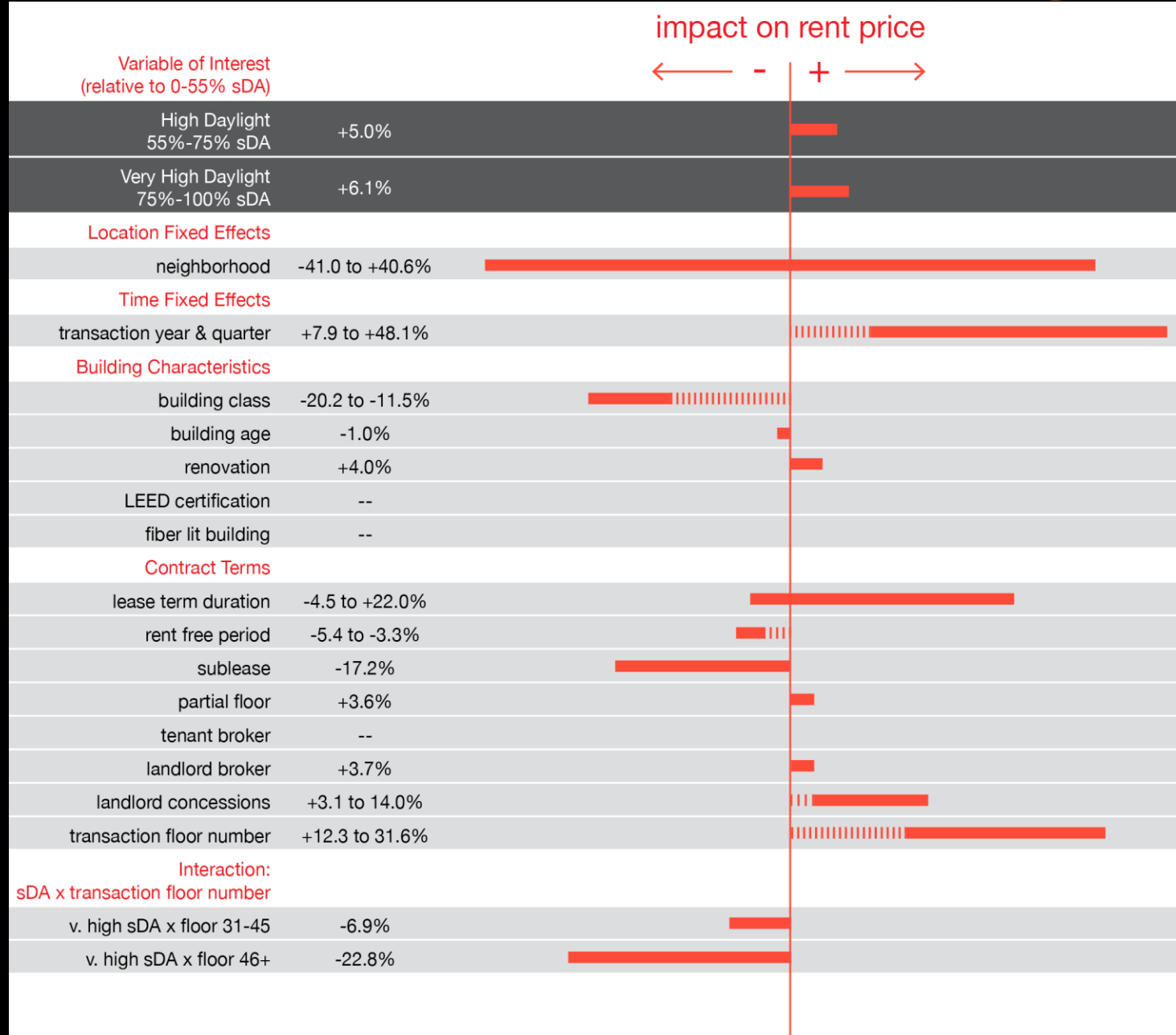


Floor	Effective Rent (\$/sq.ft.)	sDA (0-100%)
28	\$31.43	81%
26	\$34.60	82%
23	\$31.43	77%
18	\$32.30	67%
15	\$36.50	63%
15	\$32.00	63%
10	\$27.20	37%
8	\$28.26	26%



Source, I Turan, A Chegut, D Fink & C Reinhart

# Hedonic Model with Daylighting



Source, I Turan, A Chegut, D Fink & C Reinhart

# Hedonic Model with Daylighting

These results suggest that spaces with high amount of daylight ( $sDA > 55\%$ ) earn an estimated effective **rent premium of 5%** vis-à-vis buildings with low daylight penetration (i.e.  $sDA_{300lux} < 55\%$ ).

# Caveats

- ❑ We used the sDA as a proxy for both daylight and views. We are currently separating these characteristics.
- ❑ We assumed 30% WWR on all orientations and standard materials throughout all buildings. We are now trying to further adjust for some of these parameters.
- ❑ We did not consider blind use and interior floor plan layout and thus calculated the daylighting potential of a space.

# Significance

- We have shown that access to daylight has a direct and measurable impact of rent prices in commercial spaces in Manhattan.
- The rent premium of **5% to 6%** provides additional motivation for real estate developers to invest in well daylit spaces.
- It further provides **agency for architects** trying to convince developers to pay for additional daylight features.

# Thank You

MIT Building Technology Program



Christoph Reinhart MIT Sustainable Design Lab Yu Qian Ang + Alpha Arsano Zach Berzolla + Khadija Benis + Mariana Liebman-Pelaez + Jiamin Sun + Irmak Turan + Liz Young Solemma LLC Timur Dogan + Alstan Jakubiec + Kera Lagios + Jeff Niemasz + Jon Sargent Mapdwell LLC Eduardo Berlin + Alstan Jakubiec + David Nix + Nicolás Waissbluth SDL Alumni Jamie Bemis + Carlos Cerezo + Lukas Debiasi + Timur Dogan + Karthik Dondeti + Jamie Farrell + Elliot Glassman + Jeff Geisinger + Seth Holmes + Ali Irani + Alstan Jakubiec + Nathaniel Jones + Cynthia Kwan + Diego Ibarra + Rohit Manudhane + Rashida Mogri + Shreshth Nagpal + Azadeh Omidfar + Aiko Nagano + Debashree Pal + Krista Palen + Tiffany Otis + Tarek Rakha + Cody Rose + Holly W Samuelson + Manaos Saratsis + Julia Sokol + Jennifer Sze + John Sullivan + Bradley Tran