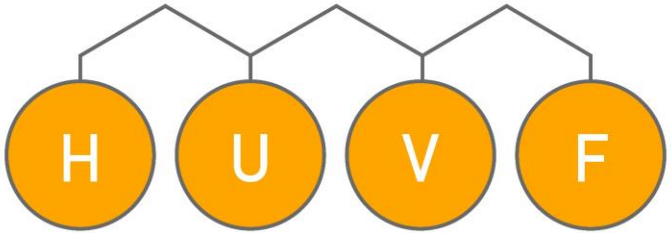
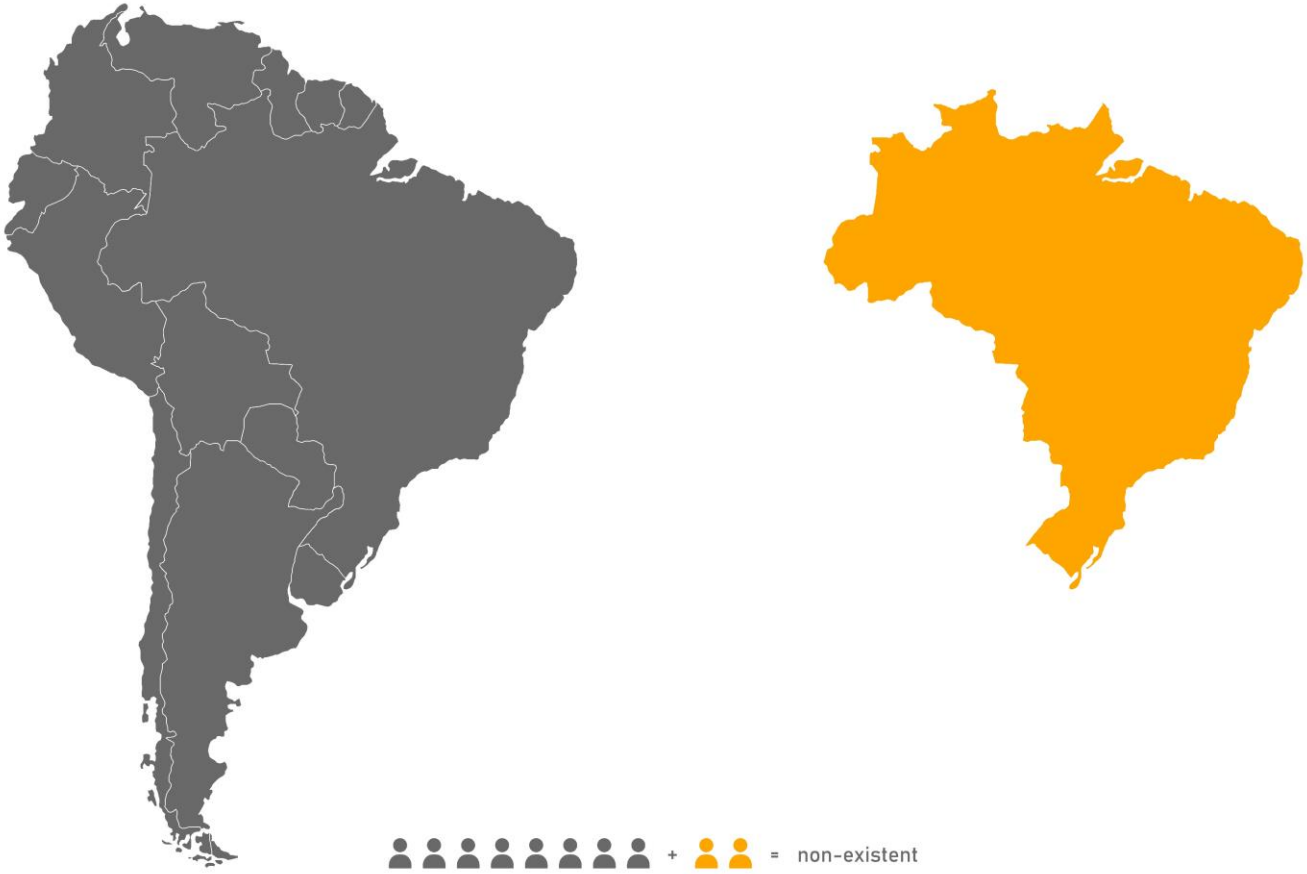


hybrid urban vertical farming

P5 by Koen Verbraeken
june 20, 2023


Petrol Industries
SERVICES


+
=
non-existent

0.55

0.75

1.80

$kgCO_{2\text{-}eq}kg^{-1}$

19%

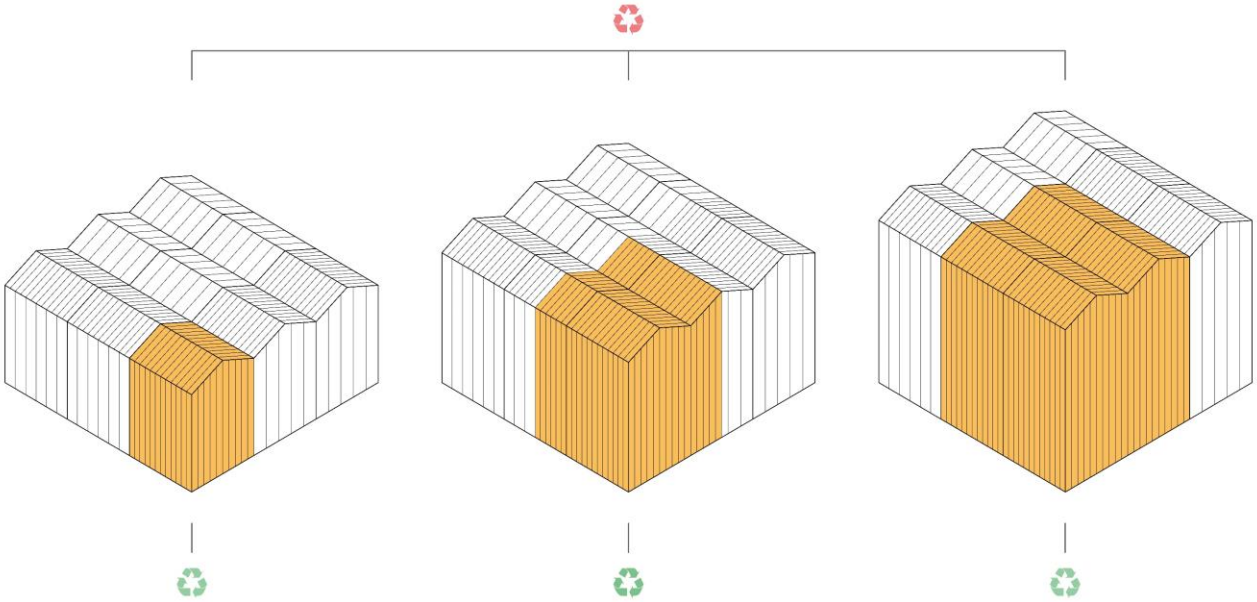
16%

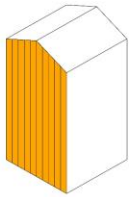
66%

electricity

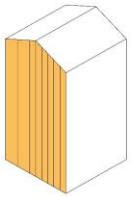
How can a modular hybrid urban vertical farming practice be constructed with reclaimed reused greenhouse components, and become high yielding, sustainable, and economically feasible?


MightyVine
phase 3

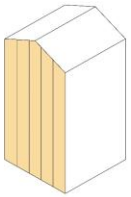




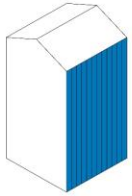
half-pane endwall



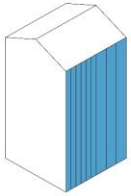
transition endwall



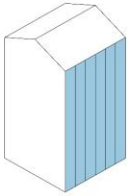
full-pane endwall



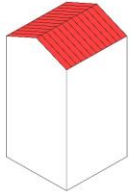
half-pane sidewall



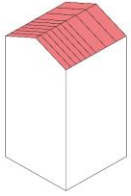
transition sidewall



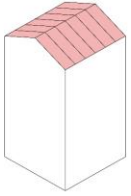
full-pane sidewall



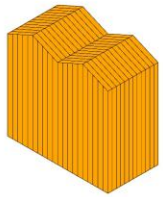
half-pane deck



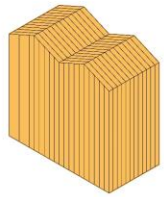
transition deck



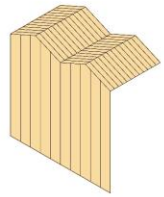
full-pane deck



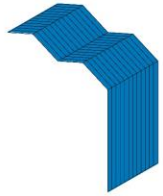
bay-link corner



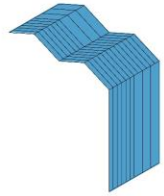
trellis-link corner



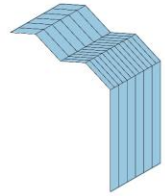
endwall



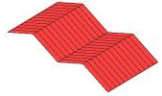
half-pane sidewall



transition sidewall



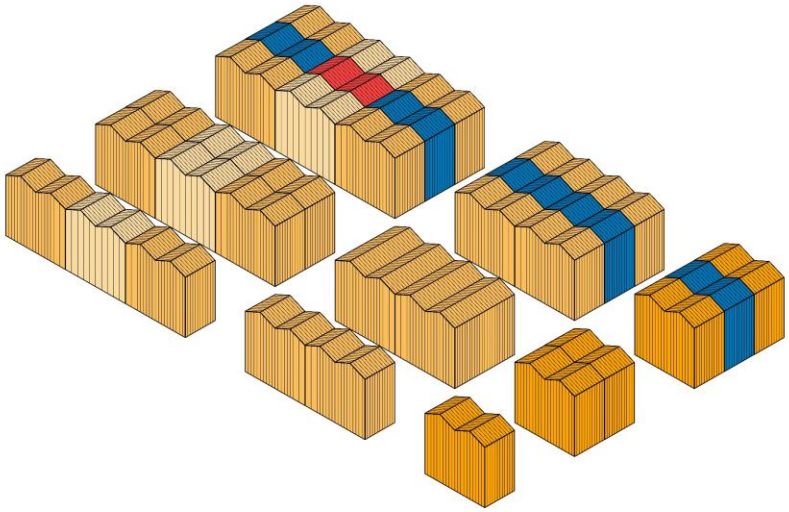
full-pane sidewall

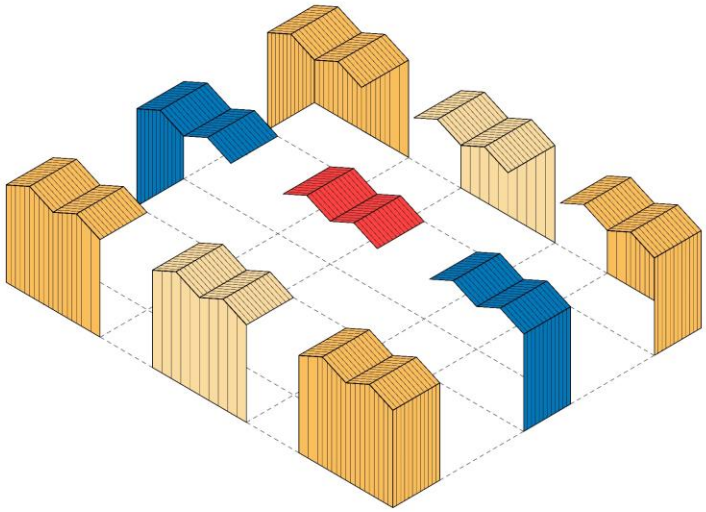


half-pane midfield

transition midfield

full-pane midfield





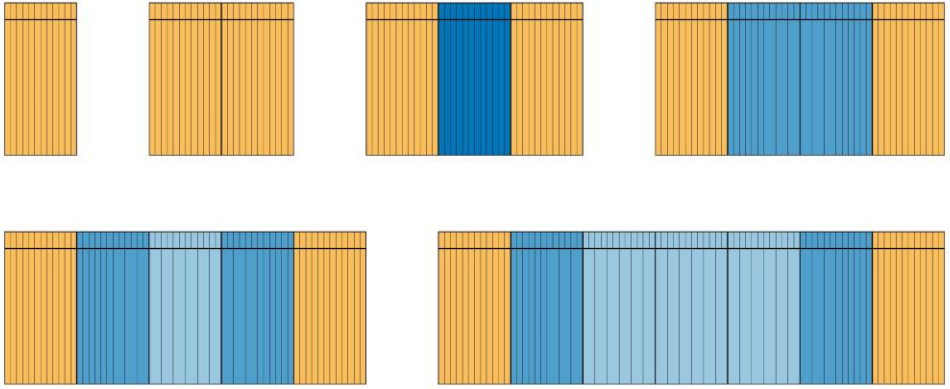
bay-link corner

trellis-link corner

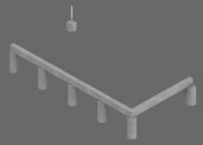
endwall

half-pane sidewall

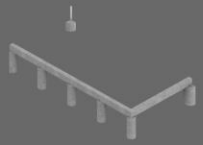
half-pane midfield



trellis-link corner half-pane sidewall transition sidewall full-pane sidewall



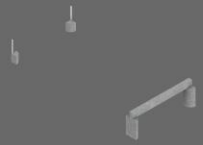
bay-link corner



trellis-link corner

endwall

half-pane sidewall



transition sidewall

full-pane sidewall

half-pane midfield

transition midfield

full-pane midfield

bay-link corner

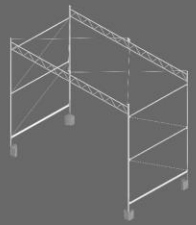
trellis-link corner

endwall

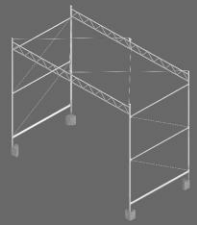
half-pane sidewall

transition sidewall

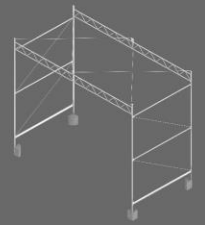
full-pane sidewall



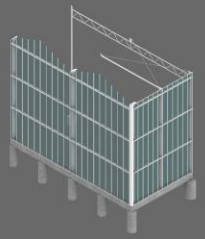
half-pane midfield



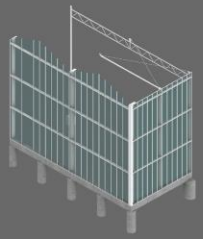
transition midfield



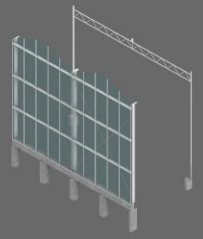
full-pane midfield



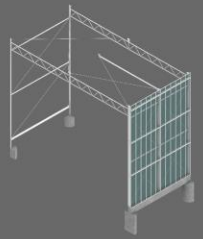
bay-link corner



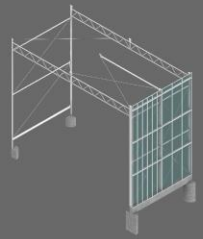
trellis-link corner



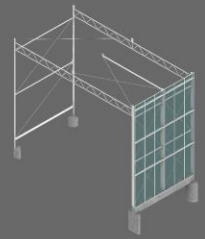
endwall



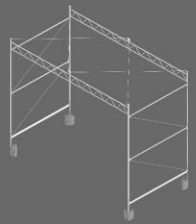
half-pane sidewall



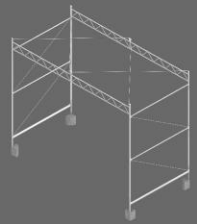
transition sidewall



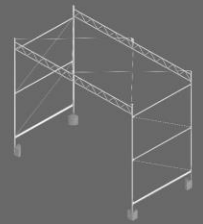
full-pane sidewall



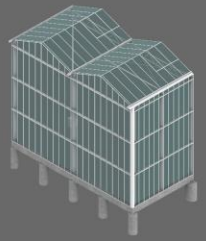
half-pane midfield



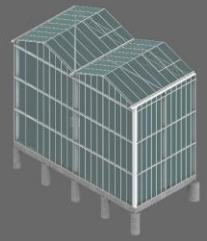
transition midfield



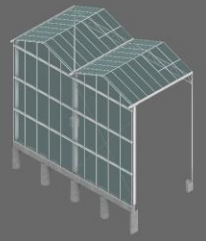
full-pane midfield



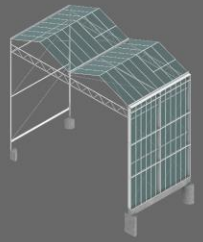
bay-link corner



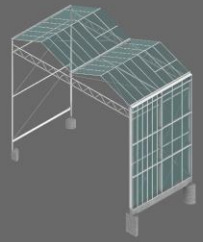
trellis-link corner



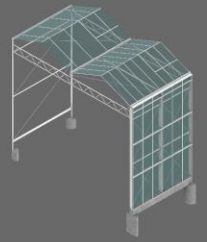
endwall



half-pane sidewall

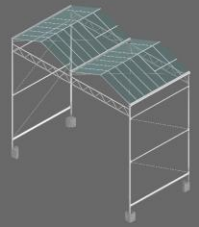


transition sidewall



full-pane sidewall

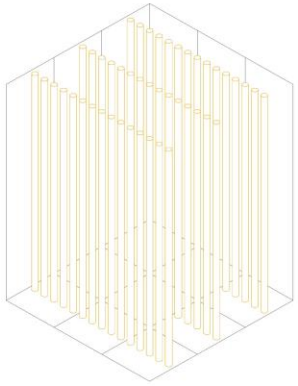
half-pane midfield



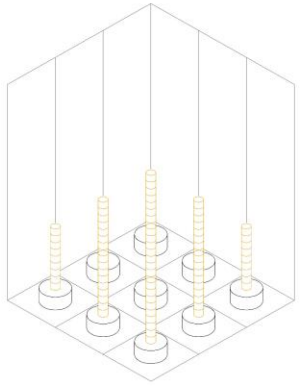
transition midfield

full-pane midfield

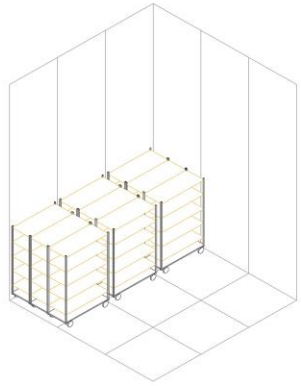
standing; fsi = 213%



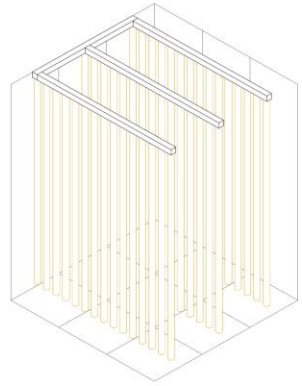
towering; fsi = 64%

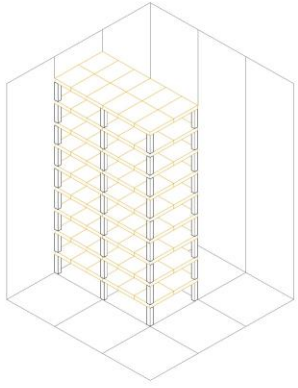


riding; fsi = 56%

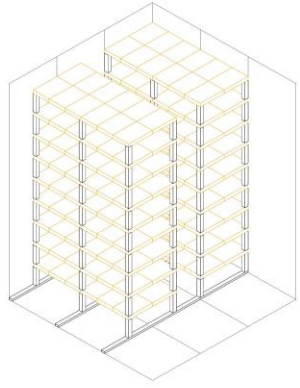


hanging; fsi = 213%

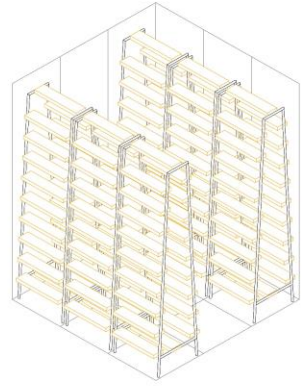




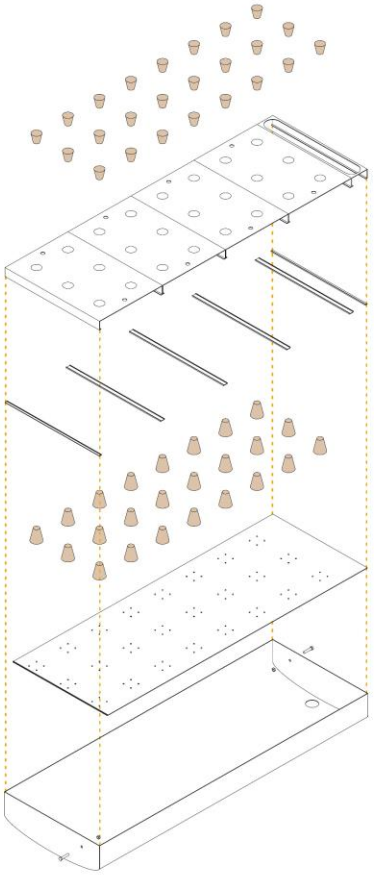
stacking; fsi = 222%

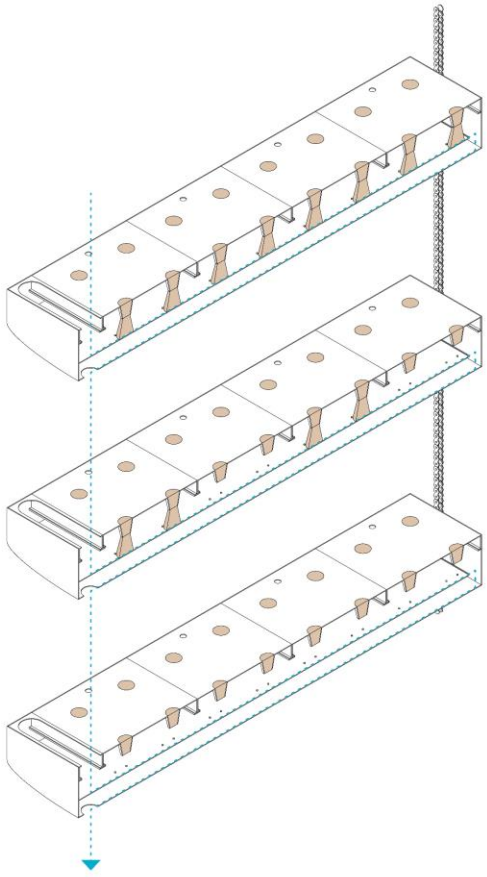


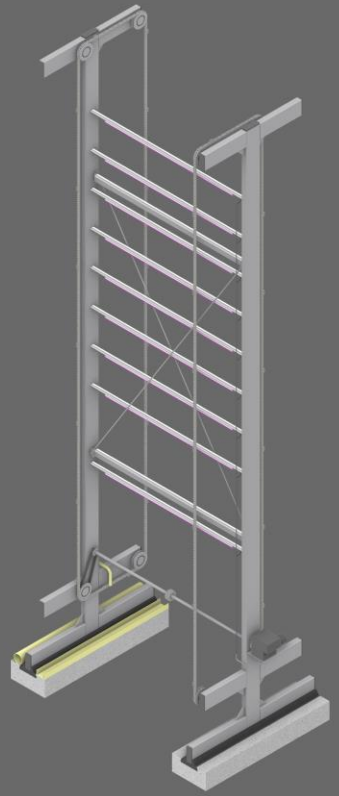
sliding; fsi = 444%

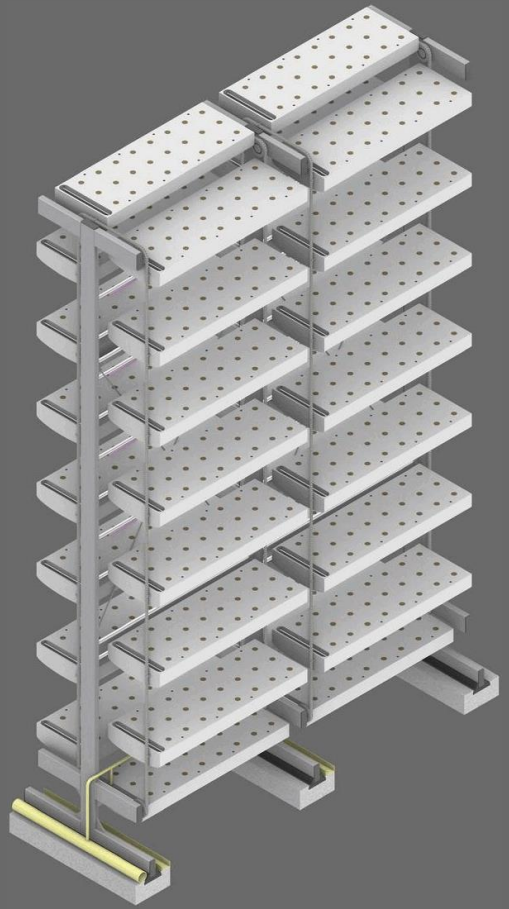


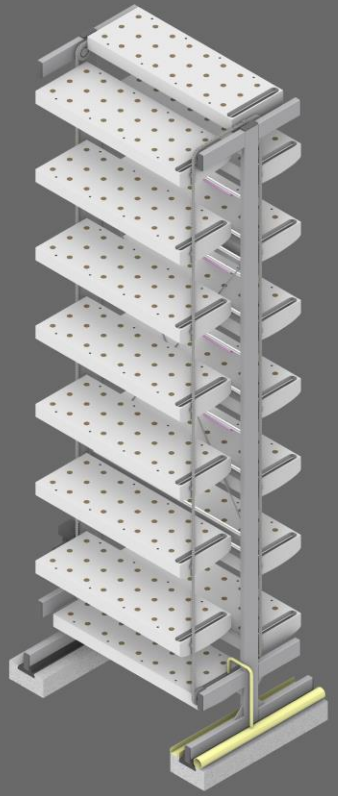
rotating; fsi = 249%

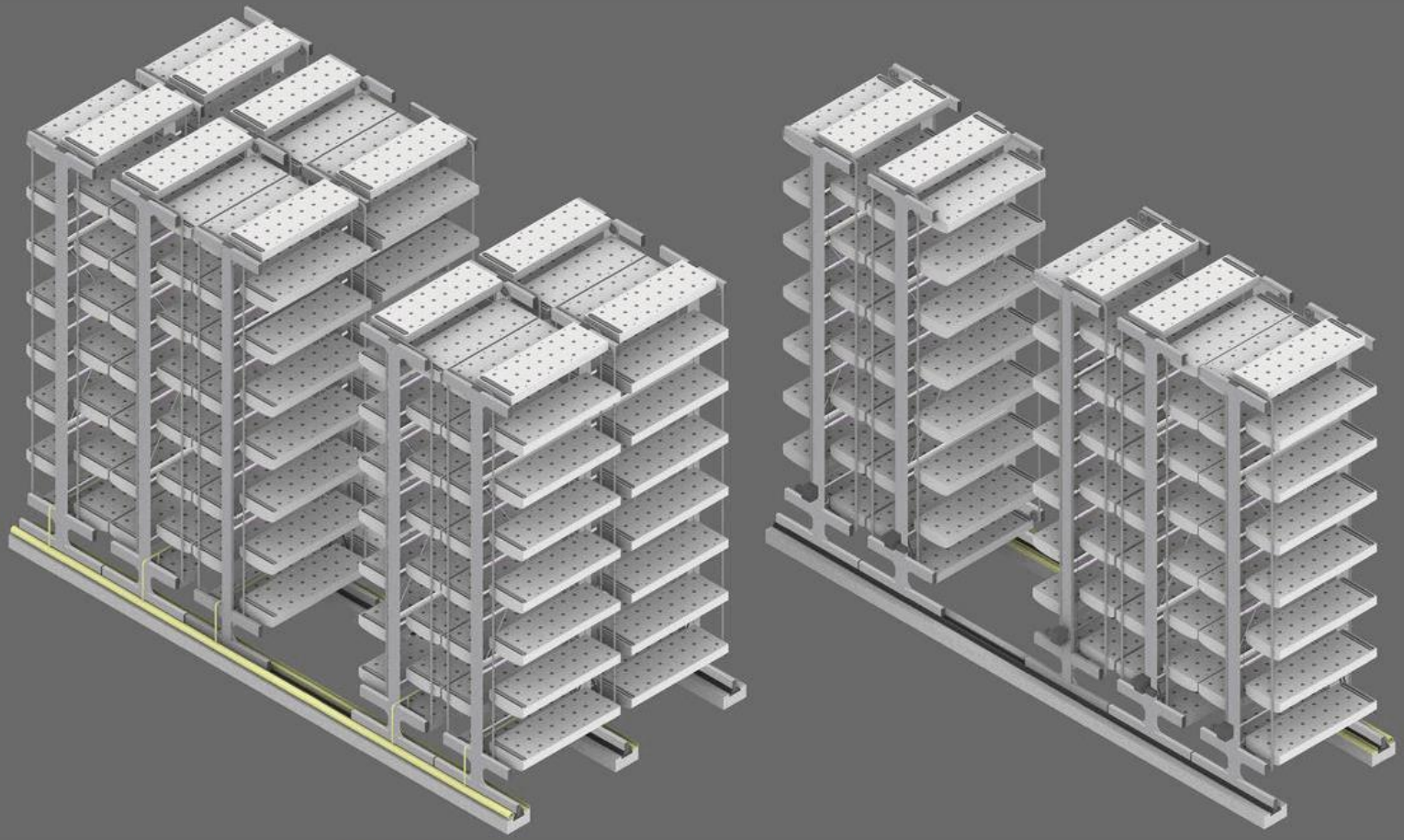


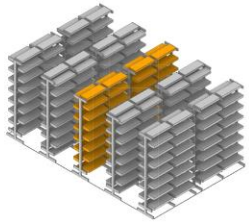




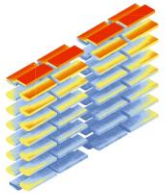








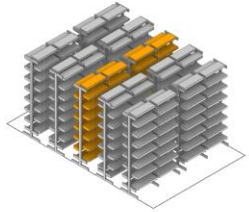
meets



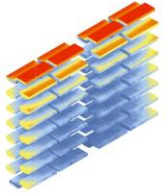
53% of PPFD with sunlight, on

56% of any footprint

30%



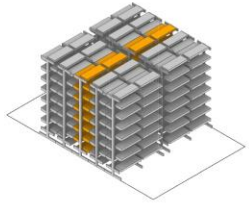
meets



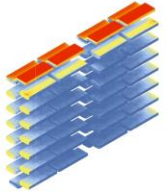
45% of PPFD with sunlight, on

67% of any footprint

30%



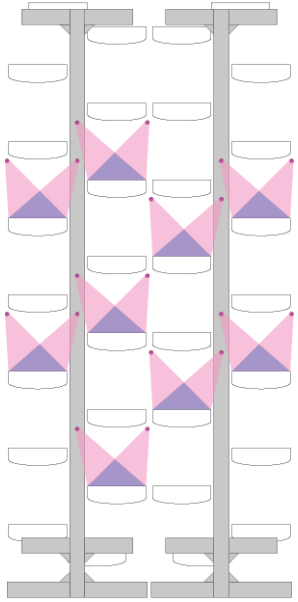
meets

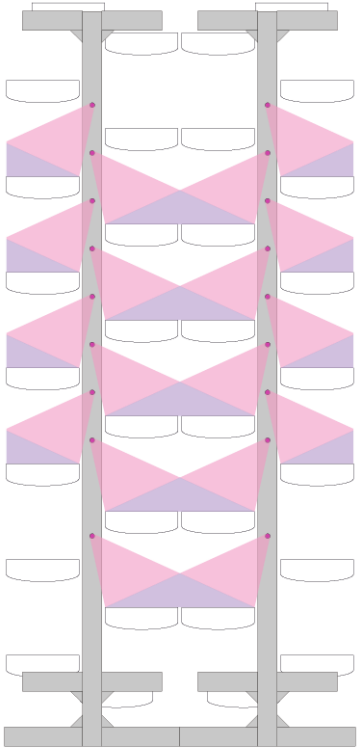


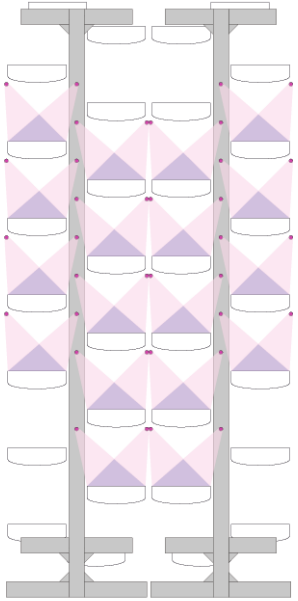
34% of PPFD with sunlight, on

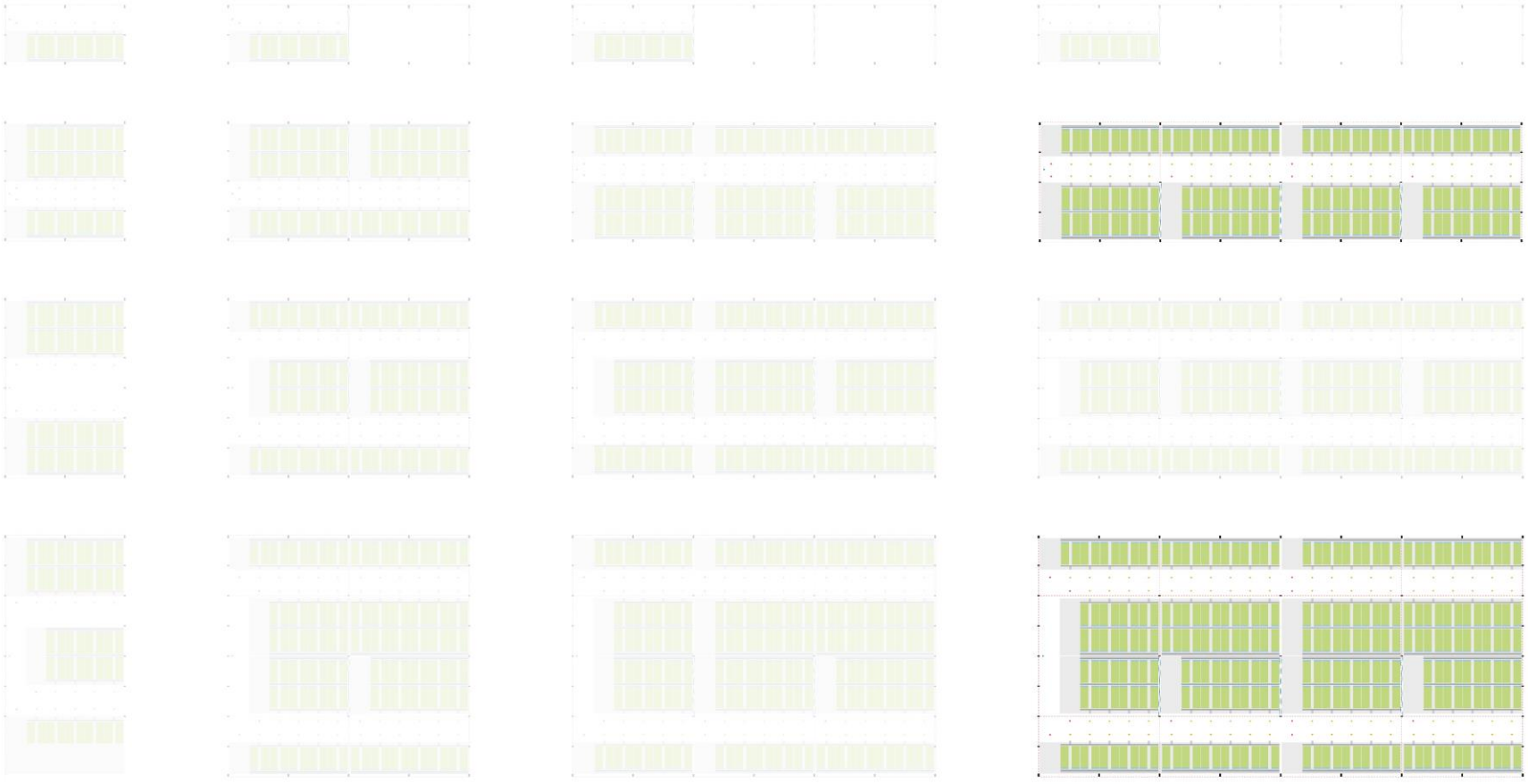
100% of any footprint

34%

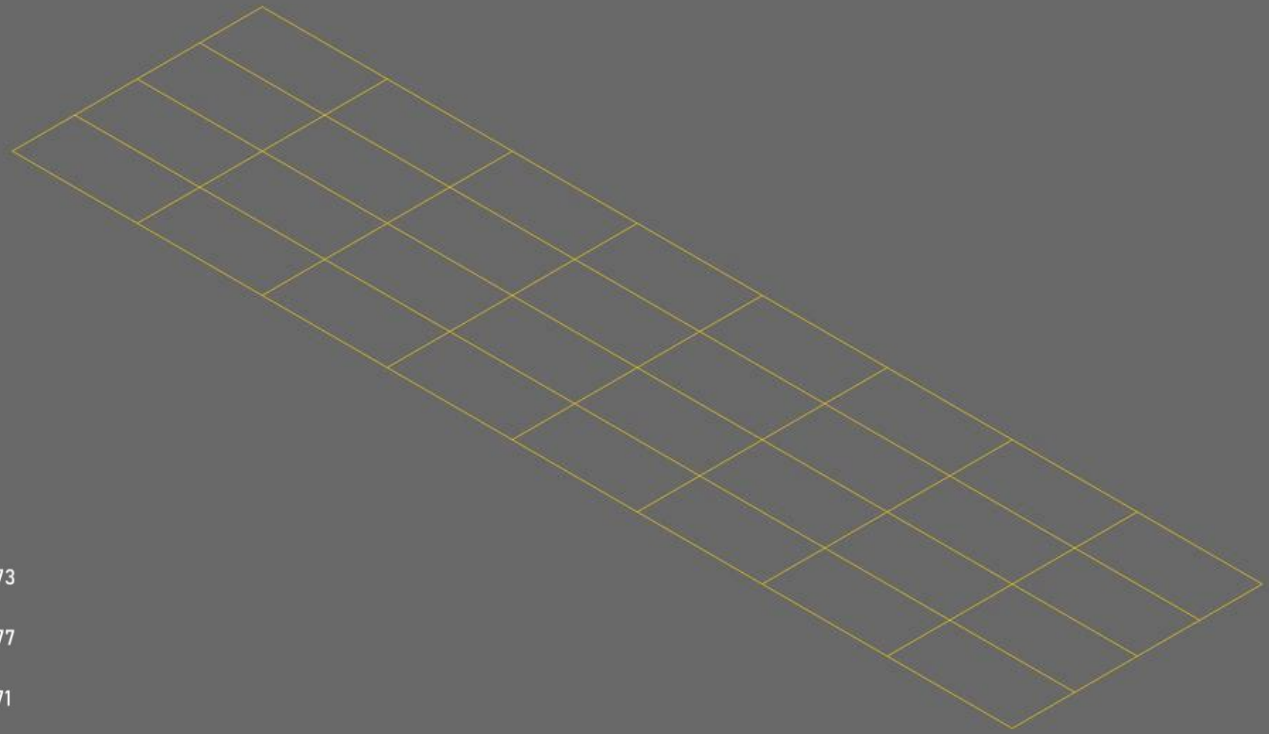




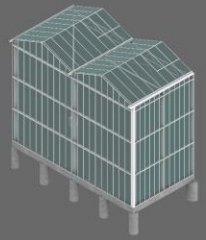




layout optimization

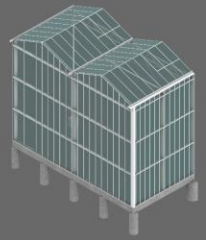


construction:	21
single systems:	273
coupled systems:	377
total:	671
reuse of 704:	95%



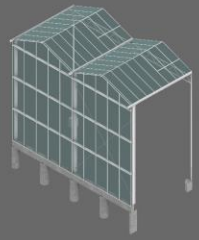
bay-link corner

total	14,614	
new	7,272	50%
reuse	7,343	50%



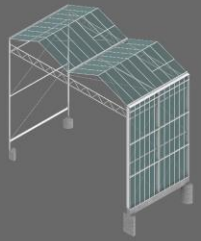
trellis-link corner

total	14,489	
new	7,269	50%
reuse	7,220	50%



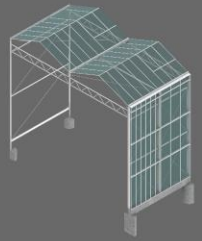
endwall

total	9,623	
new	5,273	55%
reuse	4,351	45%



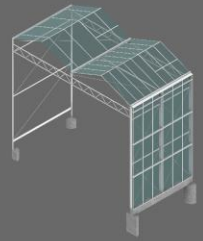
half-pane sidewall

total	6,766	
new	2,814	42%
reuse	3,951	58%



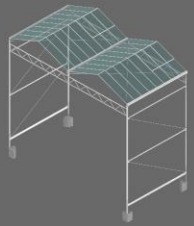
transition sidewall

total	6,555	
new	2,811	43%
reuse	3,744	57%



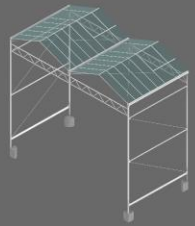
full-pane sidewall

total	6,345	
new	2,808	44%
reuse	3,538	56%



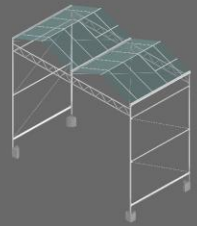
half-pane midfield

total	2,742	
new	650	24%
reuse	2,092	76%



transition midfield

total	2,722	
new	650	24%
reuse	2,073	76%



full-pane midfield

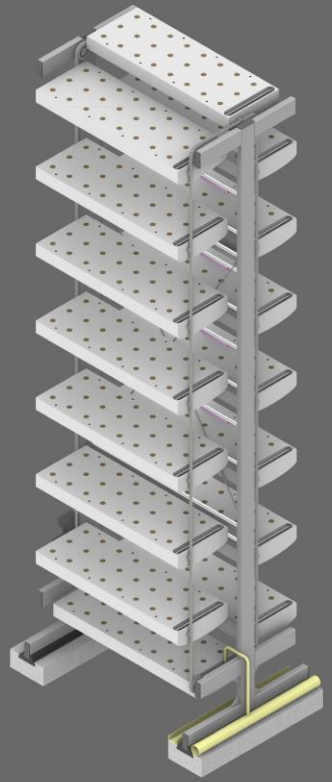
total	2,704	
new	650	24%
reuse	2,054	76%

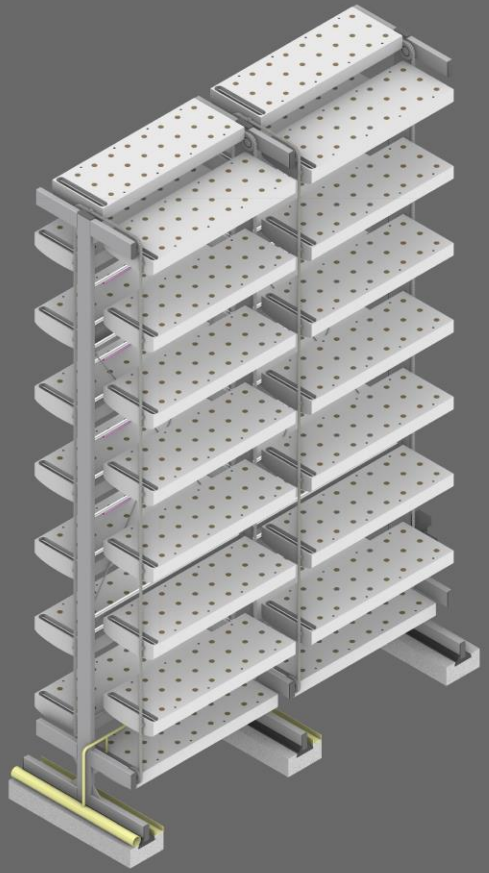
single system

total	2,512 $kgCO_{2-eq}$	
new	2,052 $kgCO_{2-eq}$	82%
p4	12,428 $kgCO_{2-eq}$	500%

coupled system

total	4,318 $kgCO_{2-eq}$	
new	3,620 $kgCO_{2-eq}$	84%
p4	24,364 $kgCO_{2-eq}$	564%





- 2x trellis-link corner
- 26x endwall
- 2x transition sidewall
- 47x full-pane sidewall
- 26x transition midfield
- 611x full-pane midfield
- 1x concrete aisle +

2,530,472 $kgCO_{2\text{-eq}}$ =

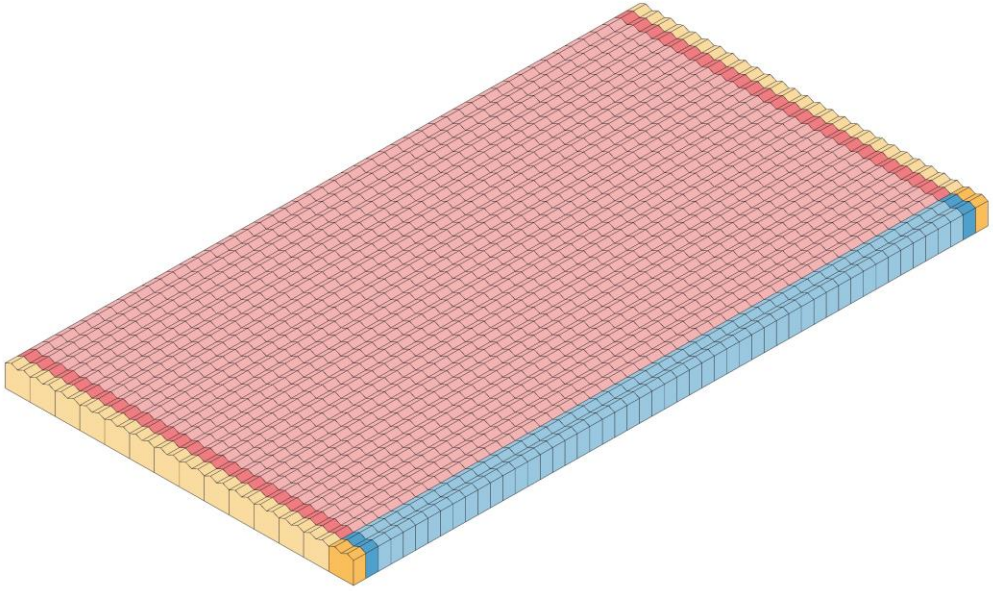
673,313 crops ÷

3.75 $kgCO_{2\text{-eq}}$/crop =

673,313 crops

29,917 m^2 ÷

22.5 crops/m^2 =



4x trellis-link corner

12x endwall

4x transition sidewall

12x transition midfield

88x single system

82x coupled system +

590,320 $kgCO_{2-eq}$ = 81% systems (477,449)

96,768 crops ÷

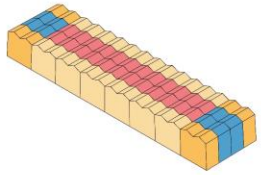
6.10 $kgCO_{2-eq}$/crop = 163%

p4: 25.95 $kgCO_{2-eq}$/crop

96,768 crops

1,296 m^2 ÷

74.7 crops/m^2 = 332%



1.00

1.36

2.40

3.27

comparative indices

future positioning

1.00

1.36

1.63

2.22

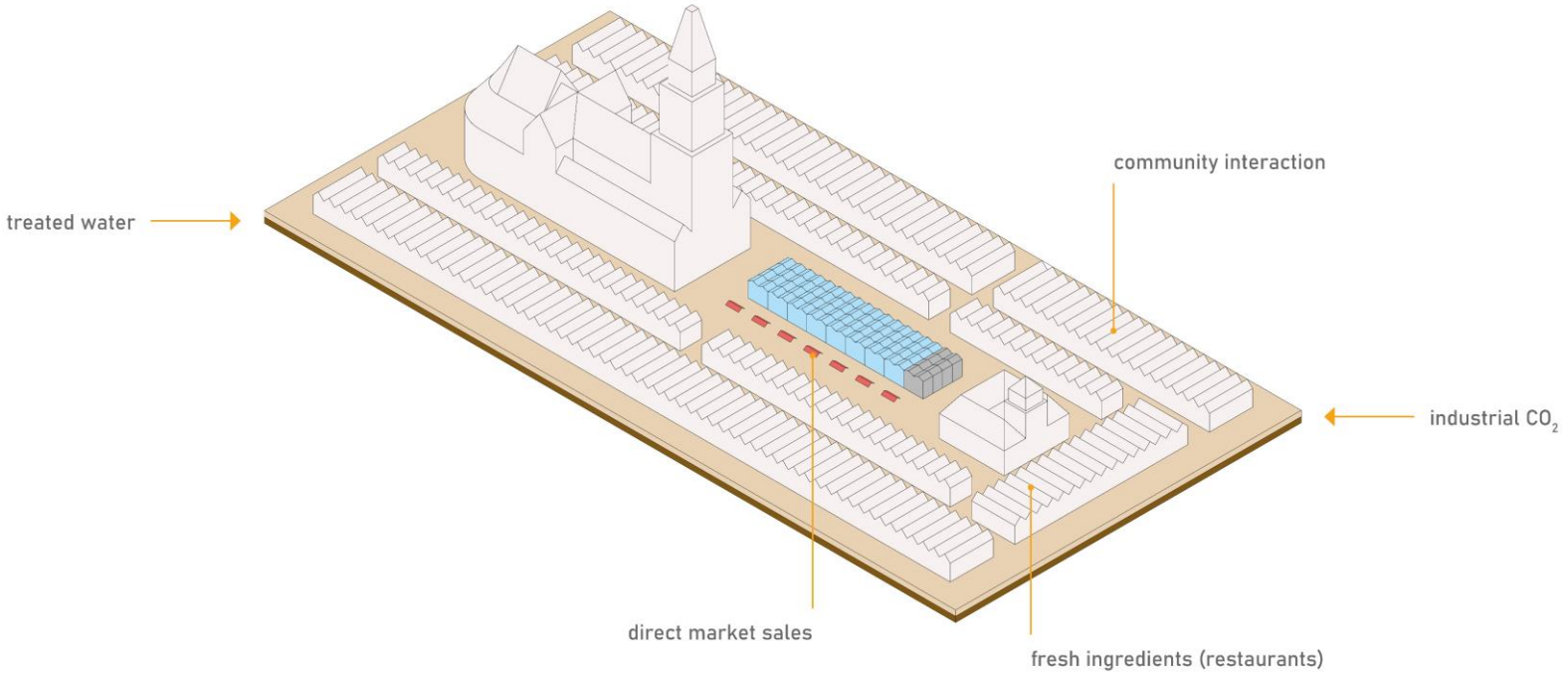
2.40

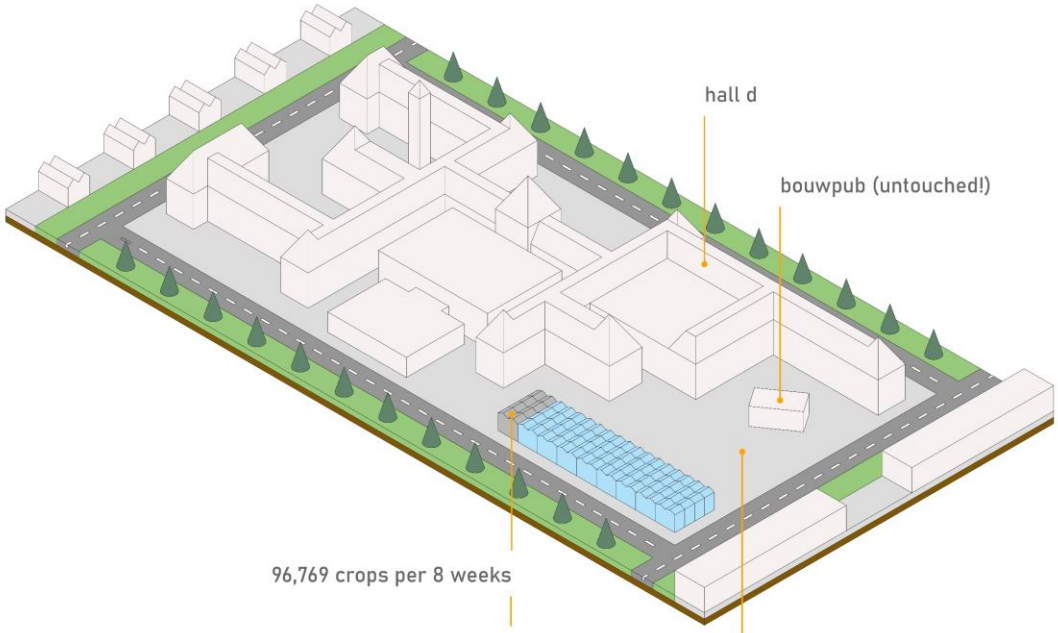
hybrid
urban
vertical
farming

3.27

comparative indices

future positioning


treated water
community interaction
industrial CO_2
direct market sales
fresh ingredients (restaurants)


hall d
bouwpub (untouched!)
knowledge
community
96,769 crops per 8 weeks
1,728 crops per day
should be enough to make the whole campus eat vegan
less cars in 2050

How can a modular hybrid urban vertical farming practice be constructed with reclaimed reused greenhouse components, and become high yielding, sustainable, and economically feasible?