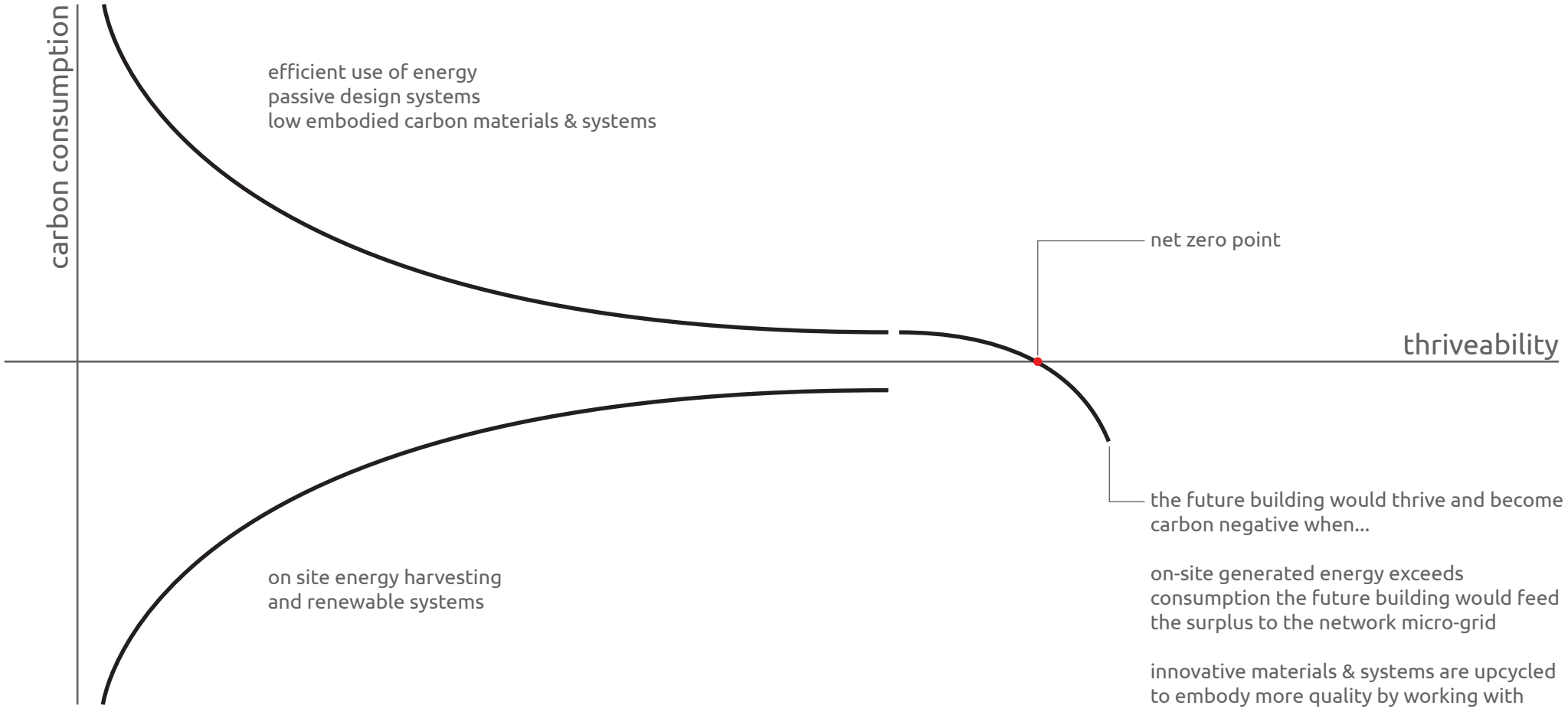
how can we design a building
beyond sustainable
beyond recyclable
beyond net zero
but advance, leap, grow, and innovate?

submission code: 116010

an idea guide to
holistic thriveable design approach to the future building

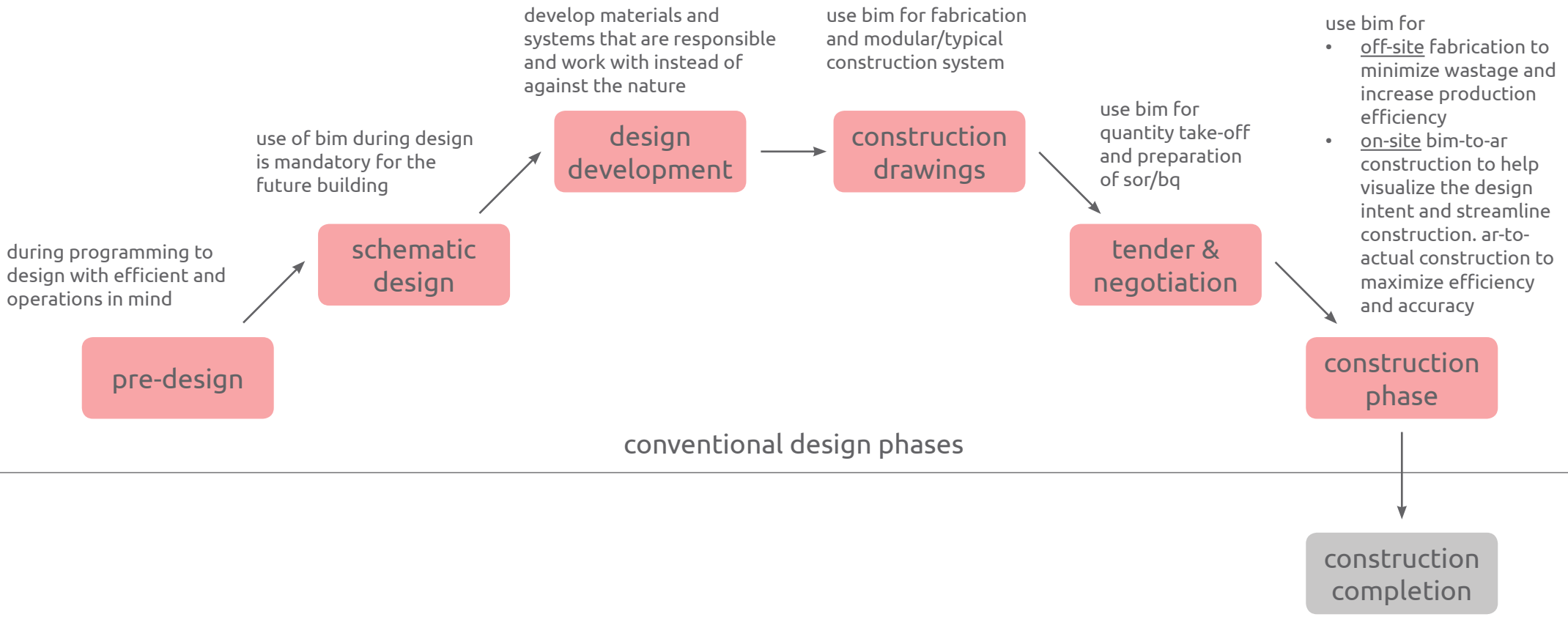
we confront the reality:
any building that requires resources to construct would contain some level of embodied carbon.
any facility that operates would consume energy.

the idea of holistic thriveable design is to:
1. think of building as part of a network, not an independent facility
2. design the process from conception to construction, to operation, to dissembling
3. optimize efficiency, eliminate need for excessive consumption of energy
4. materials and systems r&d, a combination of conventional and innovative systems to work with instead of against the nature

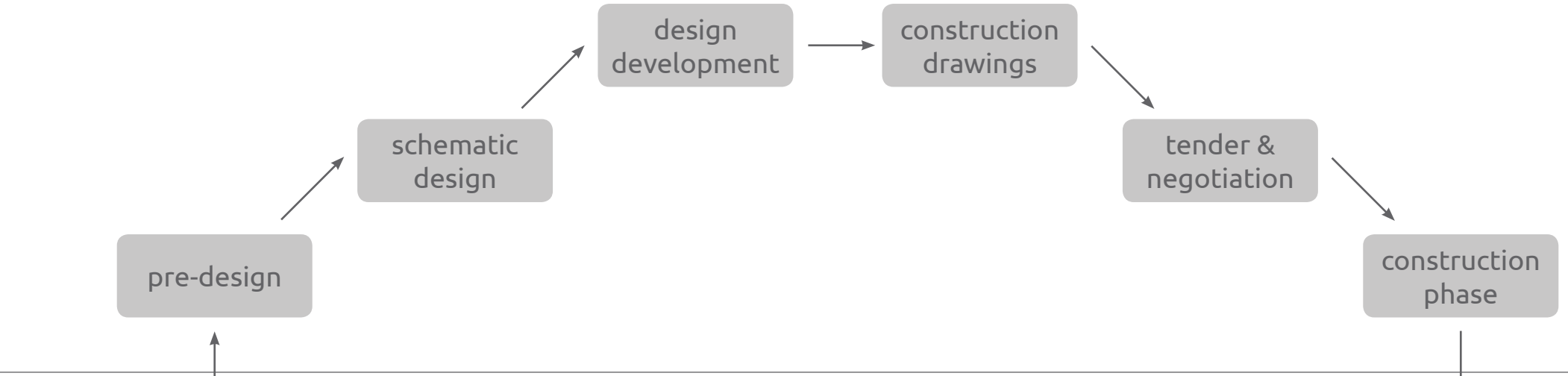


holistic thriveable design approach:

design the process, not just the building



the process is a closed loop ecosystem with no room for waste
construction materials and products shall be fresh raw materials if the future building would be dissembled at the end of its life cycle



inclusive phases for holistic thriveable design

upcycled materials that embody more quality due to nature's input, for reusing as fresh raw materials. there should be no waste.

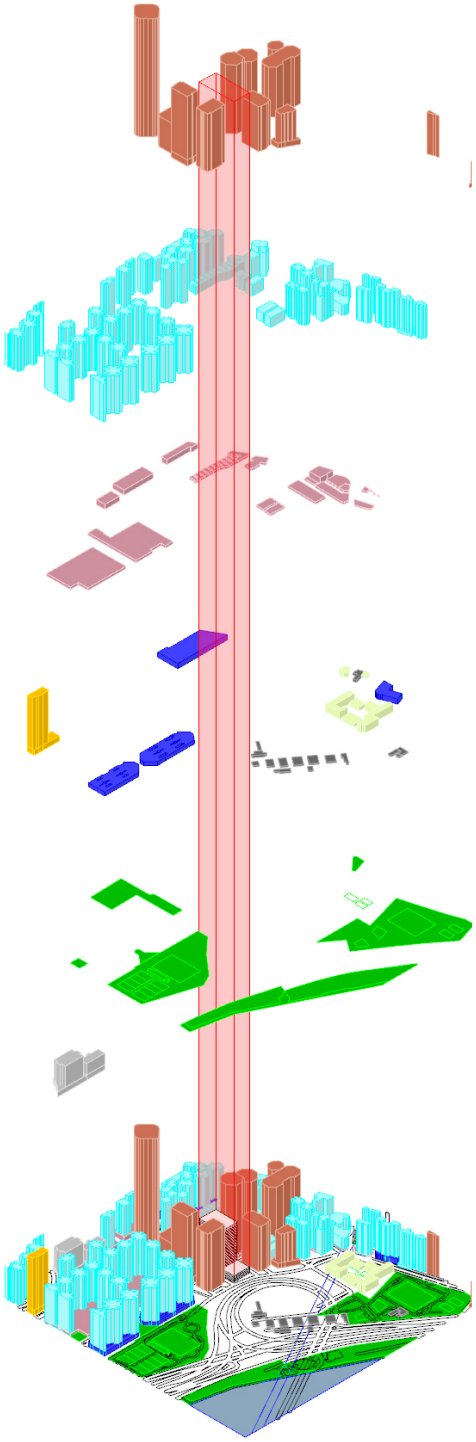
active
the future building would use conventional and innovative systems for on-site energy generation.

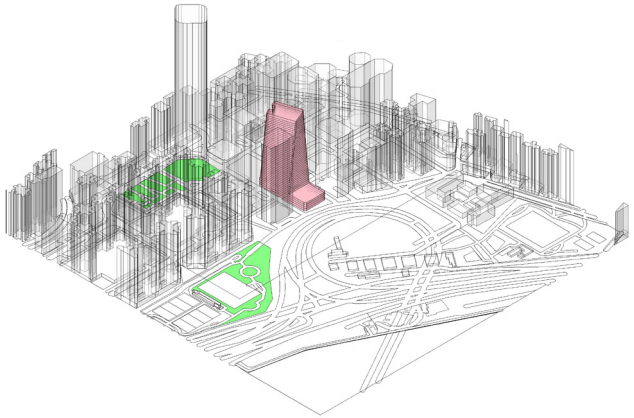
passive
the most energy consumption during operations are cooling and lighting.

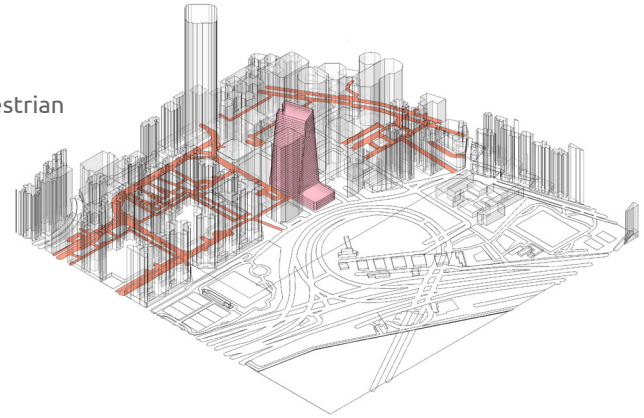
the future building would focus on reducing the need for cooling, as well as maximizing natural daylight while reducing heat gain.

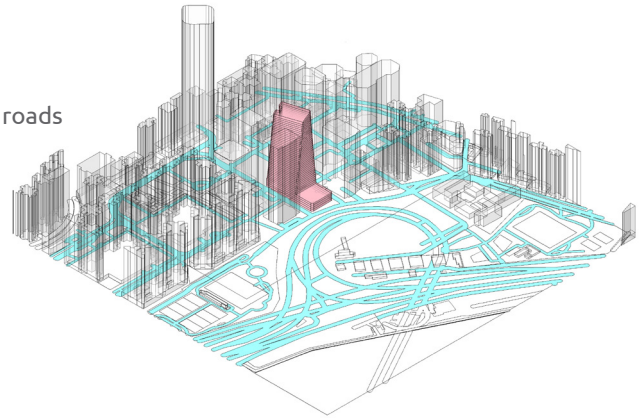
use bim to create a digital twin for long term operational and maintenance use, to start collecting real energy consumption data

to conceptualize the project
we need to understand the site and surrounding context









buildings are site specific.

each site is unique to the exposure to the surroundings.

this is important, because the future building needs to harvest all possible form of energy for on-site generation.

the “energy input” including solar, heat, wind, rain from the nature, and kinetic input from pedestrians surrounding the site, users within the future building, and vehicles that drive through or drive into the car park spaces.

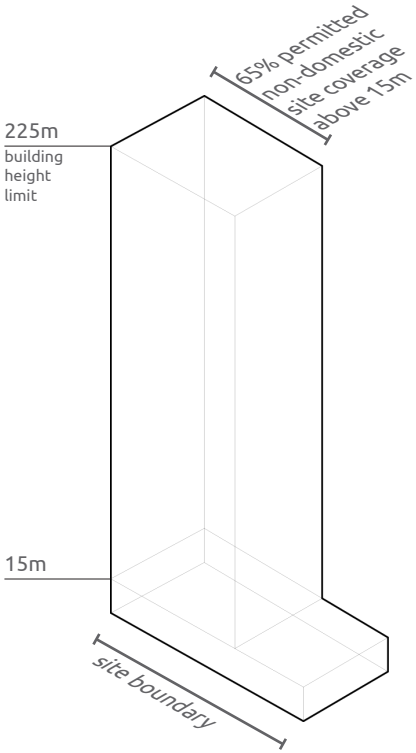
solar
heat
wind
rain

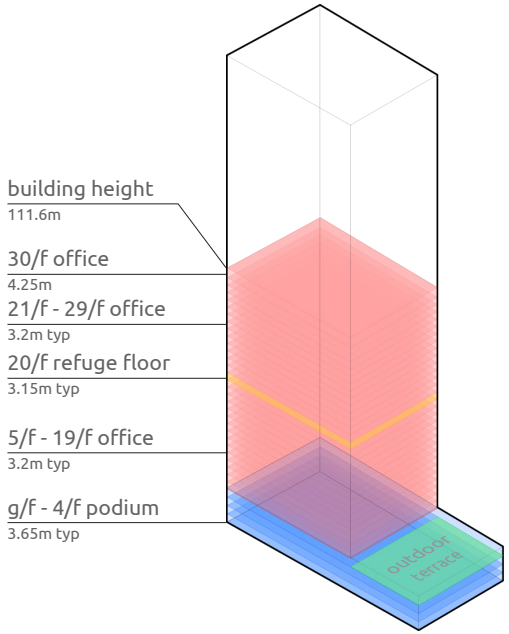
from nature

kinetic

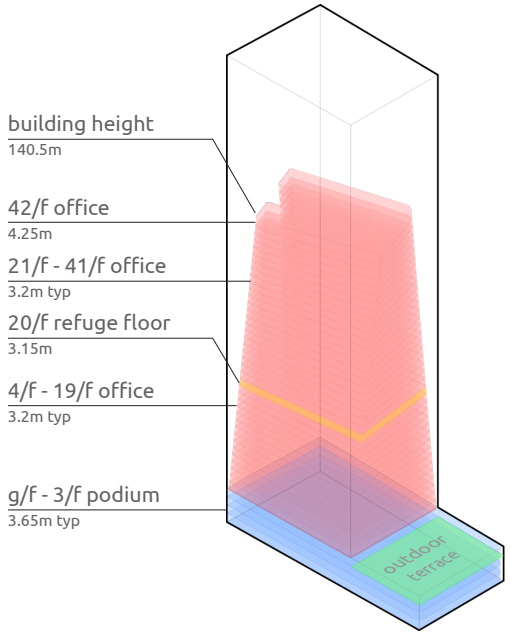
from people & cars

building massing maximized to allowable gfa with consideration of site restrictions. form and orientation rationalized to maximize exposure for on-site energy harvesting , including solar, wind, rain

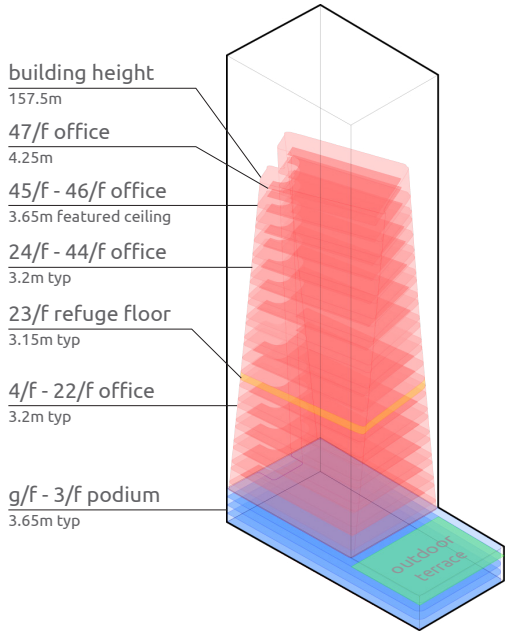




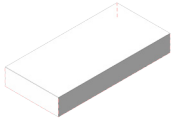
linear tower



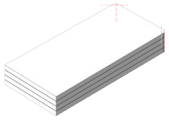
tower w/wind chimney



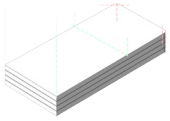
tower w/ buffer zone & recessed floor plate



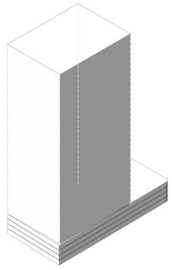
buildable area



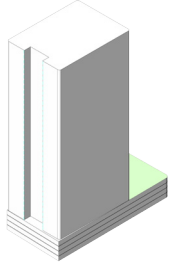
podium floors



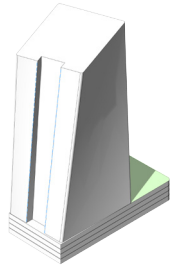
65% site coverage



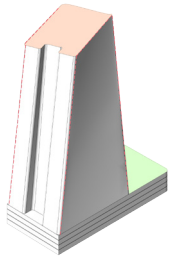
maximizing to allowable GFA



wind chimney

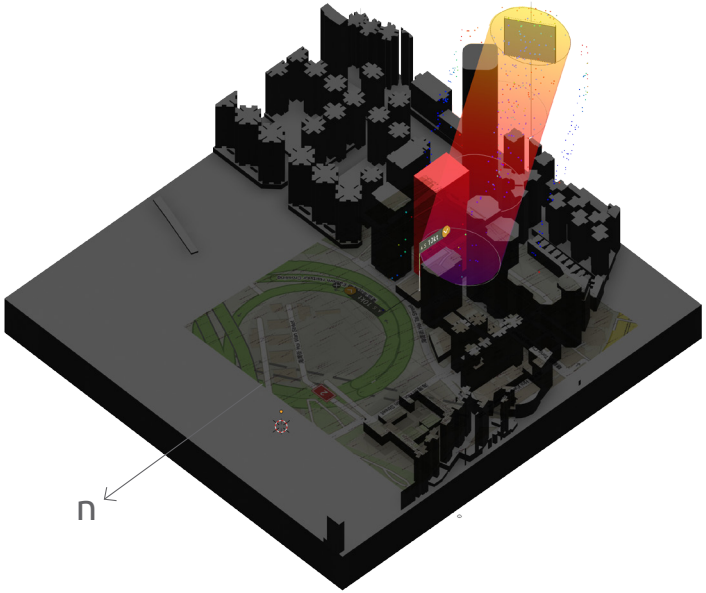


orient to max solar exposure

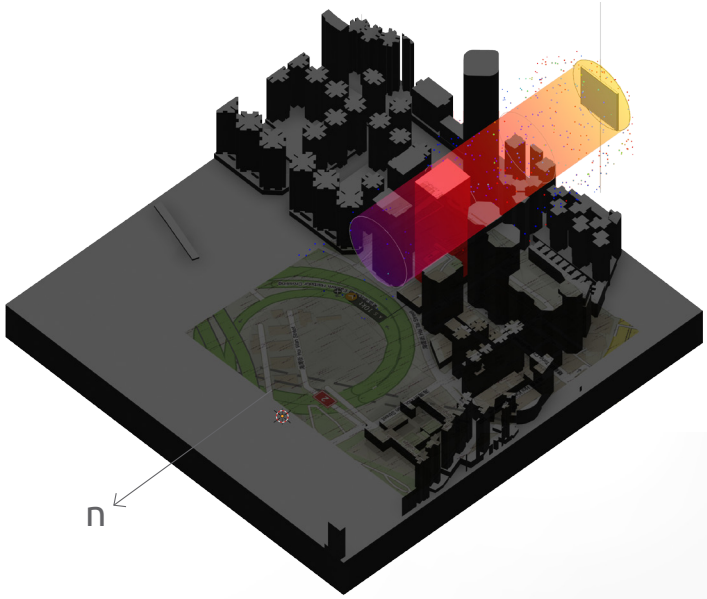


roof terrace

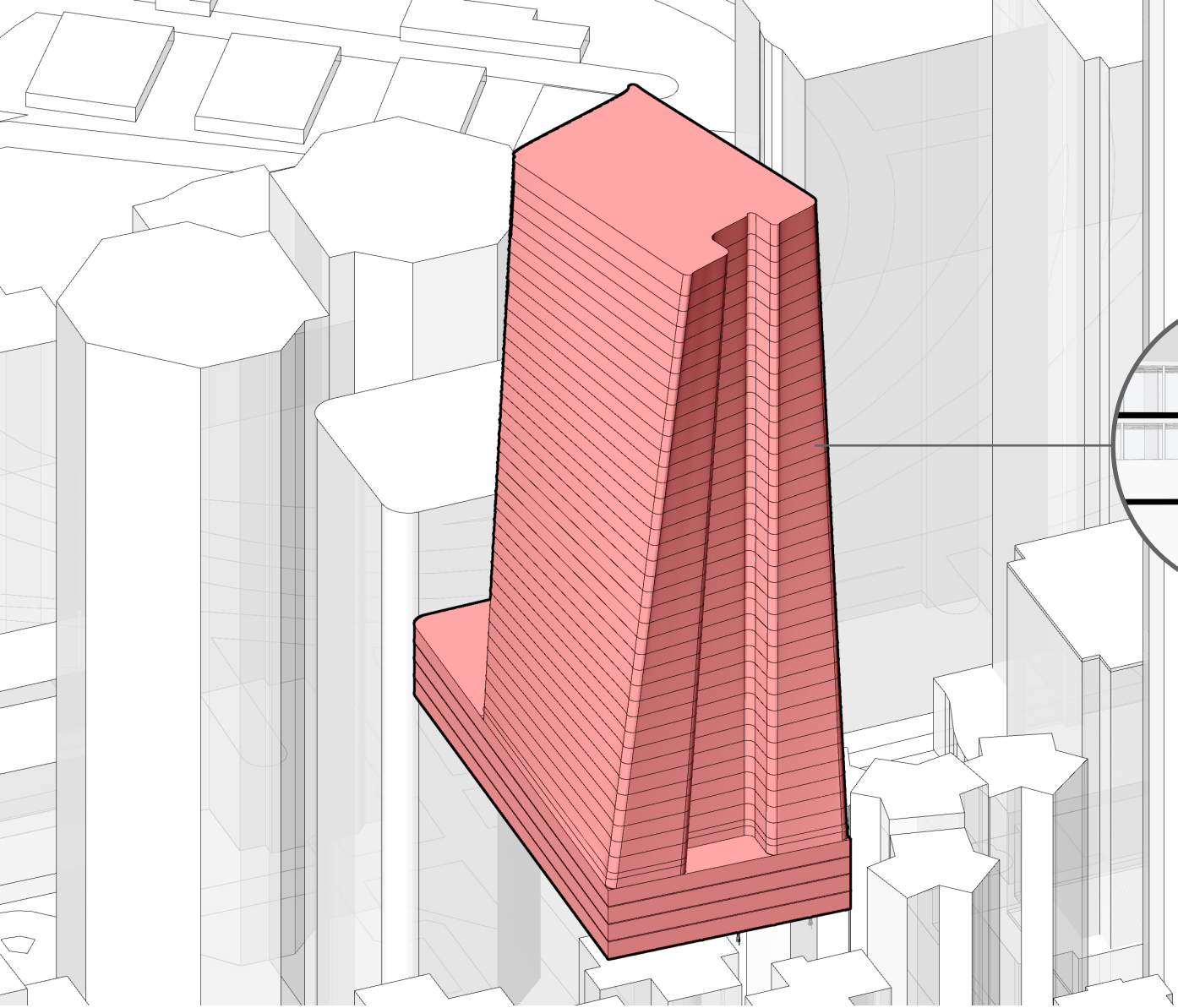
capturing wind flow is essential for the future building, as wind is the natural element that breezes around the building, also help to ventilate through the facade louvers to wind chimneys, carrying warm air to above and exit at the top, thus lowering the need for cooling.

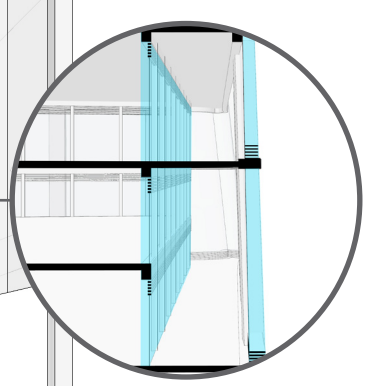


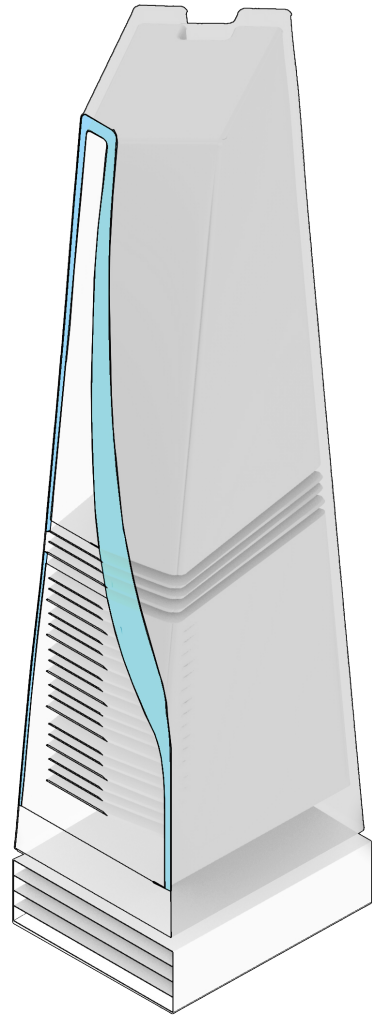
wind flow from southeast

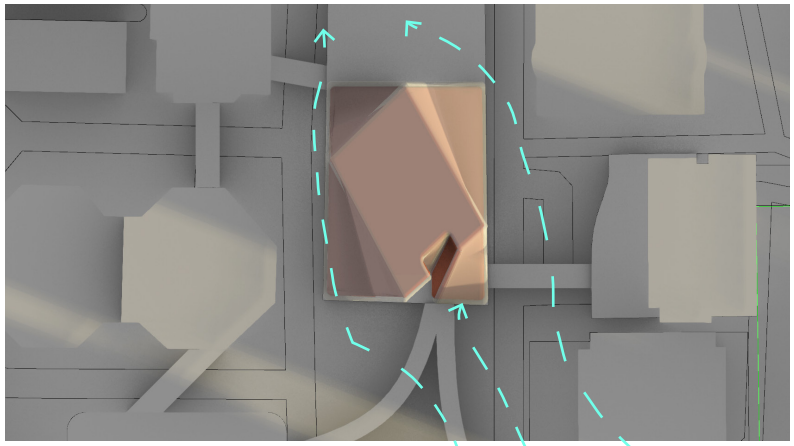


wind flow from south







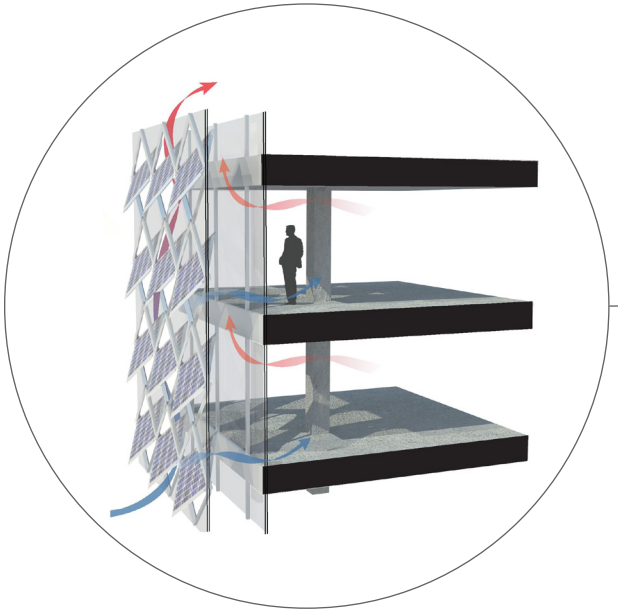


the proposed building envelope

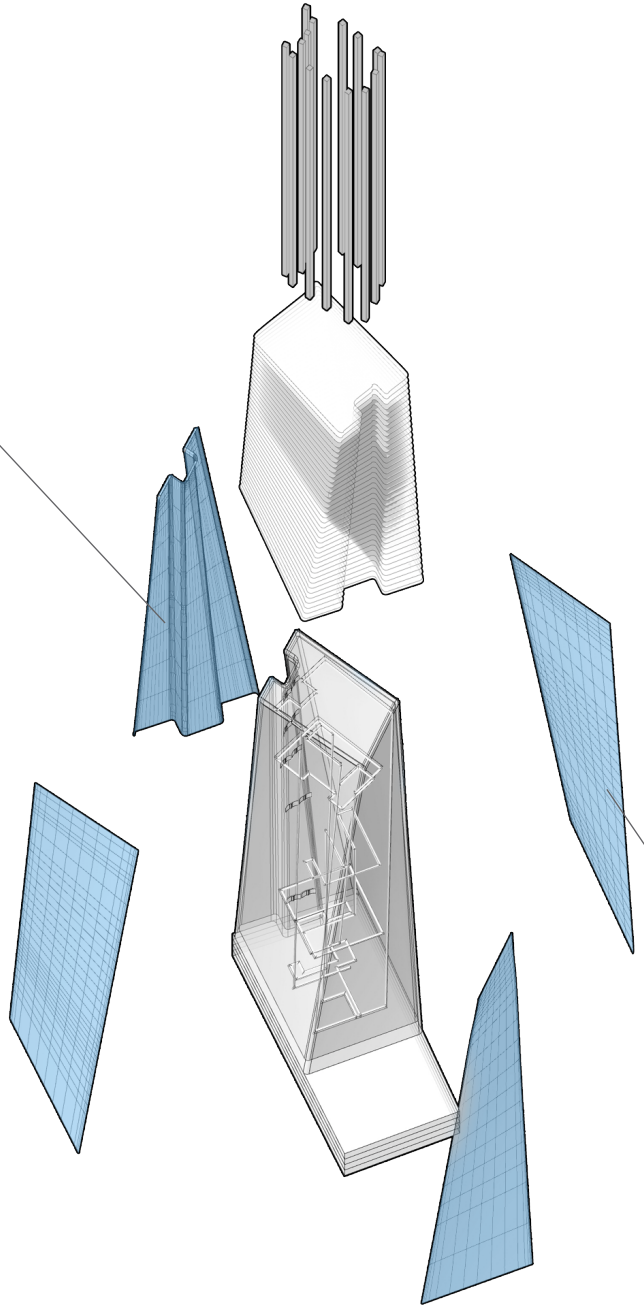
the double-skin facade envelope is formed to improve efficiency and passive system design for the future building, with an orientation adjustment the facade would capture most wind into the wind chimneys through external vents, facilitating continuous air flow to ventilate the building for warm to rise and dissipate. lowering the required cooling load is the first and immediate passive design feature that eliminate the energy need.
the adjusted orientation also improves sunlight exposure during non-peak hours for the solar harvesting panels that cover the entire exterior of the future building.

holistic thriveable design approach:

facade that reduces energy load and increases on-site energy generation



1. all surfaces as solar energy harvesting system, energy to be stored at batteries locating in building core (on-site generation of electricity).
2. allow maximum natural daylight from exterior to interior space (reducing electrical load).
3. integrated with fiber optics at exterior facade for interior architectural lighting (reducing electrical load).
4. allow minimum heat gain from exterior to interior space, as well as employing a double-skin system to allow warm air to rise to the openings at the roof (reducing cooling load).

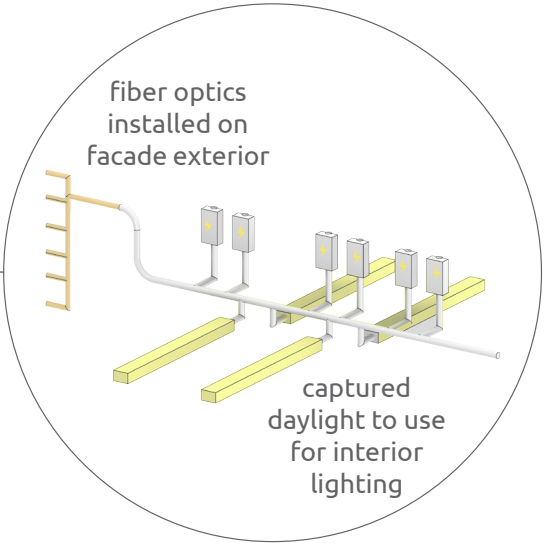


as the skin for the future building covering majority of the exterior surfaces, the facade system must employ highest concept and most cutting edge technology.

not only the facade shall provide a safe and healthy environment for the users, it should serve as the major component of the future building both in active and passive ways.

other than integrating with high efficiency solar energy harvesting panels (an active system for on-site generation), the new innovative glazing shall allow maximum incoming natural daylight (thus reducing electricity load for lighting) at the same time minimum incoming heat gain (thus reducing electricity load for cooling). The cooling is further enhanced by a double-skin system to naturally ventilate the warm air vertically to the openings at the roof.

for floor area that are deep into the floor plate, the future building is integrated with fiber optics at the exterior facade surfaces, bringing natural daylight to the interior as architectural light, further alleviating the electrical load.



holistic thriveable design approach:

reduce embodied carbon by minimizing concrete & steel

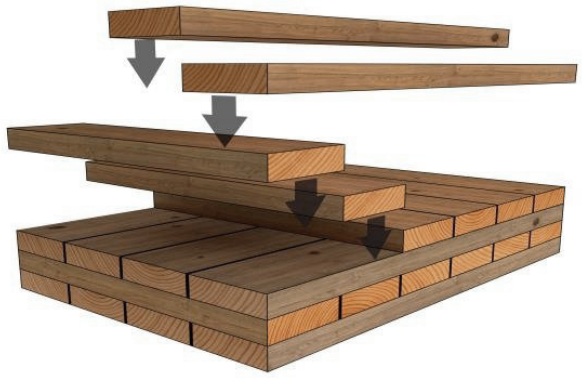
the future building intends to reduce embodied carbon, starting with the builder's works, to minimize the use of concrete and steel in building structure.

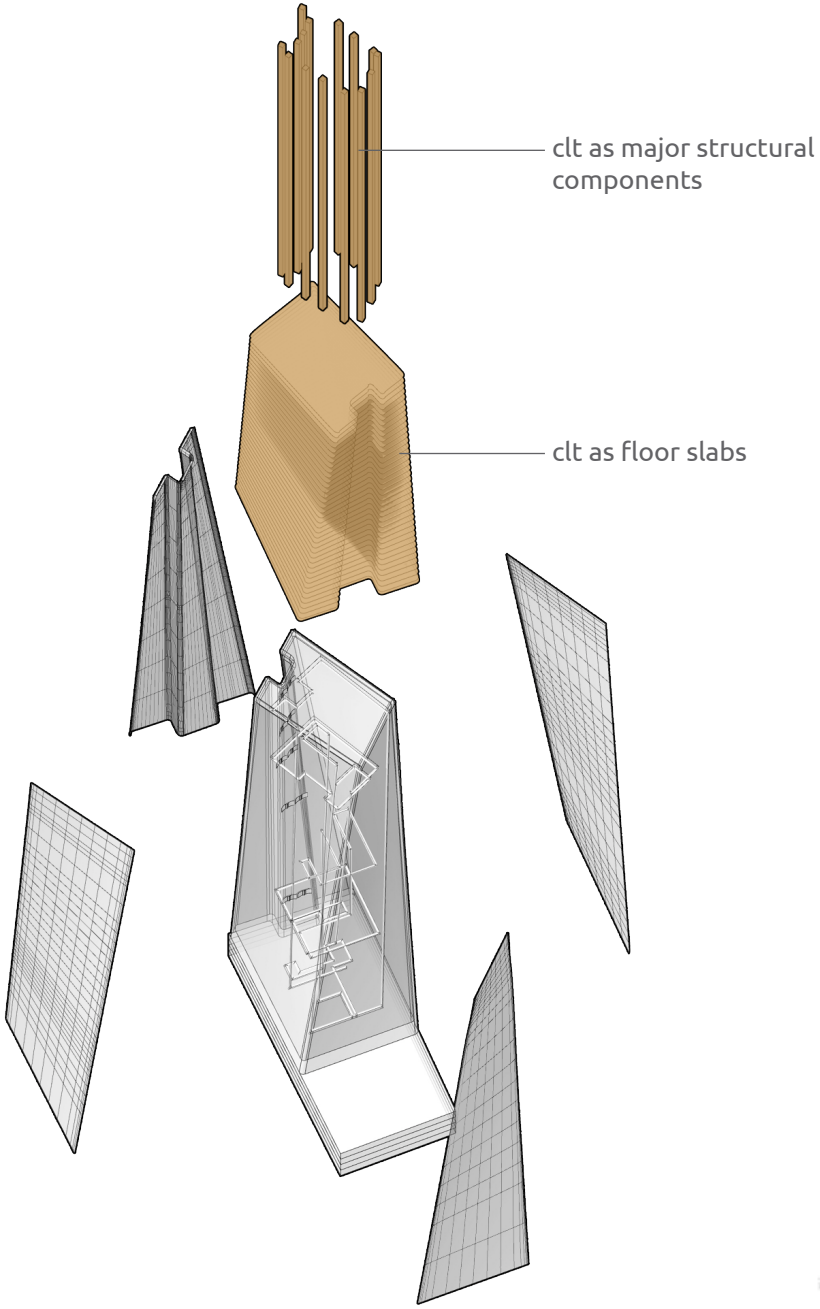
cross-laminated timber (clt) has layers of timber glued together with the grain alternating at 90-degree angles for each layer.

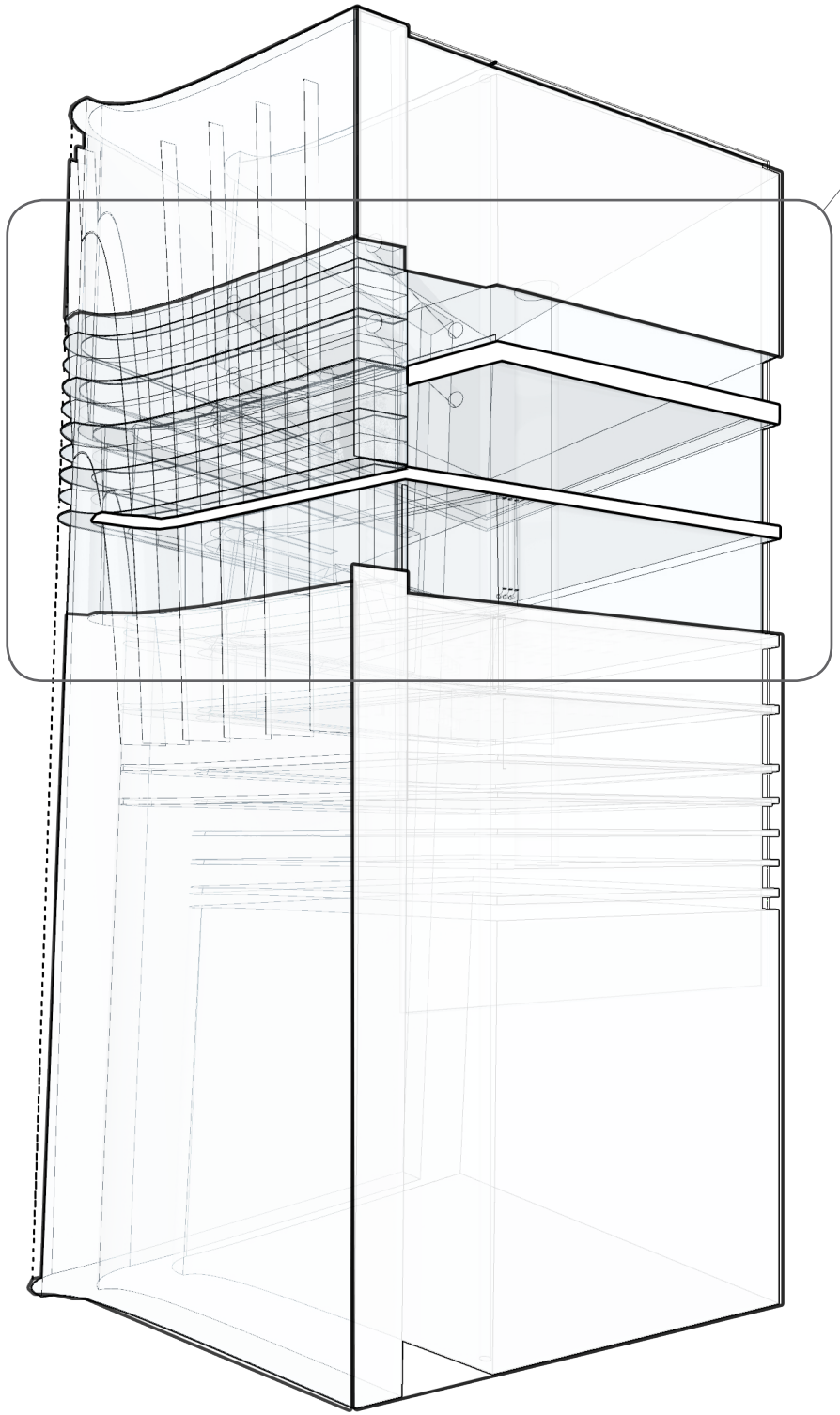
for floors and walls, cross-laminated timber (clt) would be used, pre-treated with fire resistant agent to alleviate statutory and fire safety concerns.

for vertical structural element, a hybrid system would be consider with both steel and clt establishing the columns and vertical transportation cores.

nowadays clt had been used in a hybrid structural system up to 90-meter tall building. the future building shall employ further research and development to achieve our targeted building height close to 160-meter.

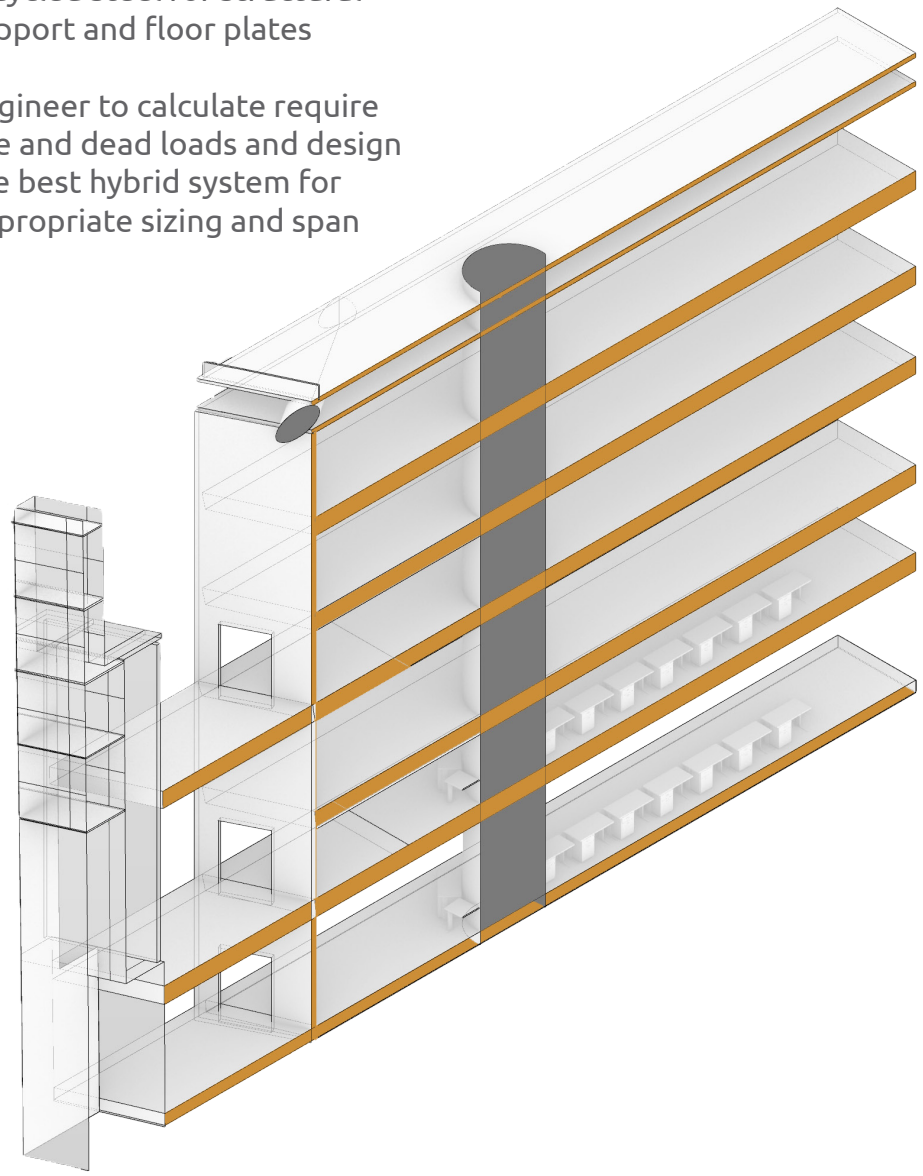






hybrid system of clt and recycled steel for structural support and floor plates

engineer to calculate require live and dead loads and design the best hybrid system for appropriate sizing and span

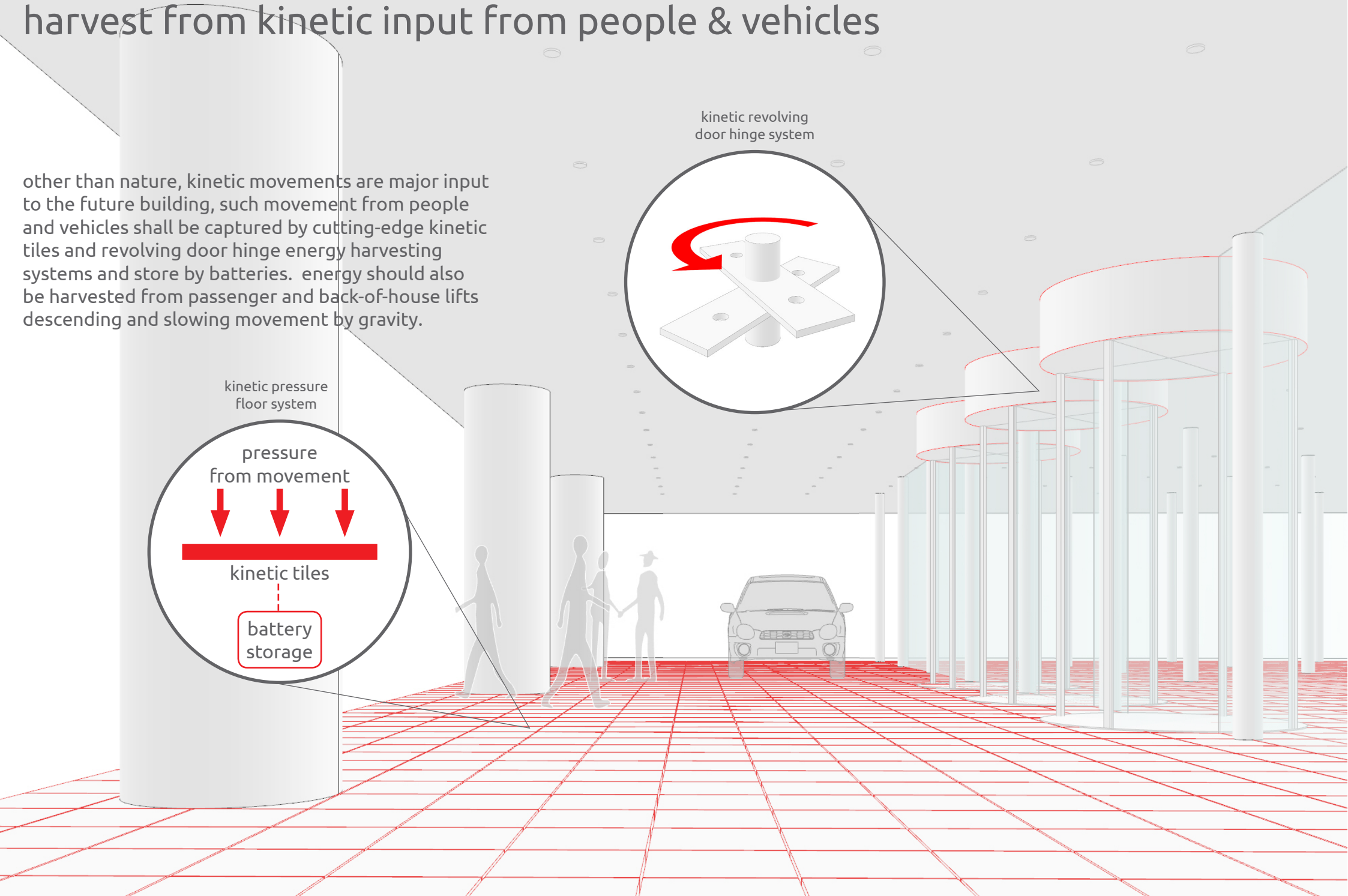


clt panels can be as thin as 90 mm and as thick as 315 mm, resulting in a maximum possible floor slab span of over 12 meter with standard office loading

electric generation system:

harvest from kinetic input from people & vehicles

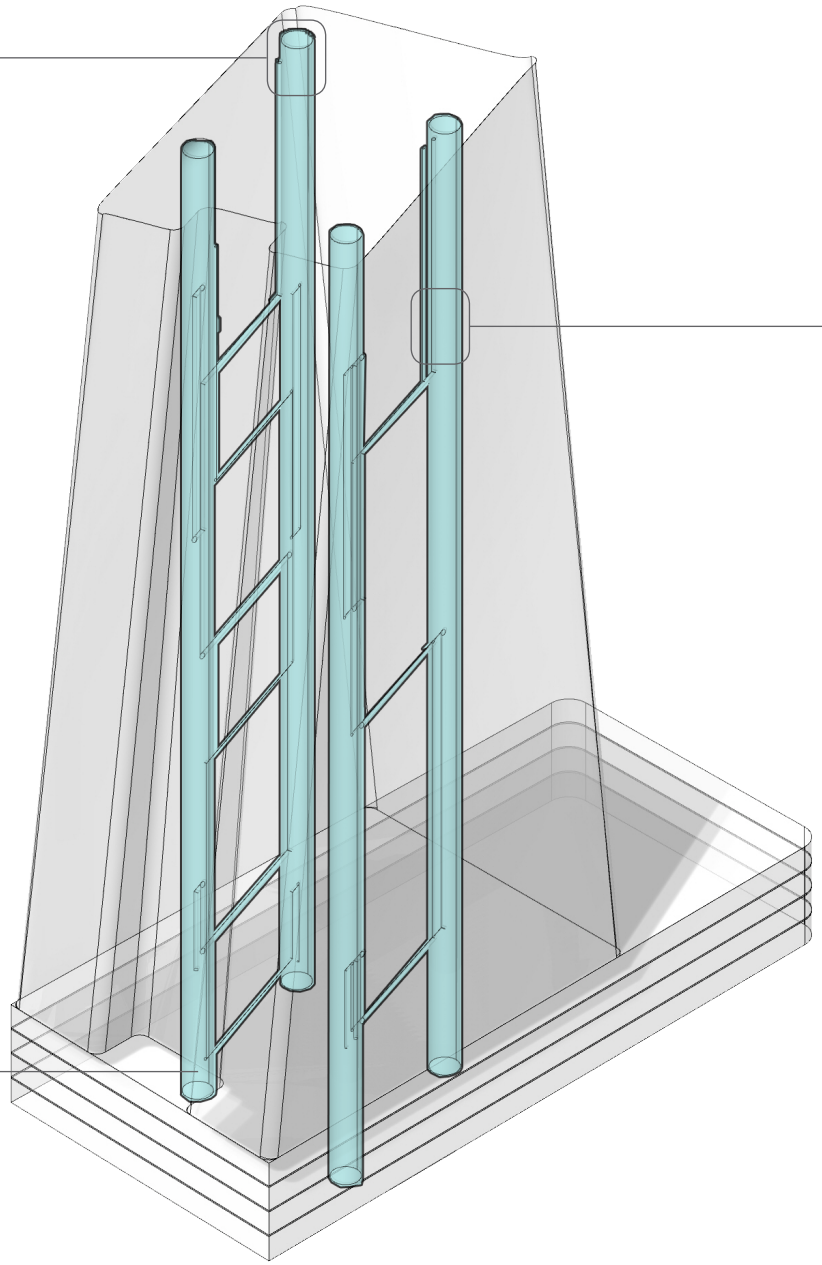
other than nature, kinetic movements are major input to the future building, such movement from people and vehicles shall be captured by cutting-edge kinetic tiles and revolving door hinge energy harvesting systems and store by batteries. energy should also be harvested from passenger and back-of-house lifts descending and slowing movement by gravity.



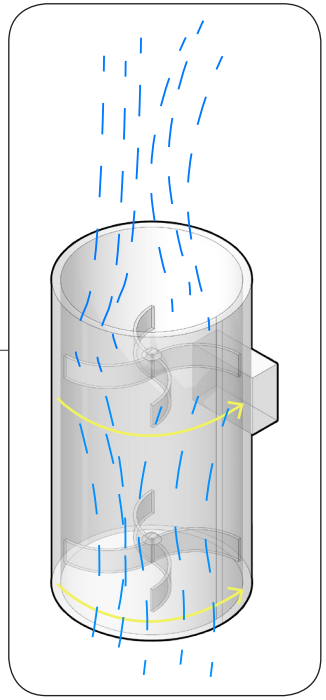
electric generation system:

harvest from gravity in potable water distribution & rainwater collection

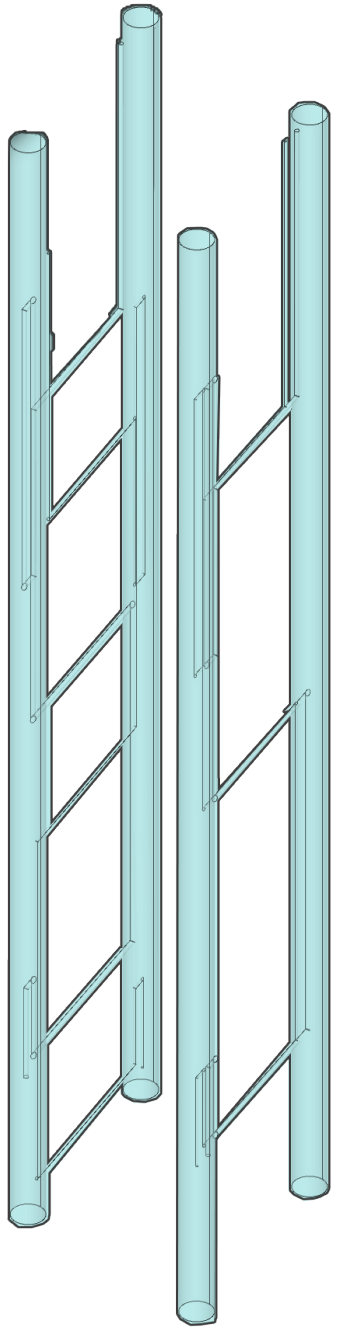
the electric generation pipe system is working in conjunction with potable water system



electric storage batteries shall locate at podium level for on-site use

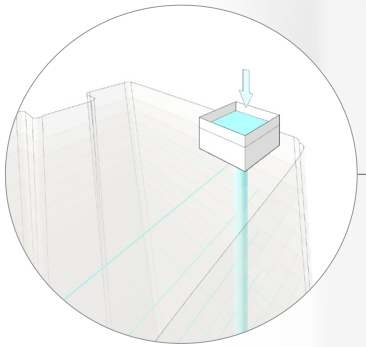


integrated electric generators are installed at regular intervals within the main riser piping system

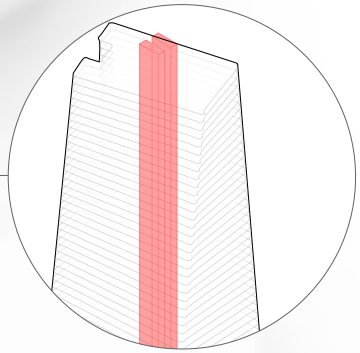


utilizing the momentum gained from potable water within pipes, fall from upper levels to ground level, micro turbines are fitted within vertical pipes, capturing the energy from flowing water by means of gravity.

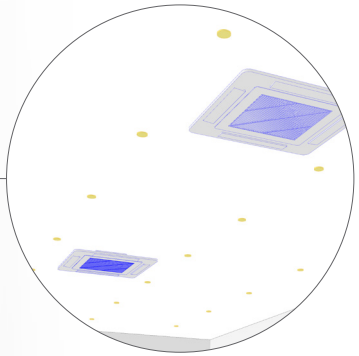
other conventional & unconventional systems



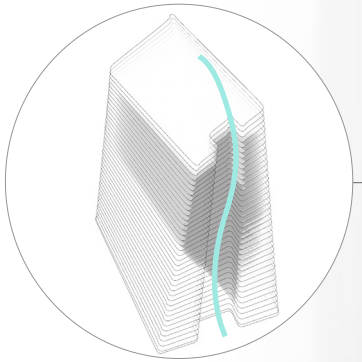
rainwater
harvesting



foh & boh lifts as
energy generators
when descending

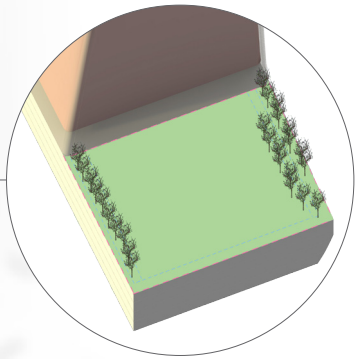


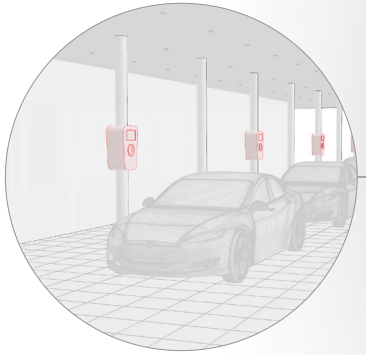
adaptive system
for mvac & lighting



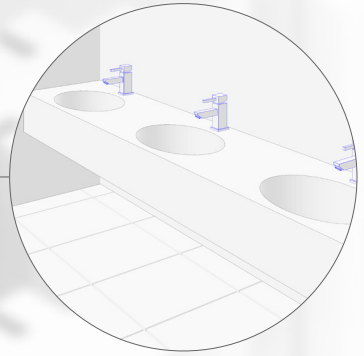
wind
chimney

podium garden





ev
charger

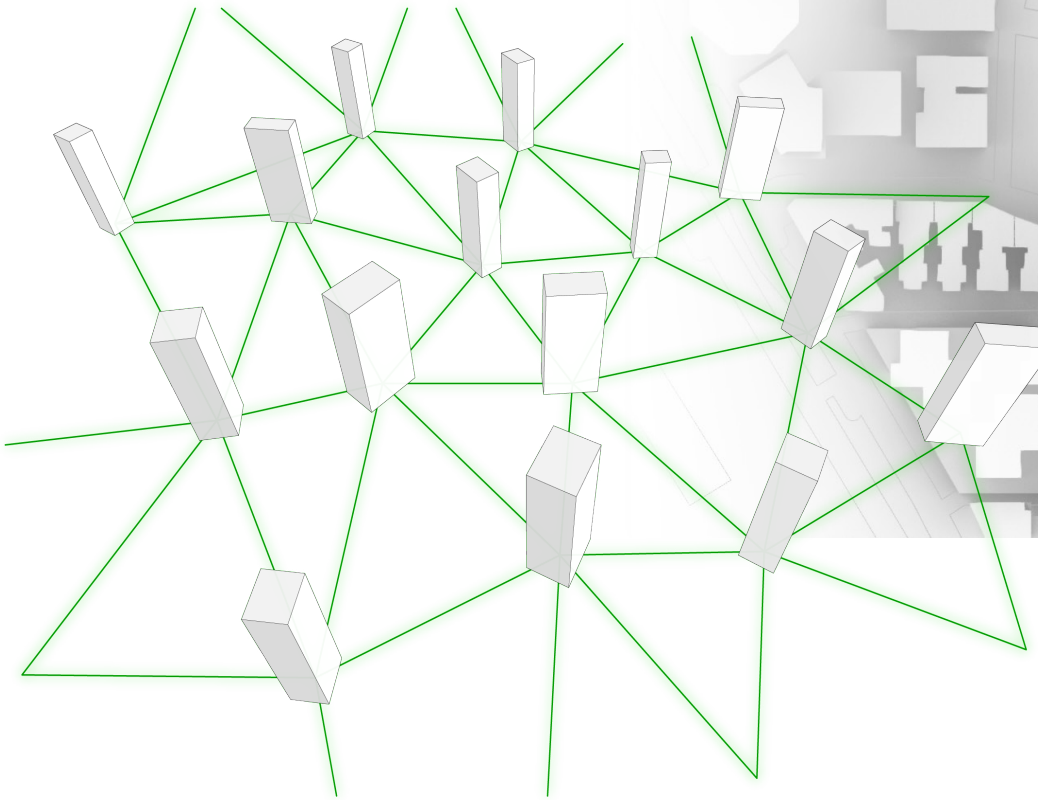


use of grey water for
flushing & irrigation

the future building shall be part of an energy network.

when on-site generated energy exceeds consumption, the future building would feed the surplus to the network.

start with a micro-grid along tong chong street, expand to entire neighborhood, quarry bay, hong kong island, the entire city, the greater bay area?



holistic thriveable design approach:

think of building as a network, not an independent facility

holistic thriveable design approach:

true upcycling materials and products that work with nature

materials would embody some level of carbon when being manufactured to be “ready for construction” and transported to factories or project site. the future building commits to majority organic, locally sourced, and rapidly renewable materials for builder’s and interior fit-out works.

some existing recycled materials would be adopted, in parallel research and development is critical to the future building on upcycled materials, e.g. materials that ages and contain higher value than when they are newly installed. such materials would need to work with instead of against the nature, taking oxidation, heat, dust, and dirt as fresh inputs to become stronger and higher valued materials. all of such materials would become raw materials instead of waste after the dissembling process.

connection by mechanical means, all clt structural components could be dissembled and use as structural components.

cross laminated timber (clt)

a biocomposite material with mixture of hemp hurds and lime, sand, or pozzolans, a light weight insulating material that can be re-used

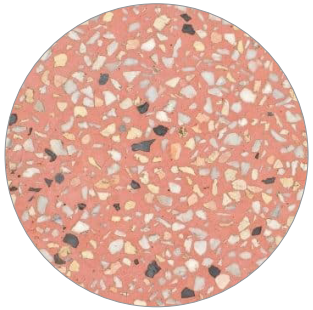
hempcrete

with living bacterial composite content, to develop a wide range of fit-out materials that would “self-heal”, saving operational replacement cost

self-healing baterial fit-out materials

to install insulation panels that made from coconut husk fibers, as they age the panels become stronger with higher thermal insulation value

coconut fiber panels



instead of chips from marble, quartz, granite, or glass, upcycled terrazzo continues to bond with any materials on the surface, including dirt and dust.

upcycled terrazzo

recycled carpet are made with shredded plastic fiber, upcycled carpet ages with nature and kinetic input, e.g. people, and become stronger panels.

upcycled carpet

using scrap fabric from all sources to repurpose new textile for furniture upholstery to windows covering

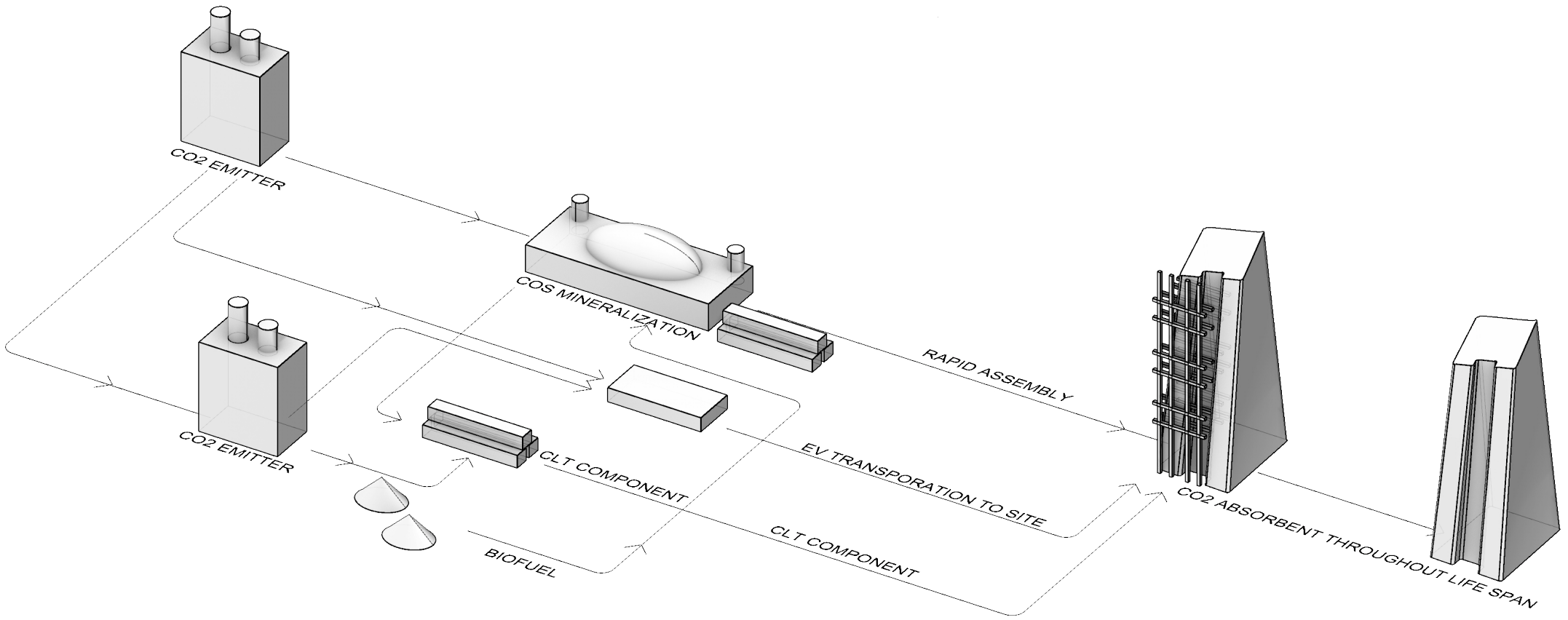
upcycled textile

cork is dead tissue formed from the bark of cork oak tree. bonded with organic agent shredded cork can make any materials from flooring to partitions panels

materials made from shredded cork

holistic thriveable design approach:

further reduction in embodied carbon for materials & their transportation



collecting shavings from clt production process, biofuel is created for other material production processes to further reduce wastage and embodied carbon. from factories to construction site, only electrical vehicles would be used for transportation of all prefabricated and modular components.

holistic thriveable design approach:

use bim-to-ar / ar-to-actual to streamline design and construction

bim would be used to implement and manage the entire project from design to construction, operations, and dissembling.

during construction, from builder's works to building systems and interior fit-out, bim model could be translated and experienced in augmented reality (ar), overlaying the conceived design intent on site.

main contractor and fit-out contractor can directly translate from ar to reality.

the future building would be visualized on site through ar technology.

contractor to prepare 3d shop drawings, on-site augmented setting out, and accurate construction that happen in real time.

holistic thriveable design approach:

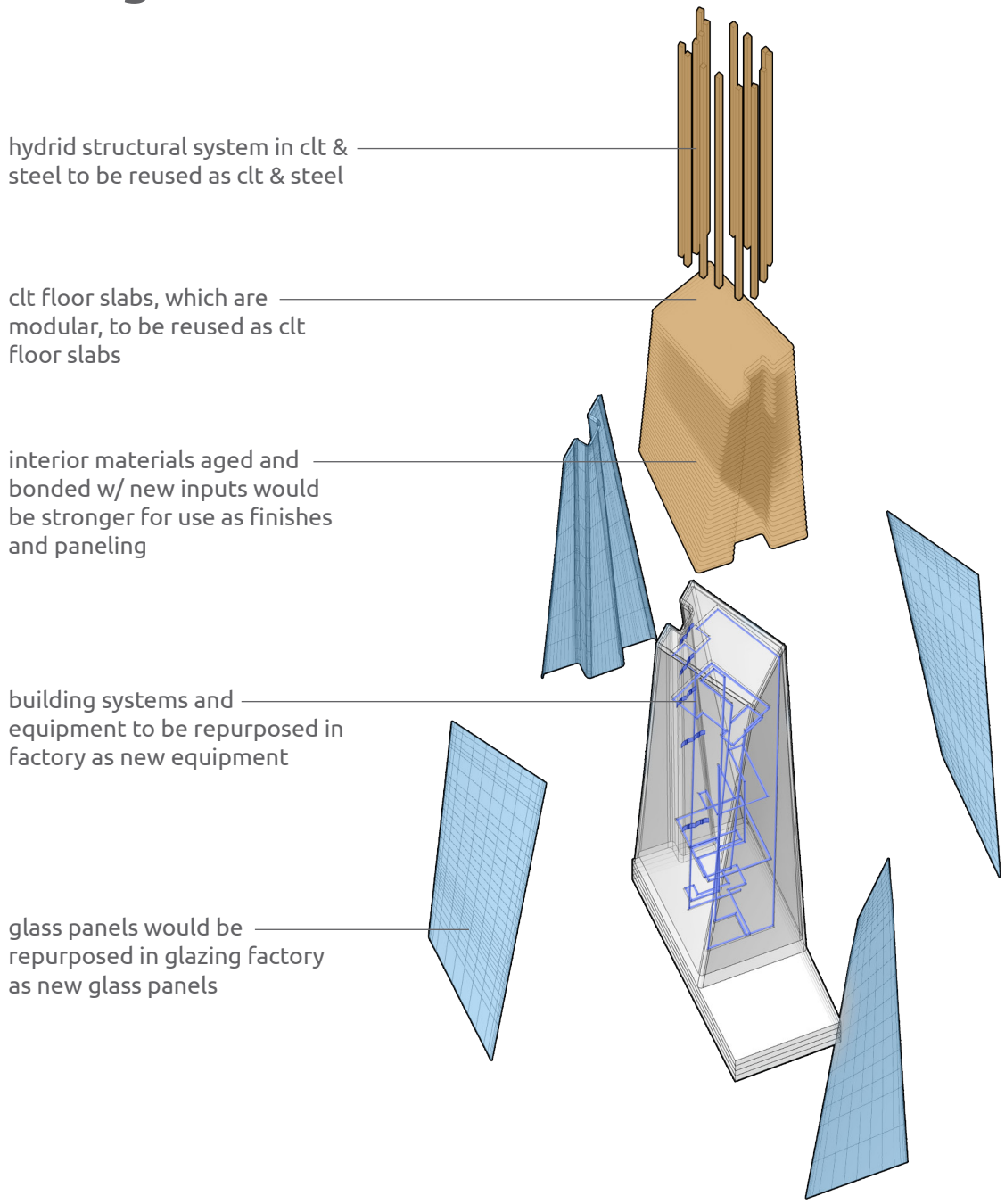
design to dissemble the future building

architects, engineers, and builders are meant to design for the construction of the physical environment, for the future building the project team would need to design the intricate process and steps to dissemble, harvesting materials, products, and components to either serve its original purpose (recycle) or embody a higher intrinsic value for a higher purpose (upcycle).

dissembling — the future building

↓

pre-design — the future future building



targeted energy consumption (minimum to achieve)

assumed office building served by decentralized air-conditioning system

assumed percentage area of total building entity:
office @70%, retail & restaurant @10%, back-of-house @10%, carpark @10% = 100%

assumed bi-weekly normal operating hours for office work (mon-sat, 08:00-19:00):	132 hours
annual total energy consumption (to achieve top 25% of hkgbc benchmarking assessment):	975,000 mj per annum **270,833 kwh per annum**

targeted on-site generated energy **to exceed 270,833 kwh per annum** to feed surplus to the network.

targeted embodied carbon content

embodied carbon co2 per sm (median range between 500-900 co2 per sm):	700 kg co2 per sm
total co2 (based on ifa):	52,721 tonnes
less 40% (aspirational target to cut 40% carbon emission by 2030):	**31,632 tonnes**

summary data (minimum to achieve)

building targeted annual consumption, kwh per annum:	**270,833**
building targeted embodied carbon content, kg co2-e:	**31,632**
building gross floor area, (gfa, sqm):	94,144
building construction floor area, (cfa, sqm):	108,266
building internal floor area, (ifa, sqm):	75,315
building targeted energy utilization index (eui, kwh per sqm of ifa per annum):	**3.60**
building targeted embodied carbon performance (ecp, kg co2-e per sqm of cfa):	**292**

energy calculation

energy savings from facade (passive)

- ventilated double-skin: reduction of cooling load needed
- high performance glass panels: reduction of cooling load needed
- fiber optics daylight for interior use: reduction of lighting load needed

energy savings from wind chimneys (passive)

- wind chimneys near facade and core: reduction of cooling load needed

energy generated from facade (active)

- solar energy harvesting system: estimated energy generated — 142,500 kwh per annum
  (approx. 950,000 sm area @150kwh per 1,000 sm per annum)

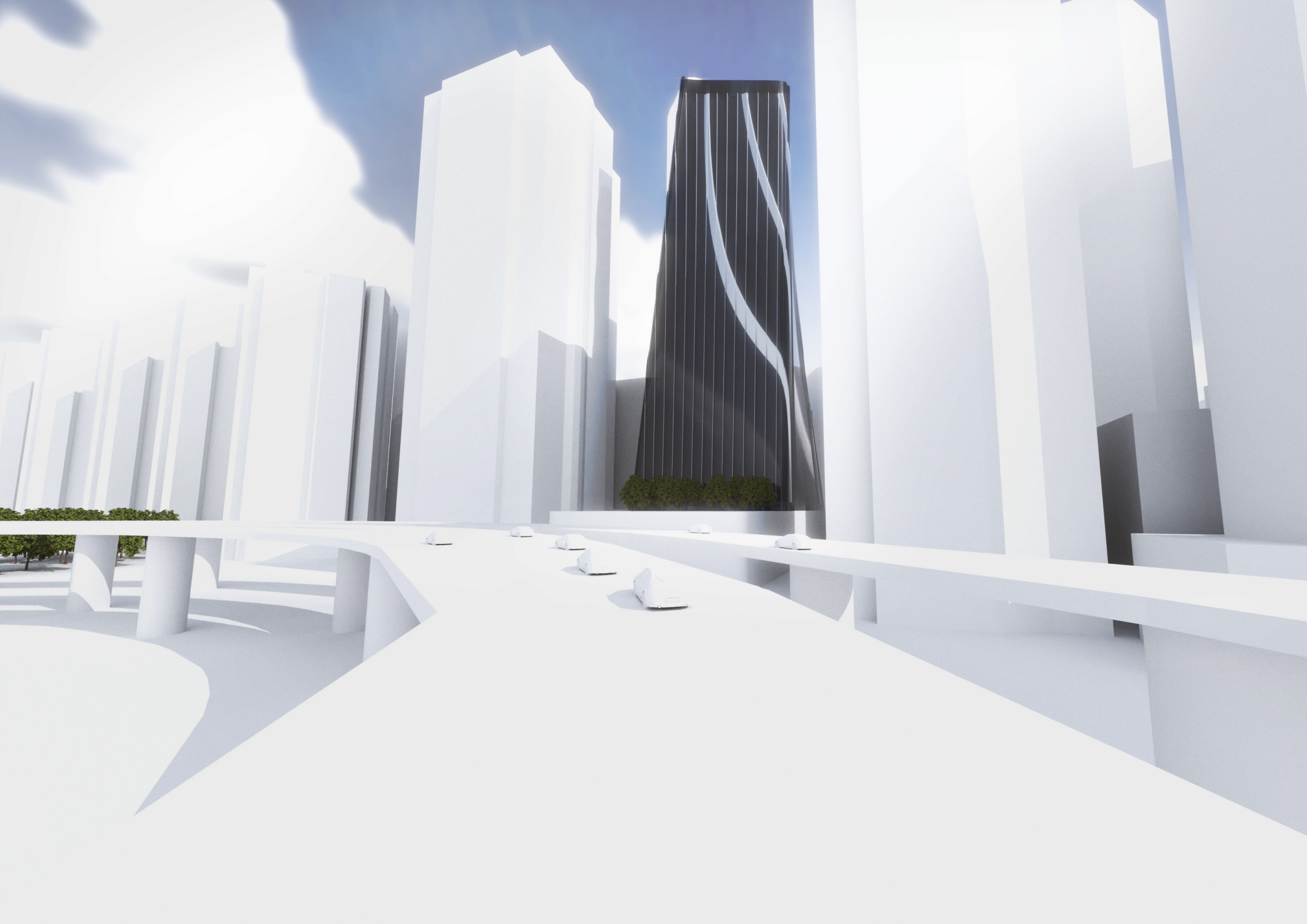
energy generated from micro turbines (active)

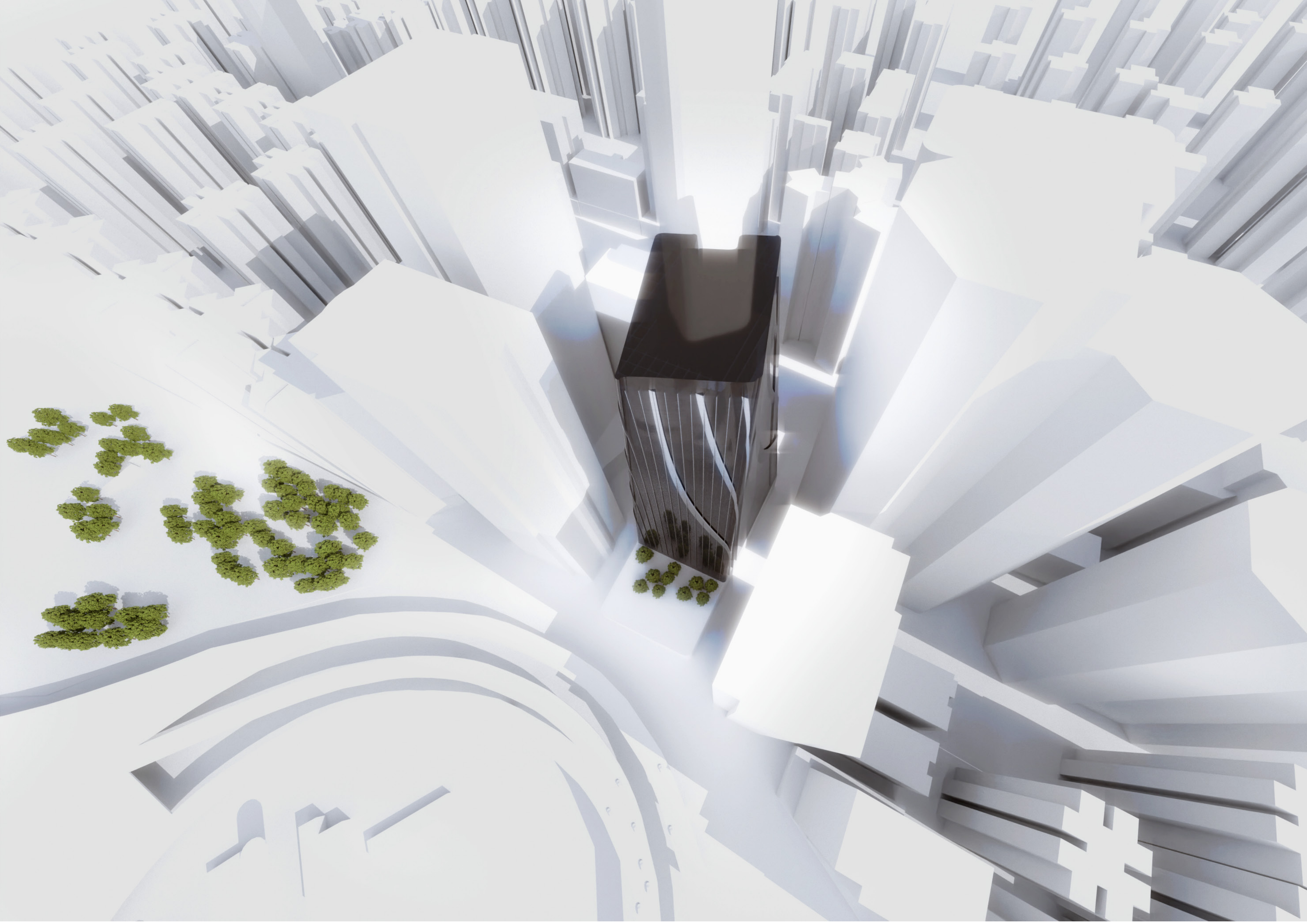
- micro turbines for potable water flow: estimated energy generated — 50,000 kwh per annum
  (approx. 10 mil gal per annum @5kwh per 1,000 gal flow per annum)
- micro turbines for rainwater flow: estimated energy generated — 10,000 kwh per annum
  (approx. 2.4 m per annum @5kwh per 1,000 gal flow per annum)

energy generated from kinetic input (active)

- kinetic walkway & floors: estimated energy generated — 60,000 kwh per annum
  (approx. 80,000 sm including ext area @75kwh per 100 sm per annum)
- kinetic driveway: estimated energy generated — 7,500 kwh per annum
  (approx. 10,000 sm including roadways @75kwh per 100 sm per annum)
- kinetic lifts: estimated energy generated — 16,000 kwh per annum
  (approx. 12 foh lifts & 4 boh lifts @1,000kwh per lift per annum)

estimated total on-site generation — **286,000 kwh per annum**
> 270,833 kwh per annum





the movement holistic thriveable design would create...

chain reaction in endogenous growth

economist jeffrey sachs summed up perfectly why innovation is the only way moving forward:

“countries have a big market, further raises productivity and expands the size of the market, and creates new incentives for innovation. this momentum creates, in fact, a chain reaction, which economists call endogenous growth.”

we need continuous economic growth, and continuous innovation is about the only means to increase market size, raising the currency to enhance a larger market and drives further innovation. therefore, innovation and economic growth must be interdependent of one another, walking hand-in-hand.

a holistic thriveable design approach is a vision to build responsible living environments that protects the health and wellbeing of people while respecting the land and our finite resources. owners and operators would see the improvements in long term quality of living as well as economic benefits by building and operating with a strong sense of responsibility to the environment.

the future building would be the prototype demonstrating so.

net zero = sustainability
thriveability = sustainability x innovation

“how we respond now will decide the future of human civilization.
we are the people we’ve been waiting for.
there is no one else. there is no other time. it’s us and it is now.”
environmentalist paul gilding