foresight

IT'S ALIVE!

Can you imagine the *urban building of the future?*

DRIVERS OF CHANGE

POPULATION GROWTH

URBANISATION

CLIMATE CHANGE

NEW PATTERNS OF FOOD PRODUCTION

SCARCITY OF NATURAL RESOURCES

SECURITY AND SURVEILLANCE SOCIETY

ENVIRONMENTAL CONSCIOUSNESS

SMART CITIES

INTELLIGENT BUILDINGS

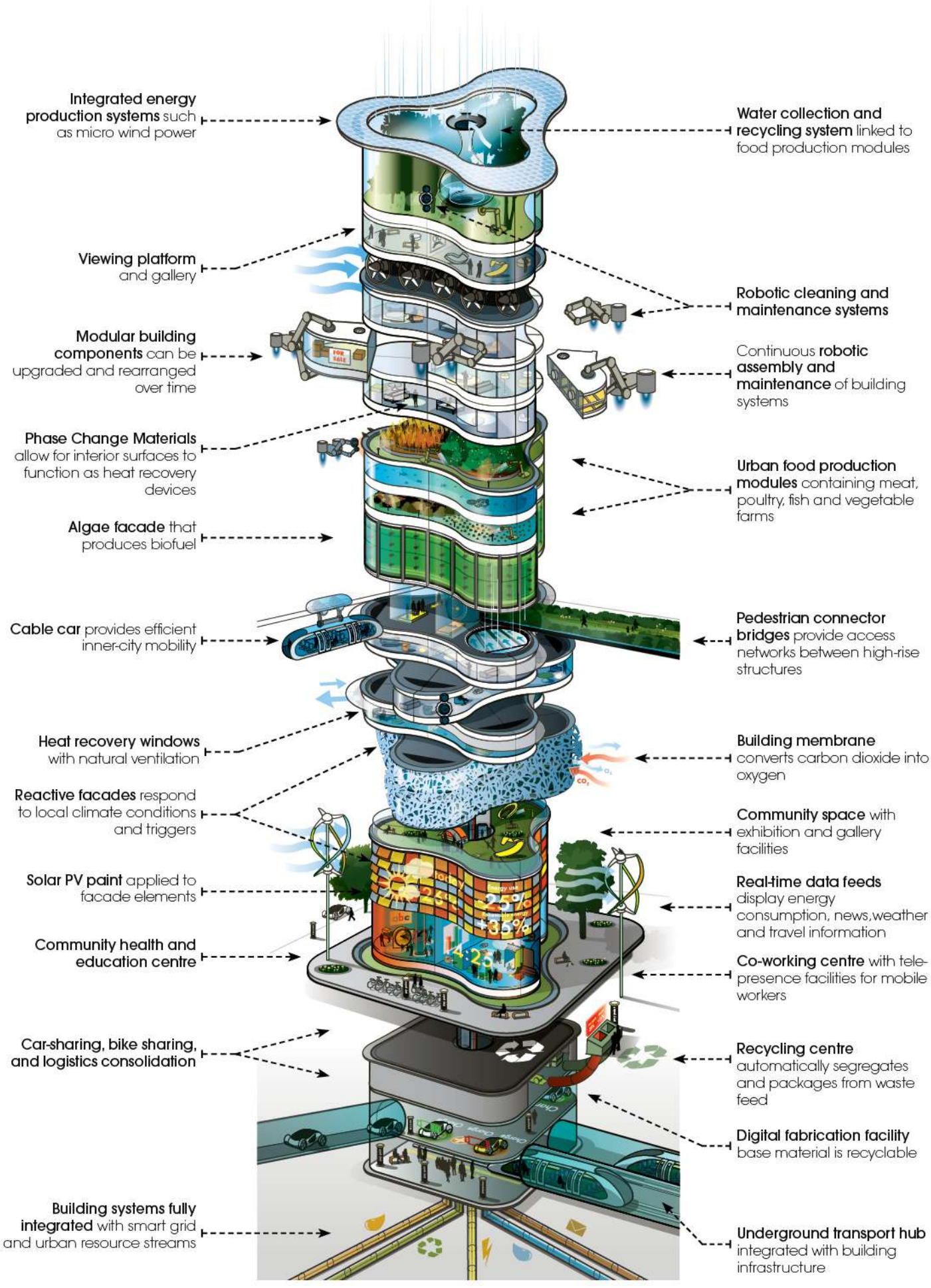
NANO- AND BIOTECHNOLOGY REVOLUTION

ROBOTICS AND AUTOMATION

USER-DRIVEN DESIGN

COMMUNITY AND SYSTEMS INTEGRATION

ECOLOGICAL AGE


Integrated energy production systems such as micro wind power
Viewing platform and gallery
Modular building components can be upgraded and rearranged over time
Phase Change Materials allow for interior surfaces to function as heat recovery devices
Algae facade that produces biofuel
Cable car provides efficient inner-city mobility
Heat recovery windows with natural ventilation
Reactive facades respond to local climate conditions and triggers
Solar PV paint applied to facade elements
Community health and education centre
Car-sharing, bike sharing, and logistics consolidation
Building systems fully integrated with smart grid and urban resource streams
Water collection and recycling system linked to food production modules
Robotic cleaning and maintenance systems
Continuous robotic assembly and maintenance of building systems
Urban food production modules containing meat, poultry, fish and vegetable farms
Pedestrian connector bridges provide access networks between high-rise structures
Building membrane converts carbon dioxide into oxygen
Community space with exhibition and gallery facilities
Real-time data feeds display energy consumption, news, weather and travel information
Co-working centre with tele-presence facilities for mobile workers
Recycling centre automatically segregates and packages from waste feed
Digital fabrication facility base material is recyclable
Underground transport hub integrated with building infrastructure

CAN YOU IMAGINE...

By 2050, the human population will have reached 9 billion; 75% of whom will be living in cities. Until then, climate change, resource scarcities, rising energy costs and a preoccupation with preventing and minimising the effects of the next natural or man-made disaster will undoubtedly shape our vision of the built environment. As major cities reach their boundary limits; extending transit networks and patterns of urban sprawl will no longer provide an effective solution. Instead, demographic and lifestyle changes will serve as major catalysts in the shift towards an increase in dense urban environments.

As city living takes center stage, what will we come to expect from the design and function of urban structures and buildings?

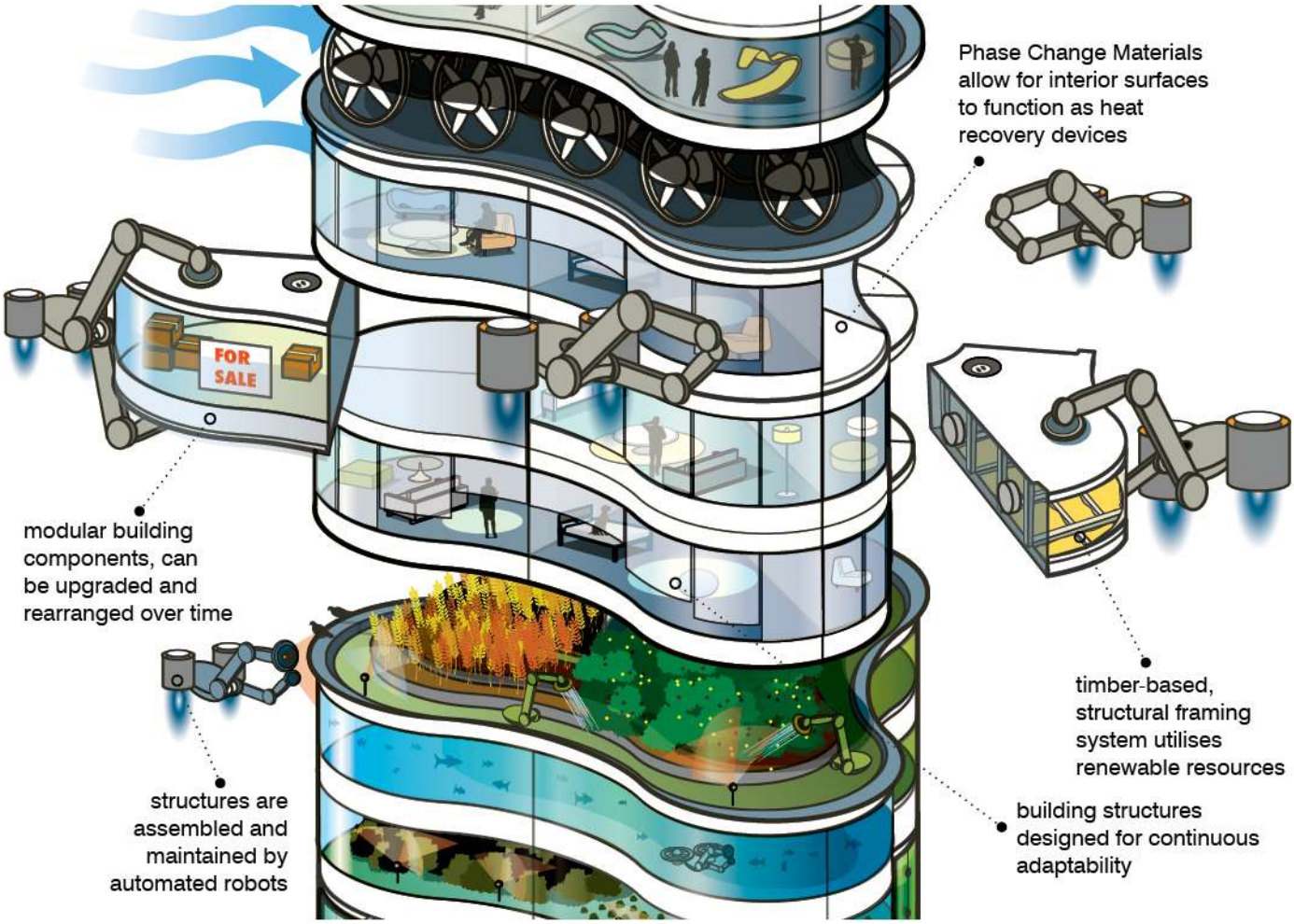
2050 will mark a generation of net-native adults who will have lived all their lives engaging with smart devises and materials. They will have experienced technological breakthroughs that will redefine how human beings interact - not only with each other, but with their surrounding environment. We will live in cities where everything can be manipulated in realtime and where all components of the urban fabric are part of a single smart system and an internet of things. These expectations set the tone for an environment that invites adaptation with ease; a place where hard infrastructure, communication and social systems are seamlessly intertwined, with a conscious necessity to integrate and engage in sustainable design practices.

Future technology will be far more focused on producing unique solutions for individual people. This necessity for our surrounding environment to inherently understand an individual's preferences and personal needs means all facets of the building network could respond to the specifics of each unique user – down to an individual's genetic composition.

In 2050, the urban dweller and the city are in a state of constant flux - changing and evolving in reaction to emerging contexts and conditions. The urban building of the future fosters this innate quality, essentially functioning as a living organism in its own right - reacting to the local environment and engaging with the users within. A dynamic network of feedback loops characterised by smart materials, sensors, data exchange, and automated systems that merge together, virtually functioning as a synthetic and highly sensitive nervous system. In this sense, the building's structure is highly adaptive and characterized by indeterminate functions; a scheme, where space and form is manipulated depending on the time of day or the user group currently activating it. The system presents a spatial and formal condition which is under constant change. A structure whose components are designed to be dynamic, intelligent and reactive - a living network activated by interaction with the users and its surrounding environment. Structural systems merge with energy, lighting and facade systems to extend beyond the confines of physical limits, and to shape a new type of urban experience.

FLEXIBLE STRUCTURES

MODULAR COMPONENTS CAN BE UPGRADED AND REARRANGED OVER TIME
MATERIALS MAINTAIN AND REPAIR THEMSELVES
STRUCTURES CAN BE ASSEMBLED BY ROBOTS
BUILDING ELEMENTS ARE DESIGNED FOR CONTINUOUS ADAPTABILITY
ACTIVE STRUCTURAL DAMPERS MANAGE MAJOR SEISMIC LOADS



Can you imagine a building that has flexible components designed for continuous adaptability?

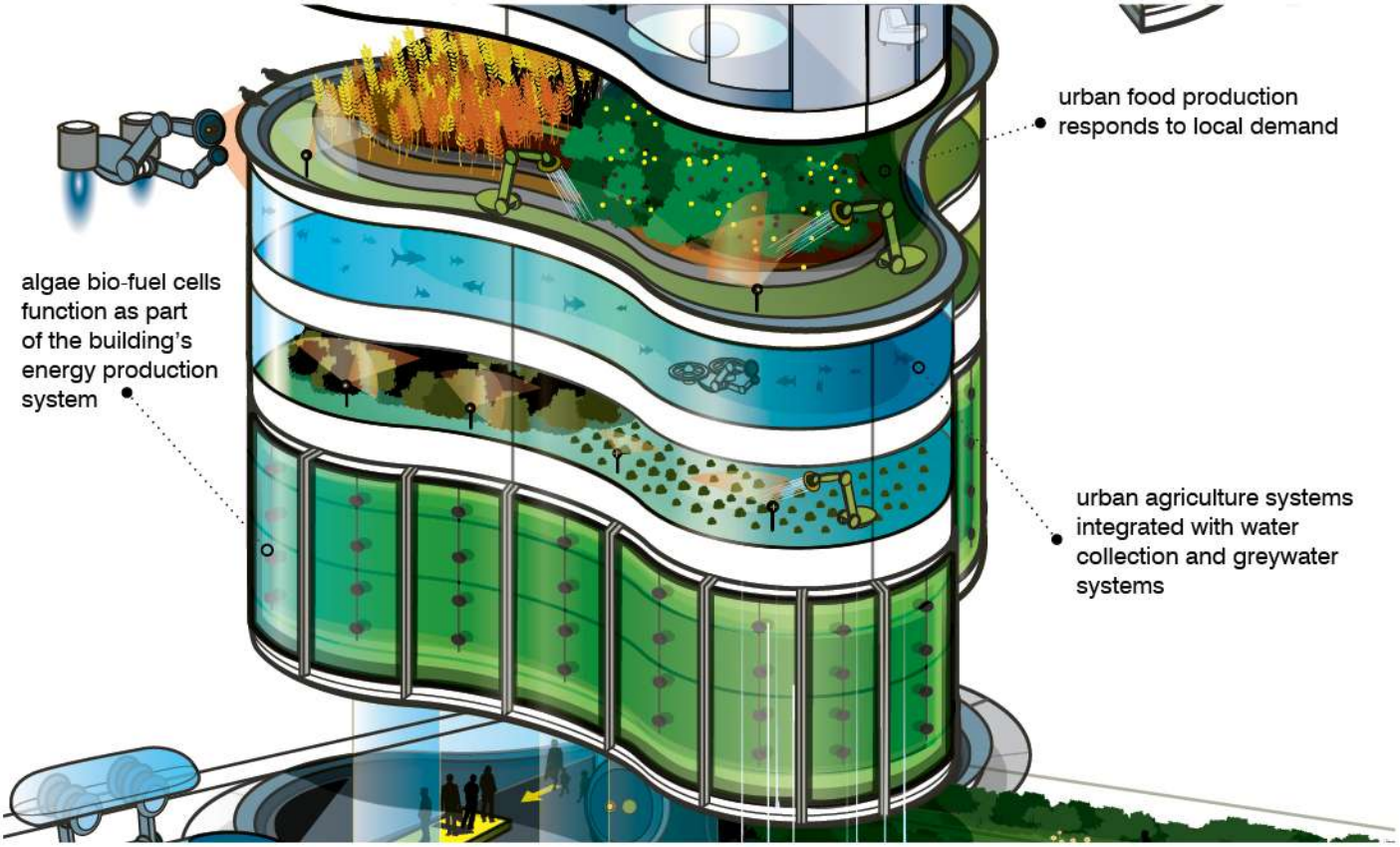
In this emerging age, with significant developments in construction - prefabricated and modular systems are moved and assembled by robots that work seamlessly together to install, detect, repair and upgrade components of the building system. Technology, spaces and facades can be rapidly manipulated and modified, dictated by factors such as, the addition or subtraction of program, density of dwellers, or other context-based and environmental cues.

Materials feature intelligent design and are formulated as high-performance composites made from recycled and renewable elements and providing functions such as self-repair or purification of the surrounding air.

Continuous adaptability of the building is established through a multi-layered approach with varying design life spans for each phase. The first layer is the permanent structure, such as floor slabs. These are deliberately designed to have a degree of permanence yet be capable of adaptation for an array of uses and a variety of functions at different times during the life-cycle of the building. The second layer of adaptability addresses occupancy-specific components. These elements have 10-20 year lifespans, which might include the façade and primary fit-out walls, finishes, or on-floor mechanical plant. The third layer utilises rapidly changing loose fitout elements – including IT infrastructure, as systems need to accomodate the rapid rate of technological developments of future devices.

SUSTAINABLE RESOURCES

BUILDING PROCESSES AND PRODUCES RESOURCES
CRADLE-TO-CRADLE DESIGN
RENEWABLE AND RECYCLABLE MATERIALS
BUILDINGS AS INTEGRAL COMPONENTS OF URBAN FOOD PRODUCTION
FULL INTEGRATION WITH THE CITY AND ITS RESOURCE STREAMS



Can you imagine a building that produces more resources than it consumes?

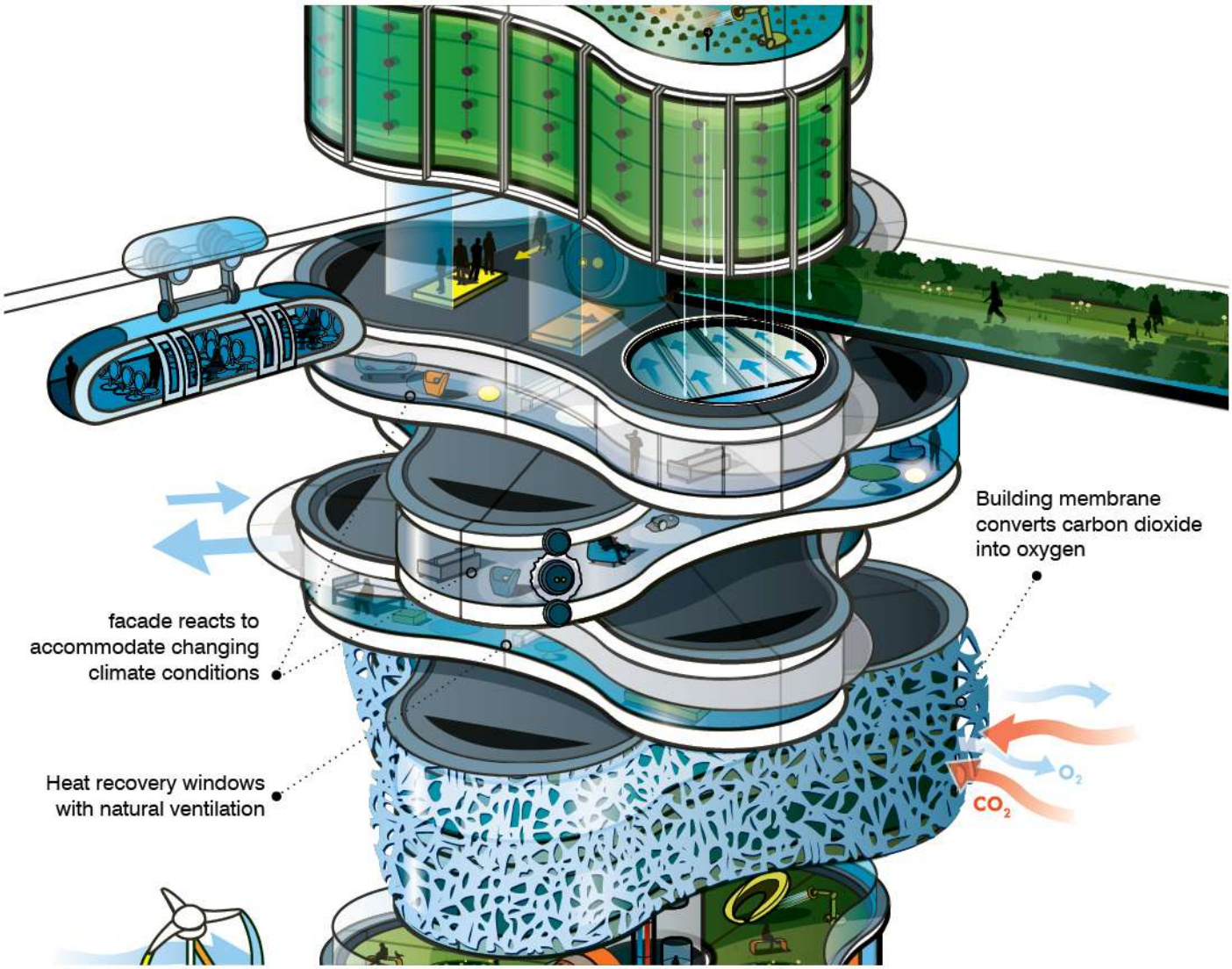
Integrated with the smart infrastructure grid, the urban dwelling of 2050 gathers information and reacts to contextual cues. Components such as photovoltaic surfaces enable on-site production and storage of energy. Energy is captured and transmitted through alternate means including on-site fuel cells, the use of vertical transportation systems to harness energy, and algae producing bio-fuel pods. Modified wind turbines can manufacture drinking water from humid air. Water systems are optimised for recycling and reuse, while filters and surfaces clean air and eliminate environmental pollutants. Green spaces and open spaces become integral elements of the high-rise building system, and are dispersed throughout the structure inviting increasing levels of biodiversity and encouraging interaction from the more inconspicuous inhabitants of the urban landscape - plants, birds and insects.

Wind downdraught protection is seamlessly integrated, minimising undesired wind microclimates around the base of the building. By 2050, these seek to harness wind downdraught to create electrical power.

The building helps to optimise city-wide production, storage and consumption of everything from food and energy to water. Brought about by a concern for depleting natural resources, lack of physical space, and drastic climate change; food production systems, like green spaces, become integral elements of the sustainable and smart city. Vertical farming techniques and urban agricultural systems, such as hydroponics, are utilised to address the impending crisis in world food production, and follow the same fundamental methodology that urban planners have used for years - building up, as opposed to out.

REACTIVE FACADES

FACADES THAT REACT TO CHANGING ENVIRONMENTAL CONDITIONS
SURFACES FOR COMMUNICATION WITH THE WIDER COMMUNITY
INTEGRATED FOOD AND ENERGY PRODUCTION
SELF-CLEANING AND AUTOMATED



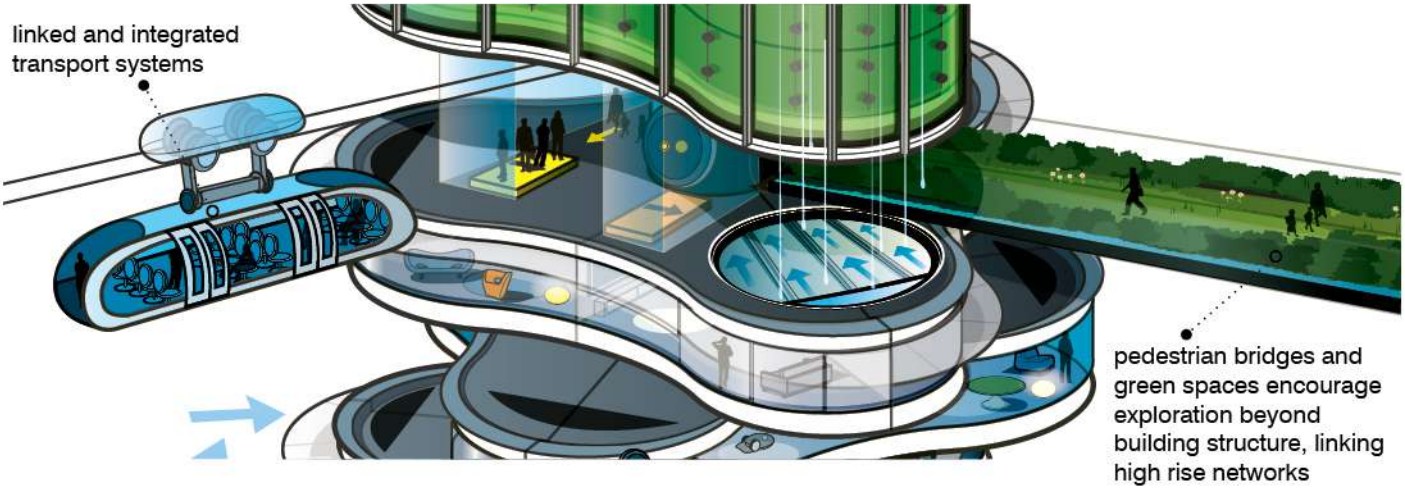
Can you imagine a building that has a sensitive and multifunctional skin?

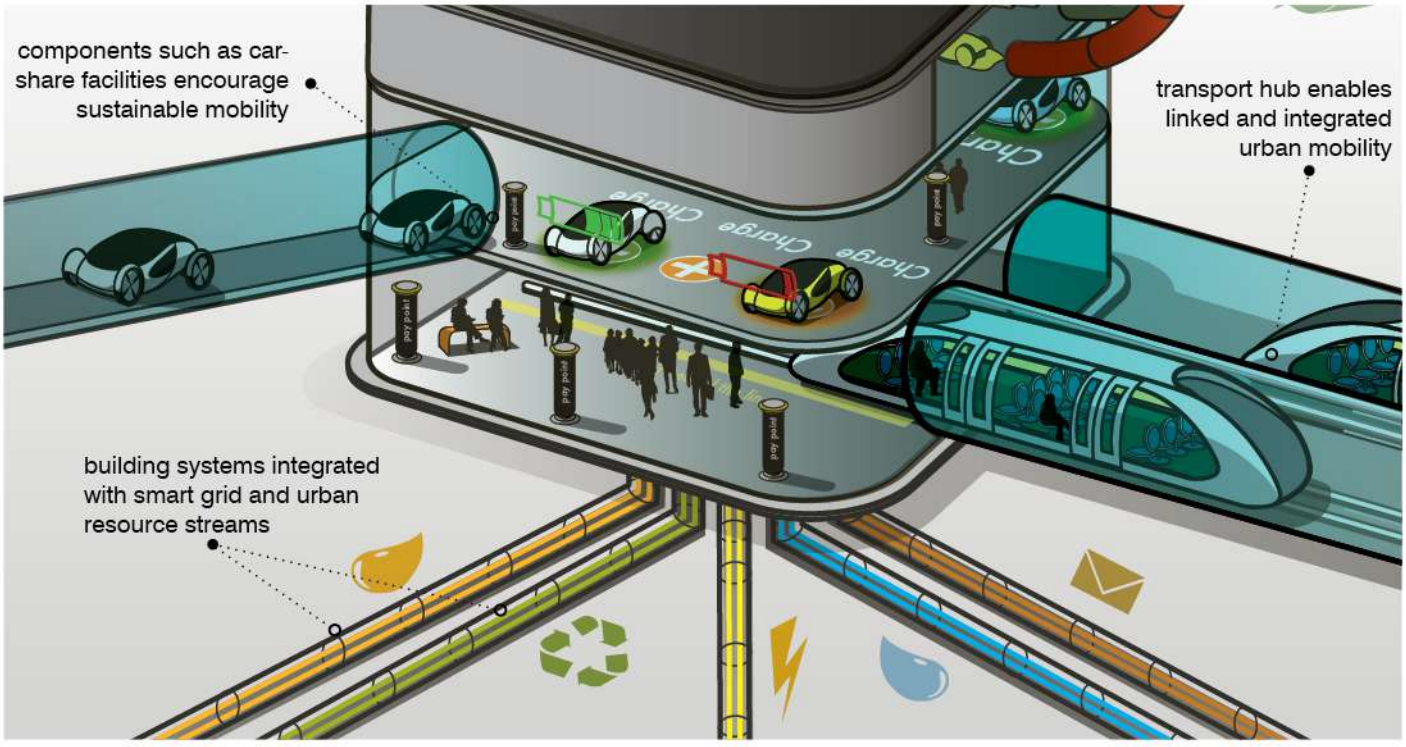
The facade system of the future is highly multifunctional, plugging in to the city infrastructure, on a macro scale, and as part of the building system. This exterior membrane provides opportunities for everything from integrated communication networks, to food and energy production.

By 2050 photovoltaics will become available in paint form allowing for mass coverage, subsequently providing a more meaningful energy contribution. Algae systems enable the on-site production of bio-fuels that are used by the city's wider transportation systems, while heat recovery windows with natural ventilation allow for air to be brought in and up, intercepting the heat that is normally lost through windows. Nano-particle treatments applied to facade systems have the capacity to neutralise airborne pollutants, capture CO_2, and clean the air around each structure. The building's highly-sensitive membrane reacts to environmental factors such as changes in temperature, wind patterns, atmospheric moisture levels and sunlight to provide optimal thermal comfort for the inhabitants and make maximum use of renewable energy production opportunities.

COMMUNITY INTEGRATION

INTEGRATION OF PUBLIC REALM
LINKED AND INTEGRATED INTO TRANSPORT SYSTEMS
PUBLIC FACILITIES AND GREEN SPACES ENCOURAGE EXPLORATION
SPACE FOR COMMUNITY SERVICES AND EVENTS
A BUILDING THAT TEACHES AND ENCOURAGES SUSTAINABLE PRACTICES





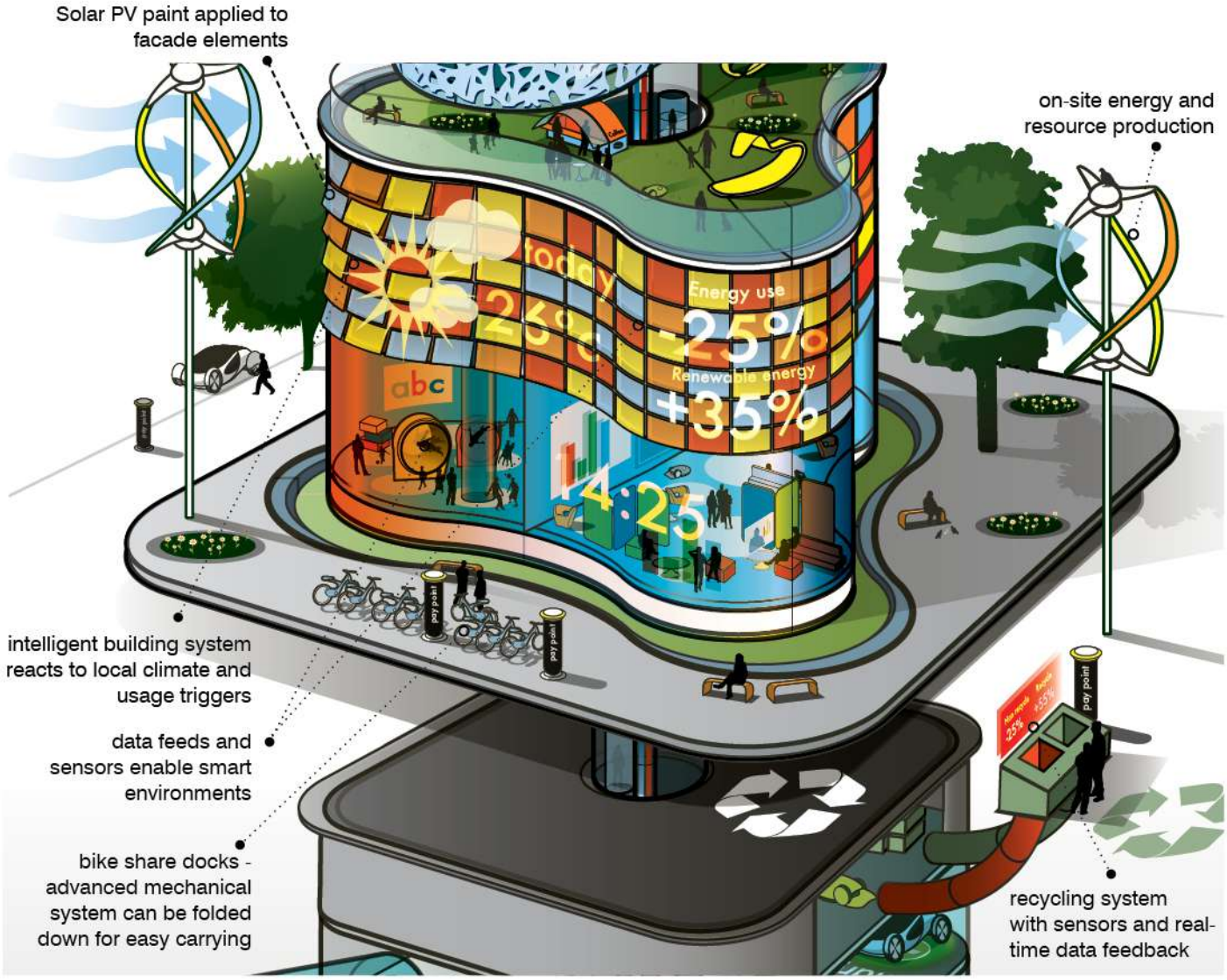
Can you imagine a city, where buildings are fully integrated with the surrounding urban infrastructure?

Future building systems link and integrate transport networks, provide green spaces, and foster and encourage sustainable behaviour. Buildings become an integral part of the community and redefine what it means to be both urban and natural at the same time.

The urban dwelling of 2050 is fully integrated within the fabric of the future city – a dense and, at times, cacophonous urban condition. These structures play a vital role within the context of the public realm, providing an ever-changing backdrop for people to live, explore and interact. On-site digital fabrication facilities allow for users to produce individually customised elements. The base material would be recyclable to be re-constituted for future products manufacturing. Necessary building components are manufactured in situ, avoiding transportion from off-site factories.

SMART SYSTEMS

INTELLIGENT BUILDING SYSTEMS REACT TO EXTERNAL AND INTERNAL CHANGES
SUSTAINABLE SYSTEMS PROVIDE ECOSYSTEM SERVICES
SENSORS, DATA AND AUTOMATION ENABLE SMART ENVIRONMENTS
ON-SITE ENERGY, FOOD AND RESOURCE PRODUCTION
USERS ENGAGE AND COMMUNICATE WITH SPACES



Can you imagine a building that has a brain?

The city of 2050 exists as a framework of highly sensitive and virtually intuitive feedback networks. This system is self-regulating within the context of each individual building, yet simultaneously functions to integrate itself within the surrounding urban infrastructure.

Utilising data collected from factors such as energy consumption, transportation, weather and even occupancy requirements; it is able to execute informed and calculated decisions about the optimal use of resources and composition of structures. As a result, the building has the capacity to create an environment expressly curated in response to the current conditions of the people, environment and city. The building system monitors reflectivity, heat absorption and heat balance, minimising effects of phenomena such as the urban heat island effect. Interior spaces are fully customisable, and can be modified to fit specific needs from climate conditions and lighting to acoustics preferences. Elements such as sensors and OLED technology allow for whole surfaces of a building to illuminate, creating a more even light source. Coupled with daylight absorbing abilities, the technology realises the possibility of 'net zero energy' artificial lighting. The user experiences realities that are perfectly tailored to accommodate the program or function desired.

CONCLUSION...

In the ecological age, buildings do not simply create spaces, they craft environments. They function as part of an urban ecosystem, promote more environmentally conscious and efficient resource management, and actively contribute to the unique needs of the individual user, as well as the wider requirements of the city. By producing food and energy, and providing clean air and water, buildings evolve from being passive shells, into adaptive and responsive organisms – living and breathing structures supporting the cities of tomorrow.

ABOUT FORESIGHT + INNOVATION

Foresight + Innovation is Arup's internal think-tank and consultancy which deals with the future of the built environment and society at large. We serve Arup's global business as well as external clients from a broad range of regions and sectors. We help our organisations understand trends, explore new ideas, and radically rethink the future of their businesses. We developed the concept of "foresight by design", the use of innovative design tools and techniques that bring new ideas to life and engage clients and stakeholders in meaningful conversations about change.

We help organisations:

- Understand and assess global and sector-specific trends
- Engage staff, clients and stakeholders in conversations about change
- Build robust and future-proof strategies
- Identify new markets and growth fields
- Develop disruptive products and services

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