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# ENERGY (R)EVOLUTION

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## PREMISE

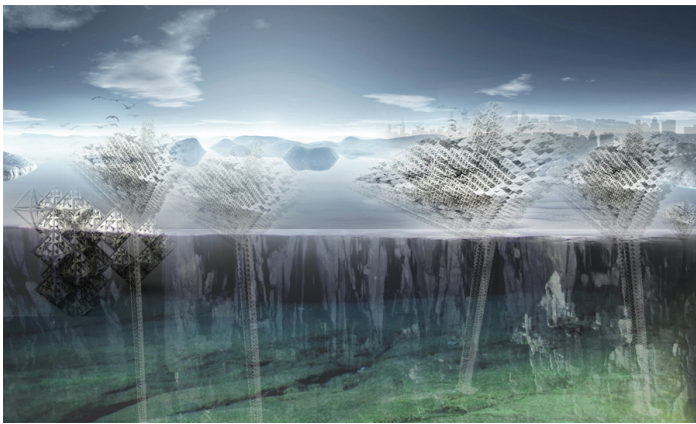


Figure 1. Amalgam – image provided by Architectural Association Visiting School Shanghai students.

As more than half of the world's population is expected to continue to live in cities, exponential urban development and population growth along with infrastructural increase are considered as parallel concerns and topics of discussion. The purpose of these design speculations is to offer potential design applications for architects and urban planners to form into dynamic investigations, integrating a layered approach of amalgamating architecture / landscape / infrastructure within future scenarios of "edge-based" urban environments (Hong Kong, Shanghai, Bangladesh, Houston, Texas, and Orlando, Florida). This topic of discussion, which has been in the past fifty years, and will continue to be under relentless scrutiny given the challenges of ecological changes, sustainable anxiety, and those aspects of urban development deal with design processes that consider the urban fabric and taking into account to the scalability of agricultural and ecological research, which has been and will continue to be a necessary requirement for future city planning.

To better understand the repercussions within the current state of the world, case-studies developed in past studios were developed using several international major 'hit' zones: orlando, florida and Houston, Texas (two us cities that are predicted to be 60 meters under water within the next 100 years to 200 years), and Bangladesh, Shanghai, China, and Hong Kong (three asian edge cities

that have been historically influenced by its contact with western culture, and are consistently suffering from overpopulation). These case-studies of locations were used to develop topological research proposals of inquiry into alternative energy solutions that anchor itself within the system of developmental research using non-solar and non-wind driven sustainable energy solutions.

The case-studies took into specific environmental conditions into consideration to explore the various levels and aspects that pertained to design approaches that have certain ecological effects and techniques of self-sustainable systems. Each researched location has specific contextual approaches that were based on a manifold of environmental conditions defining the ecological designs. Topics of design used both analogue and digital tools to further urban strategies as related to each individual city. Much of the research originated through finding innovative forms of connections and a quest for paradigms within digital designs applied to sustainable urban cities.

The dominant theme within the speculative and developmental proposals questioned the edge condition of urban coastal developments, and actively ponders the role of architects, designers, and urban planners, onto edge intervention and construction along coastlines and waterfronts. Within the socio-developmental aspects, these projects are in search of a new set of relationships between democracy, individualism, sustainability, and capitalism for 'edge' conditions and their typological repercussions. Whether the ecological, economical and equity are balanced within a triangular relationship between urban development and our sustainable future cities, many of the proposals systematically questioned the authenticity of current cities, and whether the regard of sprawl and dynamic urban growth has affected the developmental behavior of the human understanding of places and non-places. Likewise, energy is viewed simply as another good to be consumed by the individual rather than in a more connective fashion where the urban environment must be cognizant of and involved in the efficient production, distribution, and recycling of energy.

Investigations partially manipulated, maximized, and extended the potentials of fabrication as a means of developing variable conceptual means of investigations between discussions of global benefits, agricultural investigations, and urban strategies of cities.

Michel Foucault defined a heterotopia as a real place that facilitated change and research, mirroring in miniature the larger urban system within which urban actors were located (like small cities within cities). Foucault thought that all systems could only become logically consistent by excluding nonconforming items. He proposed to study the logic of systems by looking at exclusions. In Foucault's theory excluded elements were placed in real, heterotopic spaces, resulting in a strange mixture of disparate elements and people with no consistent urban models that Foucault saw as unreal, imaginary, repressive, generic non-spaces. Actors used real spaces, heterotopias, embedded in their systems to accelerate or slow change. Foucault gave as examples of heterotopias 19th-century state-run prisons, hospital, universities and schools whose design helped bring the modern city and society into being. In the late 20th century many new heterotopias such as world's fairs, shopping malls, theme parks, and olympic events have helped bring a postmodern society into the world.

### EXPLORATIONS (CASE STUDIES)

The following case studies were developed and researched with the assistance through several international studios in collaboration with several institutions, but not limited to: the Chinese University of Hong Kong, HKU-AA Shanghai Visiting Studio invited by Professor Tom Verebes, Gerald D Hines College of Architecture—University of Houston, and the University of Florida – Gainesville over recent years.

### AMALGAM (AGGREGATE-BASED URBAN PROCESS) – SHANGHAI, CHINA

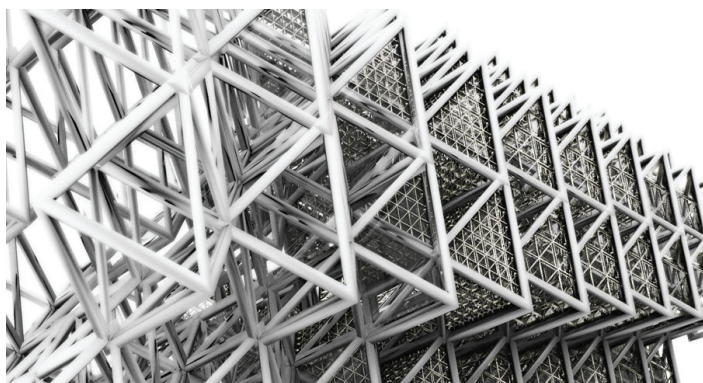


Figure 2. Amalgam – image provided by Architectural Association Visiting School Shanghai students.

*Amalgam* is an investigation into the developmental nature of designing within the basis of exponential growth as a result to population increase, environmental changes, and the incremental nature of contextual factors that surround Shanghai and Suzhou Creek (site). The systematic approach of the design is demonstrated and rooted on the temporal predilection between the current state of Shanghai in the year 2012, and phased into the progressive future of a two hundred year period (2212).

By nature the definition of *Amalgam* pertains to the concept of combination, amalgamation, addition, mixture, growth, fusion, et al. The exploration of the proposal includes investigations into particle/attractor systems, topological/typological logics, mathematical approaches, cellular systems, and incremental densifications/transformations, driven by the most base energy system provided by nature: carbon. The explorations for the project included numerous and varied approaches that explored the comprehension of the geometric and structural integrity of design—which geometric form or fusion of forms could possibly bring the design to another level in developing an alternative technique of building.

### URBAN STRATIFICATION (CULTURAL-TECHNOLOGICAL-TRANSPORTATION HUB) – Maribor, SLOVENIA:

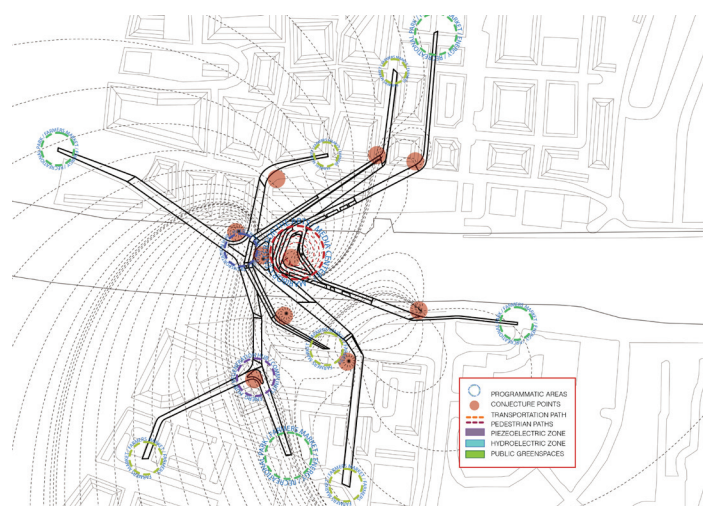


Figure 3. Diagram – conjecture points – urban stratification, Maribor 2112ai 100yc, image provided by author.

In an era of environmental extremes and the influx of 70% of the globe's population to the major urban settlements, the Maribor's 2112 *Visionary Ecologies – Urban-Stratification* master plan re-examines the city's current obsolete infrastructure proposing a new interlaced and *stratified* regenerative system creating urban conditions throughout the city where clean technologies, interactive architecture, and sustainable commerce can reside.

Urban-Stratification is a connective tissue reacting as a threshold between an active transportation hub, Maribor interactive center for the arts, and technological energy generator that will provide a reformative highway and transportation system for Maribor. The project will introduce over 100 kilometers of additional roadways to serve as a departure point for this urban intervention as well as embedded piezoelectric harvesting membranes. The embedded membranes will harvest the energy from vibration, weight, and motion, through several means of traffic, including but not limited to trains, vehicles, bicycles and pedestrians; thus, assisting Maribor 2112

to become one of the first net zero cities by three main sources of productivity energy systems: piezoelectric, hydro, and thermal.

As the citizens of Maribor, visitors, and cultural critiques meander the city through the *Urban-Stratification* ecological and interactive promenades, they will be led experience the architecturally icon of the 2112 Maribor interactive center for the arts. Convening multiple systems of complexities and parallel programmatic systems, the landscape and pathways outline purposeful accidents that change through programmatic shifts and movement.

The center will become an opportunity to experience a new sustainable typology of architecture, clean technologies, and design intelligence. Acting as an active iconic architectural infrastructural and cultural piece, *Urban-Stratification* will be the stage of public relations, social, and digital interactions, which in turn converts the city of Maribor into an urban catalyst that propagates sustainable development throughout the rest of the city.

The Maribor 2112 *Urban-Stratification* master plan provides a multi-lateral approach to the expansive programmatic display of landscape / building/ infrastructure to introduce a new ground plane which reacts as a generative system of energy activating developmental zones along the drava river. The project fosters new interactive social urban ecologies to redefine the existing city, not only as the cultural capital of Europe but also as Europe's first net zero energy city to become the first urban laboratory where architecture intelligence, social interaction, and clean technologies interact simultaneously.

**FLOATING MARKET (AGGREGATE-BASED URBAN PROCESS) – STANLEY, HONG KONG**

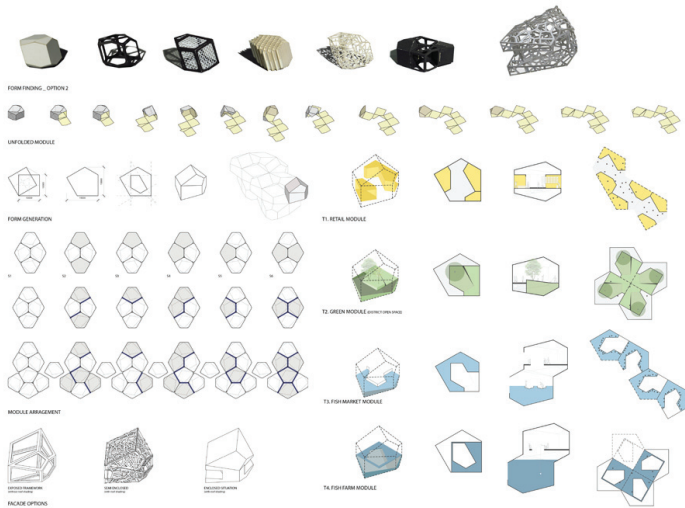


Figure 4. Diagrams - primitive development of programmatic form, image provided by Michelle Lok.

A floating market is introduced as an extension of consuming journey from old Stanley market to the center of sea in Stanley bay, and envisions a cornerstone of providing a new layer of public space for long-term sustainable development in Stanley.

The initial idea of the form is evolved from the formation and erosion of crystallized stone outcropped along the coastline. Its appearance is constantly evolving with wave erosion and decomposition, while the deconstructed particles are carried by sea current and construct the beach on the other side of coastline.

The new market attempts to abstract the idea and programs with two types of market: one exists as a positive profile and permanently constructed along the main stream providing articles for daily use, while another is flexible and fluctuates on the top level of the sea without a rigid space or pre-allocated designed location to contain the floating stalls (e.G. Sam-pan).

Programmatically, the floats operate in cycles of day and night. During the day, the floating stalls exist as fresh market stalls, selling fresh or salted seafood products imported from nearby coastal area, while during the evenings, the modulars retreat into prospective barriers and residential homes, or typhoon shelter. By providing different typologies of market organization, the evolutionary approach to the design develops a sense of emergence through typological shifts that playfully interact between pedestrian level and sea market level environments.

**PRODUCTIVE ARTERIES (THE HIGHWAY AS A PRODUCTIVE ENERGY SYSTEM) – HOUSTON, TX**

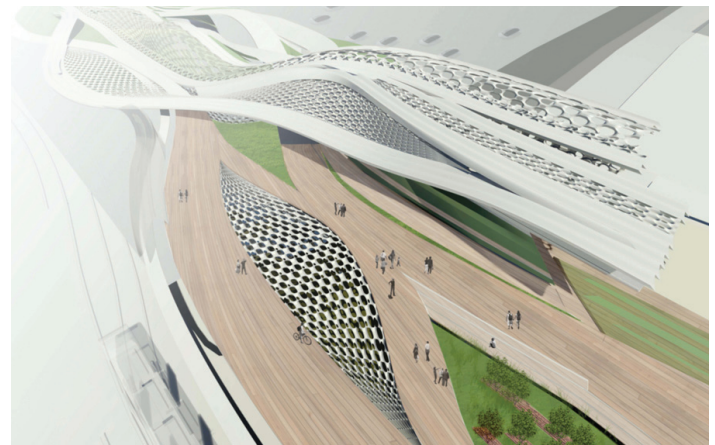


Figure 5. Aerial perspective – productive arteries, image provided by Jose Aguilar.

The current climatic changes and diminished natural resources are sending us signals that we have to rethink the cities we live in. Cities have to start shifting from a consumer built environment to more active based environments that behave more like an organic



system that is able to generate and produce its own energy, fuel and food. Systems that promote cohesive urban typologies that can support the influx of people expected to migrate into the cities.

Utilizing the outdated networks of infrastructures within cities, the project serves as a case study and a departure point to re-examine how urban infrastructures serve could be re-used as productive energy regenerative systems. The highway (motorway) system for example, was envisioned and built as a response to solve automobile's congestion by improving connectivity and mobility in and out of the city. It can be argued that the highway system has solved the issues for which it was intended for, but it's physical manifestation result in an urban typology of concrete arteries that has, in the past, disrupted and dissected the tightly woven urban fabric that once existed.

*Productive Arteries* is a case study that proposes a regenerative system that re-uses the wasted and inhabitable spaces created by the colossal footprint of the highway system. A system that weaves these wasted spaces back into the urban fabric while constantly being fed with energy captured from vehicular friction. A system that produces energy, cleanses the polluted air, and blocks vehicular noise pollution in order for new urban typologies to take place. Highway interchanges; elevated and depressed roadways will be the area of intervention, which are the areas where urban disconnection is experience the most.

Houston is an example of a city that has been shaped by the highway system. The city has endless opportunities to re-utilized this wasted spaces introducing self- sustain building typologies contributing the generation of a productive system that creates a more physically connected urban fabric.

**CO-EXISTENCE WITH THE CALAMITY (FLOOD AS AN ENERGY GENERATING FORCE) - BANGLADESH**

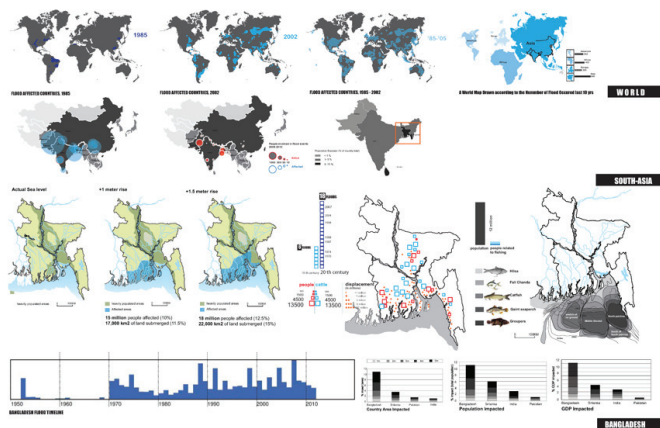


Figure 6. Site research & development – image provided by Nahid S Haimonty.

It is predicted that within next 50-100 years 60% of the coastal land area of the world will submerge under water. Presently, numerous global cities are facing flood as a major threat to the lives and properties of people. The Netherlands, Italy, Bangladesh, India, Bahamas, coastal regions of US, Vietnam, Egypt are few of the cities which are included within the database of 'sinking' cities.

Flood is seen as a devastating calamity for people and natural resources. Therefore, this case study is to investigate on the passive and evitable property of flood into active energy source. Reasons for flooding around the world are differ, the reasons range from tidal, wind, heavy rainfall, storm and cyclones, and (predicted) rise in sea-level due to the earth's cyclic changes. Among the reasons except the rise in sea level, all the others are temporary surge of water thus having a great force embedded within them, which may be a possible source of resilient energy harvesting. Predictably, should sea level rise, flood will eminently become a long-term/permanent phenomena.

Both temporary and permanent causes for flood can be used as a potential renewable source for energy. Tidal range (tidal rise and fall) energy is already an established and a matured technology. It can be used as a major source of energy when the flood is caused by tidal surge. Also osmotic energy is gradually grabbing attention as the netherlands and norway has demonstrated this as a very good source of energy for places near river mouths or estuaries.

Co-existence with the calamity is a case study that proposes a system that will mitigate the temporary flooding by acting altogether as a dyke, a power-generating source and a habitable shelter for people. The protective part will save the agricultural land from being washed away by sea water; the power generator part will produce energy which will supply energy to the system, surplus energy may also be added to the overall energy grid of the country and the shelter part will act as a safe-house for extreme cases where flood is actually brought by inevitable tropical cyclones and storms. In the long run, if the sea level rises and flooding becomes a permanent situation, this safe-house part will act as a permanent housing and the whole system will be able to adjust itself with the gradual rise of sea-level.

According to a World Bank report, Bangladesh is one of the most affected countries of the world by flood and will be continued to be like that in future too. Among the six ocean energy categories (waves, tidal range, tidal currents, ocean currents, ocean thermal energy conversion and osmotic power), tidal range and osmotic energy are most effective for the specific wave and tidal situation of the country. Thus, the proposed system will be implied in the context of Bangladesh that is potentially applicable within other global regions, which suffer from similar calamities.

**RE-DEFINING WASTE (RE-PURPOSED URBAN DEVELOPMENT) – BAYTOWN, TX**

Almost all industries generate some level of pollution, either directly or indirectly, but some industries are particularly famous for the high

level of pollution, and the basis of an oil refinery is one of the major sources of pollution. Fundamentally, oil refineries convert crude oil, coal or natural gases into fuel including petrol, diesel, paraffin, and kerosene. There are various processes involved, which include heating and chemical reactions, which is directly a threat to ozone layer.

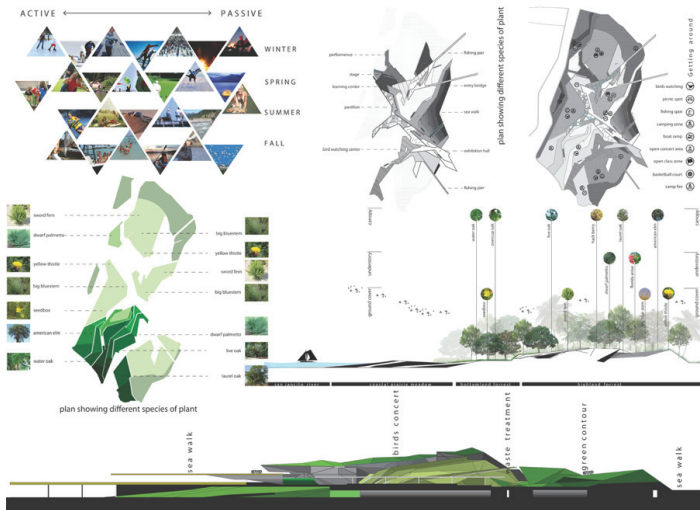


Figure 7. Programmatic sections - image provided by Pratik Eamon.

Concentrating on these industrial wastes, which could be converted to produce energy instead of polluting the environment, this particular case study looks into an infrastructure and urban regenerative bird sanctuary and park that potentially collects 40% of the waste materials from oil refineries, before it is redispersed and pollutes the environment, and instead is regenerated and converted into the production of energy to serve the community located around the refineries.

This case study looks upon the potentials of re-defining an ecosystem through the integration of a bird sanctuary and hybridizing the urban and repurposing of waste produced by the oil refineries, within the region of Baytown, Texas (an industrial area outside of Houston).

Baytown is number 8th polluted city in USA by Ozone. The oil refineries located around Baytown have polluted the air, land and water. The proposal is based on potential regenerative use and collection of petroleum coke. Through the collection of between 5000-6000 tons of petroleum coke from oil refineries, and the post-processing combination with oxygen and water at extremely high temperatures, the opportunities of such process will result in the creation of hydrogen. The potential of creating hydrogen with a waste product could potentially fuel a 500-megawatt power plant capable of supplying approximately 325,000 houses in the region of Baytown.

The similar process could potentially be integrated and implemented within similar context, whereby creating further opportunities and suggestive prospects for comparable industrial regions around the world.

## URBAN HARVESTING (URBAN-BASED AGRICULTURAL FARMING) – LOS ANGELES, CA

The global population currently requires a portion of land the size of south america to produce the food needed to support itself. The global population in 2050 will require an additional portion of land the size of Brazil to support needed food consumption. As this amount of land is not available on earth, Urban Harvesting is a case study, which looks into a possibly alternative resolution to the inevitable problem of food shortages that will hit the global urban condition.

The case study looks into the design of an adaptive vertical farm system located in Los Angeles, USA. Where, the architecture itself functions as an evolutionary structure that feeds into the city, and becomes a self sustaining ecosystem that could potentially produce all needed consumables and dispose of all waste responsibly, in a resilient manner, without the need to alter the surrounding landscape.

Greenhouse farming has already become an economically viable option within the produce industry, but the design of the buildings still uses the traditional farming method of horizontal layouts. Using aeroponic systems in controlled environments means that plants can grow without pesticides, with 99% less water consumption, and totally protected from natural disasters. Thus, suggesting the production of consumables could be produced year round and of the exact same quality, without yield; consequently, allowing the potential of cost-benefit through depleting the necessity of transportation costs, which subsequently reduces the potential pollution basis redispersed by fossil fuels and cuts significant CO2 emissions.

Producing consumables within the city limits denotes that transportation costs are cut down to a minimum, whereby, shelf life of the product lengthens by nearly 2 weeks, due to reducing the product's mobility and storage from the vine to the distribution center in 1 day, as opposed to 10 days. Theoretically, Urban Harvesting is a case study which looks into urban farming that has the potential growth of becoming a form of distribution center, cutting out the middle man altogether.

## BIFURCATING ECOLOGIES (EDGE-BASED DEVELOPMENT) – WAN CHAI TERMINAL, HONG KONG:

Bifurcating Ecologies is a developmental master planning proposal which traces through humanizing the accessibility of the Hong Kong Wanchai District Waterfront through proposing new branching open landscapes and bifurcation of programs, which introduces new innovative topological energy creation that regenerates and re-connects the community.

The case study is composed of modular straps in an urban scale. It starts as a surface bisecting into multiple layers. By manipulating the layers with operations like perforation, triangulation, bifurcation, punctuation etc, urban landscapes and spaces are created

which could houses various functions and needs. The straps interwoven to form a park that is fluid and ever going.

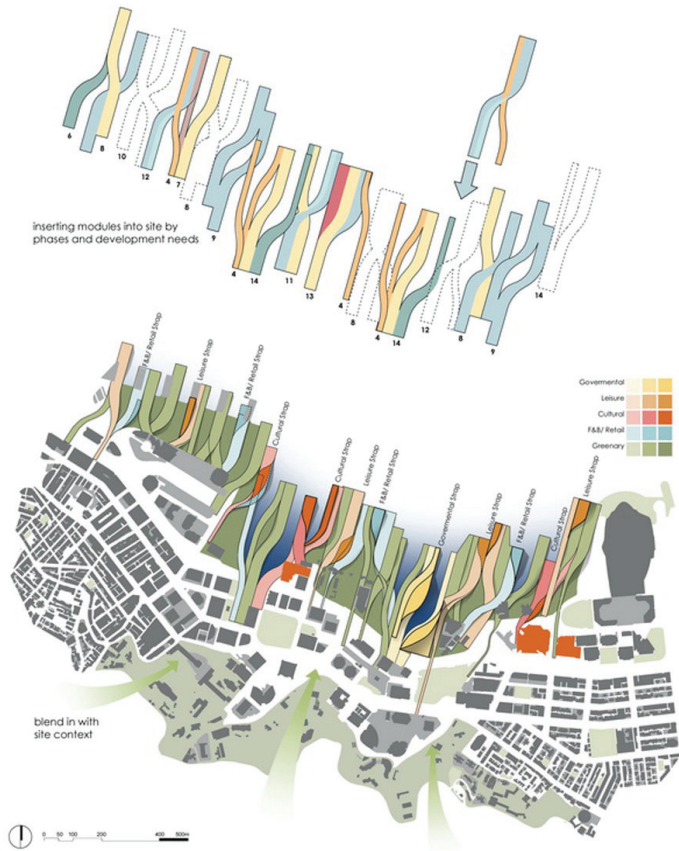


Figure 8. Programmatic 'strip' diagrams - image provided by Kenneth To.

Acting as an intermediary “connector” and “infiltrator” within four main strands of intertwined organization, between levels of: ecology, pedestrian, vehicular, and infrastructure, Bifurcating Ecologies challenges the visceral and abundantly urbanized Hong Kong waterfront that feeds itself through both land and water.

The straps are not only landscapes but also an innovative idea combining nature, leisure/function and sustainability. These multilayered developments offer a plethora of opportunities, microclimates, and developmental programs. On the top layer natural landscape provide citizen with a fresh breathe of a city runaway. The straps provide different microclimates to help adjust the city's environment and temperature while sustaining itself with little maintenance needed.

Through building a new and innovative infrastructural system that feeds into the 'connectors', each layer of program weaves and intersects each other and regenerates new energy and systematic advancement and growth through renewed energy, which each path brings.

The park would be zoned into different themed area, where different programs and event venues are inserted into the straps. The linear arrangement of the ecological straps creates maximum edges for different interactions to happen in between the ecological zones and the programs. Human activities and nature combined. Circulation spaces are a spatial journey that walks the landscape, up and down, in and out, and across.

Pioneering H2O desalination technology below the central and Wanchai Town Pier at the deepest levels of the infrastructure layer of the Bifurcating Ecological landscape, houses a high-powered desalination plant, which functions to collect and purify the water of Hong Kong Bay. Enough to introduce new programs that involve a water park next and open landscape playground, but also an economic lead to recycle the grey water system which could hydrate the plantation and urban farms at the western district markets, and provide an additional 20% of drinking water back to the Hong Kong citizens.

Bringing together a fusion of technological, economical and cultural entities, and combining a public free space into an interwoven landscape the newly developed bifurcating ecologies becomes an open playground of hidden gems, which offers the community countless integrated opportunities to develop and harmonize the Hong Kong Wanchai District Waterfront.

**IMMINENT CONDITIONS**

The case studies within this article are work-in-progress and the development design scenarios of visionary attributes, which contribute to the emergence and evolutionary urban and architectural theory, developed through the practical and research standpoint of energy and socio-political stance. The projects act as a form of transmissive departure into an architectural design discussion, which devises a systematic and metabolic attitude of using a transformative approach to design. Through challenging the architectural urban brief of scenario-based and creating complex visionary projects, the case studies develop an organizational complexity of which natural and contemporary systems are proven to co-exist within futuristic conditions. These futuristic conditions will require a revisioning of how space is viewed and used, expand the range of possible renewable sources of energy, and attempt to continually optimize the interaction between architecture, design, and its effect on the urban environment.

The projects moved past existing and contemporary contextual state of the 'now', and developed themselves into projected scenarios that looked past the dystopic and/or utopic architecture, and instead, were grounded upon sourced, researched, and substantiated facts, whereby develop a much larger metabolic sense of design proposals based on the behavioral, scalar, and environmental conditions. In another sense, the visionary case studies are rather 'opportunistic' approaches to architectural 'potentials', rather than the design of 'fixed' conditions, which utilizes existing states.

Larger databases conducted by the research from these case-studies build upon each project through understanding the living forms and conditions affected by natural global conditions, yet, also citizen-based contextual interpretation of cognition of geographic space, which goes beyond the traditional understanding of designing of linear project type. The projects investigated and offered intricate dynamisms into different ecological systems, often, offering the understanding of the distinct relationship of energy systems, pairing with geographical lifespan, statistical databases, population analyses, fluctuation urban and global conditions, among other dynamic conditions driven by measureable perspectives that could potentially affect different locales around the world.

As indicated by Rob Kitchin and Mark Blades, in *The Cognition of Geographic Space*, Chapter 2, the function and behavioral approaches to the condition of design are contained within the process of information gathered are comparatively driven by the individual who filters the environmental information. The bases of the information gathered from the differentiated approaches from the case studies are a source of exploration into the intersections of urban design concepts that are driven by and generated through precedent understanding of top-down and bottom-up urban planning, from Jane Jacobs to Robert Moses, the projects underlie a larger concern of using 'energy' as a programmatic, support, or platform which either complements or inherently divides the research into understanding the repercussions of architectural design.

Looking past the American model, and yet, periodically and functionally referencing back to the American model of the fragmented megalopolis, the case studies are not to use 'energy' purely as a system of design, in the sense of how engineers would design a system of infrastructure of urban planning or theory, but utilized 'energy' as an opportunistic prospect of operational, or natural fuel, system to create and design the hyper-relation between the localized and global city.

Repeated and emerging discussions which spawned from the case studies included the perception of critical thresholds, of which are systems that develop over a given number of time, over the cyclical number of changes. Whether it be local, regional, or international (global), the systematic development of change is often devised from the nature of the ecological and evolutionary classification recognized within a specific locale, yet, is inherently non-specific. By means of non-specific, the terms is realized that the evolutionary process created by a critical threshold within a megalopolis, pertaining to a set of form fact or data within one urban region or city, is usually applicable to another locale. Therefore, the harvested research from the gathered case studies are equally applicable in one region as with another, other than the intrinsic exponents, which diminishes or augments certain parameters, within specific regions.

Thus, through using 'energy' as a tool, and means of exploration, of socio-demographic and socio-political approach to design, the larger discussion of urban theory and architectural approaches within

'energy-(r)evolution' is formed within the hopes of finding innovative forms of connections and quest for paradigms within digital designs applied to sustainable urban cities.

### ACKNOWLEDGEMENTS

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