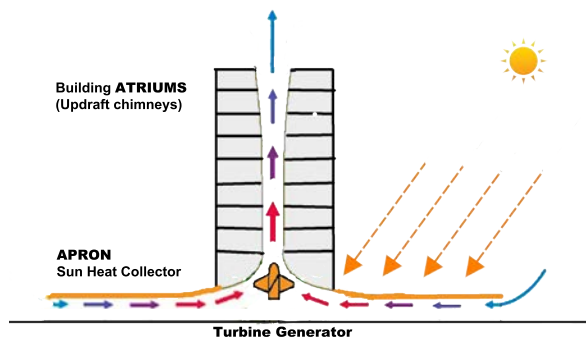


## ***Electric City -*** **BUILDINGS AS ENERGY GENERATORS WITH NEW URBAN FORM**

**Expected Urban explosion will have substantial energy demands:** Research anticipates a significant increase in global urban population, sloganized by some as “double the population, triple the area in 20 years”. The resultant is an increased demand on cities is seen with foreboding, with particular concern about energy supply. The magnitude of increased demand – coupled with increased reliance on energy-hungry technology – stimulates a significant need for innovative energy sources. More intense urban development with high-rise buildings cum atriums offer potential power potential sources parallel to accommodating necessary urban growth to meet population demands. Clearly, innovation must be able to meet substantial demands, readily implementable.

**Innovative capture of solar-generated wind energy in large atrium buildings:** Buildings become energy self-sufficient structures and reduce the dependency on generation stations and transmission of energy. The common atriums found in many large high-rise buildings provide the basis for power generation. Modifications would be required to existing buildings to accommodate the new energy concept. In summary, the ‘PowerAtrium’ concept may be applied for both new and existing construction.



**Solar energy is captured at the base of buildings through ‘aprons’, relying on the greenhouse effect to heat the air at the ground level, then direct and funnel it into a building’s atrium.** The atrium acts as a chimney, providing hot air updraft, and driving an electrical generator turbine. The heat capture ‘aprons’ at the base of atrium buildings provide a mechanism for solar heat capture and increase the updraft for effective

generator performance. Additional ‘push’ and ‘pull’ measures further augment the updraft airflows. The interior airflows could continue to provide ventilation inside the building.

The technical approach has been proven, based on solar chimney concepts, but the adaptation of buildings into chimneys is a step forward.

Apron materials could be any material which allows effective heat transfer, translucent materials in tent form is a good candidate and has been already used extensively in coverings.

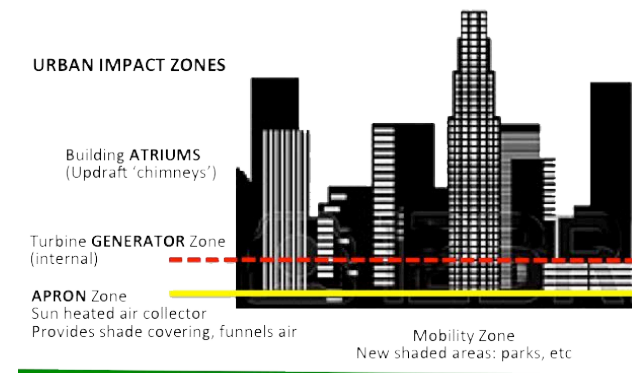
**Buildings become mini energy suppliers instead of consumers, each acting like an electrical ‘generator’ and suggesting new urban form.** In essence, it relies on capturing solar energy in large atrium buildings, offering new urban strategies and form. Demand on electrical cables and power stations would be reduced from the urban face along with its considerable cost. At nighttime, lower power demands would function from residual heat and augmented by existing sources.

**Changing power demands from urban growth would be simplified with individual buildings as power generators.** Expansion of urban areas would not require additional power plants to meet demand. Transmission lines and intermediary substations would be largely eliminated or downsized.

**Changing demands from temperature fluctuations parallel power generation.** Particularly, heavy cooling demands as temperature rise parallel increased power generation from increased updrafts, from increased solar heated updrafts.

**New urban elements arise from the solar heat capture aprons and have dual characteristics: heat capture and as new urban elements:** They may act as a roof for shopping areas, sheltering the stores below while funneling heated air into the atrium. Parks could be partially covered, providing shade as well as solar heat capture. Covered sidewalks would act as energy collectors capturing and funneling heated air. Essentially, they could be considered as public utilities, unlike power lines today.

**Traditional characteristics fit well with Electric City concepts.** ‘Souk’ forms covering streets could capture and funnel hot air as well as



capture and funnel hot air as well as dramatically influence the urbanscape and create boulevards, which would be very effective in high temperature climates. Traditional house forms of Indonesia seem ideal forms for hot air capture with chimney forms surrogates.

**Heat capture aprons offer urban farming opportunities:** The apron area could also be used for agriculture as a greenhouse, while capturing hot air to drive the electrical generators in buildings, an effective way to make the link to urban farming.



**Pollution from urban areas and power generation is reduced or eliminated.** Pollution from greenhouse gas emissions is estimated at 80% globally from urban areas, and the generation of electrical power produces more pollution than any other single industry in the United States. Extensive byproducts pollute when released in the environment. Reducing reliance on traditional power generation would have an immediate effect on pollution and global warming – a difficult challenge unlikely to succeed, but eliminating polluting power generation with individual solar wind generated power - PowerAtriums - would be more effective.

**“PowerAtriums for the new smart city of the future”** may be another way to characterize the energy self-generating concept. This parallels the increased trend of independence of cities, and ‘Smart City’ strategies further demand innovative ways of supplying the increased reliance on electrical power with new invention. For example, electric powered vehicles are limited by their battery power – with each building as electrical generator, this technology would make such non-polluting source more reliable as new form of mobility. (Cars in Manila produce 80% of the air pollution; 70% of air pollution in China. Shifting to electric transport would be a substantial benefit. ) Non-polluting vehicles allow channeled travel under platforms above, freeing 25% of land in a typical urban area.

**Status of Project:** Preliminary conceptual studies have been carried out at MIT in partnership with the Eco-City Group at Nanjing University of Technology. Further development and refinement is planned with the Masdar Institute in the technical issues. A technical and urban planning workshop is scheduled at MIT in January 2016 with Singapore University of Technology and Design and Masdar Institute. Focus is on the new urban form that the Electric City concept allows and on detailed technical testing of building designs.

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*“Don’t undertake a project unless it is manifestly important and nearly impossible.” – Edwin Land*

## ONGOING RESEARCH ON SOLAR UPDRAFT POWER

- Addresses massive energy demands from population explosion expected by 2020.
- Offers innovative capture of solar-generated wind energy in buildings with atriums.
- Buildings become energy suppliers and not consumers.
- Pollution is eliminated: a green energy system.
- Makes urban electric vehicles feasible which reduce urban pollution by 70%.
- Suggests new urban form.

**ELECTRIC CITY**  
Energy self-sufficient,  
Non-polluting  
New Urban Form

**POWER ATRIUM**  
Buildings as  
electricity  
generators

**SOLAR CHIMNEY**  
Basic principle:  
Heat capture  
apron feeds chimney  
with turbine at base

Manzanares Test Tower  
1982, Jörg Schlaich

SIGUS (Eco-City Research) 2013

– Cambridge –    – Abu Dhabi –    – Nanjing –    – Singapore –

MIT SIGUS    Masdar INSTITUTE    Ecocity 生态城市研究所    SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

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