Urban-Climate&Energy Inc

The Urban Heat Harvester

The Mission of Urban-Climate&Energy Inc

Climate Change

- reducing global warming and extreme weather events

City Livability

- reducing urban heat island phenomenon,
  urban-climate extremes and associated health risks

Energy Generation

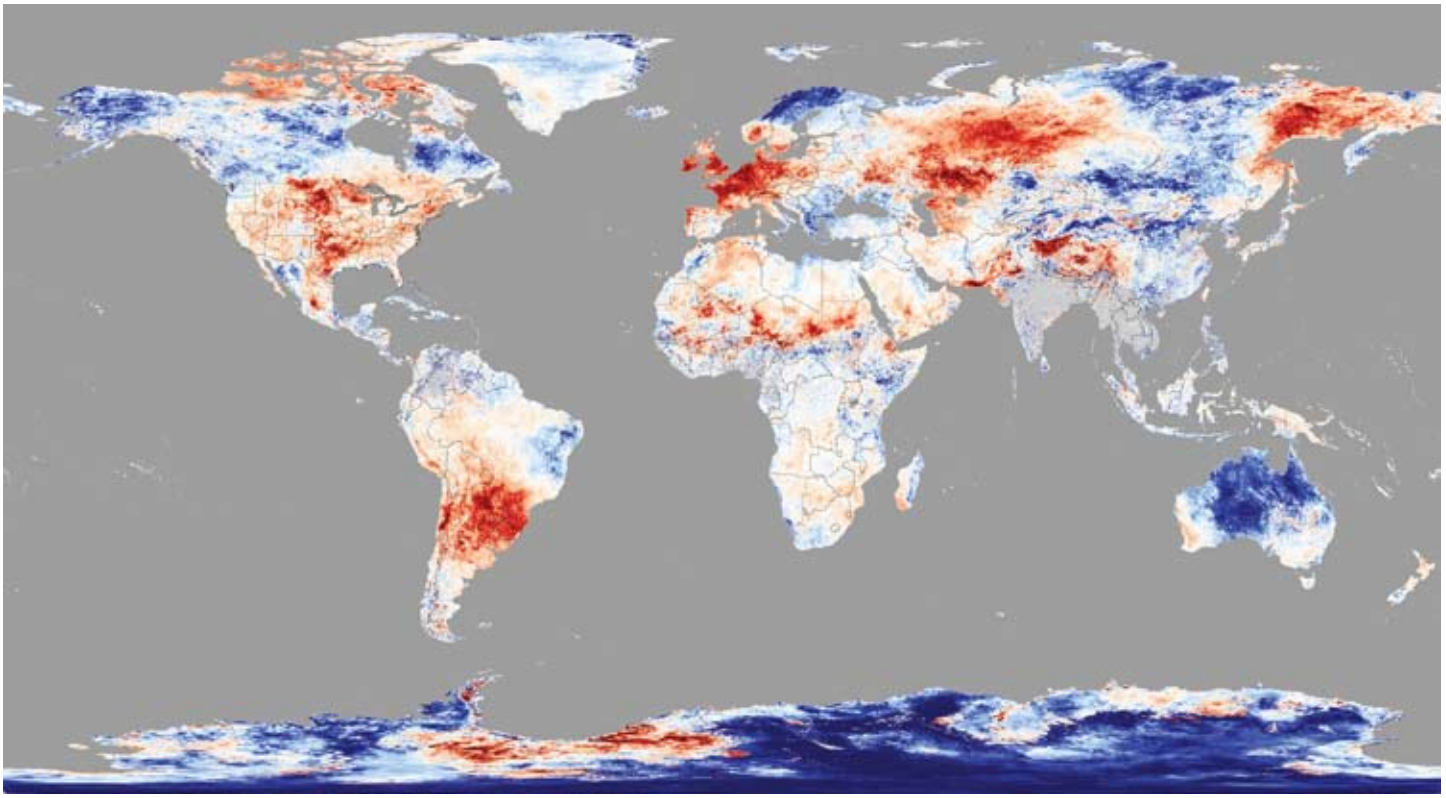
- creating clean and renewable zero-emission energy

Energy Efficiency

- reducing energy required for air-conditioning cooling in cities

Energy Equivalence

- recycling waste heat to warm water



Global Heat-Wave July 2006

Image Reference: 1. *Source:* NASA Earth Observatory
http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=17354

What is the Heat Harvester Technology?

An innovative strategy to cool cities by harvesting waste heat
by withdrawing thermal pollution from the urban atmosphere via city buildings
utilizing their air-conditioning systems

Thus moderating urban climate extremes and heat-stress experiences, increasingly livability and reducing energy use for cooling

While simultaneously recycling and transforming the heat into zero-emission renewable energy and energy equivalent (to heat water)
by means of a Heat Harvesting (HH) device.

The Impact of Heat on Global Warming

Both greenhouse gas emissions and heat-emissions are forms of pollution, and work in unison to bring about climate change - at global and urban scales. The heat absorbed by the greenhouse gases causes the climatic disruptions, and any reductions in thermal pollution should reduce the impact of the gases trapped in the atmosphere.

Thus, it is not sufficient (although essential) to reduce greenhouse gas emissions. Even the current levels of gases in the air, not taking into account any future additions will ensure many more decades of rising temperatures unless the thermal pollution itself is also rapidly reduced.

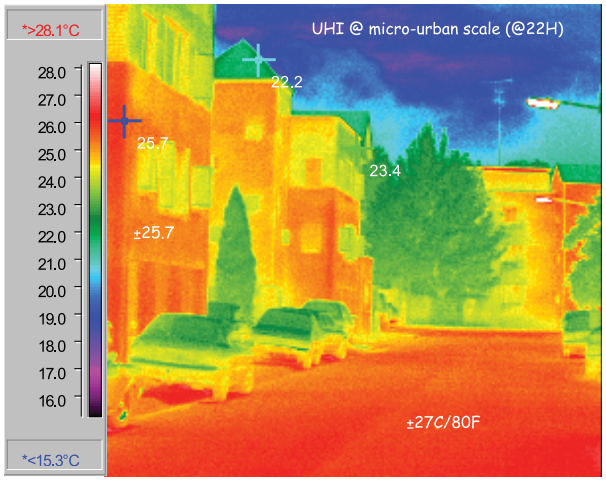
The Urban Heat Island Phenomenon

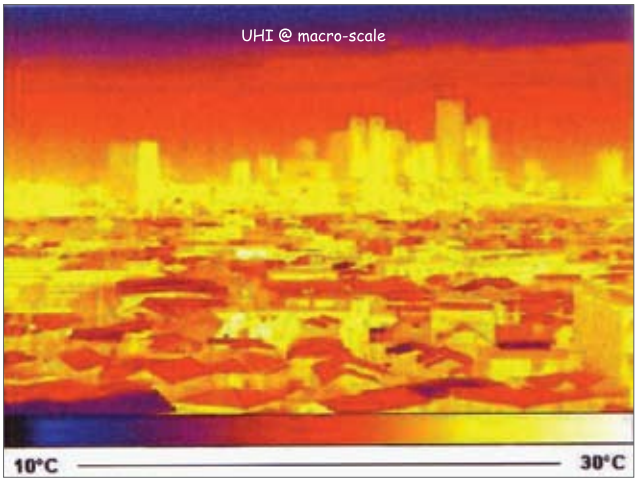
The urban heat island phenomenon traps heat in thermally massive cities which absorb, store and re-emit radiant and anthropogenic heat with far-reaching environmental sustainability and human livability implications. Temperatures of urban air domes can range up to 10-16C (50-60F) warmer than the surrounding countryside.

- Urban climate impact: intensification of extreme urban climatic events (floods, violent winds etc)
- Health consequences: increased heat-wave mortality, air-pollution intensification
- Public safety consequences: public-realm avoidance-behavior, leading to increased crime opportunity
- Energy consumption consequences: increased consumption of energy for air-conditioning of buildings, unsustainable peak electricity demand, brown-outs
- Global warming impact: urban thermal emissions are trapped by greenhouse gas emissions ($CO_{2\text{-}e}$) thus contributing to climate-change

The infra-red thermal images below illustrate the Urban Heat Island phenomenon.

The Urban Heat Island traps heat in thermal mass and thermally massive 'canyon' cities that absorb, store and re-emit radiant and anthropogenic heat.





Heat Index Chart

% Relative Humidity

Temperature	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
110	108	112	117	123	130											
105	102	105	108	113	117	122	130									
100	97	98	102	104	107	110	115	120	126	132						
95	91	93	95	96	98	100	104	106	109	113	119	124	130			
90	86	87	88	90	91	92	95	97	98	100	103	106	110	114	117	121
85	81	82	83	84	85	86	87	88	89	90	92	94	96	97	100	102
80	76	77	78	78	79	79	80	81	82	83	84	85	86	87	88	89

Legend

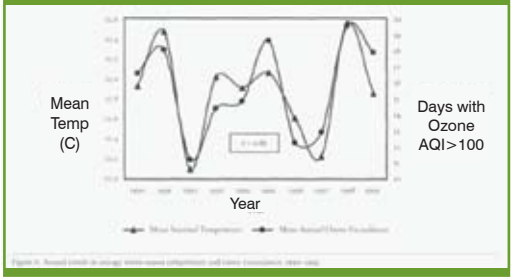
80-89 degrees	Fatigue is possible with prolonged exposure and/or physical activity.
90-104 degrees	Sunstroke, heat cramps and heat exhaustion are possible with prolonged exposure and/or physical activity.
105-129 degrees	Sunstroke, heat cramps and heat exhaustion are likely. Heat stroke is possible with prolonged exposure and/or physical activity.
130+ degrees	Heatstroke/sunstroke is highly likely with continued exposure.

HEAT STRESS DEATHS

USA: Chicago 1995: **'hundreds die'**

EUROPE: Summer 2003: **35,000 excess deaths**

HEAT x OZONE pollution intensity



2. **3.**

4. **5.**

Image References: 2. UHI @ micro-urban scale, *Source:* Authors **3.** UHI @ macro-scale (Tokyo), *Source:* Urban Climatology and Urban Thermal Climates http://publish.uwo.ca/~javoogt/urban%20climate%20.htm, *Photo:* courtesy M. Roth, National University of Singapore **4.** Heat Index Chart, *Source:* http://www.tvweather.com/awpage/heat_index_chart.htm **5**. Heat x Ozone Pollution Intensity, *Source:* Stone, B., Urban Heat and Air Pollution, Journal of the American Planning Association, Vol 71, No 1:13-25, 2005

How can heat pollution be captured and removed?

1. Capture the heat pollution

Draw waste heat from the Urban Heat Island via building air-conditioning systems and capture at ***rooftop outlets*** of:

offices
high-rise residential buildings
hospitals
shopping malls
cinemas
libraries
sport arenas
train and bus stations
airports etc

2. Convert or transform the heat pollution

The Heat Harvester technology converts and transforms waste heat into ***electrical energy***, and captures the remaining heat to ***warm water***.

Heat extracted from inside buildings is not removed but simply concentrated and displaced: from the inside to the outside. On a summer's day in NYC when the air temperature is 32C/90F, the waste heat at street-level air-conditioner exhausts of CBD buildings is ±58C/136F – substantially hotter than the ambient temperature. Each air-conditioner thus pumps superheated air out into the city.

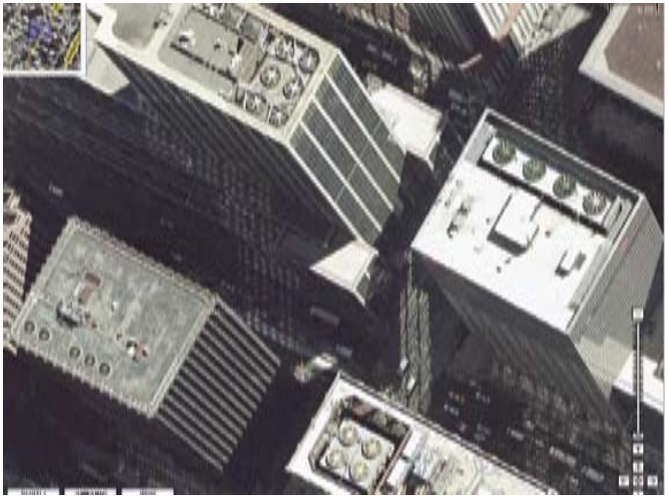


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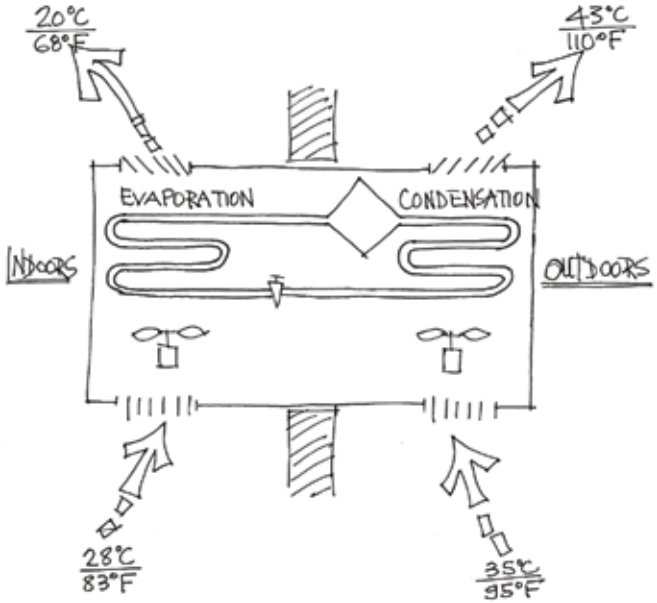
Image References: 6. Rooftop Waste Heat Temperatures, *Source*: Authors **7.** Rooftop Air Conditioning Exhausts, NYC, *Source:* http://earth.google.com/



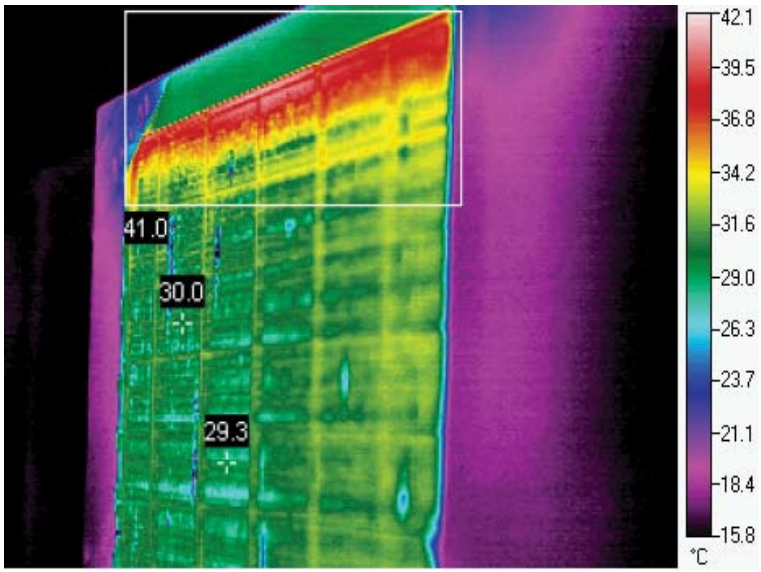


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Image References: 8. Sketch of Heat Transfer from Indoors to Outdoors via Air Conditioner, *Source:* Authors **9.** Thermal Image of Air Conditioner Waste Heat Emissions on mild Autumn day, *Source:* Authors

Income Stream Potential

- Lease of HH units to Energy Utilities
- Percentage returns from Energy Utilities on sales of renewable electricity produced
- Tax credits or government grants
- Mayors offering capital incentives and tax credits to Energy Utilities or individuals mitigating heat emissions and producing clean energy via HH technology
- Sales to air-conditioning manufacturers, green-building designers and developers

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Urban-Climate&Energy Inc

Dr Robert Samuels
PhD (Reading) MSc (Surrey)
M Urban & Reg. Planning (UCT) BA (Wits)

CEO

cell+61 422 683 411
robert.samuels@u-c-e.com

Dr Kirsti Samuels
DPhil BCL (Oxon) LLB BSc (Syd)

Director

cell+1 917 496 3025
kirsti.samuels@u-c-e.com

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www.urban-climate-energy.com