



**EMF|ECBC**  
FUNDING THE REAL ECONOMY

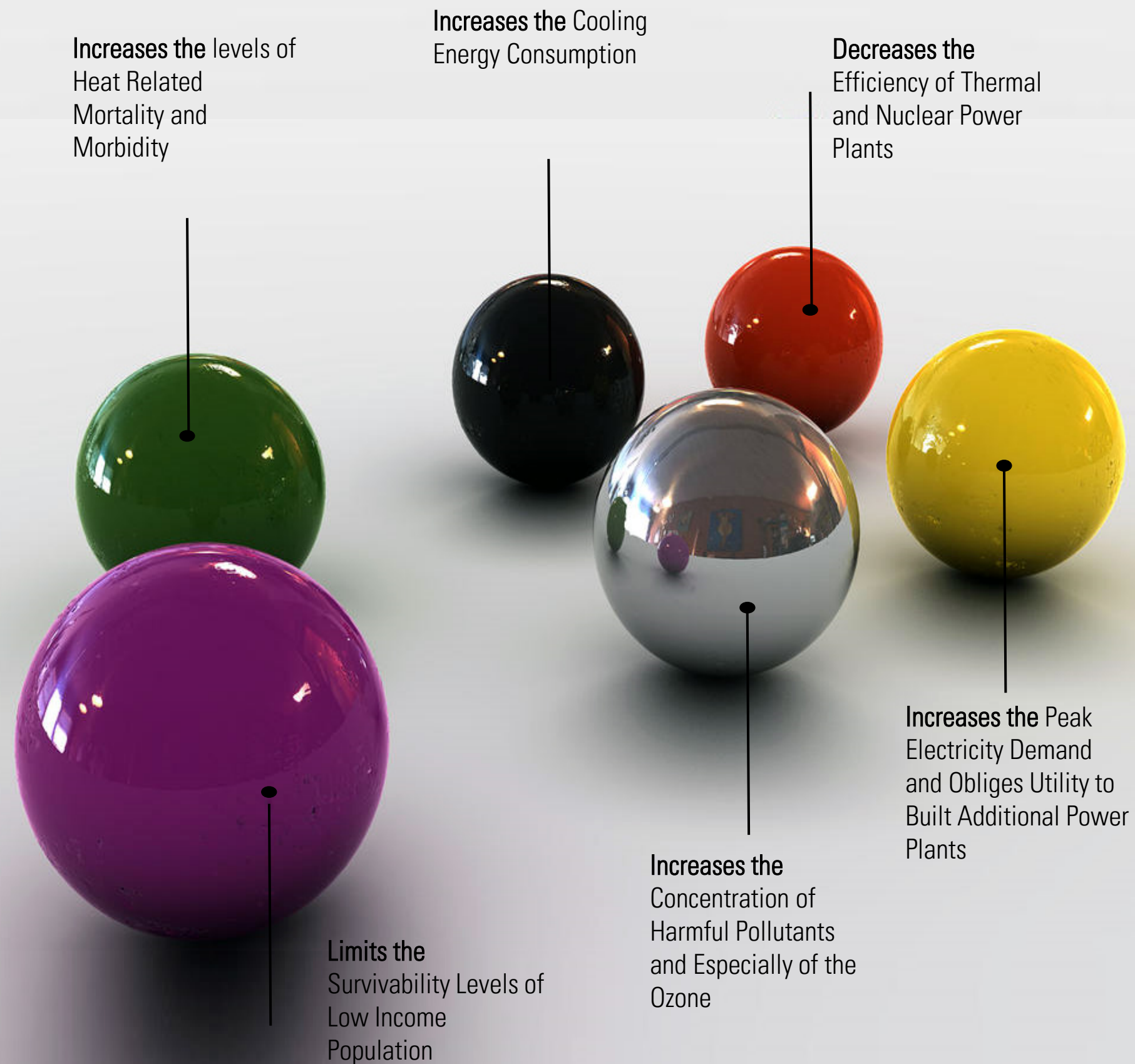
# Housing the NextGeneration:

**Hypostat 2023**

11 December 2023, Mat Santamouris

## Virtual Event





Rises the cooling energy consumption in cities ,

Decreases the efficiency of power plants

Rises the peak electricity demand

Increases the emission of pollutants of the power plants

Increases the concentration of ozone

Intensifies heat related mortality and morbidity

Causes serious Mental Health Problems

Lowers the productivity of population

Increases the Risk of Accidents

Affects the survivability of vulnerable population

## Increases the Cooling Energy Consumption

Urban overheating is inducing an additional energy penalty at the city scale close to  $0.74 \text{ kWh/m}^2 / ^\circ\text{C}$ , while the average energy penalty per person, is close to  $237 (\pm 130) \text{ kWh/p}$

## Increases the Peak Electricity Demand

The peak electricity rise per degree of temperature increase varies between 0.45% and 4.6%, corresponding to an additional electricity penalty close to  $21 \text{ Watts } (\pm 10.4)$  per degree of temperature increase and per person

## Decreases the Efficiency of Power Plants

A  $1 ^\circ\text{C}$  rise of the ambient temperature reduces the power output of thermal and nuclear power stations by 0.6%

M. Santamouris, "Recent progress on urban overheating and heat island research. Integrated assessment of the energy, environmental, vulnerability and health impact. Synergies with the global climate change," *Energy Build.*, , 2020,



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# PRICING POWER

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On August 2022, the UK Met Office recorded the country's first-ever temperature above 40 degrees Celsius (104 degrees Fahrenheit) at London's Heathrow Airport just before 1 p.m., as temperatures were still rising.

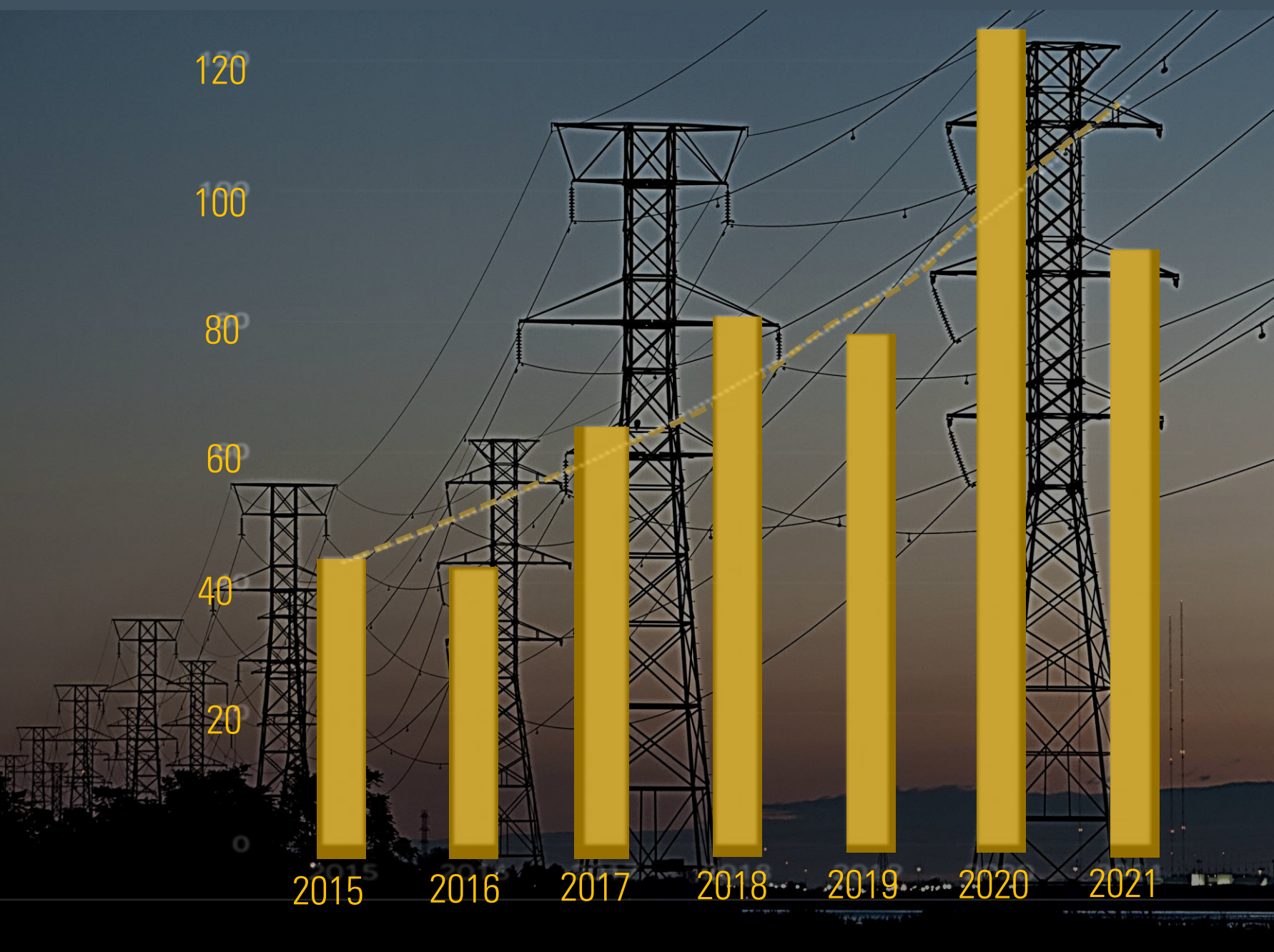
High demand sent power prices in the UK up 5% in one day.

Across the Channel, things have been even more volatile. Europe's heat wave has reduced France's available nuclear power, as the river water used to cool nuclear plants became too hot to be effective.

As a result, day-ahead baseload power prices settled at 610 euros per megawatt-hour — about 10 times higher than prices from 2017 to 2021.

The incidence of electrical grid failure or “blackout” events is increasing all around the world

In USA, since 2015, when the U.S. Energy Information Administration commenced monthly reporting on major blackout events, the number of such events nationwide has more than doubled, increasing by 151% between 2015–16 and 2020–21

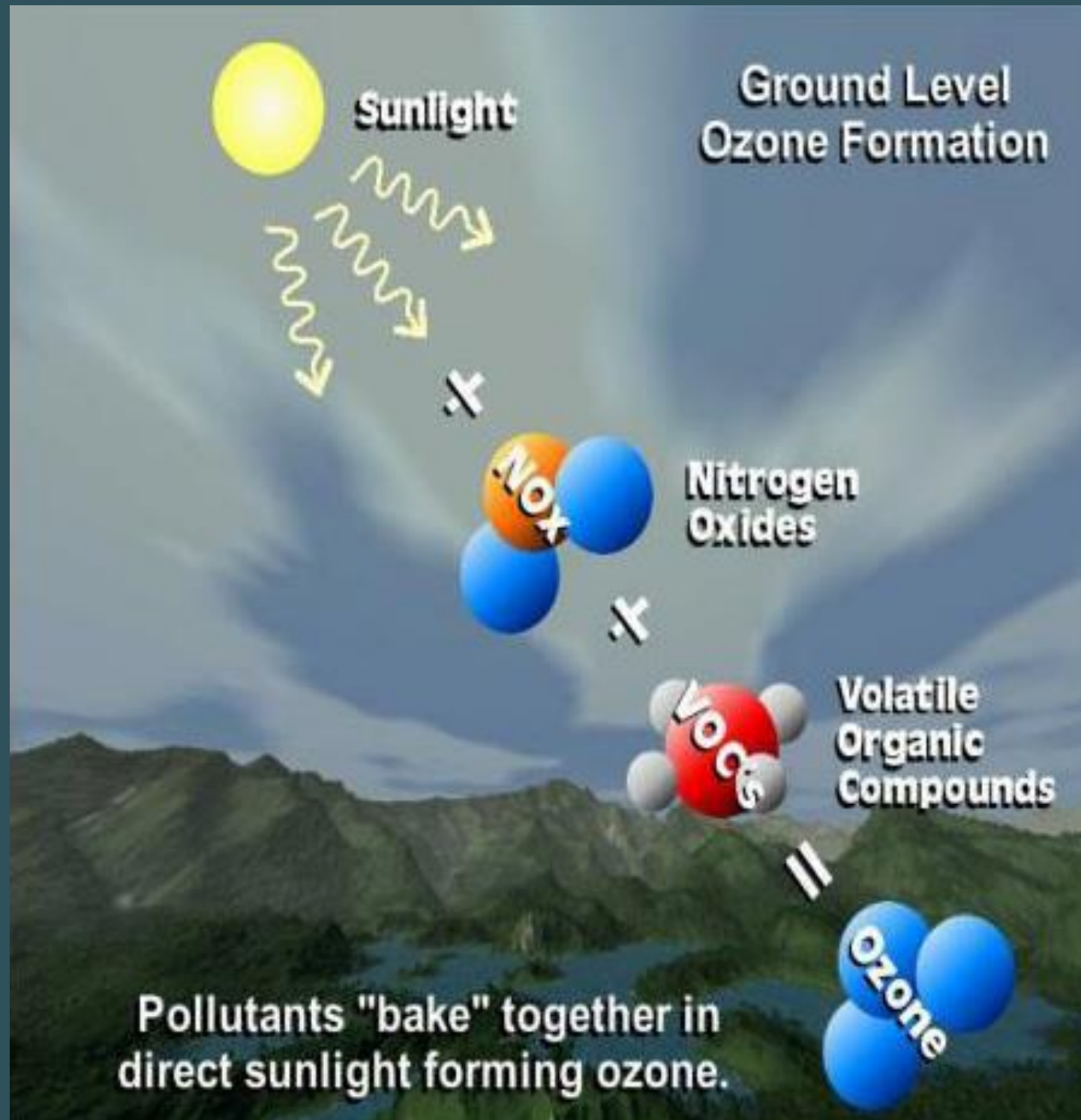


In June of 2021, electrical grid failures because of a very high intensity heat wave in the Pacific Northwest zone of USA resulted in at least:

- 600 excess deaths,
- 3500 emergency hospital visits, and
- Loss of electricity to tens of thousands of citizens in the area.

How Blackouts during Heat Waves Amplify Mortality and Morbidity Risk Brian Stone, Jr.,\* Carina J. Gronlund, Evan Mallen, David Hondula, Marie S. O'Neill, Mayuri Rajput, Santiago Grijalva, Kevin Lanza, Sharon Harlan, Larissa Larsen, Godfried Augenbroe, E. Scott Krayenhoff, Ashley Broadbent, and Matei Georgescu, Env Research and Technology, 2023





Overheating affects the urban environmental quality increasing the concentration of harmful pollutants.

Higher urban temperatures accelerate the formation of ozone precursors like VOC's and NO<sub>x</sub> combining photochemically to generate ground level ozone.

Ozone is toxic and an oxidant affecting the human respiratory and cardiovascular systems.

The expected future increase of the ambient temperature is expected to further increase the concentration of the ground level ozone and the frequency of future severe ozone episodes, as well as the concentration of other pollutants.

It is estimated that the frequency of severe ozone episodes in four Canadian cities may increase up to 50% by 2050 and 80% by 2080.



Urban overheating obliges utilities to operate power plants for an extended period to satisfy the peak electricity demand

Increased operation of thermal power plants significantly rises the emissions of pollutants and increases the concentration of secondary pollutants like the ground level ozone.

Each degree of temperature rise in the Eastern United States during the period between 2007-2012, resulted in a rise by:

3.35%/°C  $\pm$  0.50%/°C of the SO<sub>2</sub> emissions,  
3.32%/°C  $\pm$  0.36%/ °C rise in CO<sub>2</sub> emissions, and a  
3.60%/°C  $\pm$  0.49%/°C increase in NO<sub>x</sub> emissions.

It is predicted that in 2050 the corresponding NO<sub>x</sub> emissions may increase by 16%, and the SO<sub>2</sub> emissions by 18%.



# FUEL POVERTY

THE INABILITY TO MEET HOME ENERGY NEEDS DUE TO INCOME AND RISING FUEL PRICES.

15% OF UTILITY CONSUMERS ARE IN FUEL POVERTY.

## THE EFFECTS



**1 in 8** HOUSEHOLDS IN AMERICA IS LIVING IN FUEL POVERTY



### HEALTHCARE COSTS

Those living in fuel poverty are more likely to suffer heat stroke, heart attack, hypothermia, kidney failure, and respiratory disease. These costs are put on the tax-payer as many of those in fuel poverty do not have adequate access to healthcare.



### MORE POLLUTION

Many fuel poor homes rely on forms of fossil fuels to heat their homes. Access to renewable energy would decrease carbon emissions and the health risks associated with pollution.



### ECONOMIC BURDEN

When fuel poor homes cannot pay their debts this cost is deferred to the taxpayer. \$1 billion is spent annually to cover bad utility debts. Weatherized and energy efficient homes and the ability to pay energy bills would save nearly \$6 billion.

## CONTRIBUTING FACTORS



### RISING FUEL COSTS

"The rising cost of generation fuels, particularly natural gas, contributes to a projected increase in the residential price of electricity" according to the US Energy Information Administration.



### ENERGY INEFFICIENCY

Homes that are not energy efficient require more energy to keep them warm in the winter and cool in the summer. The use of renewable energy would reduce the energy costs.



### HOUSEHOLD INCOME

60% of respondents to the 2010 National Energy Assistance (NEADA) Survey Report stated that lower income and/or a lost job were factors that led to the inability to pay energy bills.

## PROBLEMS IT CREATES



26% kept their home at a temperature that was unsafe or unhealthy.  
36% closed off part of their home.  
20% left their home for part of the day due to lack of heat.  
33% used their kitchen stove or oven to provide heat for their home.



31% did not make their full mortgage or rent.  
5% were evicted from their home or apartment.  
4% had a foreclosure on their mortgage.  
12% moved in with friends or family.  
3% moved into a shelter or were homeless.



41% went without medical or dental care.  
33% did not fill a prescription or took less than the full dose of a prescribed medication.  
30% went without food for at least one day.  
25% had someone in the home sick because the home was too cold.



EVERY WINTER FAMILIES MUST DECIDE BETWEEN **FOOD or FUEL**

\*Statistics taken from the 2009 NEADA National Assistance Survey

## HOW YOU CAN HELP



### INVEST IN RENEWABLE

By using and investing in renewable energy sources, you help create jobs and reduce pollution. Renewable energy creates long term, sustainable, cost effective solutions for everyone - especially those affected by fuel poverty. Your energy choice matters.



### DONATE TO RREAL.ORG

Unique in the nation, RREAL's Solar Assistance program has been pioneering the delivery of solar heat to low-income families as a clean, domestic and lasting solution to fuel poverty. Every dollar donated to RREAL goes directly to Solar Assistance, moving households from impoverished to empowered.



### TAKE A STAND

Write your senator and your congressperson demanding that they push for renewable energy. Take a stand in your community by attending local city and town hall meetings and bring the problem of fuel poverty to the forefront.



### SHARE THIS MESSAGE

By sharing this message, you can help create awareness to this growing crisis. By bringing awareness to this problem we have the opportunity to make a RREAL difference in the lives of those who live in fuel poverty.



Low-income population lives in deprived urban zones with high overheating. Urban Overheating results in high mortality, energy cost and discomfort.

Overheating affects the urban socioeconomic and biophysical vulnerability and has a serious impact on low-income population.

Vulnerable population lives in districts of disproportionately high UHI intensity, excess heat stress, higher risk of heat related mortality and significant socioeconomic vulnerability

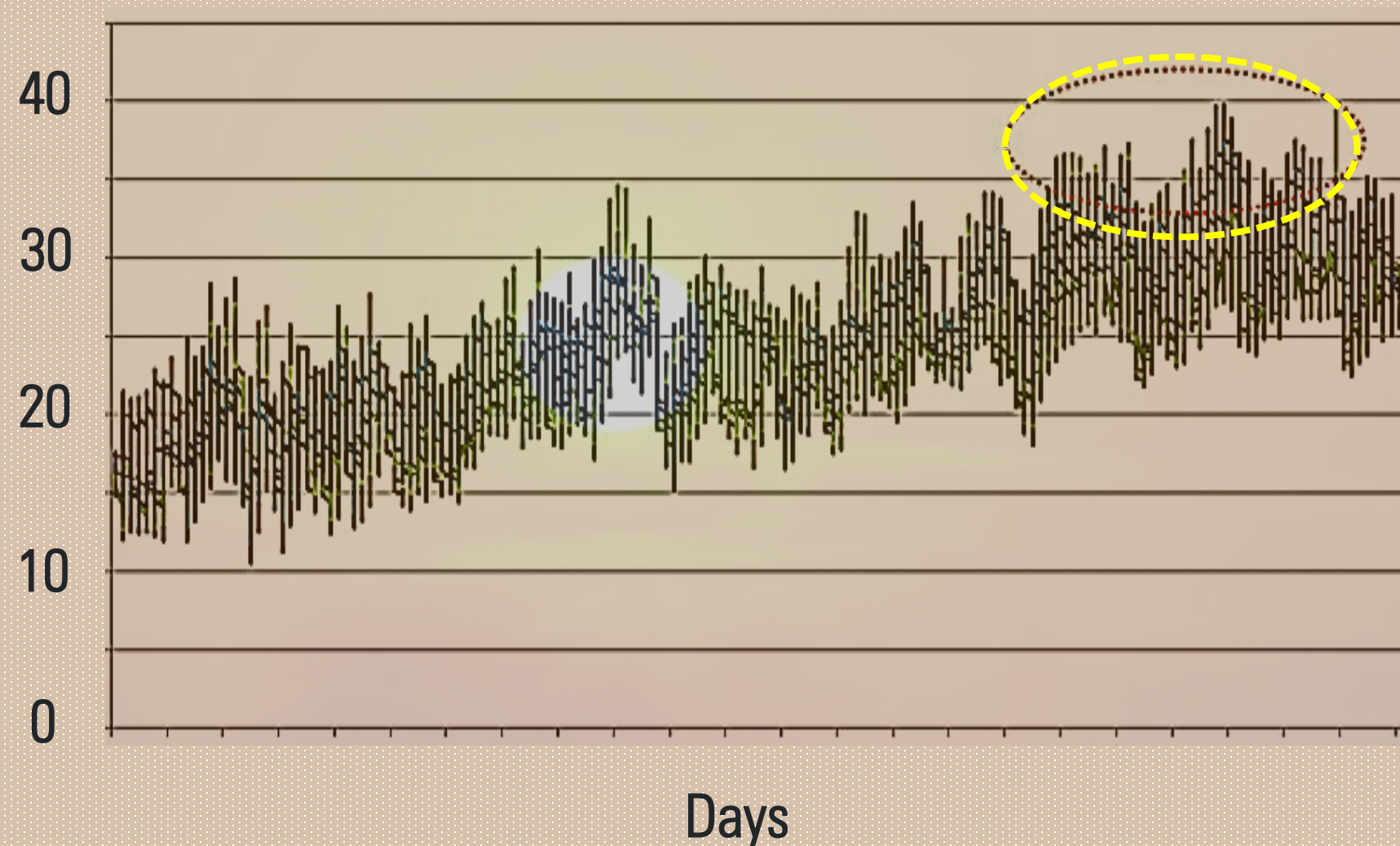
A significant correlation between exposure to extreme heat and the socioeconomic vulnerability exists for several cities resulting in almost twice the mortality risk in the deprived districts.

Vulnerable population lives in buildings of considerably lower thermal quality. Extreme indoor temperatures, 35-40°C, are recorded during extreme events in low-income houses.

Only 2% of the necessary cooling load is covered by low-income population in Portugal, while in Greece the cooling cost for low-income households is approximately double the average cost.



Indoor Temperature ( C )



Rich experimental data exist in the developed countries regarding the indoor environmental quality of low-income houses during the period of high ambient temperatures.

Continuous measurements of the indoor ambient temperature and CO<sub>2</sub> concentration, are performed in 110 low-income buildings in Western Sydney and rural NSW, for about 12 months.

It is found that during the summer period and not during a heat wave, indoor temperature was close to 40 C.

In parallel, the indoor concentration of CO<sub>2</sub> was up to 4 times higher than the threshold acceptable levels.

During the winter period, indoor temperature was as low as 5- 7 C.



## URBAN OVERHEATING AND HEALTH



Temperature in cities is highly heterogeneous and affects the intra-city mortality

## EXPOSURE TO HIGH AMBIENT TEMPERATURES IS A SERIOUS HEALTH HAZARD



Heat Related Mortality Increases above a Threshold Temperature



### DEMOGRAPHIC

Demographic factors  
and population levels



### SOCIOECONOMIC

Socioeconomic factors and  
deprivation levels



### HEALTH INFRASTRUCTURE

Quality of Medical system,  
institutional protection

POPULATION LIVING IN WARMER NEIGHBOURHOODS WITHIN CITIES HAVE ALMOST **6 %**  
HIGHER RISK OF MORTALITY COMPARED TO THOSE LIVING IN COOLER URBAN DISTRICTS

When exposed to temperature beyond a certain threshold, the human thermoregulation system cannot offset the impact of extreme heat resulting in increased global mortality and morbidity

Heat related morbidity and mortality caused by the local climate change, is highly alarming, and it seems to be one of the current and future peak scientific topics .

Elderly is the most vulnerable population group

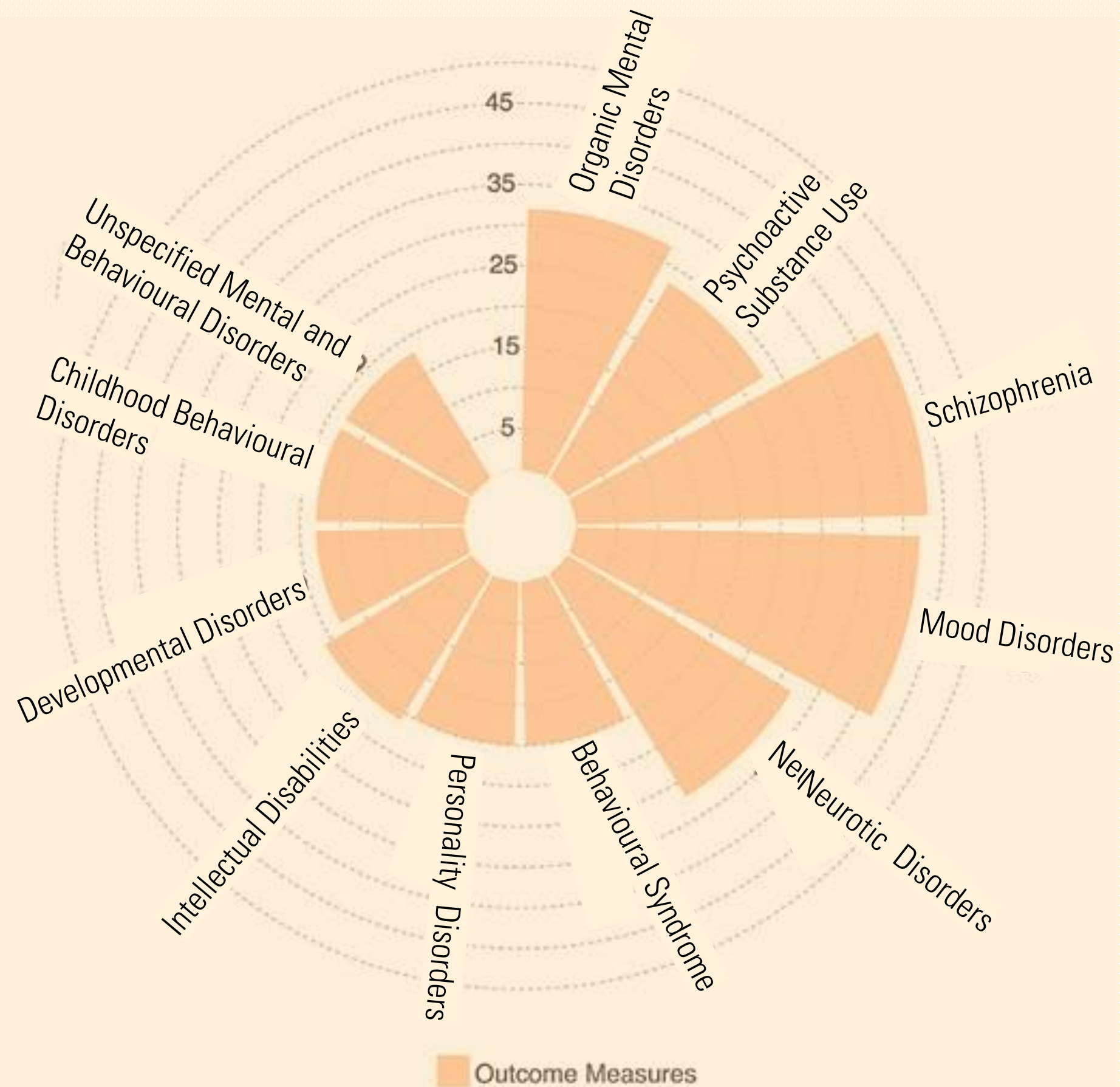
Those with preexisting health problems like respiratory, cardiovascular, or mental health problems

Those using medication that affects thermoregulation, and

Those 'lacking in economic assets and access to public support systems, with diminished physical or cognitive capacities to respond to warnings and missing strong and enduring social support systems like social isolated people, and those living in hazardous places'

According to the existing epidemiological records almost 59,114 people passed away between 2000 and 2007 during 52 extreme heat events around the world





Numerous studies have revealed critical associations between temperature extremes, and mental illness

Three types of climate-related events (acute, subacute, and long-lasting changes) on mental health are identified. Extreme heat events that occur in summer could pose a serious risk to human mental conditions.

Meta-analysis showed that heatwaves and extreme high temperatures were associated with higher risk of schizophrenia, mood disorders, neurotic disorders.

A strong association between increases apparent temperature and elevated risk of Mental Behavioral Disorders.

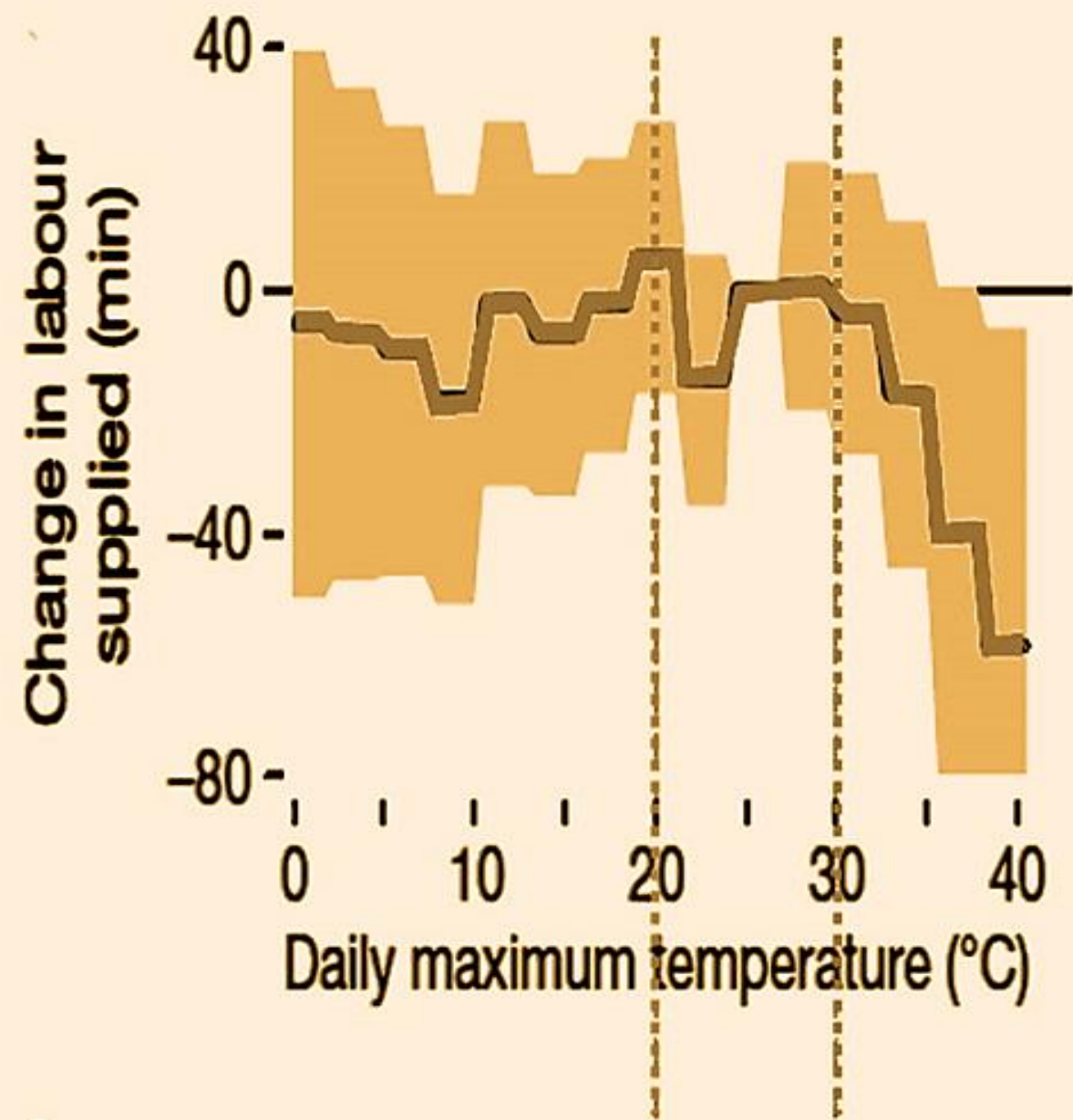
A 99th percentile high temperature was associated with increased schizophrenia risk



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## Boosting Sustainable Urban Investments

To accelerate urban cooling and finance urban heat mitigation and adaptation it is critical to value urban overheating with liquidity. The development of a voluntary Urban Warming Market could bring urban mitigation and adaptation investments sooner to the market and make them more affordable.

The scheme will bring new sustainable urban business, will boost profits and will skyrocket the investment of new green capitals in cities.

