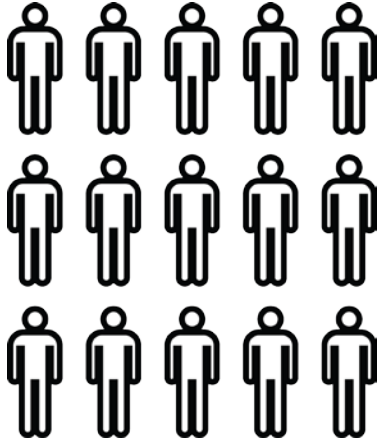
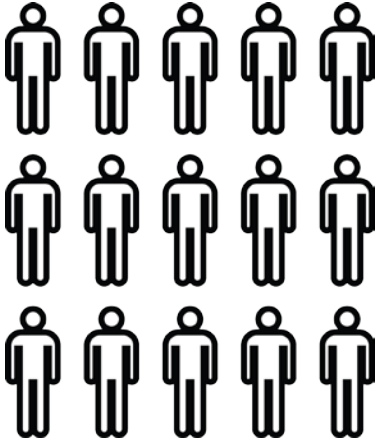


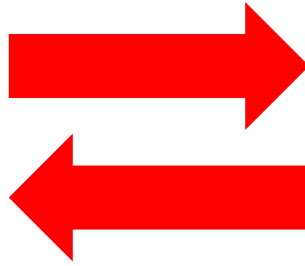
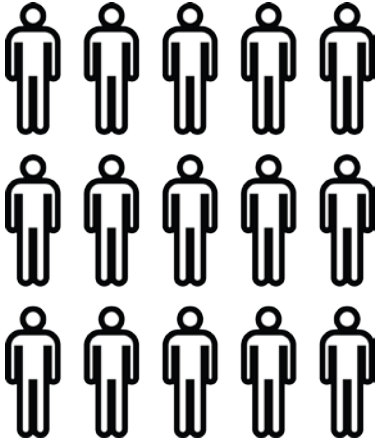
RESILIENCE

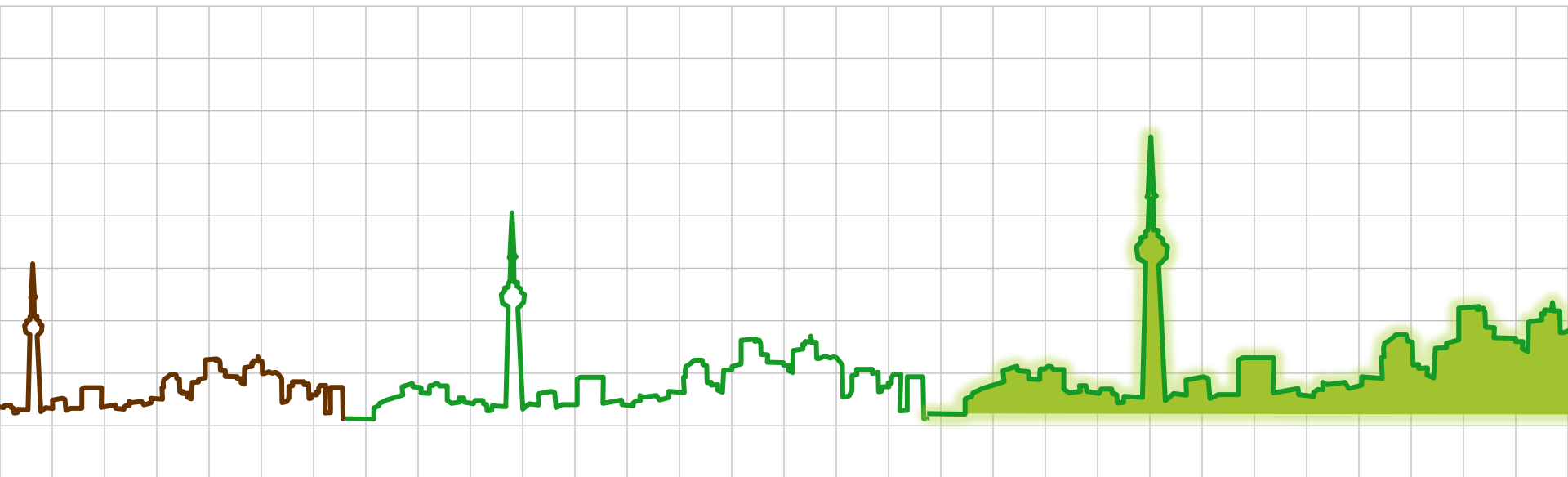
Part 1

THE CHALLENGES AHEAD









RESILIENT CITY

2010 >> 2030 >> 2050 >>

CARBON CITY

REGENERATIVE CITY

SYMBIOTIC CITY

A POSSIBLE FUTURE FOR OUR CITIES?

PART 1 - AGENDA

- 1. WHAT IS “RESILIENCE”?**
- 2. ATTRIBUTES OF RESILIENCE**
- 3. SIX KEY DRIVERS OF...**
- 4. SHOCKS AND STRESSES**

**SO WHAT IS
RESILIENCE?**

re-sil-i-ence [ri-zil-yuhns, zil-ee-uhns]

1. the power or ability to return to original form, position, etc., after being bent, compressed, or stretched; elasticity.
2. ability to recover readily from illness, depression, adversity, or the like, buoyancy.

<http://www.dictionary.com>

*“**Resilience** is the capacity of a community’s economic, social, political and physical infrastructure systems to absorb **shocks and stresses** and still retain their basic function and structure.”*

<http://www.ResilientCity.org>

*“**Resilience** is an emergent property of a system – it’s not the result of any one of the system’s parts but of the synergy between all of its parts.”*

Thomas Homer Dixon,
The Upside of Down

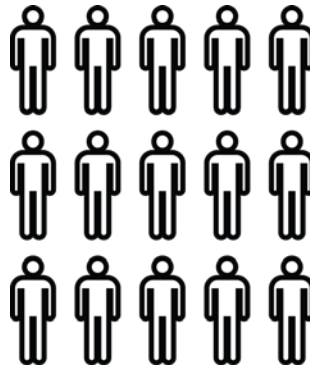
**RESILIENCE
TO WHICH
SHOCKS AND
STESSES?**

1. ECONOMIC
2. ENVIRONMENTAL
3. ENERGY SUPPLY / PRICE SHOCKS
4. INFRASTRUCTURE FAILURES
5. POPULATION CHANGE & MIGRATIONS
6. FOOD SHORTAGES / PRICE SHOCKS
7. SEVERE WEATHER EVENTS
8. DISEASE / PANDEMICS
9. REGIONAL RESOURCE CONFLICTS
10. TERRORISM (BIO / CYBER / DIRTY NUKES)

**THE SIX
POWERFUL
FUTURE
DRIVERS!**



CLIMATE CHANGE



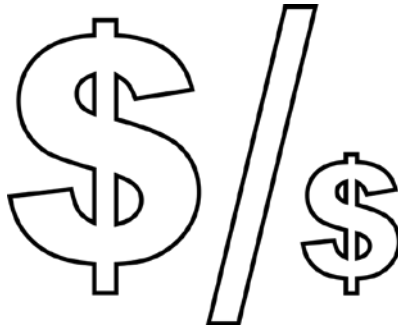
**POPULATION
GROWTH/MIGRATION**



ENERGY SUPPLY



**ENVIRONMENTAL
DEGRADATION**



**REGIONAL RESOURCE
CONFLICTS**

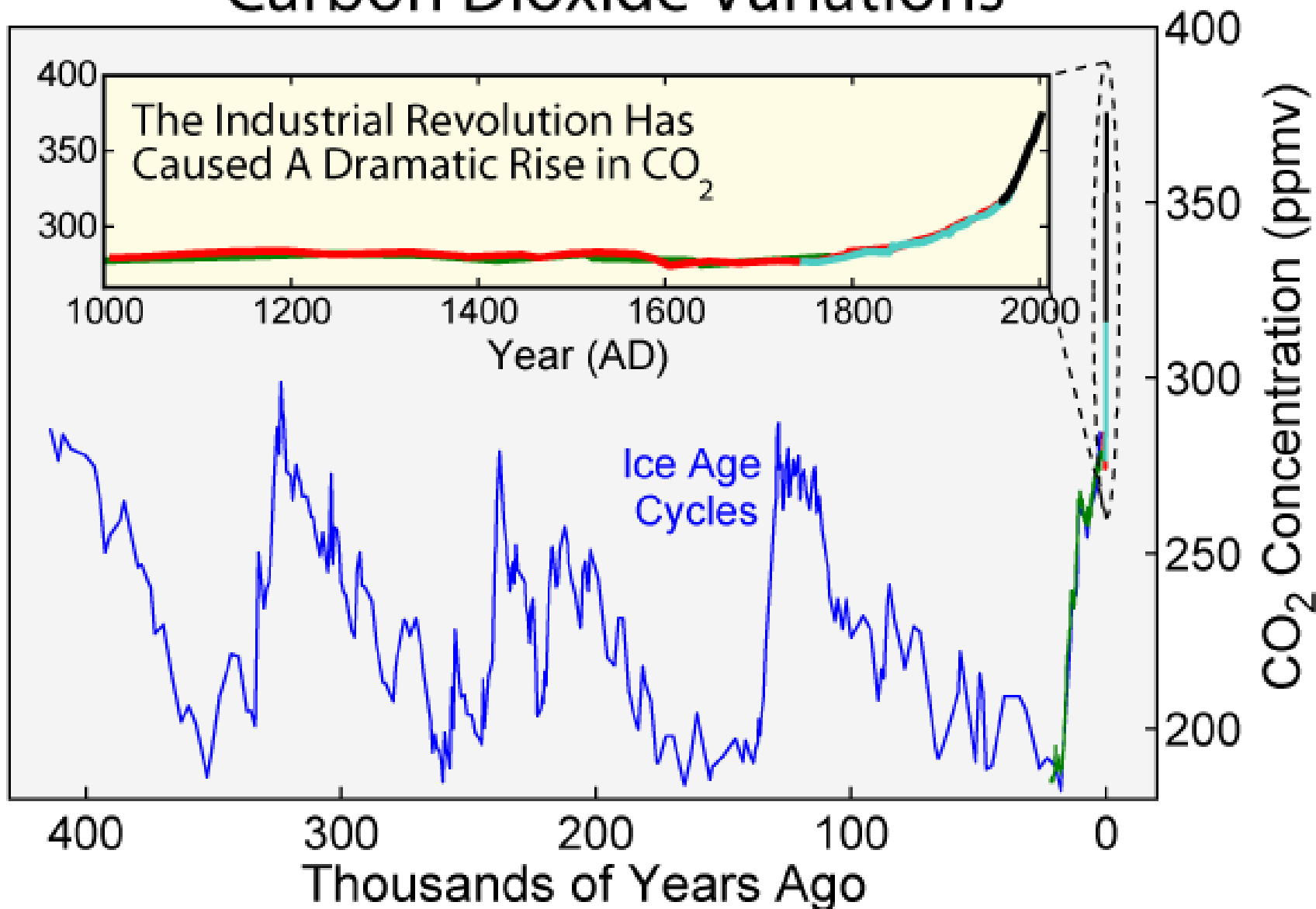


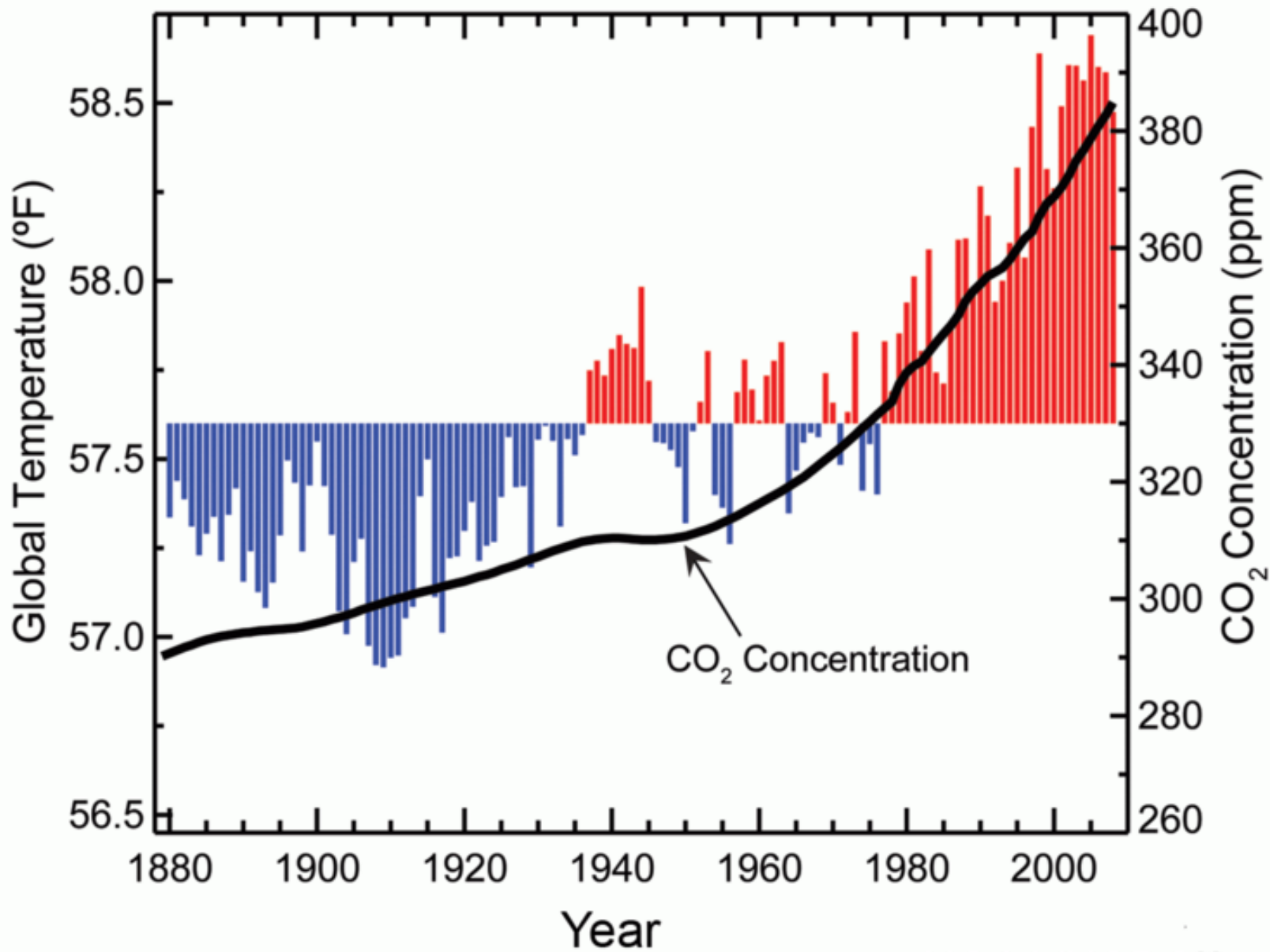
SOCIO-POLITICAL

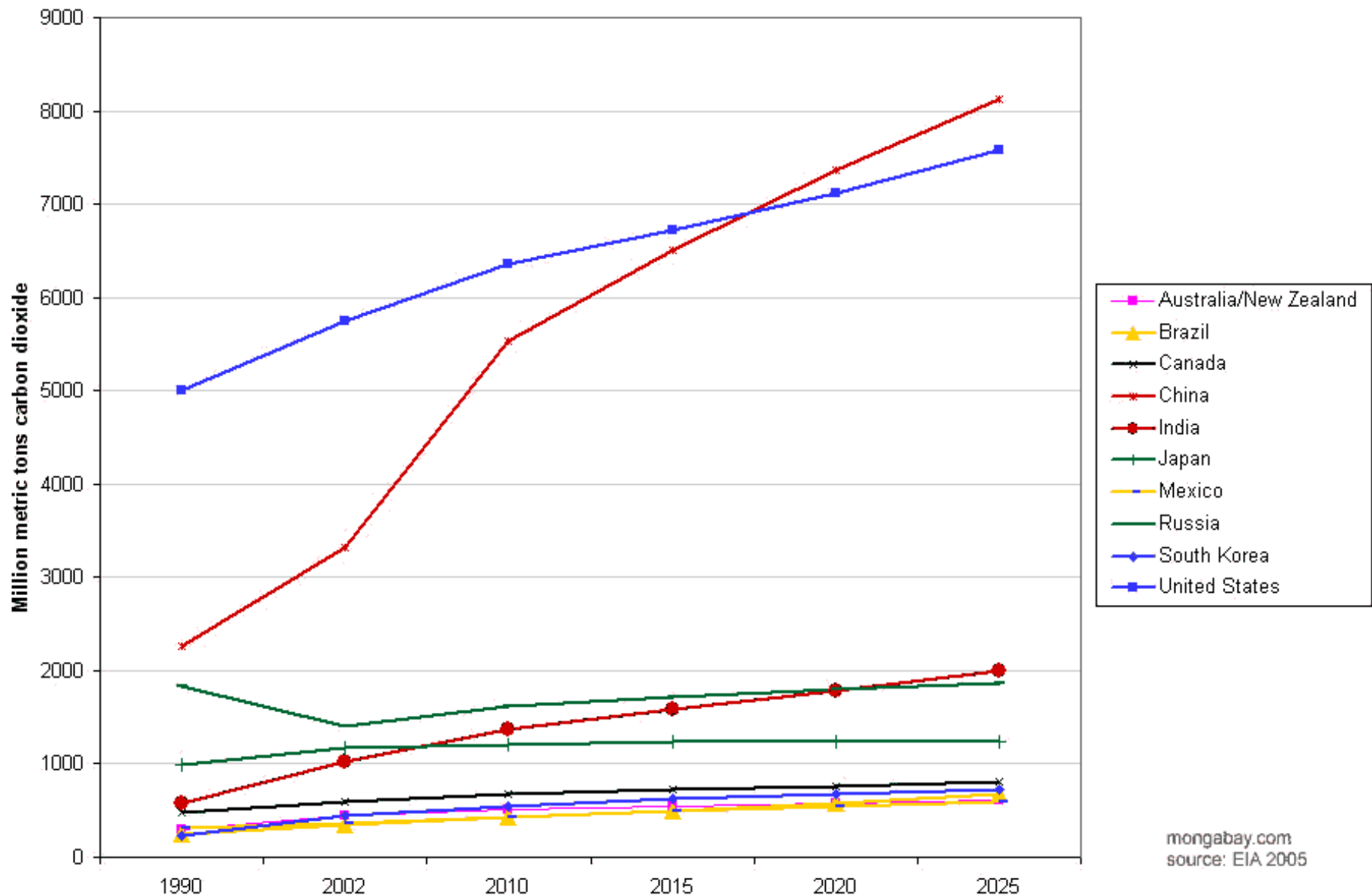


CLIMATE CHANGE

Carbon Dioxide Variations

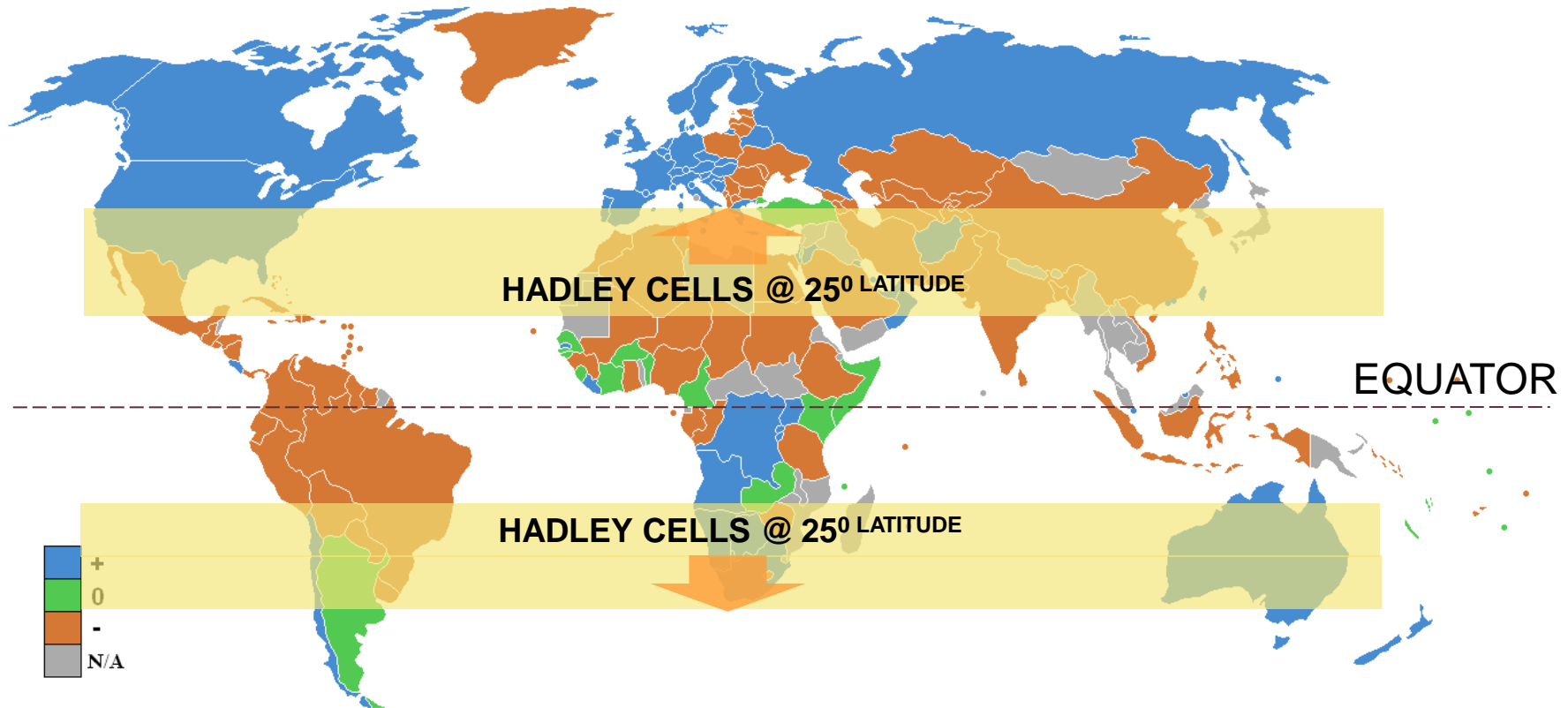


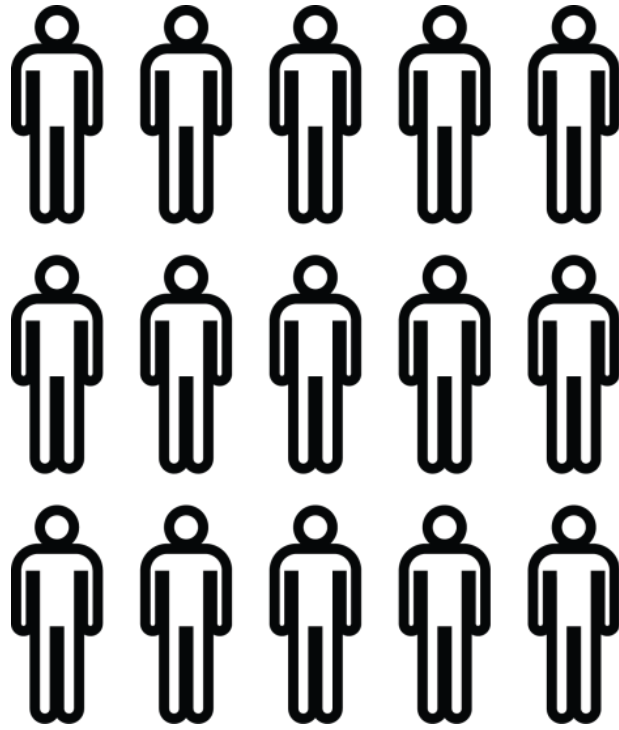




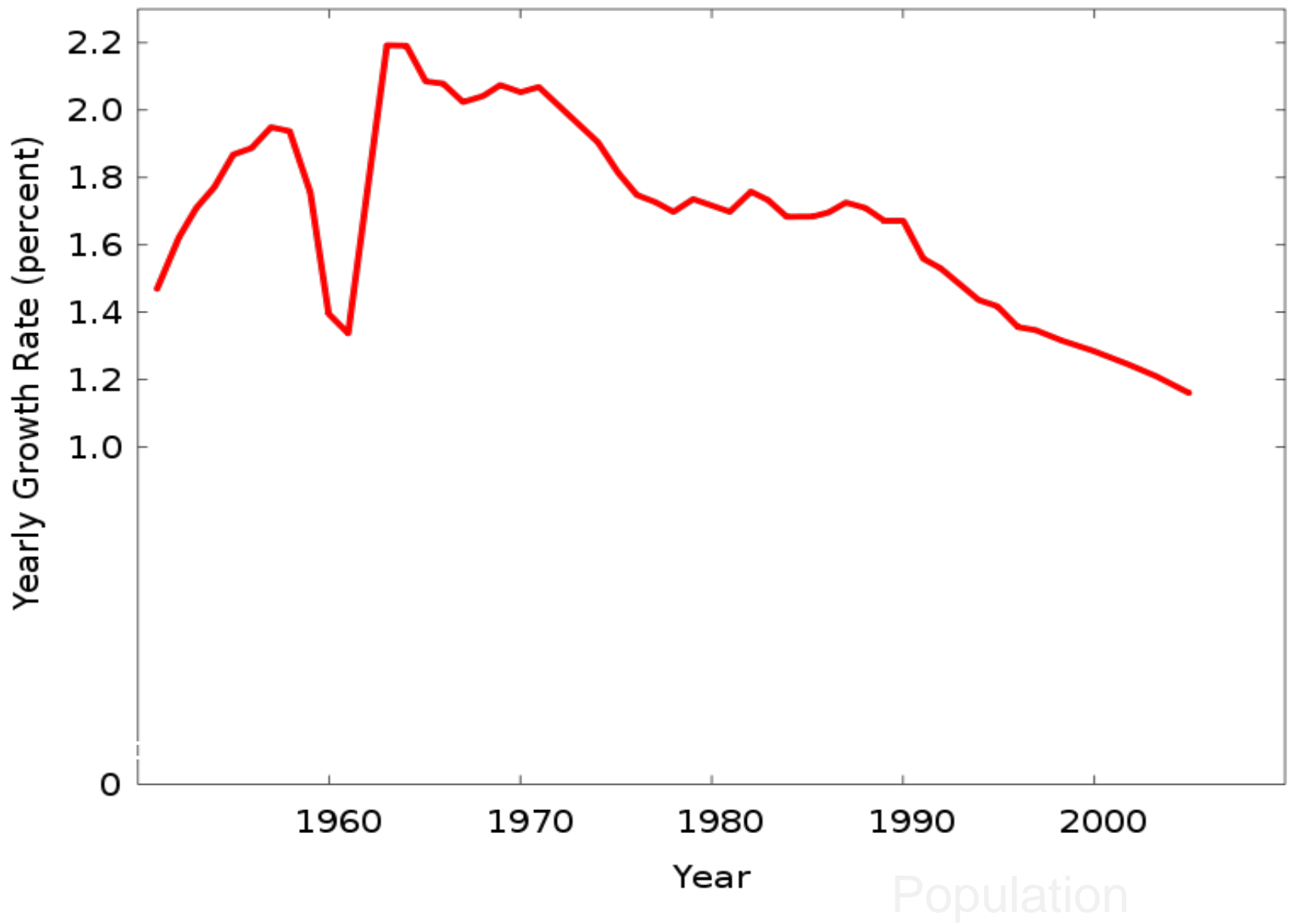
WORLD CARBON DIOXIDE EMISSIONS BY COUNTRY

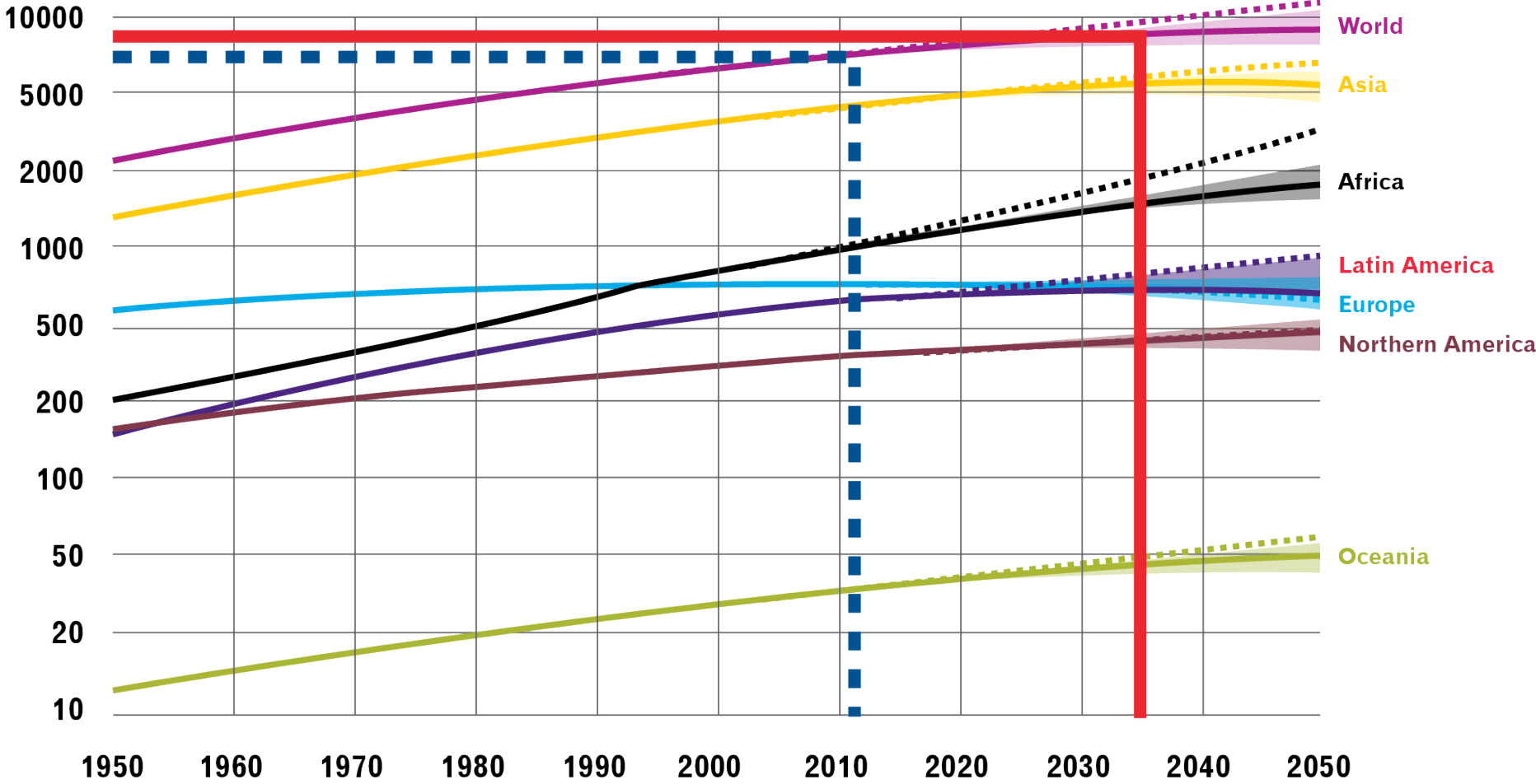
CLIMATE IMPACT ON AGRICULTURE





POPULATION GROWTH & MIGRATION

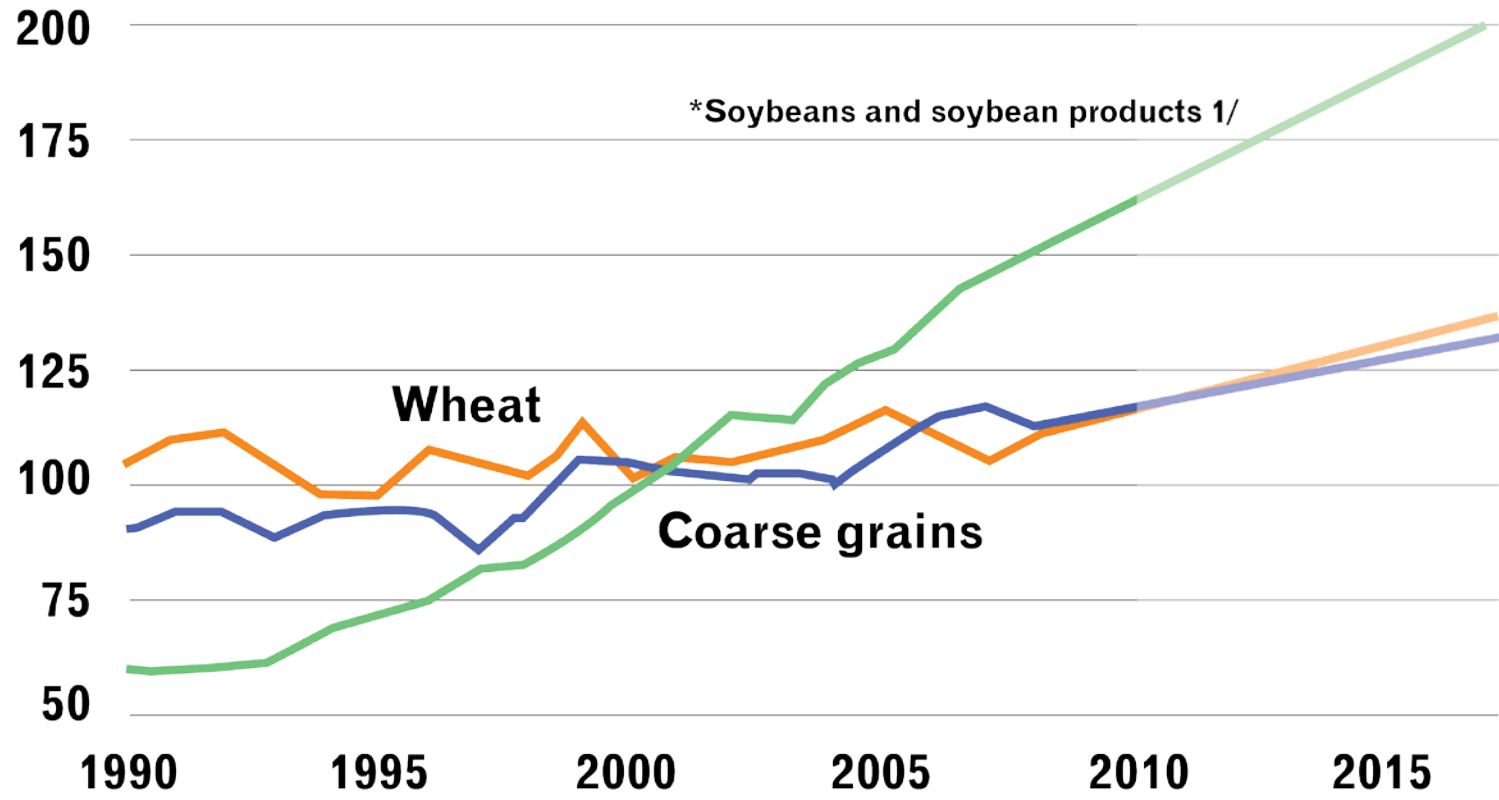




2 BILLION PEOPLE IN THE NEXT 25 YEARS!

POPULATION IMPACT ON AGRICULTURE

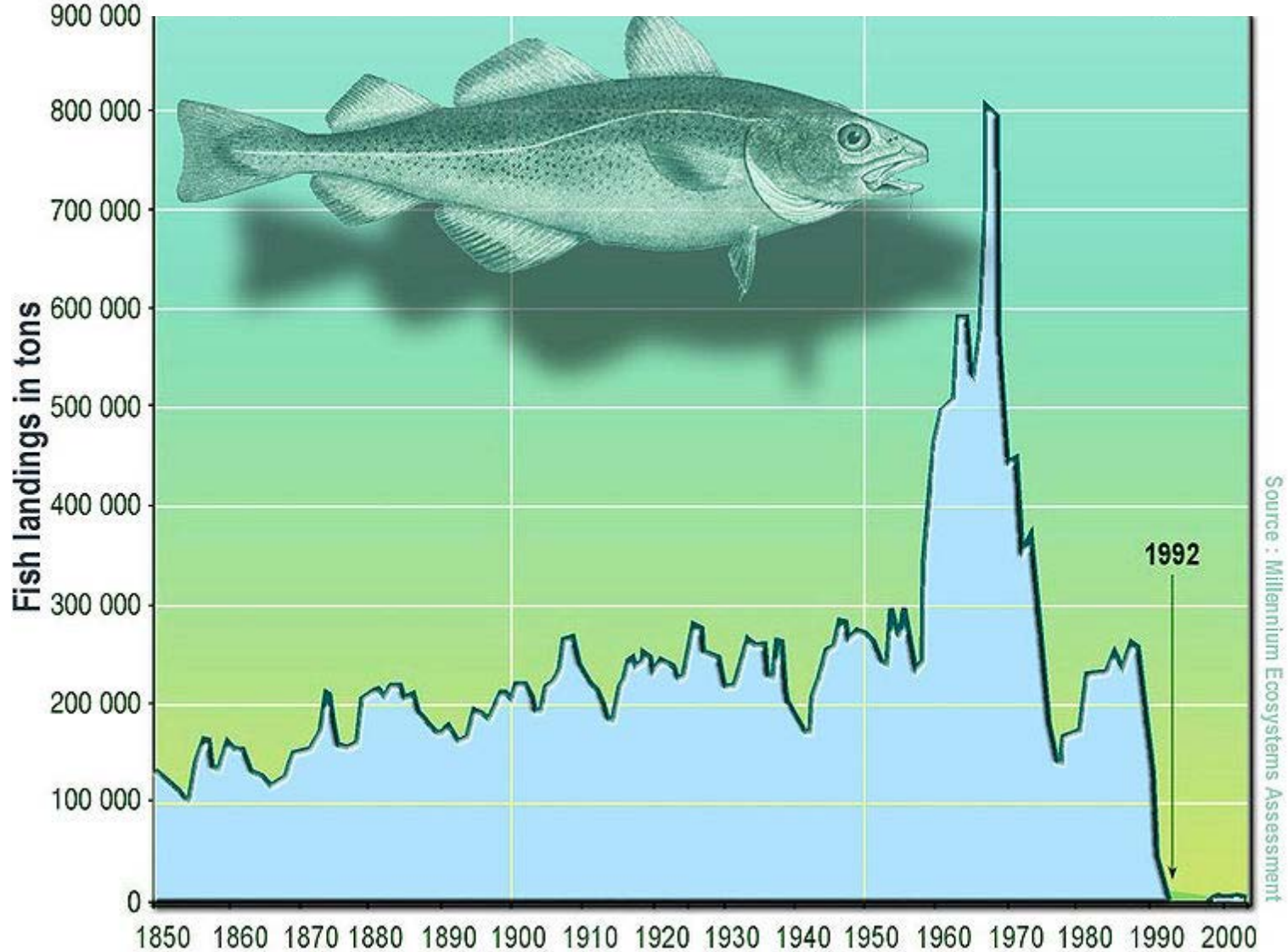
MILLION METRIC TONS



* Soybeans and soybean meal in soybean-equivalent units

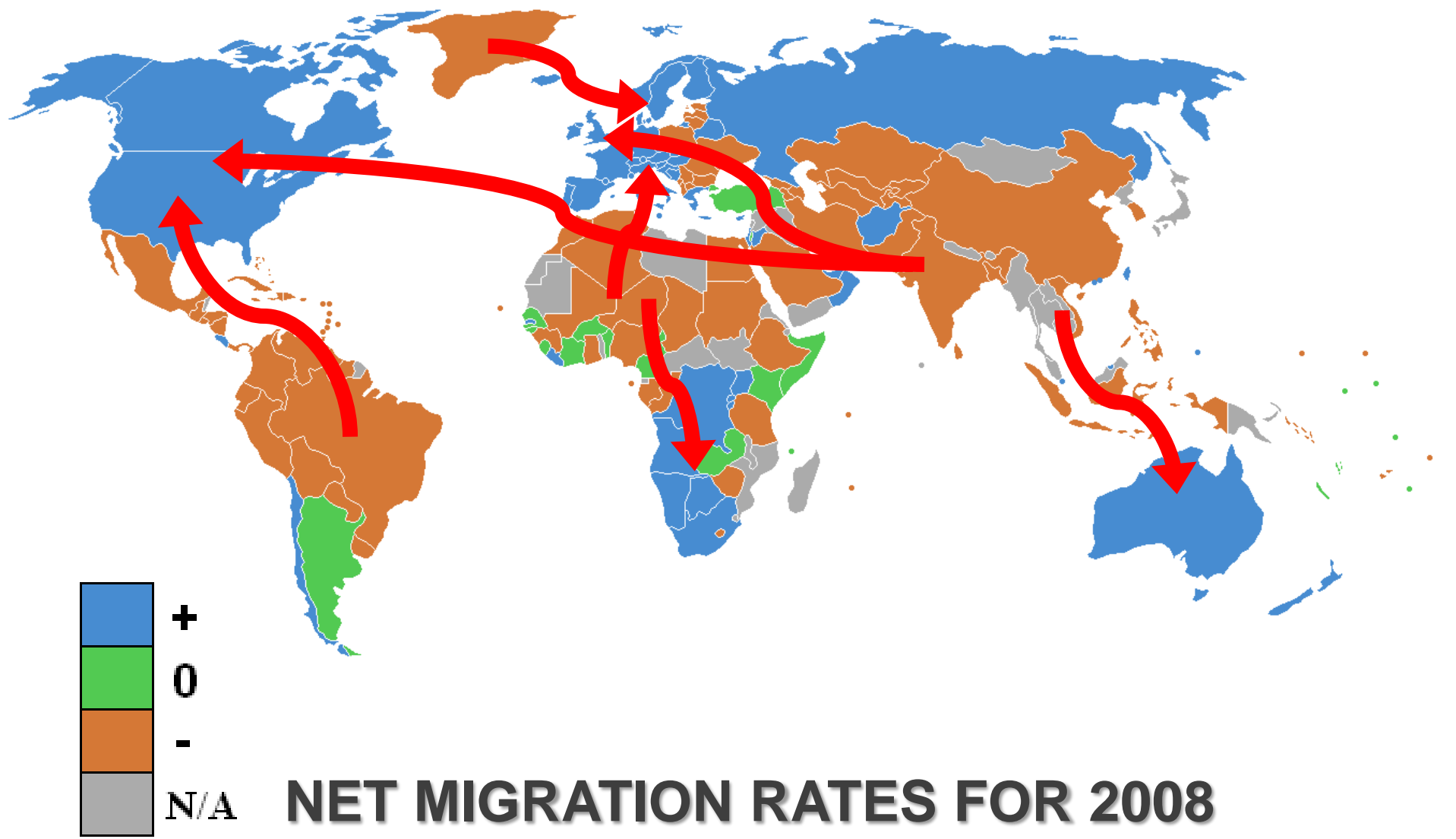
The USDA projects a 20% and 33% increase trading of key food products over the next 5 years

FISH STOCK COLLAPSES



COLLAPSE OF THE ATLANTIC COD FISHERY

POPULATION MIGRATION



**ADDITIONAL 3.1 BILLION
PEOPLE IN CITIES BY 2050**





x



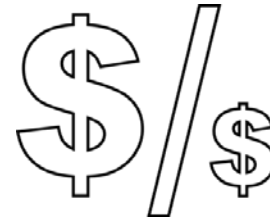
x



x

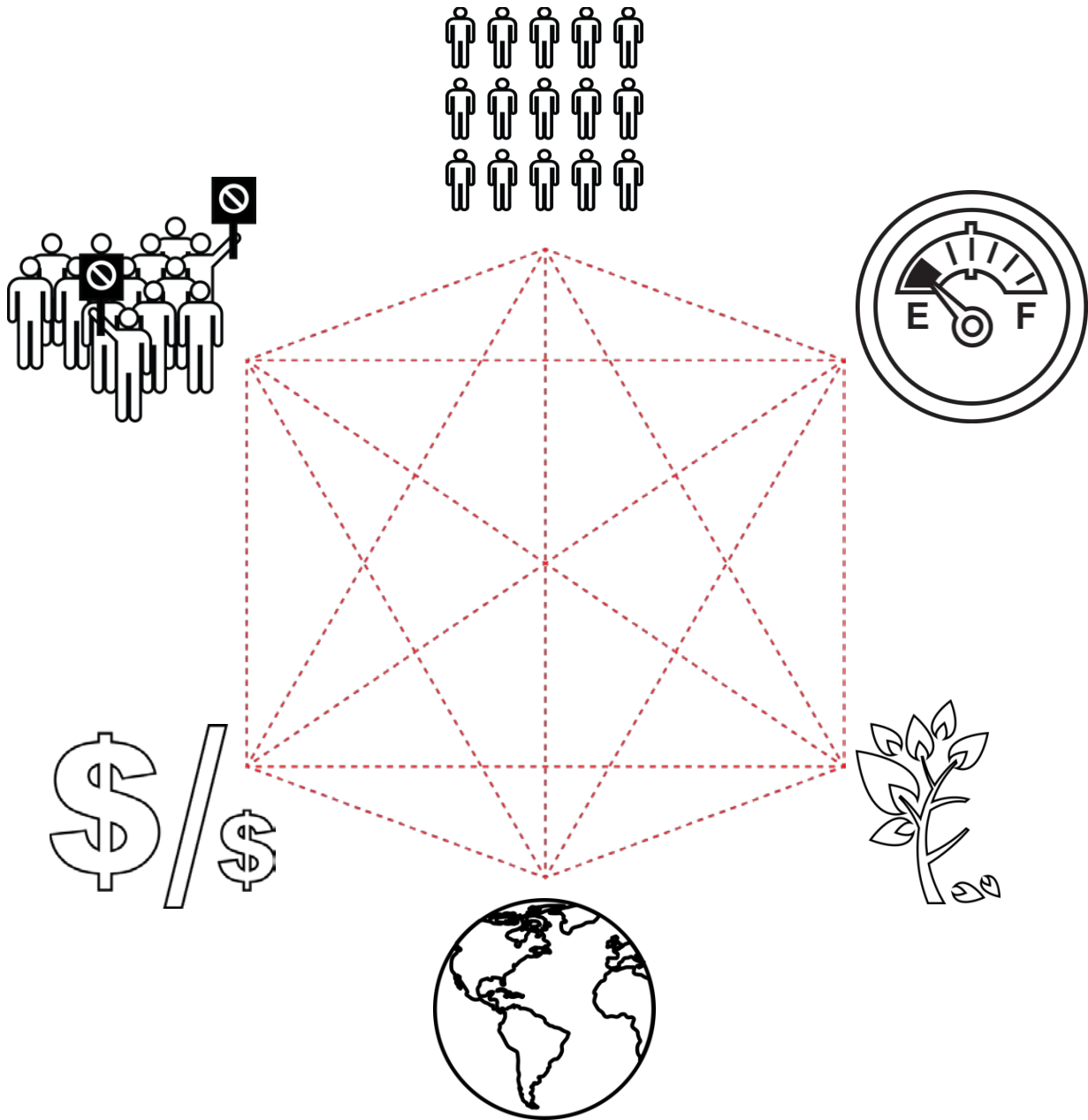


x



x





*So how do we start to build
capacity for greater
resilience
to these future shocks and
stresses in our
communities and cities?*

SIX
IMPORTANT
RESILIENCE
ATTRIBUTES

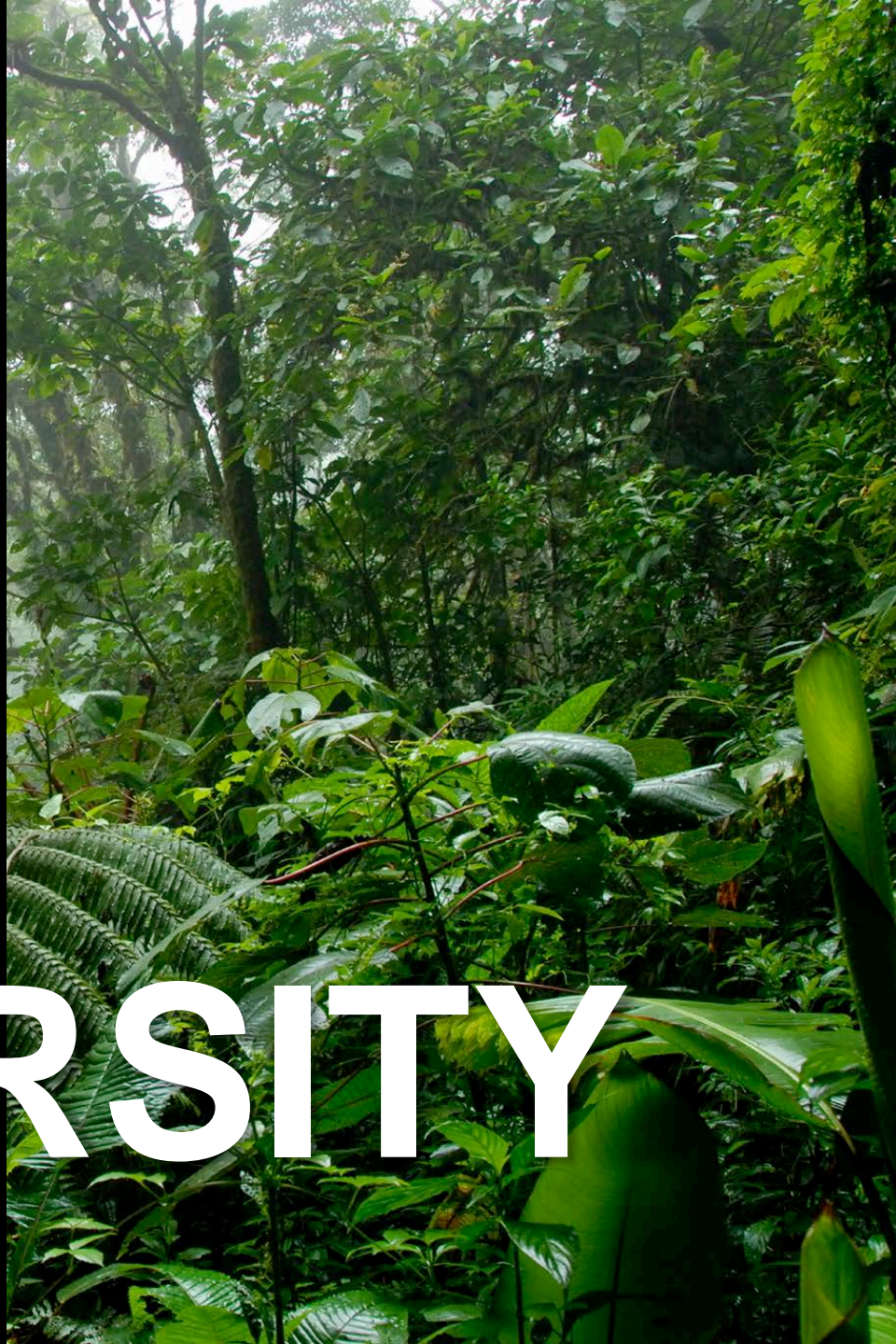
- 1. Flexibility**
- 2. Redundancy**
- 3. Diversity**
- 4. Decoupling (self-sufficiency)**
- 5. Decentralization**
- 6. Environmental Integration**



FLEXIBILITY

REDUNDANCY



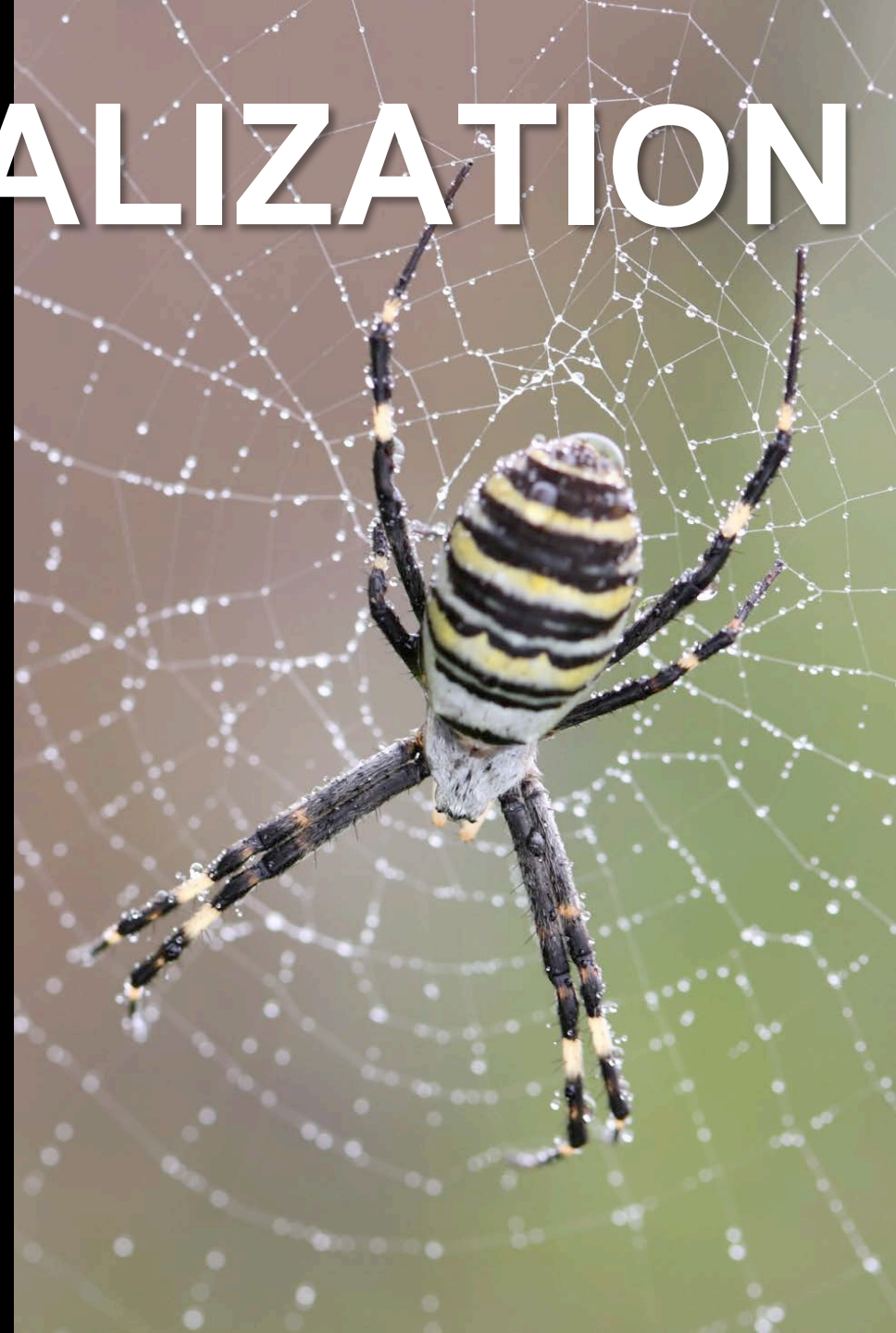


DIVERSITY



DECOUPLING

DECENTRALIZATION



ENVIRONMENTAL INTEGRATION

An aerial photograph showing a vast residential area in New Orleans completely inundated with dark floodwater. The houses are densely packed, and their roofs are the only parts visible above the water level. In the foreground, a large, cylindrical concrete structure, possibly a water tower, stands partially submerged. The background shows a mix of residential and industrial buildings, with some taller structures and cranes visible under a clear sky.

New Orleans after Hurricane Katrina, August 2005

RESILIENCE

– Part 1 –

DISCUSSION

RESILIENCE

Part 2

OPPORTUNITIES FOR BUILDING RESILIENCE

SO HOW DO WE
INCREASE THE
RESILIENCE
CAPACITY OF OUR
COMMUNITIES
AND CITIES?

OPPORTUNITIES FOR BUILDING RESILIENCE

- 1. PUBLIC HEALTH**
- 2. EDUCATION & TRAINING**
- 3. GOVERNANCE**
- 4. ECONOMY**
- 5. JUSTICE / PUBLIC ORDER / SECURITY**
- 6. BUILDING FABRIC & TRANSPORTATION**
- 7. ENERGY INFRASTRUCTURE**
- 8. FOOD PRODUCTION INFRASTRUCTURE**
- 9. C.I.T. INFRASTRUCTURE**
- 10. WATER AND WASTE INFRASTRUCTURE**

EXPLORE 5
APPROACHES
TO BUILDING
RESILIENCE
CAPACITY

01

PLANNING FOR
**GROWTH
+ DENSITY**

WHY?

POPULATION

**GROWTH &
MIGRATION**



50%

**Of the World's Population
Live in Cities**

NOW

70%-80%

**Of the World's Population
Will Live in Cities**

by 2050

TWO VERY

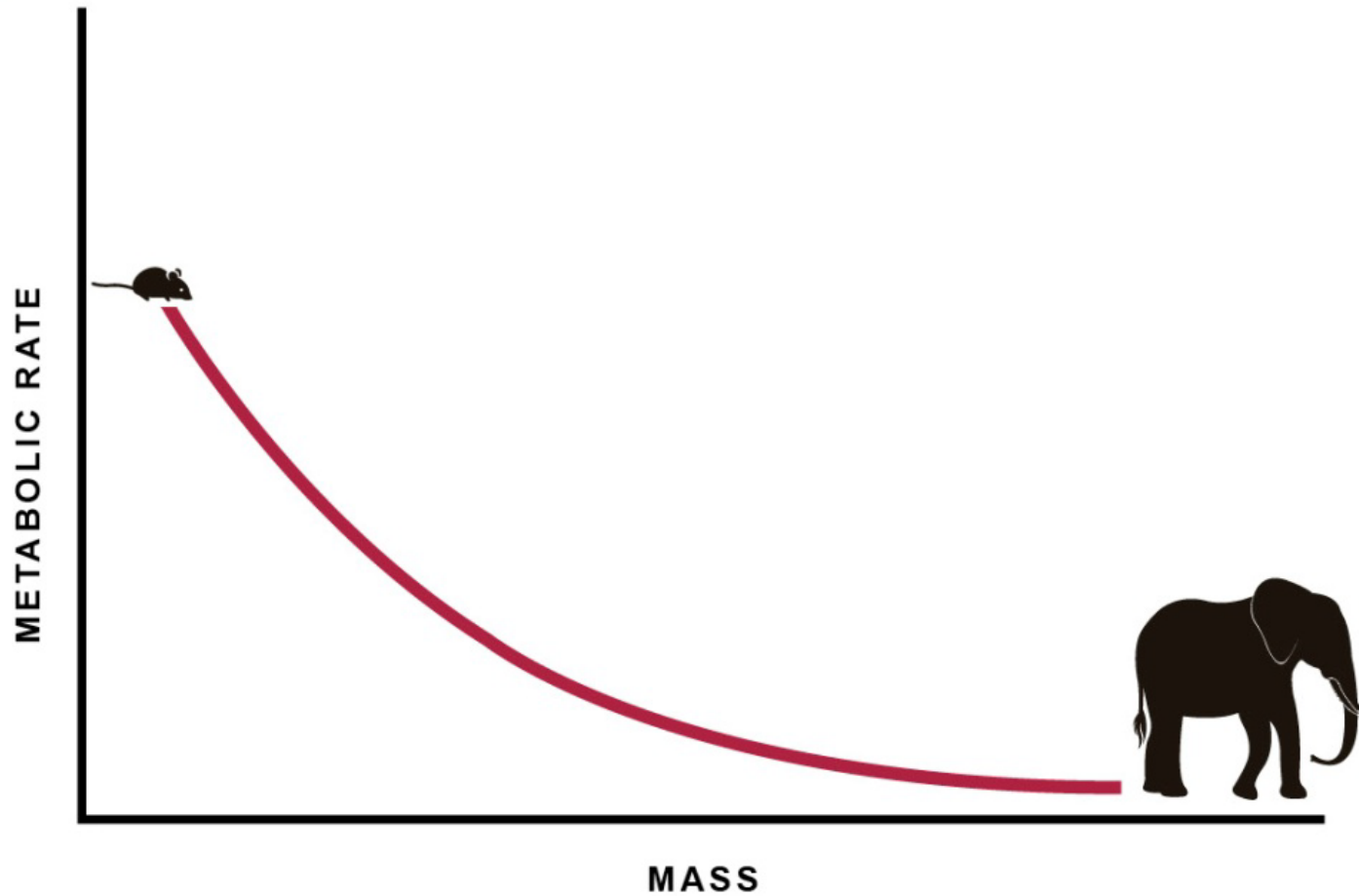
GOOD

THINGS

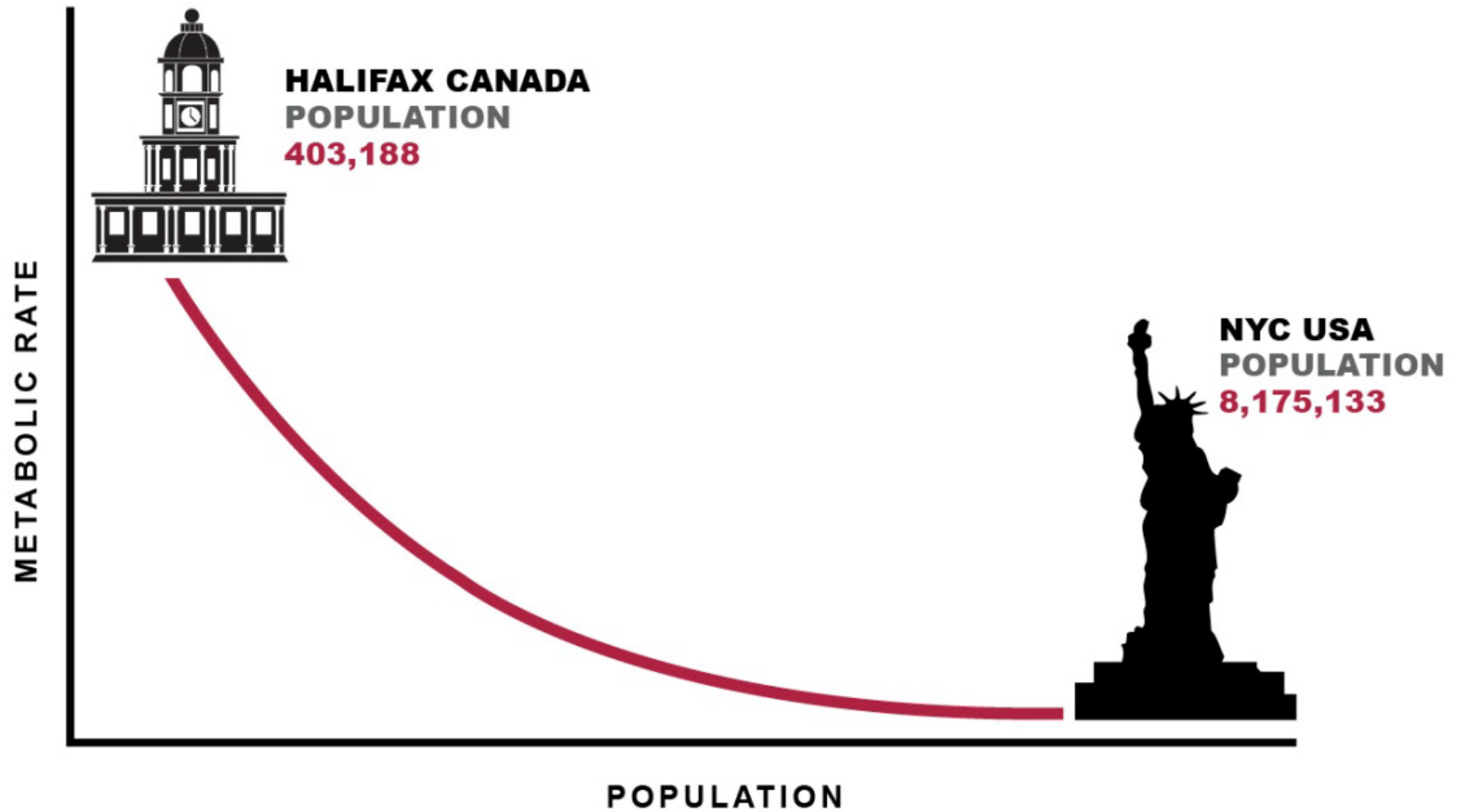
ABOUT THIS

SITUATION!

1st:



KLEIBER'S LAW



WEST'S 1st DISCOVERY

2nd:

INNOVATION



HALIFAX CANADA
POPULATION
403,188



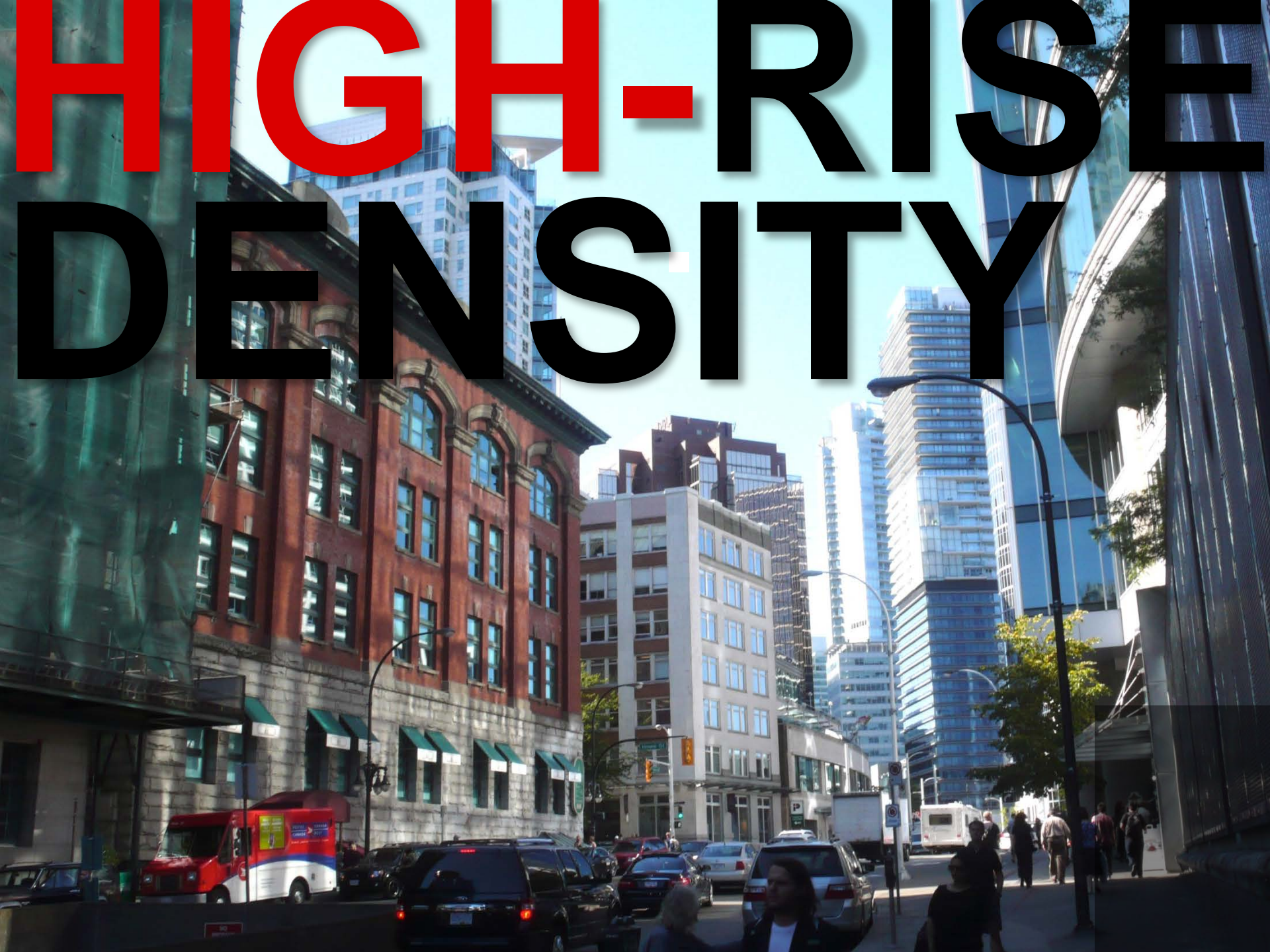
NYC USA
POPULATION
8,175,133

POPULATION

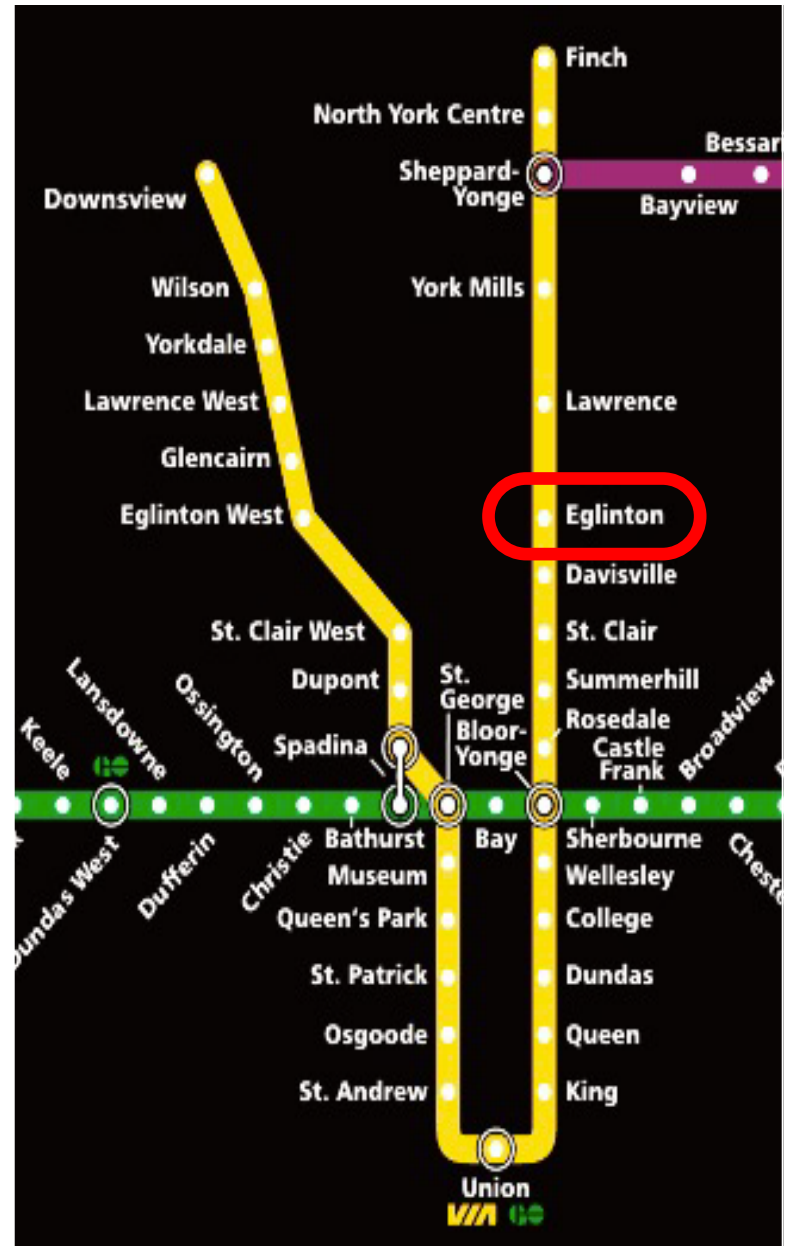
WEST'S 2nd DISCOVERY

HOW?

HIGH-RISE DENSITY



T.O.D.



Minto Towers at Eglinton Subway, Toronto



50-60

**DWELLING
UNITS PER
HECTARE**

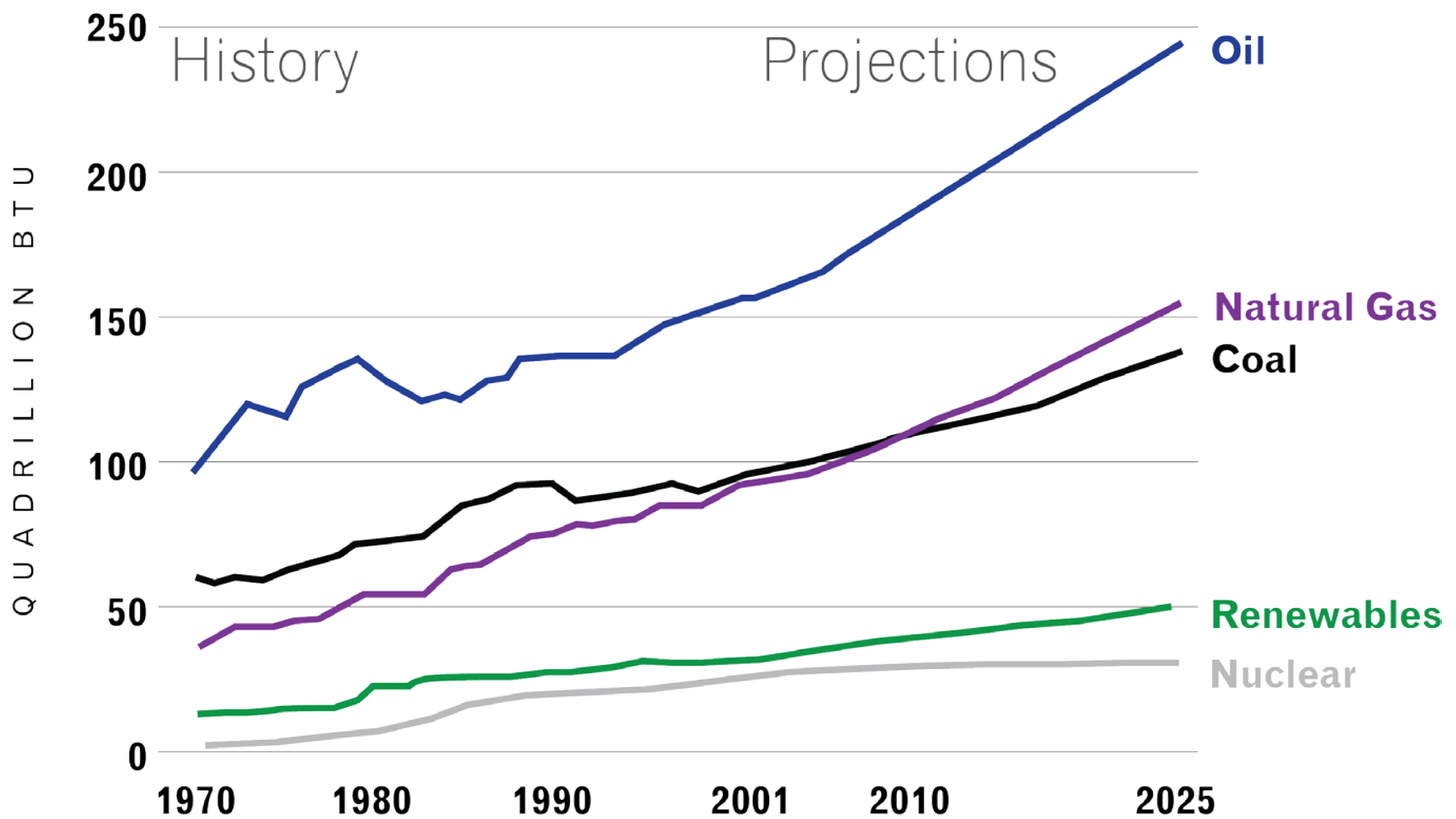
[=100M x 100M]



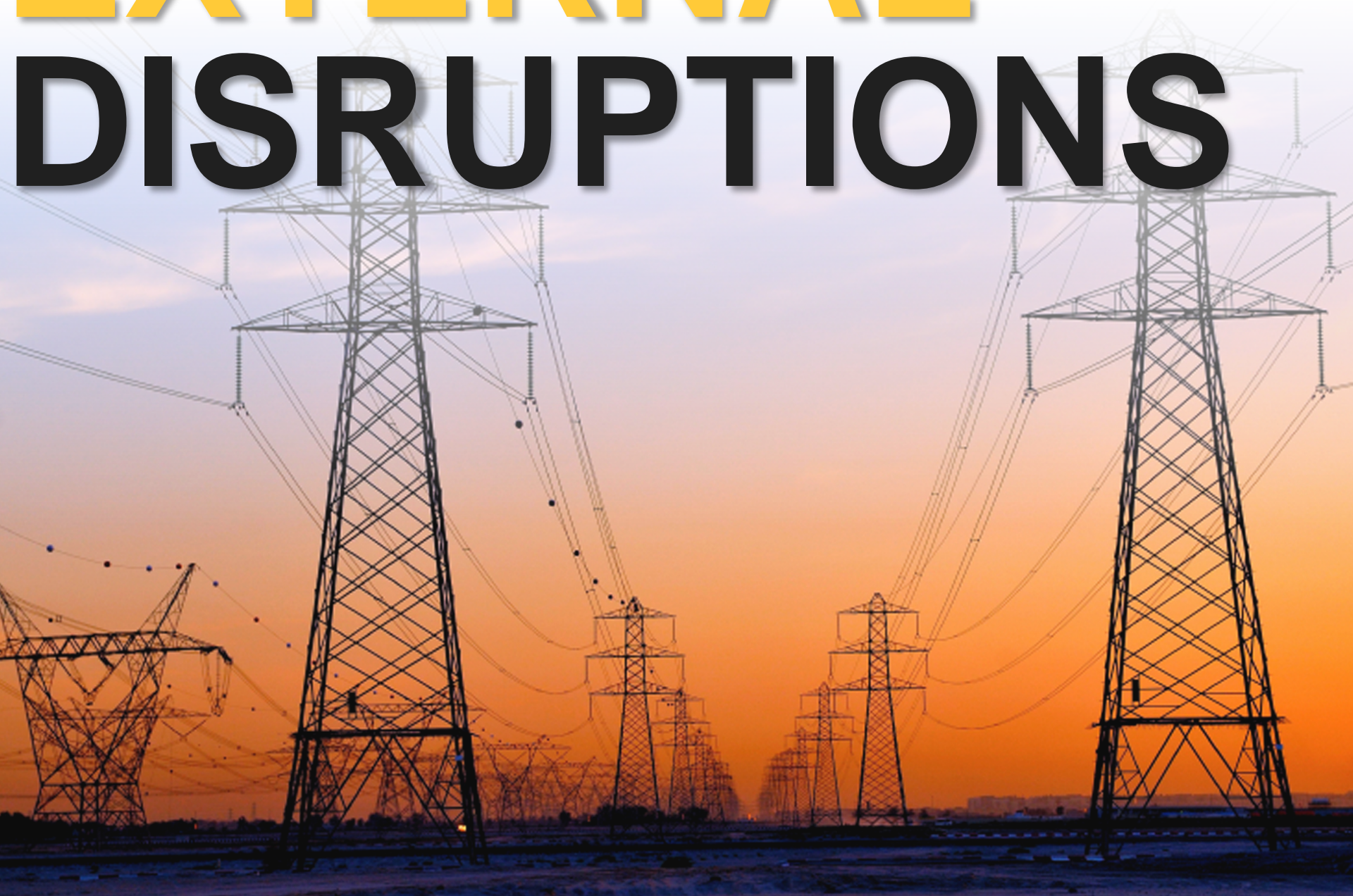
**LOCAL LOW-CARBON
ENERGY**

WHY?

ENERGY DEMAND



EXTERNAL DISRUPTIONS



FUTURE **CARBON TAXES**



HOW?

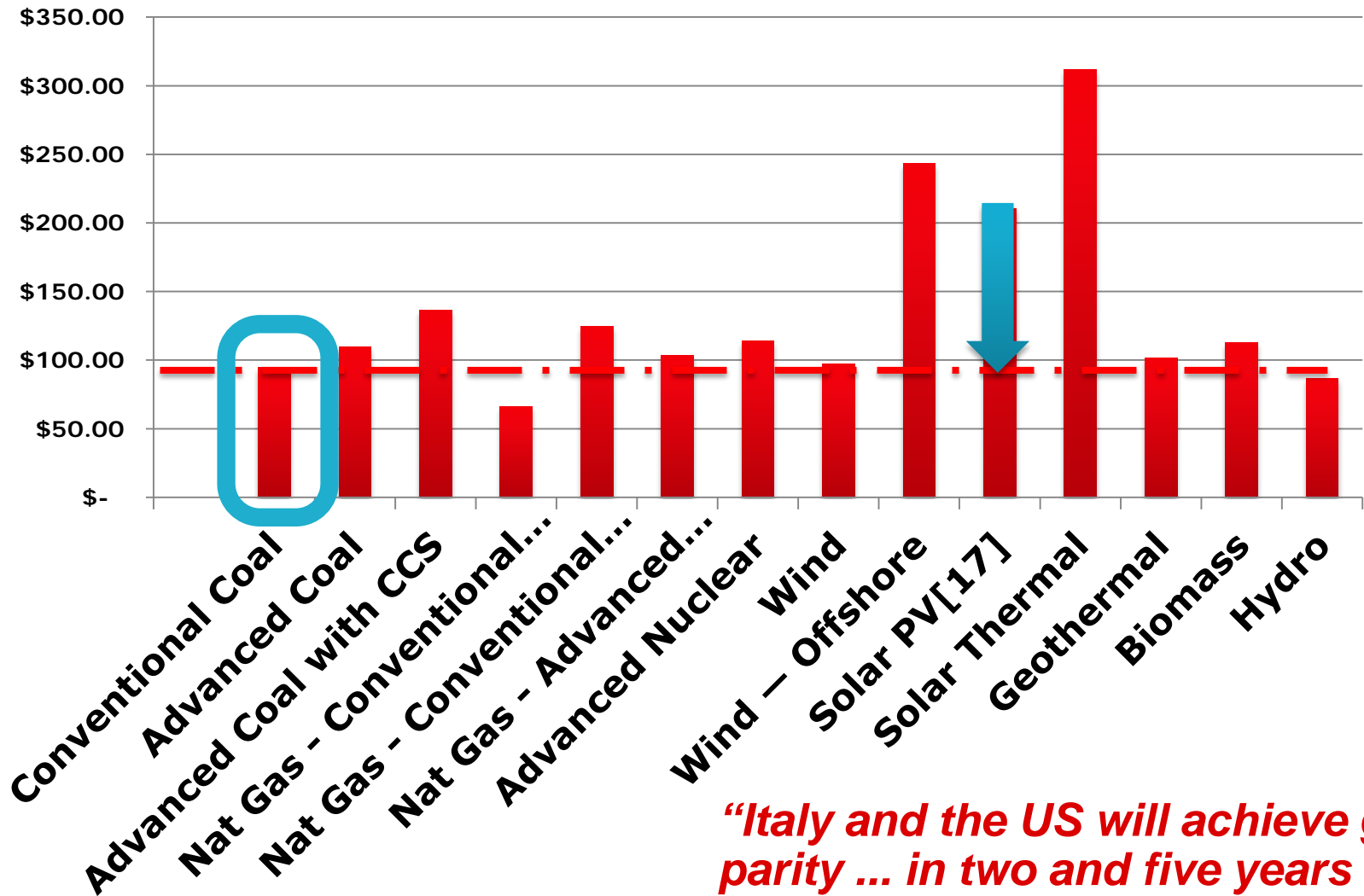
**ZERO-CARBON
ENERGY IS
NEARING NET
PARITY !**



**PV PARITY IS
5 YEARS AWAY!**



Total System Levelized Cost [2009 US\$/MWh]



“Italy and the US will achieve grid parity ... in two and five years respectively.”

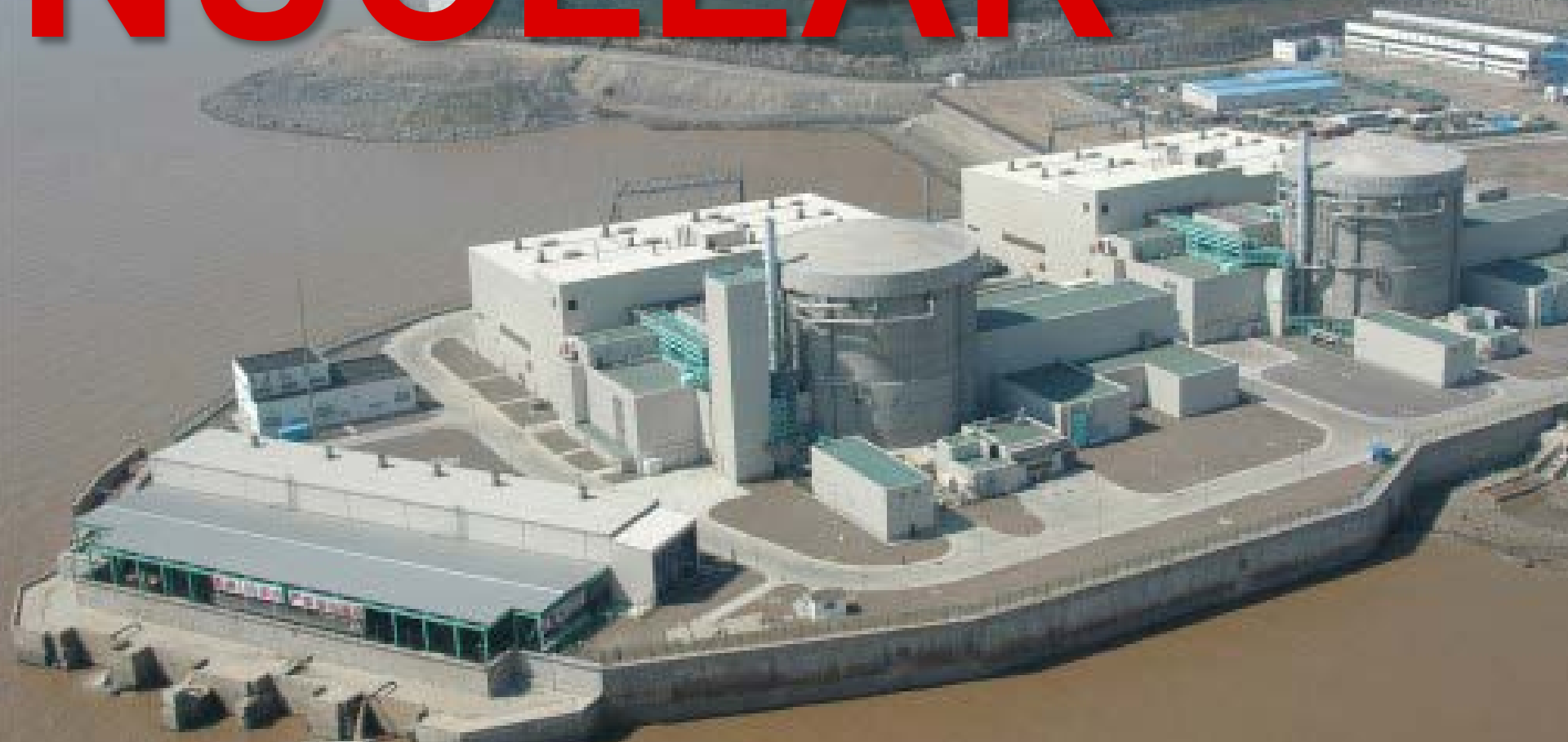
Andrew Beebe,
Energy Innovations

LIQUID METAL BATTERIES!

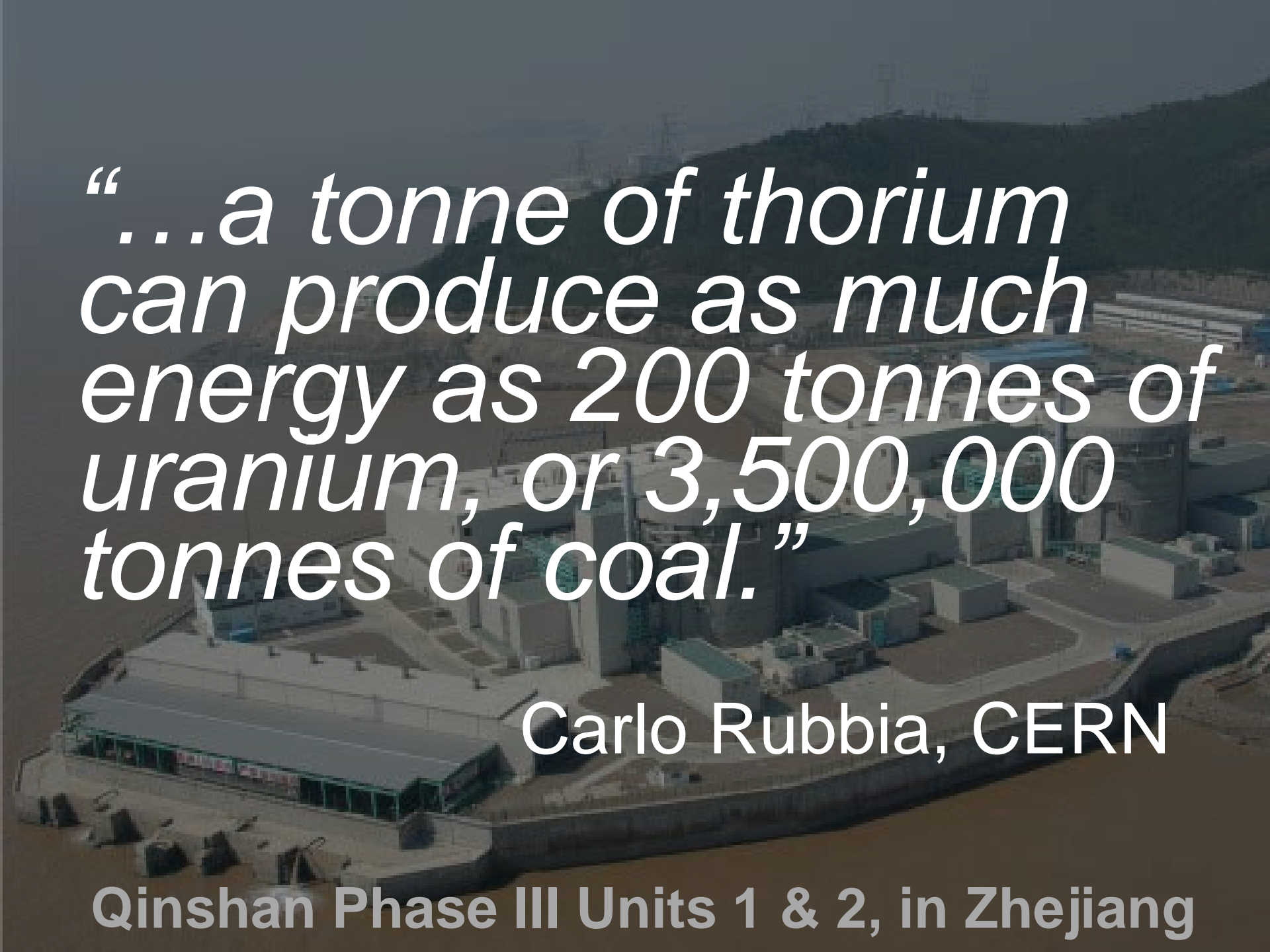


**\$250 per Kilowatt-hour fully installed
[10x less expensive than Lithium-ion!]**

THORIUM NUCLEAR



Qinshan Phase III Units 1 & 2, in Zhejiang



*“...a tonne of thorium
can produce as much
energy as 200 tonnes of
uranium, or 3,500,000
tonnes of coal.”*

Carlo Rubbia, CERN

Qinshan Phase III Units 1 & 2, in Zhejiang

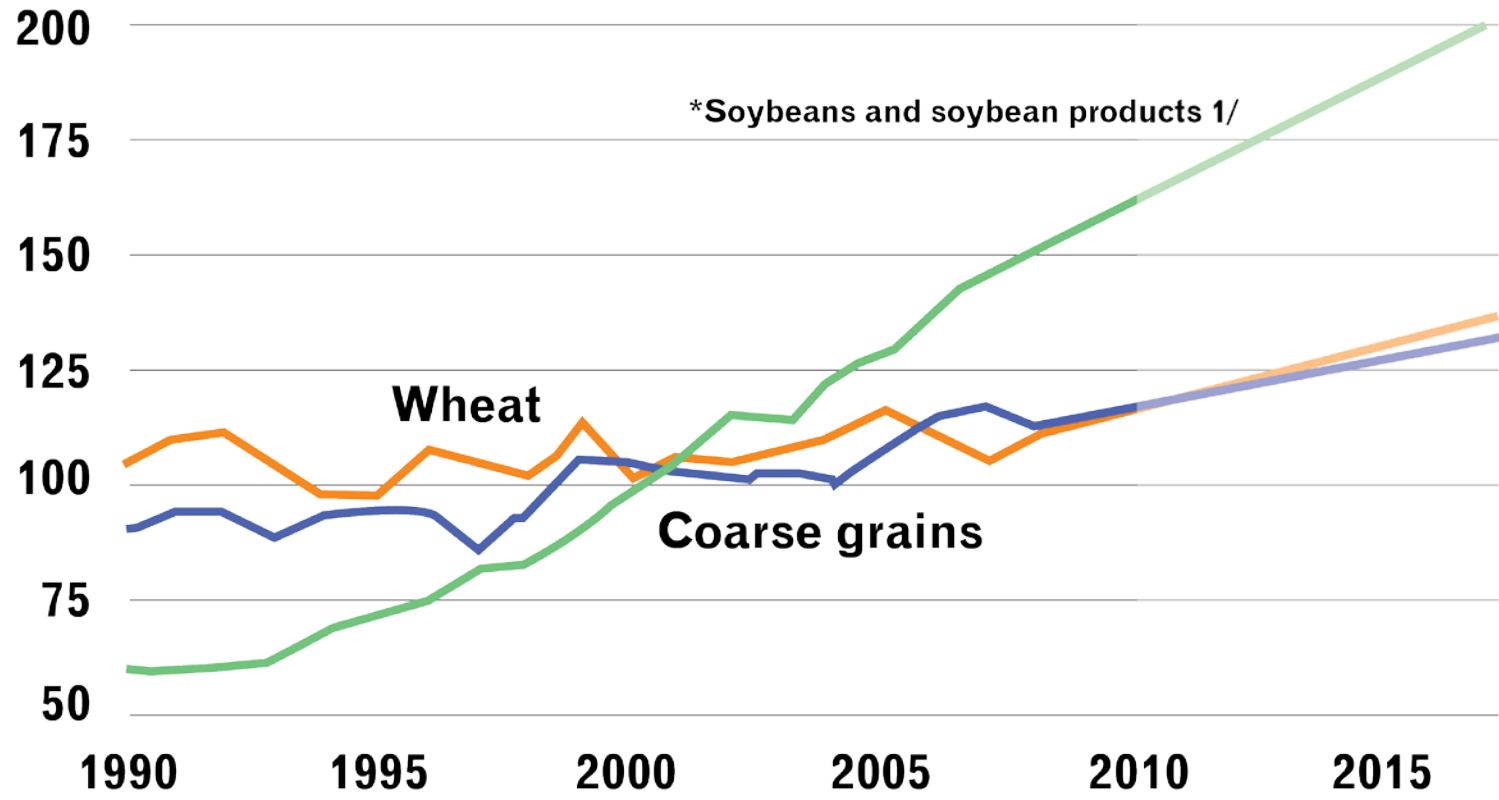


LOCAL
FOOD
PRODUCTION

WHY?

POPULATION IMPACT ON AGRICULTURE

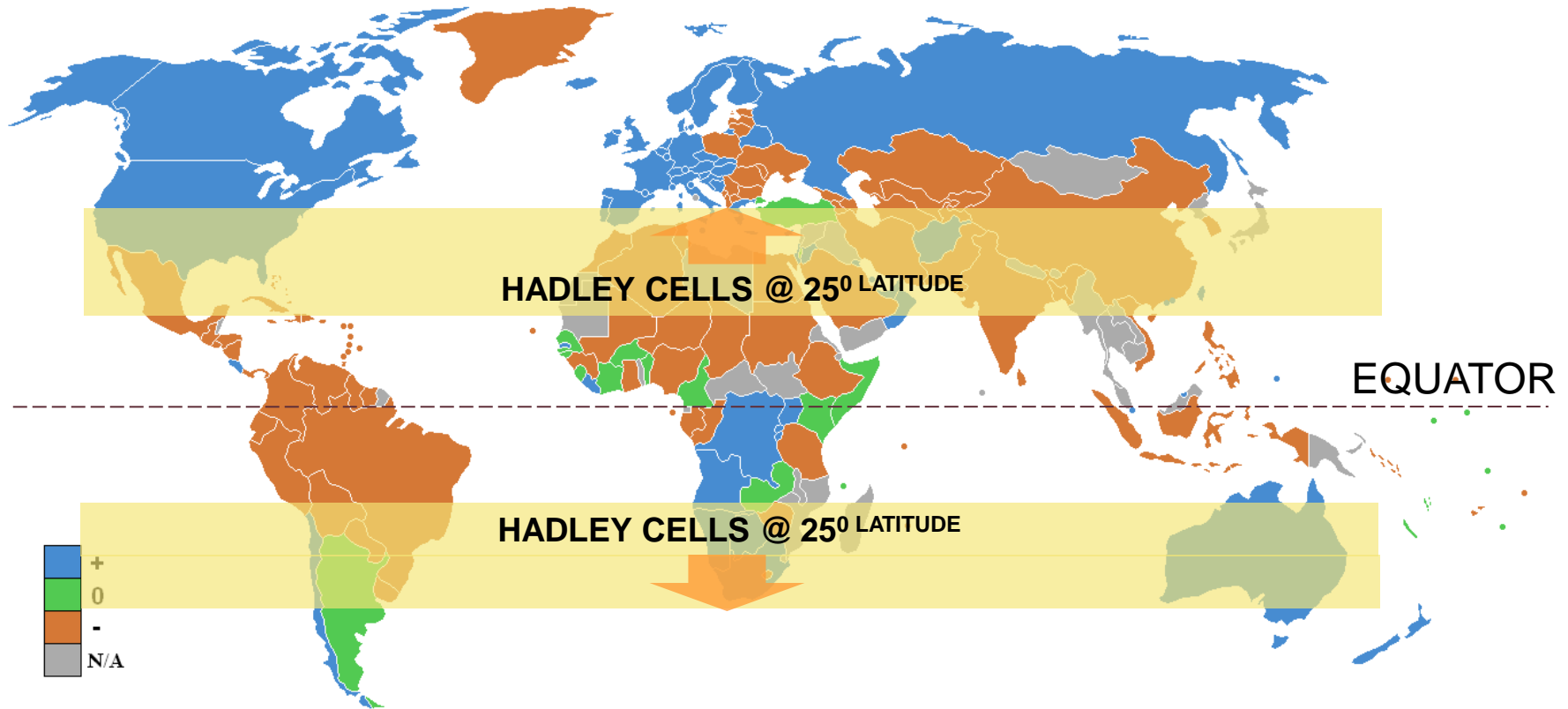
MILLION METRIC TONS



* Soybeans and soybean meal in soybean-equivalent units

The USDA projects a 20% and 33% increase trading of key food products over the next 5 years

CLIMATE IMPACT ON AGRICULTURE



HOW?



Ormet

**LAND
REQUIRED = 2 ACRES
PER
PERSON**

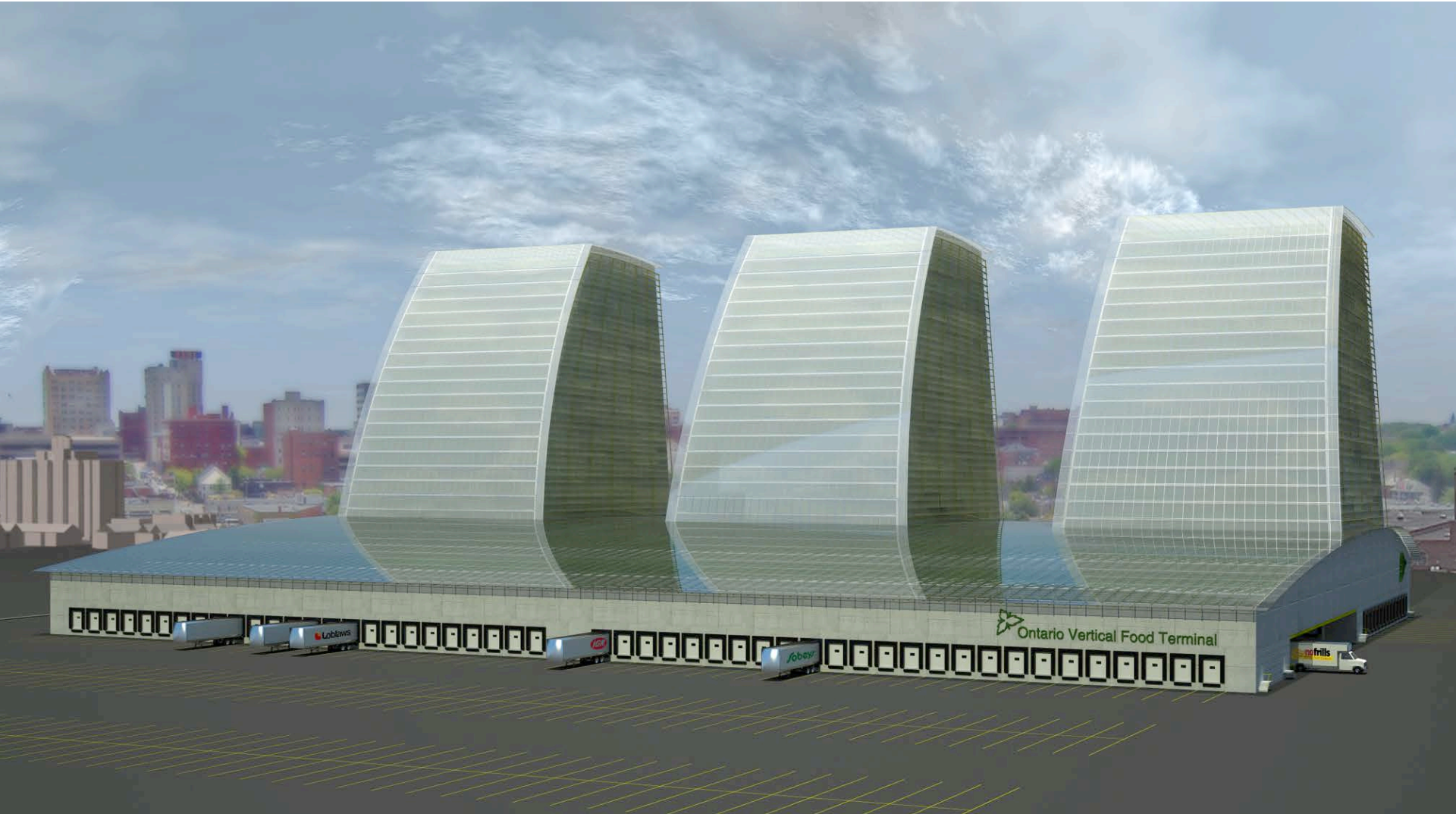
**TORONTO = 6 MILLION
ACRES**

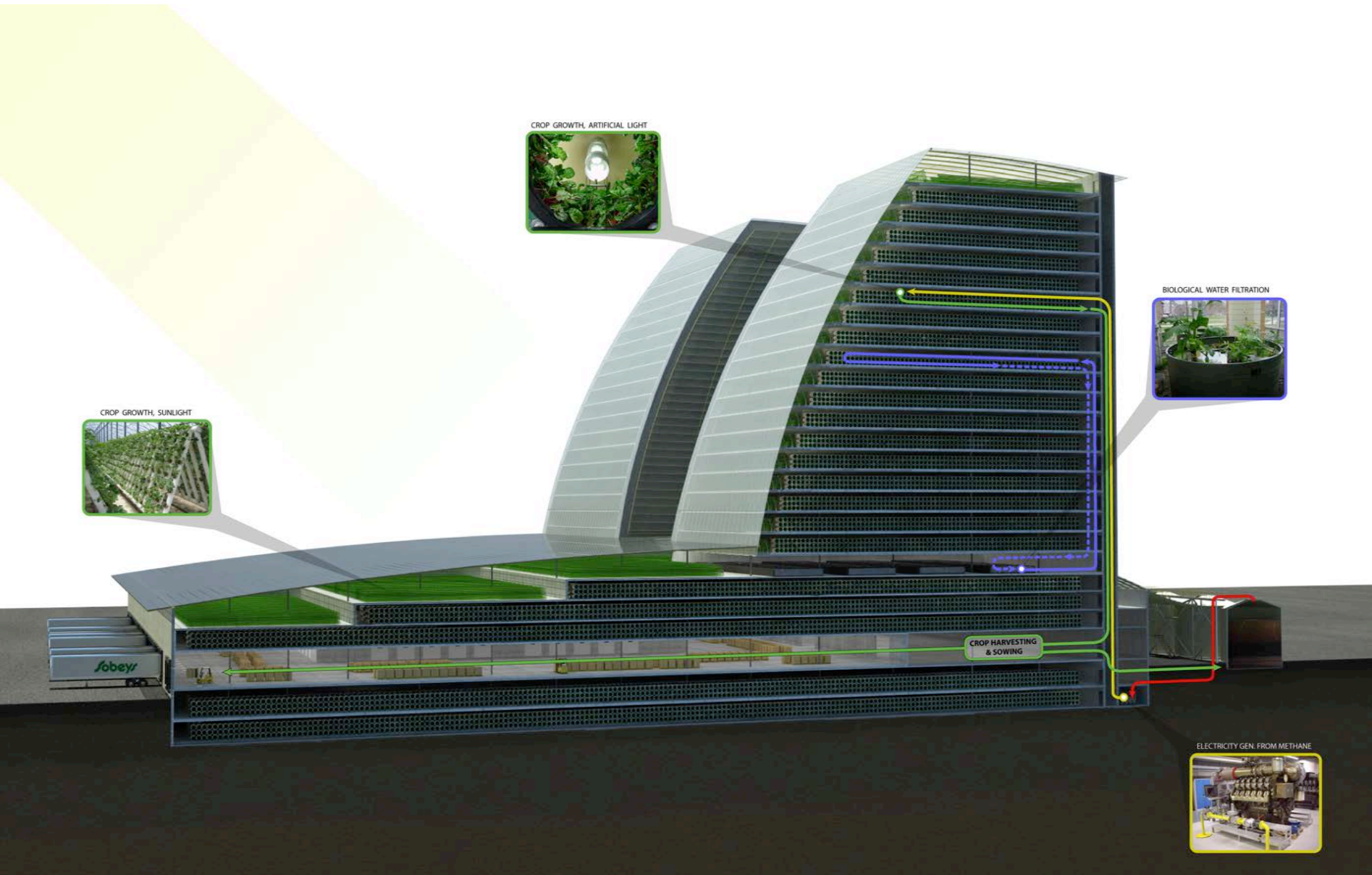
VERTICAL FOOD PRODUCTION



FOOD PRODUCTION PROPOSAL

CREDIT: GORDON GRAFF





CROP GROWTH, ARTIFICIAL LIGHT



CROP GROWTH, SUNLIGHT



BIOLOGICAL WATER FILTRATION



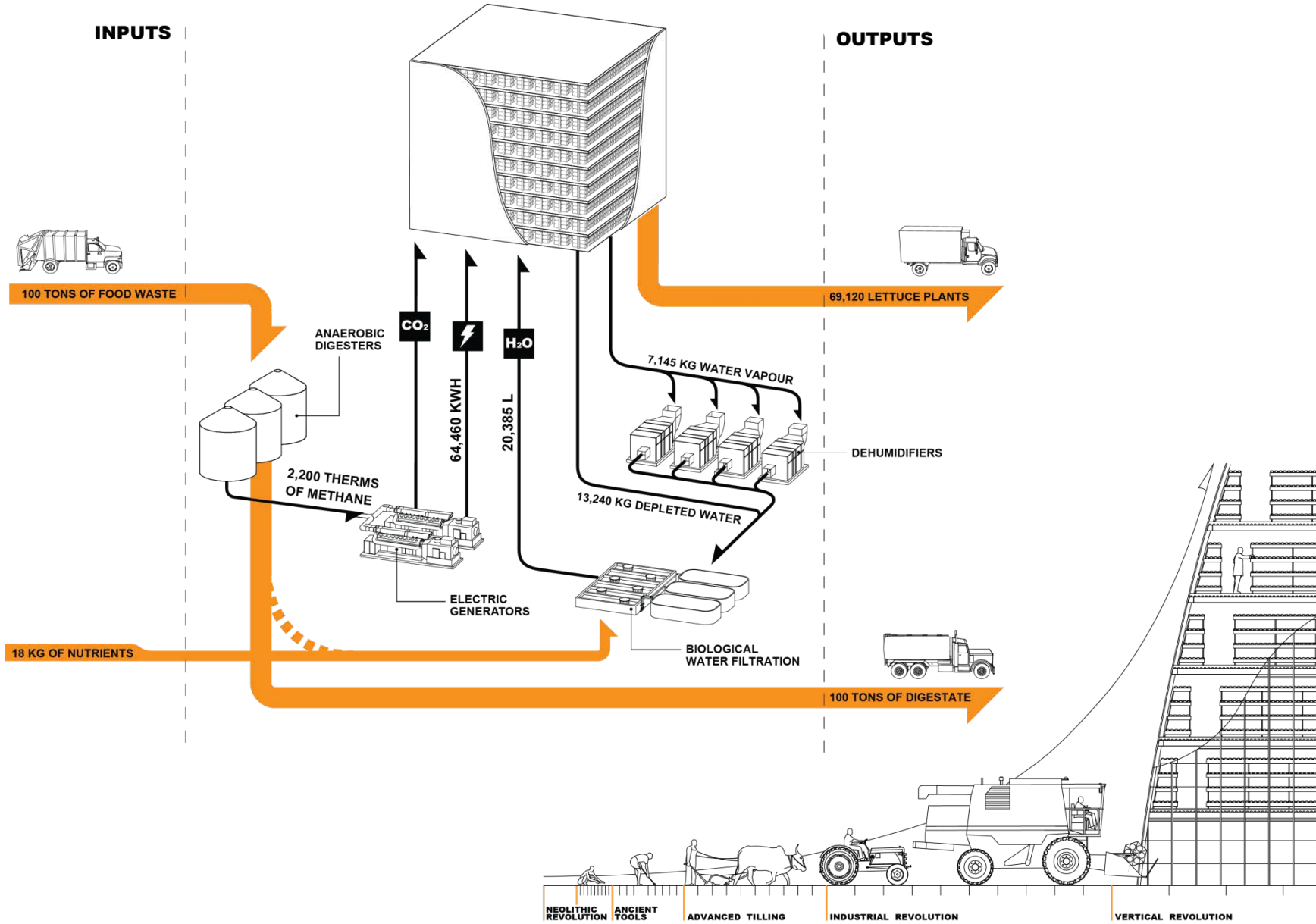
CROP HARVESTING & SOWING

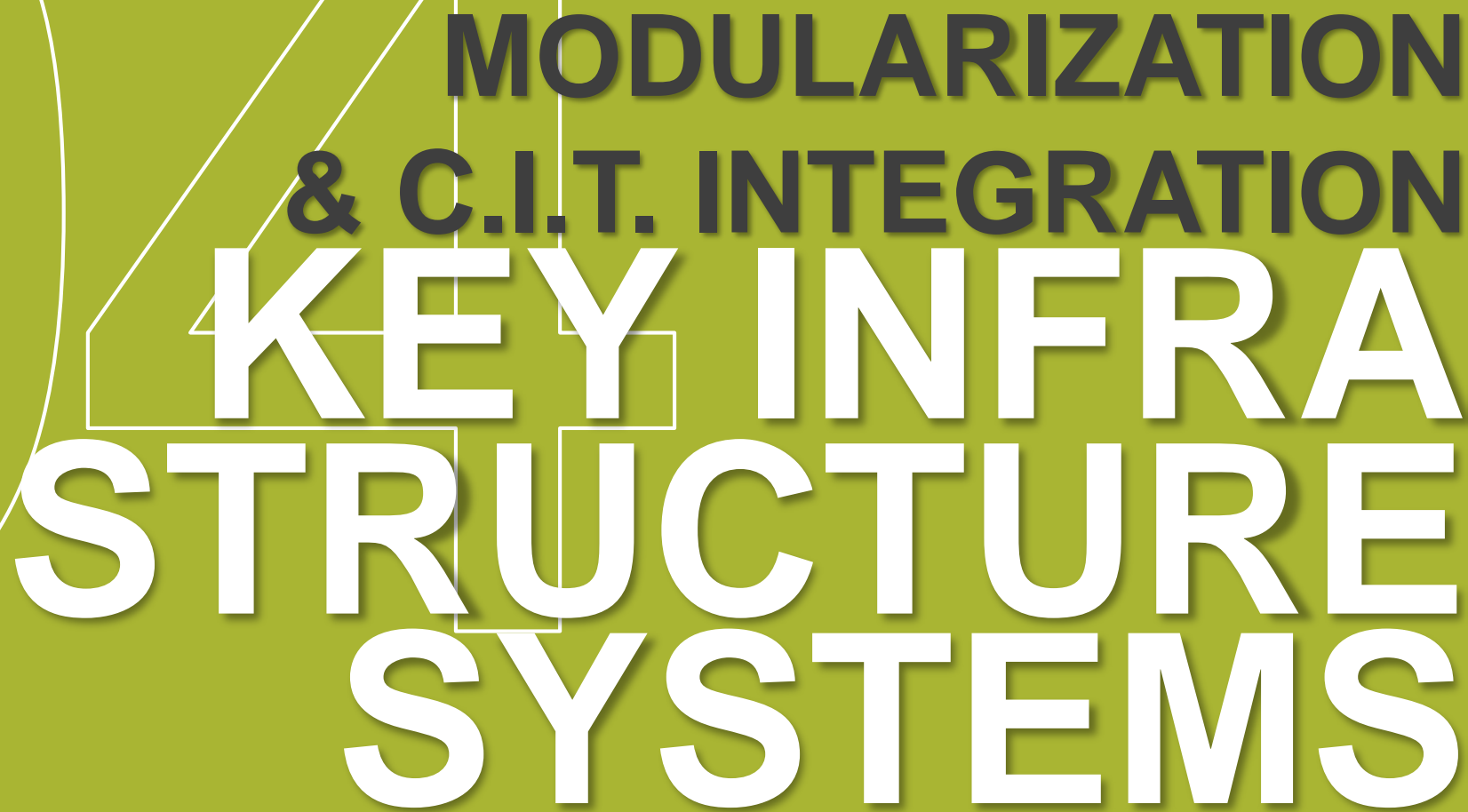
ELECTRICITY GEN. FROM METHANE



INPUTS

OUTPUTS





**MODULARIZATION
& C.I.T. INTEGRATION**
**KEY INFRA
STRUCTURE
SYSTEMS**

WHY?

SHOCKS TO AGING INFRASTRUCTURE SYSTEMS

A photograph of the Toronto skyline at sunset, with the CN Tower and various skyscrapers silhouetted against a warm, orange and yellow sky. The water in the foreground is dark and reflects the sky.

August 14th 2003

Beyond the Rack  **SHOP CHIC DECOR FOR YOUR HOME AND KITCHEN AT UP TO 80% OFF SEE TODAY'S DEALS**

Many Areas Still in Dark After Series of Storms



Jason Reed/Reuters

Workers for the Pepco utility company on Monday inspected power lines brought down by weekend storms in Wheaton, Md.
 By JOHN SCHWARTZ
 Published: July 2, 2012

Millions of people learned a new word over the weekend: "derecho." It was not a happy lesson.

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The Spanish term for what is essentially a squall line that moves rapidly across the landscape was widely used to describe the wall of storms that killed 22 people, according to The Associated Press, and knocked out power for some 4.2 million

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- TWITTER
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What's Popular Now
 Honor Code A Leader's Renunciation of 'Ex-Gay' Tenets Causes a Schism

Well Tara Parker-Pope on Health
 VISIT DAILY
 NYTIMES.COM/WELL

TicketWatch: Theater Offers by E-Mail
 Sign up for ticket offers from Broadway shows and other advertisers. Sign Up
 See Sample | Privacy Policy

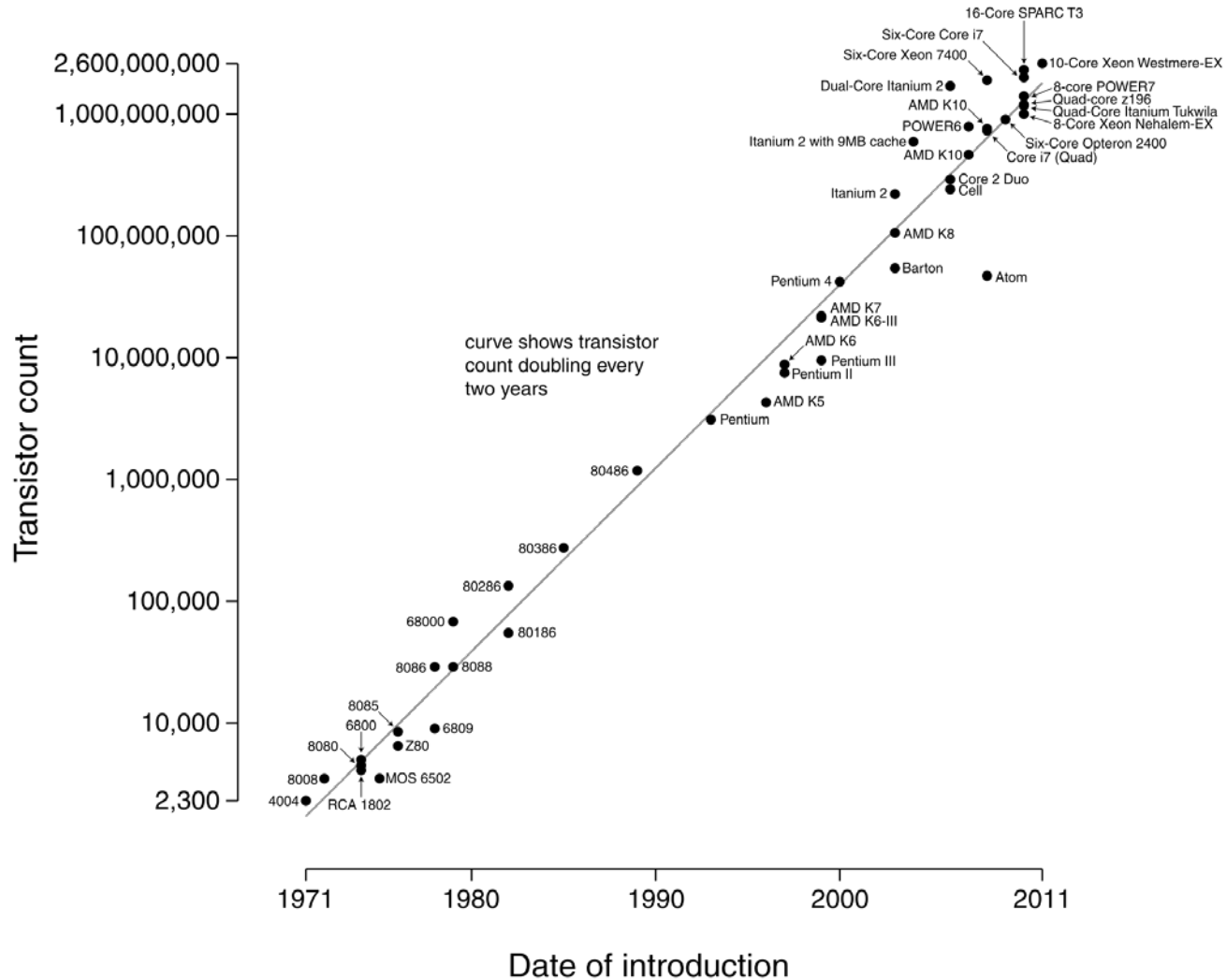
MOST E-MAILED RECOMMENDED FOR YOU

HOW?

MOORES LAW

Microprocessor Transistor Counts 1971-2011 & Moore's Law

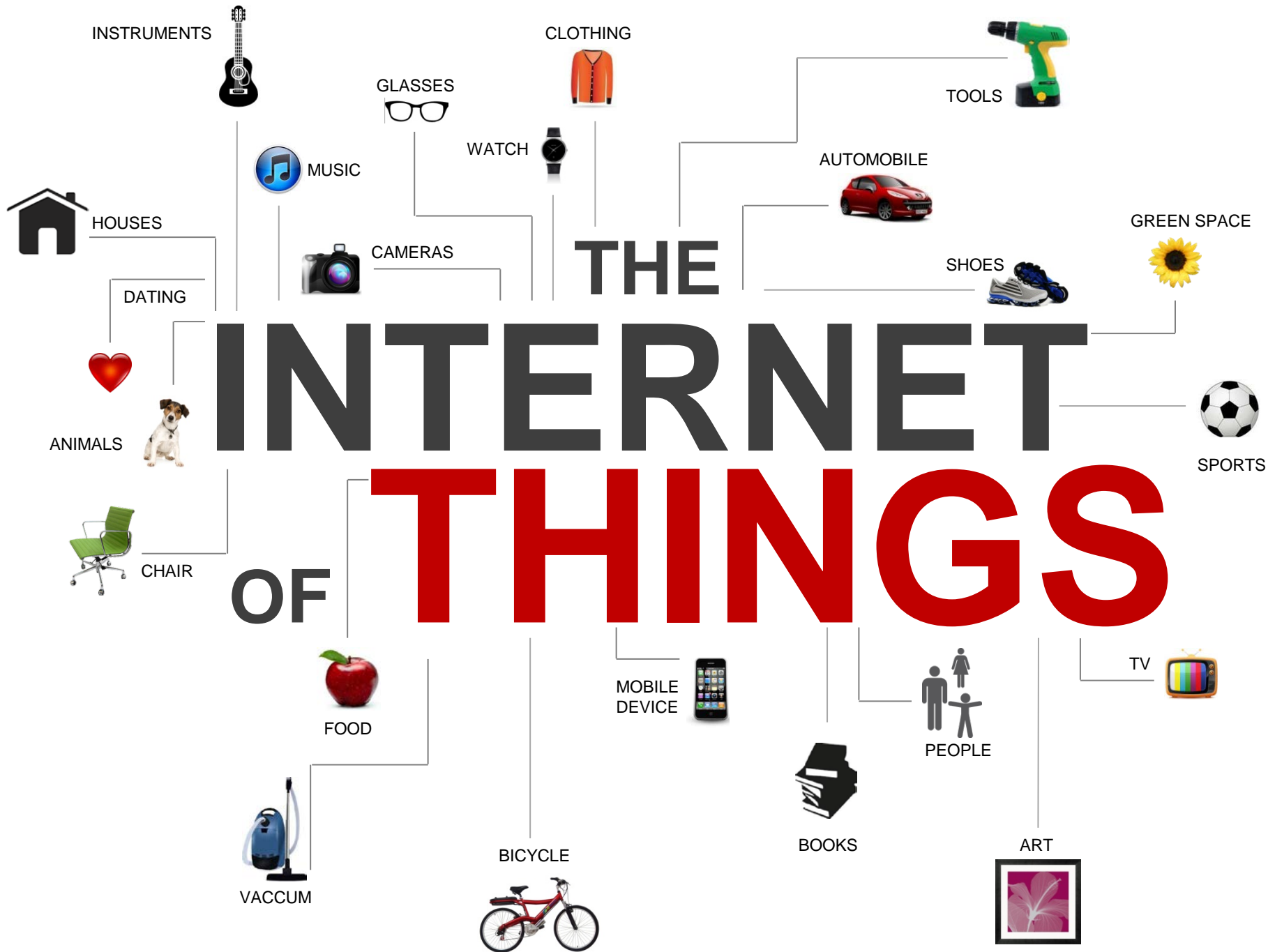
(Logarithmic Vertical Scale)



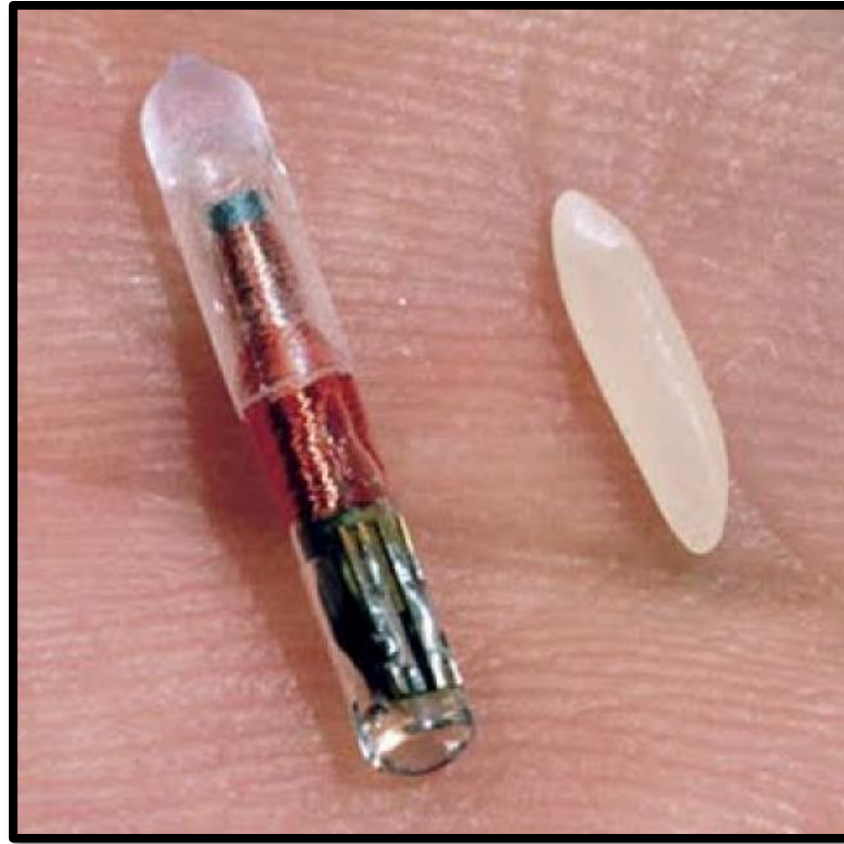
Facebook is founded in February 2004



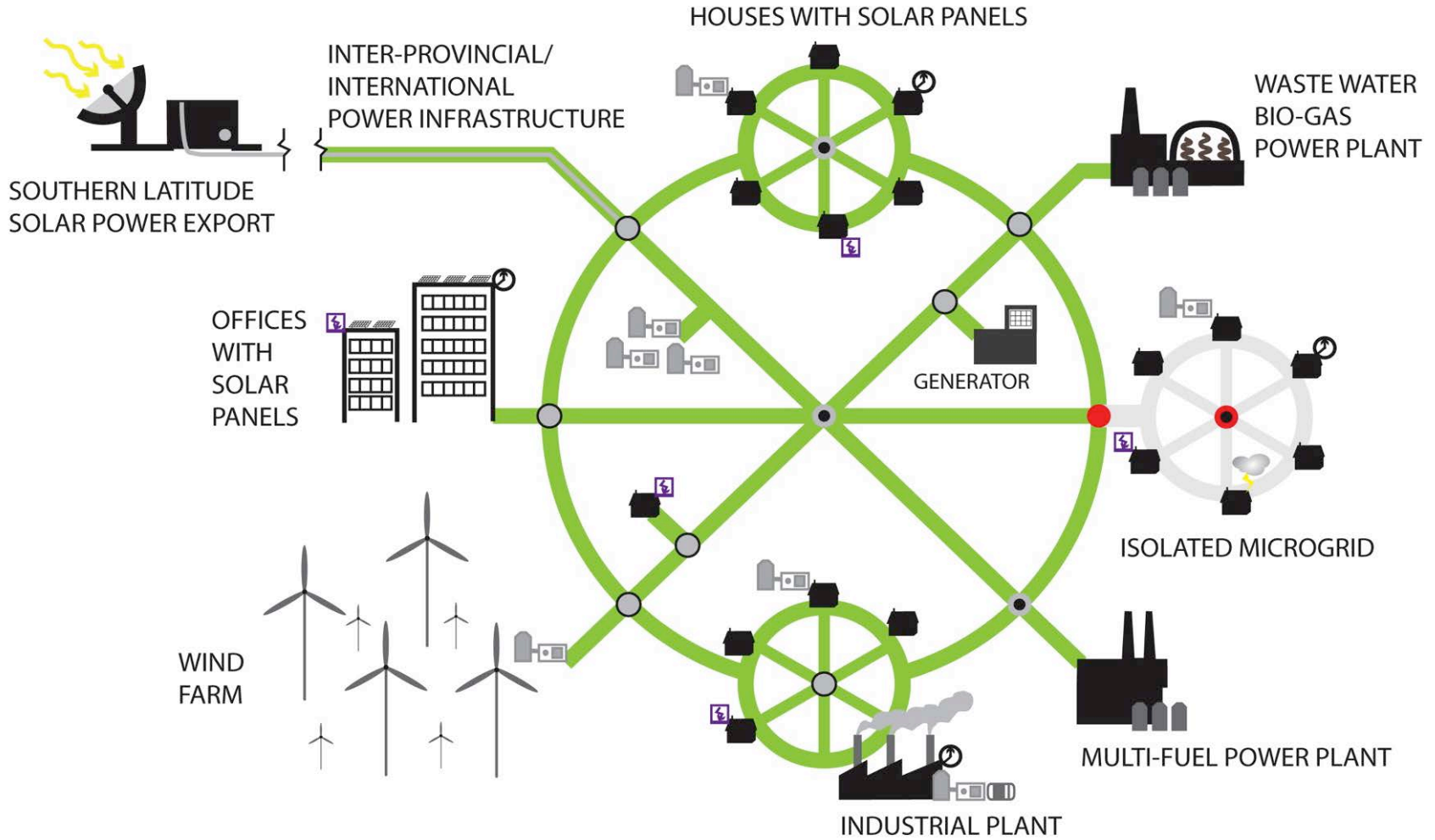
Facebook now has 800 million subscribers!



RFID!



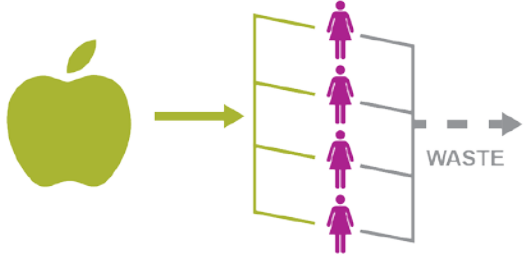
[Radio Frequency Identification Devices]



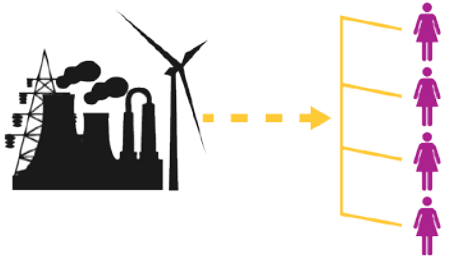
- PROCESSORS
- SENSORS ON 'STANDBY'
- SENSORS ACTIVATED
- ☑ SMART APPLIANCES
- ⌚ DEMAND MANAGEMENT
- 🔋 GENERATORS
- 📦 STORAGE
- ⚡ ELECTRICAL DISRUPTION

**CENTRALIZED
PRODUCTION
MODEL**

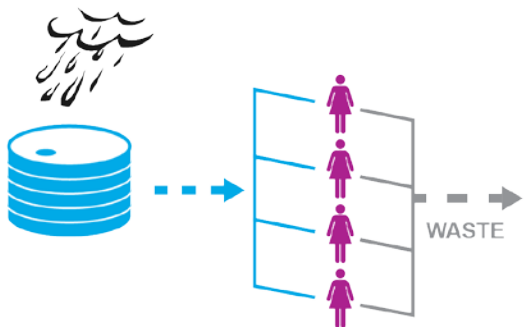
FOOD



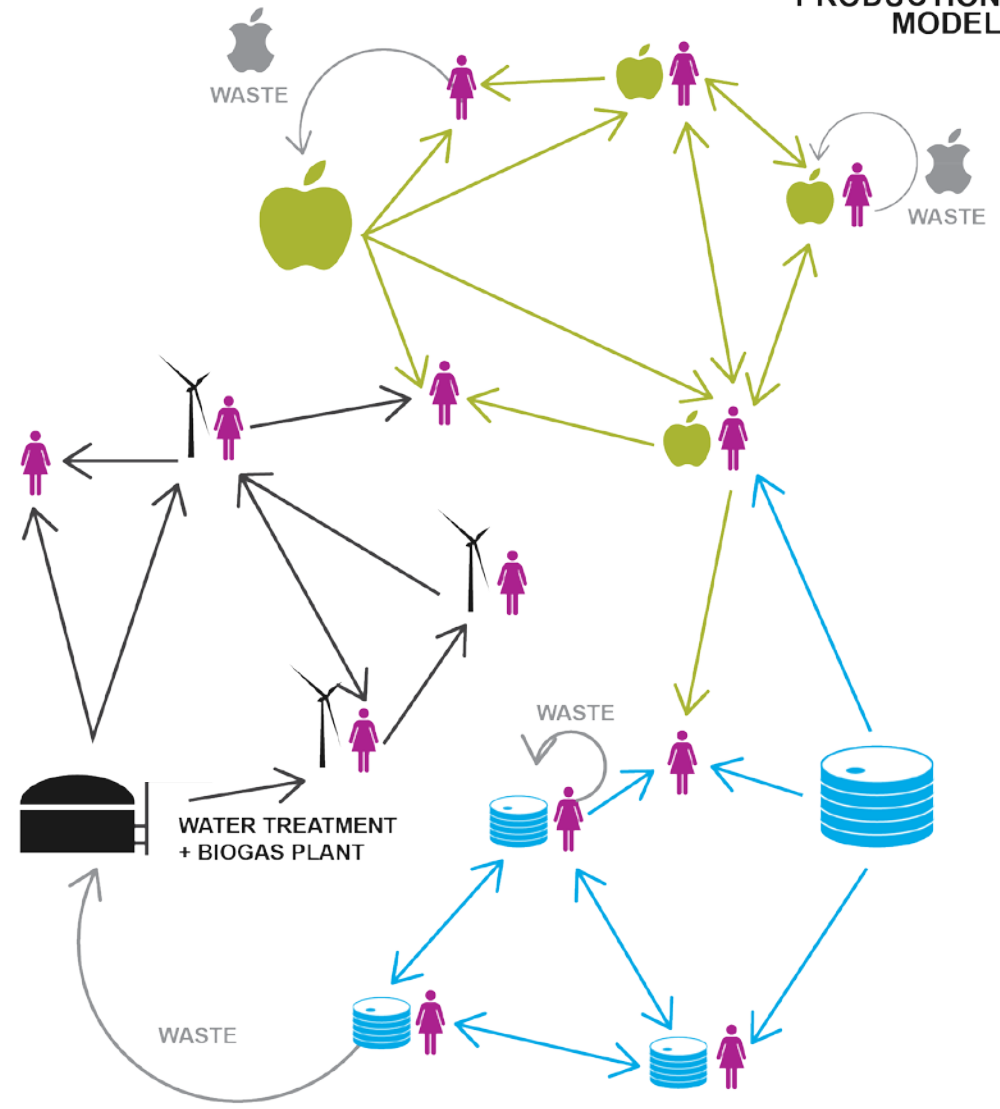
ENERGY



WATER

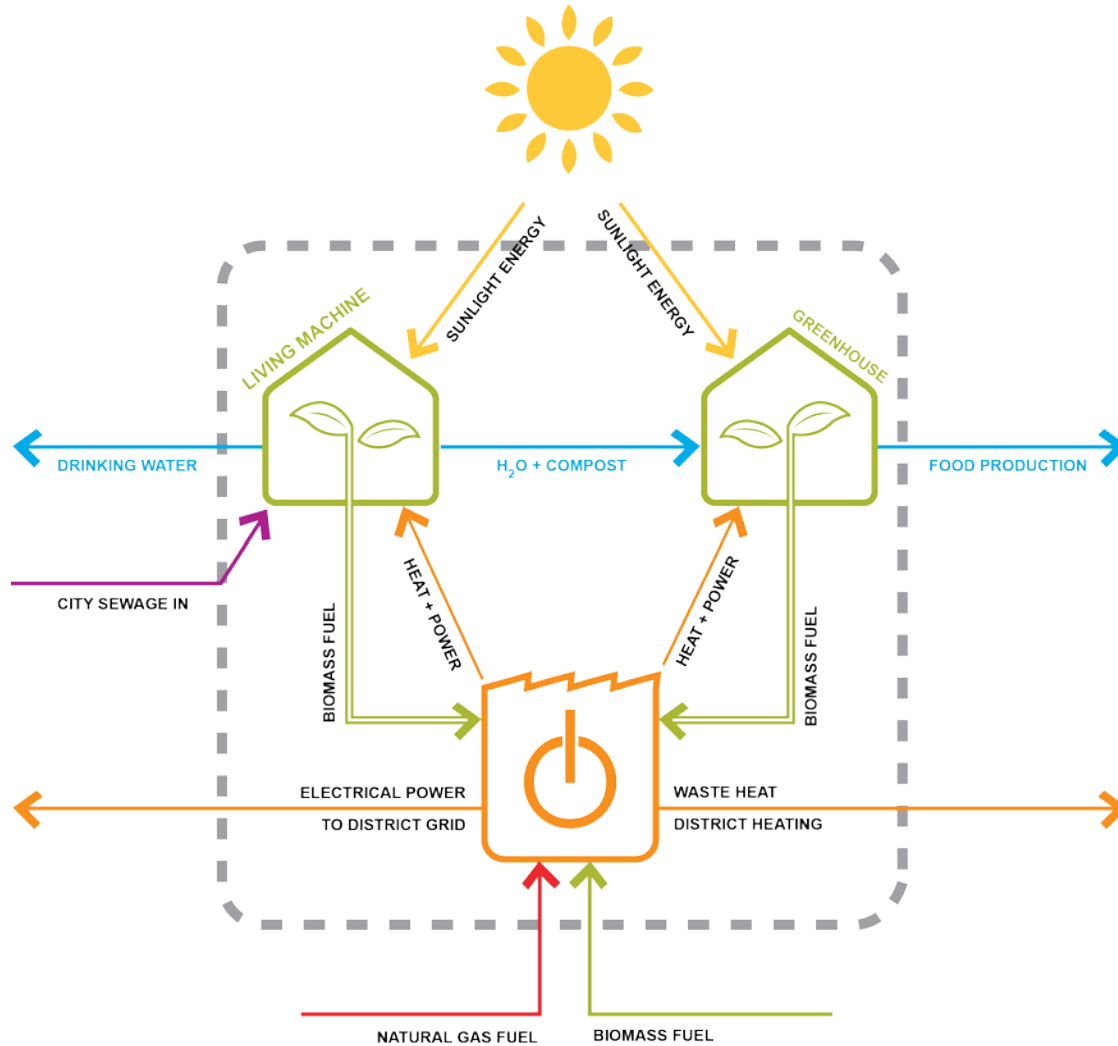


**INTEGRATED/
DISTRIBUTED
PRODUCTION
MODEL**



MODULAR GENERATION / FOOD / WASTE PROCESSING

CREDIT: DIALOG





**INFRASTRUCTURE &
BUILDING FABRIC**

“HARDENING”

WHY?

**SO WHAT HAPPENS
WHEN THIS...**



OR THIS...



HITS THIS . . .



OR THIS...



YOU GET THIS...



New Orleans after Hurricane Katrina

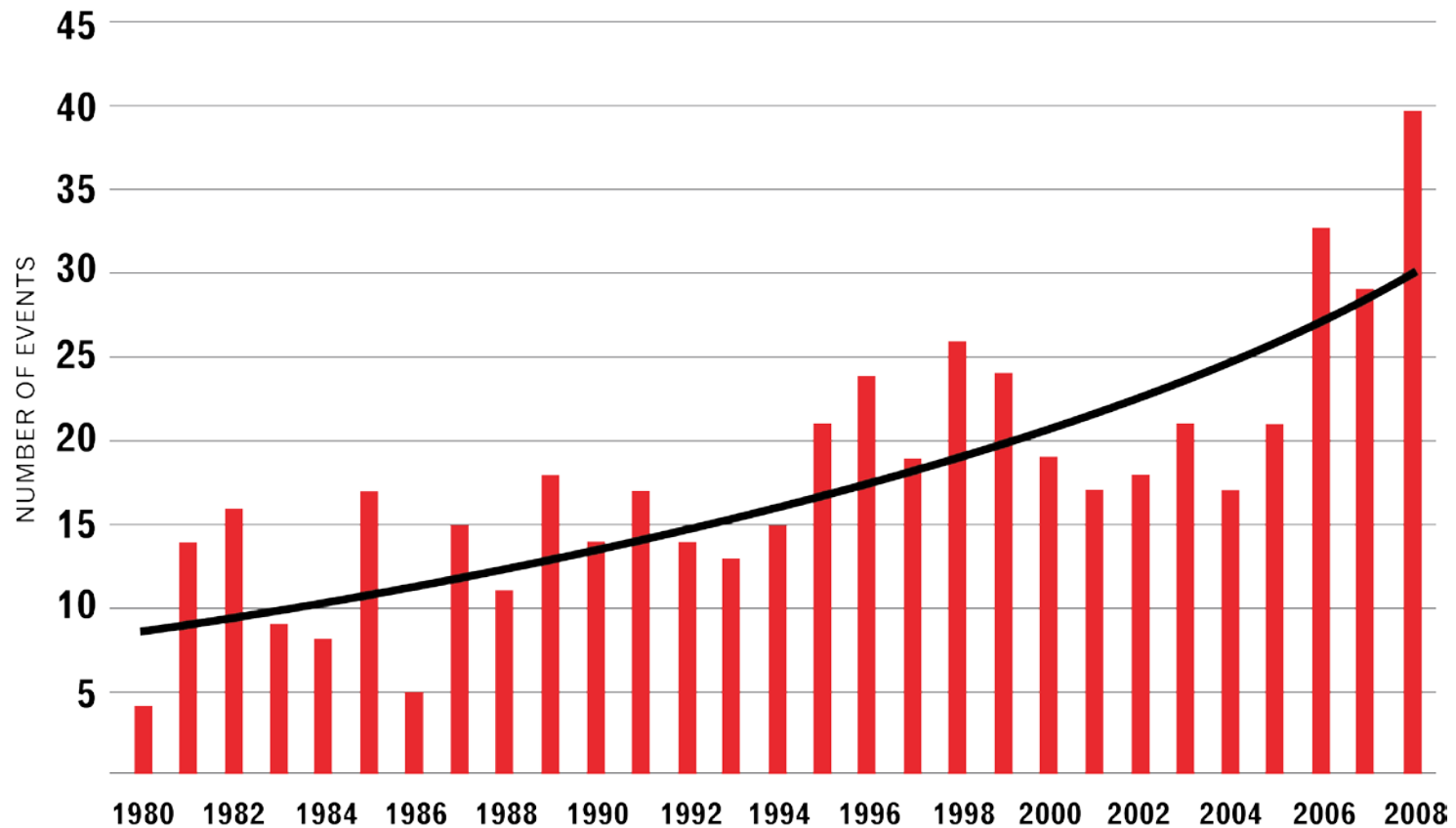
AND THIS...



SEVERE WEATHER EVENTS

SOURCE: WORLDWATCH INSTITUTE (MUNICH RE)

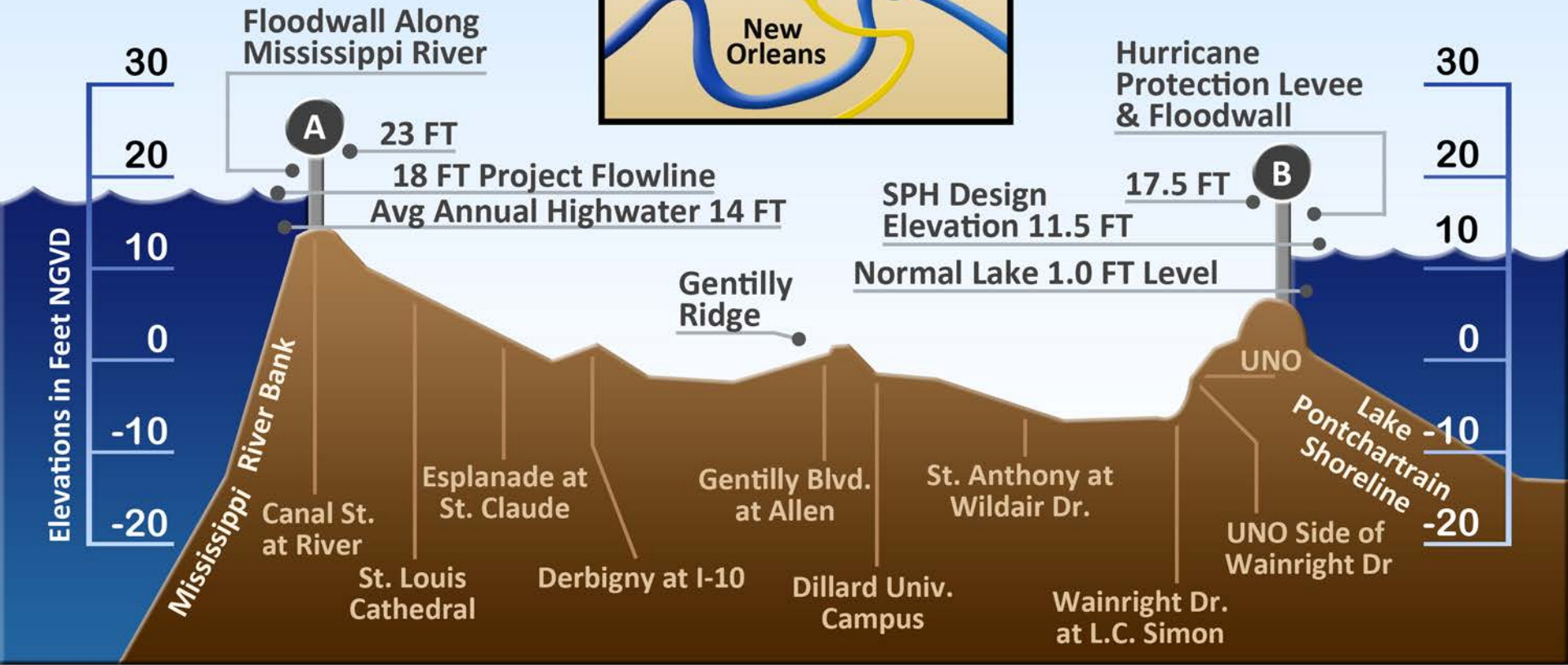
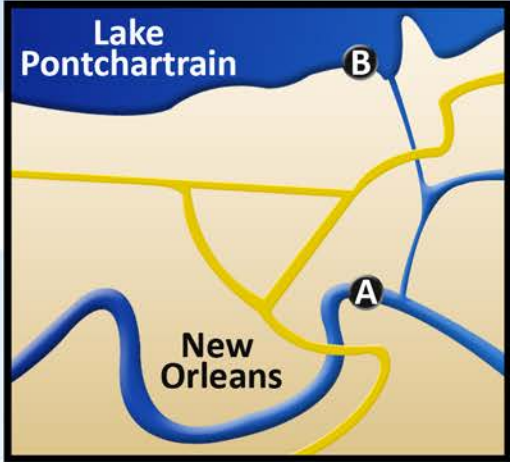
Figure 1. Number of Devastating Natural Disasters (Category 5), 1980-2008



HOW?

INFRASTRUCTURE HARDENING

New Orleans Area Map



City of New Orleans Ground Elevations

From Canal St. at the Mississippi River to the Lakefront at U.N.O.

LESSONS FROM THE PAST



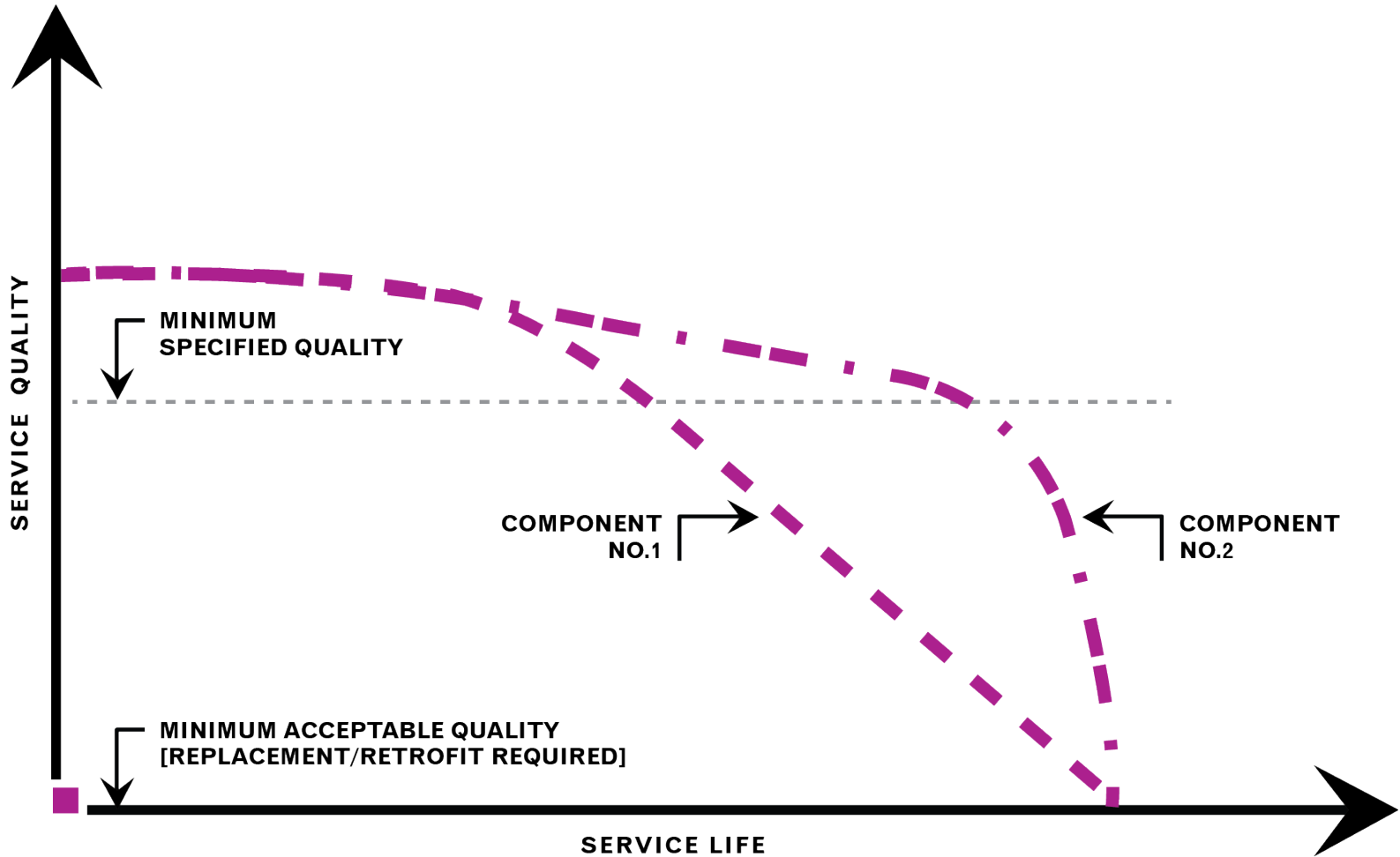
INTEGRATED DURABILITY

SOURCE: DIALOG



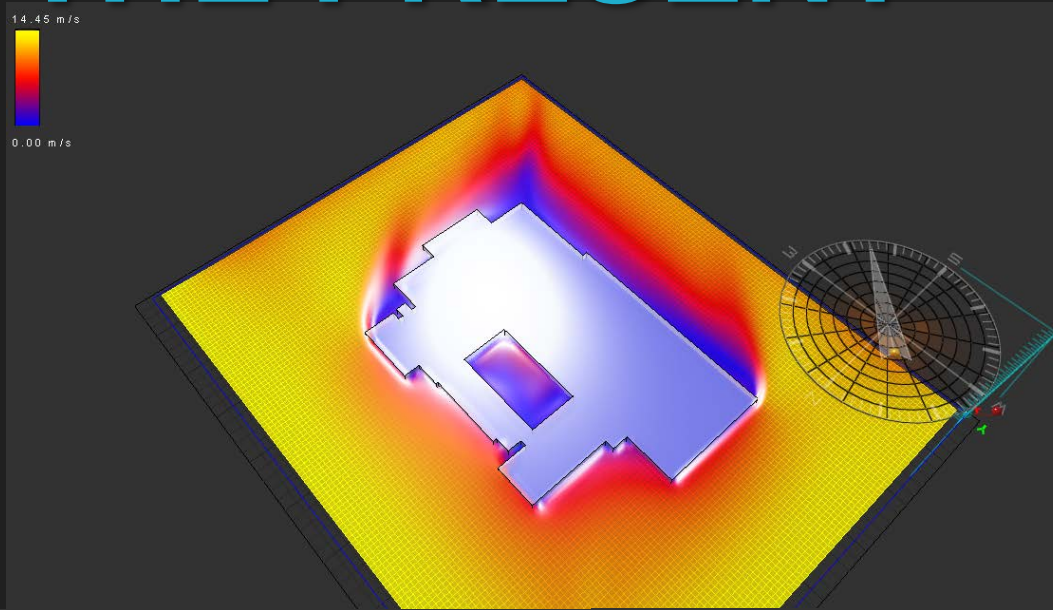
INTEGRATED DURABILITY

SOURCE: TED KESIK

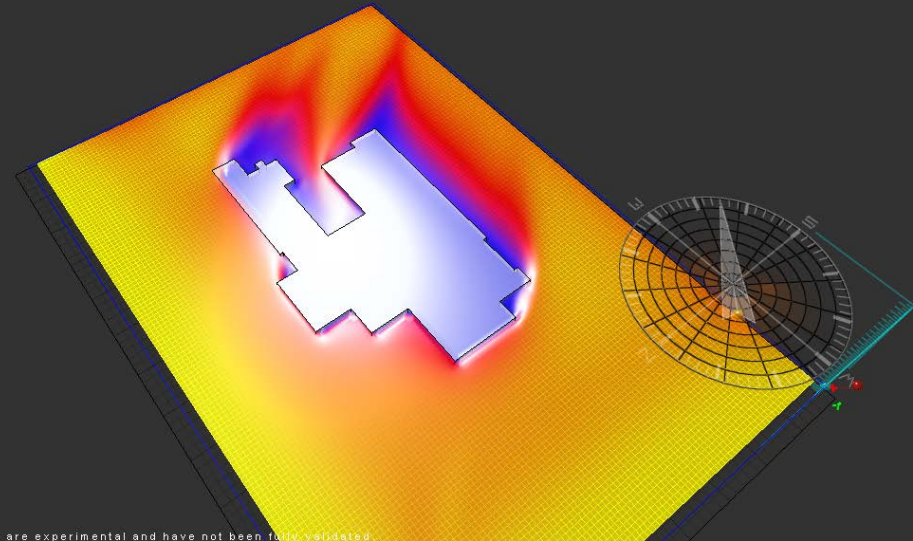
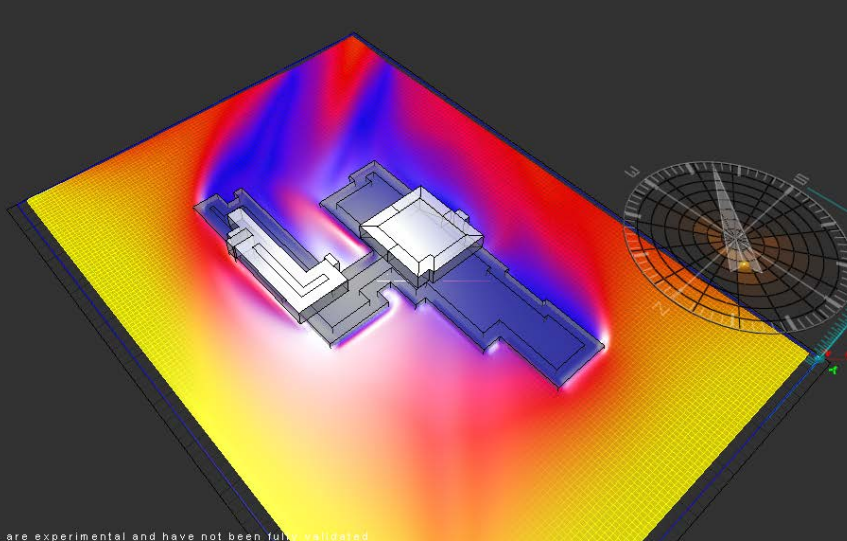


$$\text{SERVICE QUALITY} \times \text{SERVICE LIFE} = \text{DURABILITY}$$

LESSONS FROM THE PRESENT



14.91 m/s
0.00 m/s

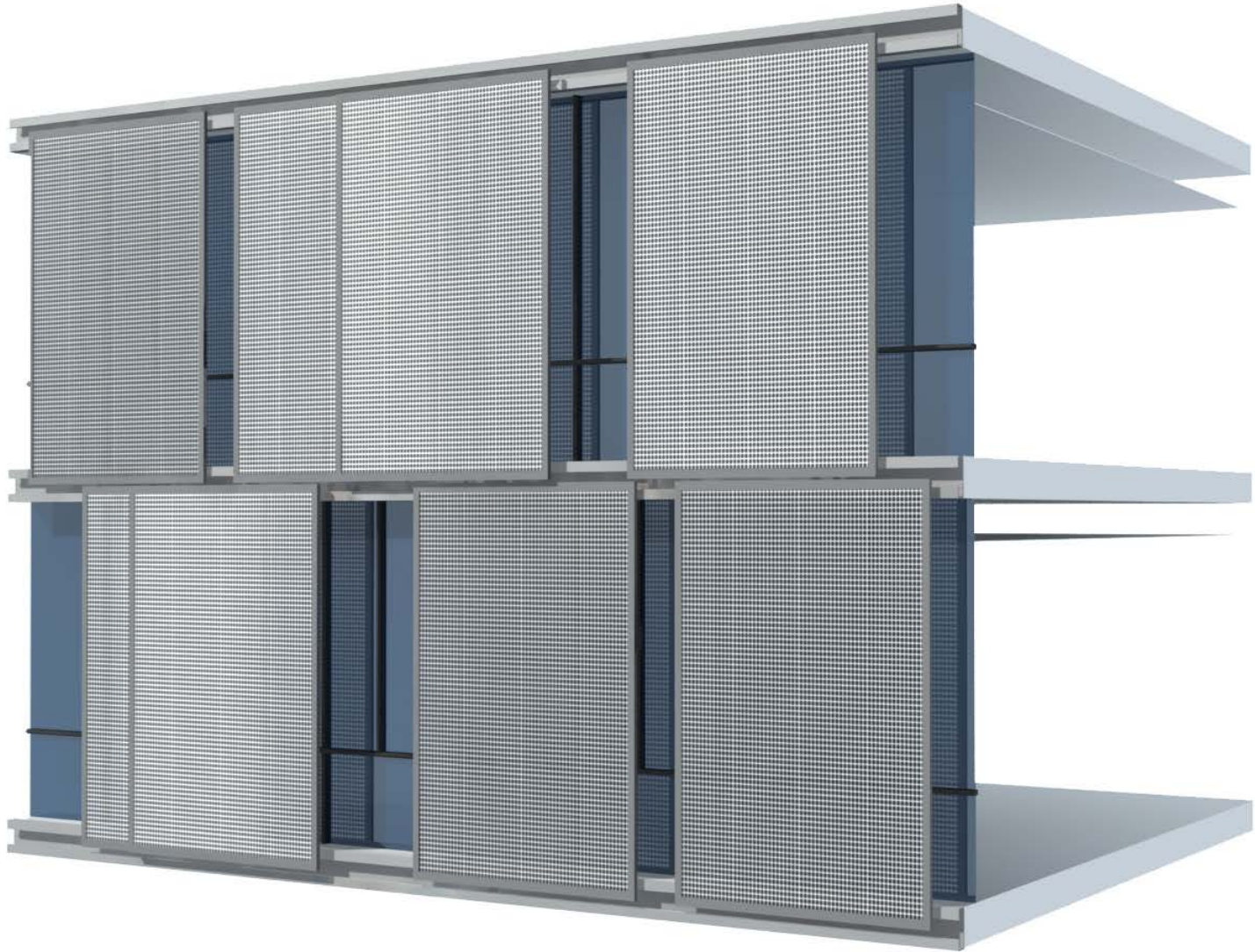


Note: These results are experimental and have not been fully validated.

s are experimental and have not been fully validated.

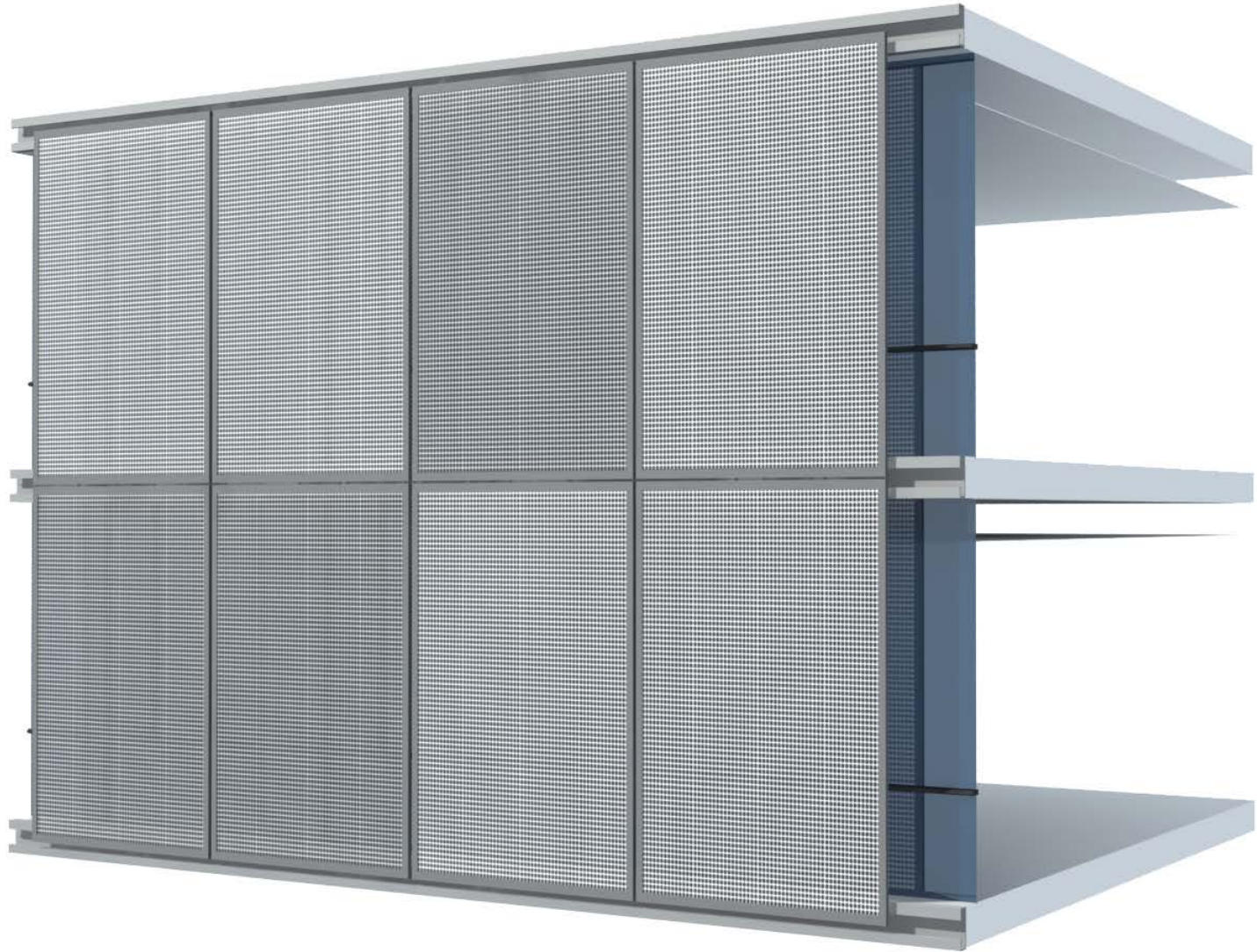
WEATHER PROTECTION

SOURCE: DIALOG



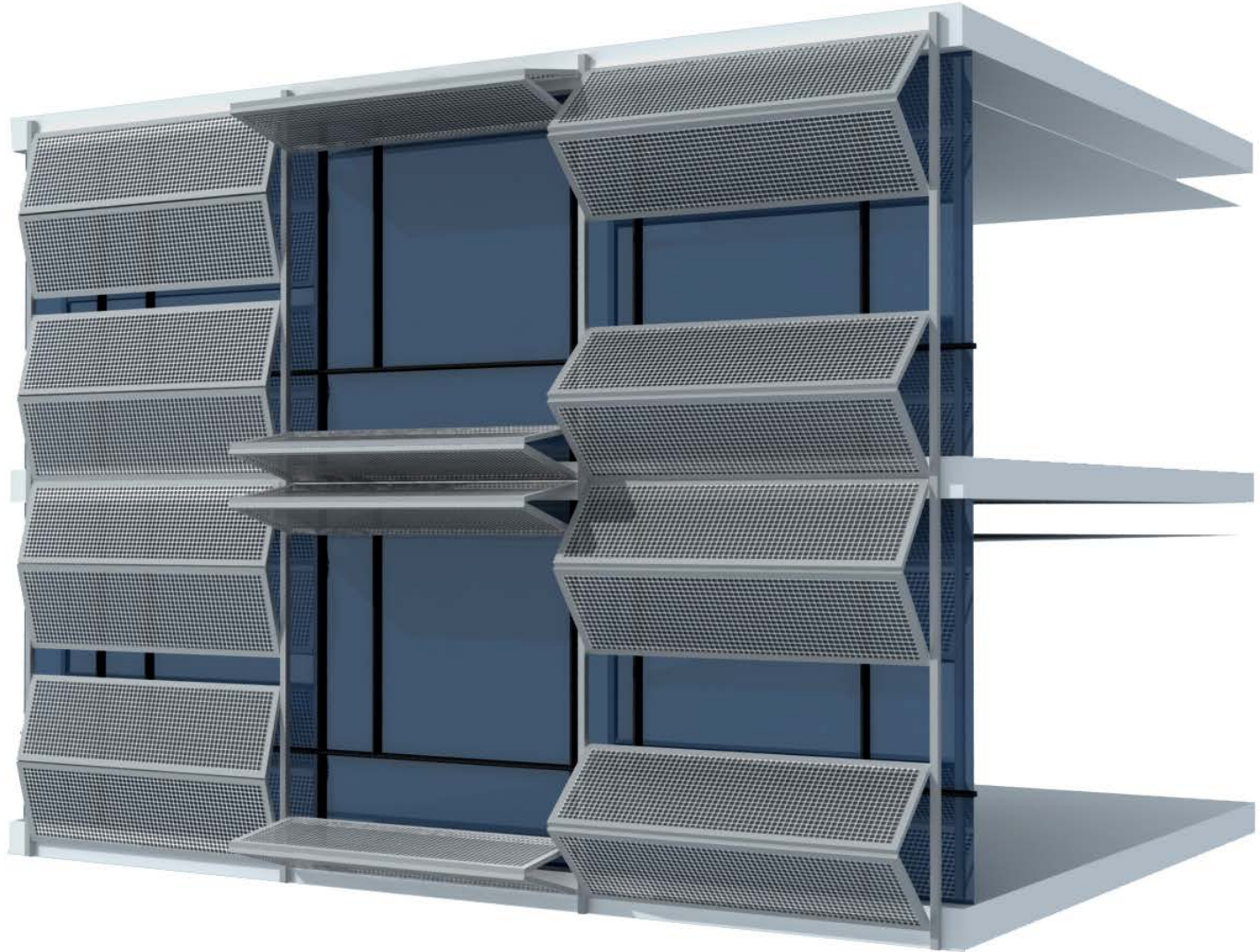
WEATHER PROTECTION

SOURCE: DIALOG



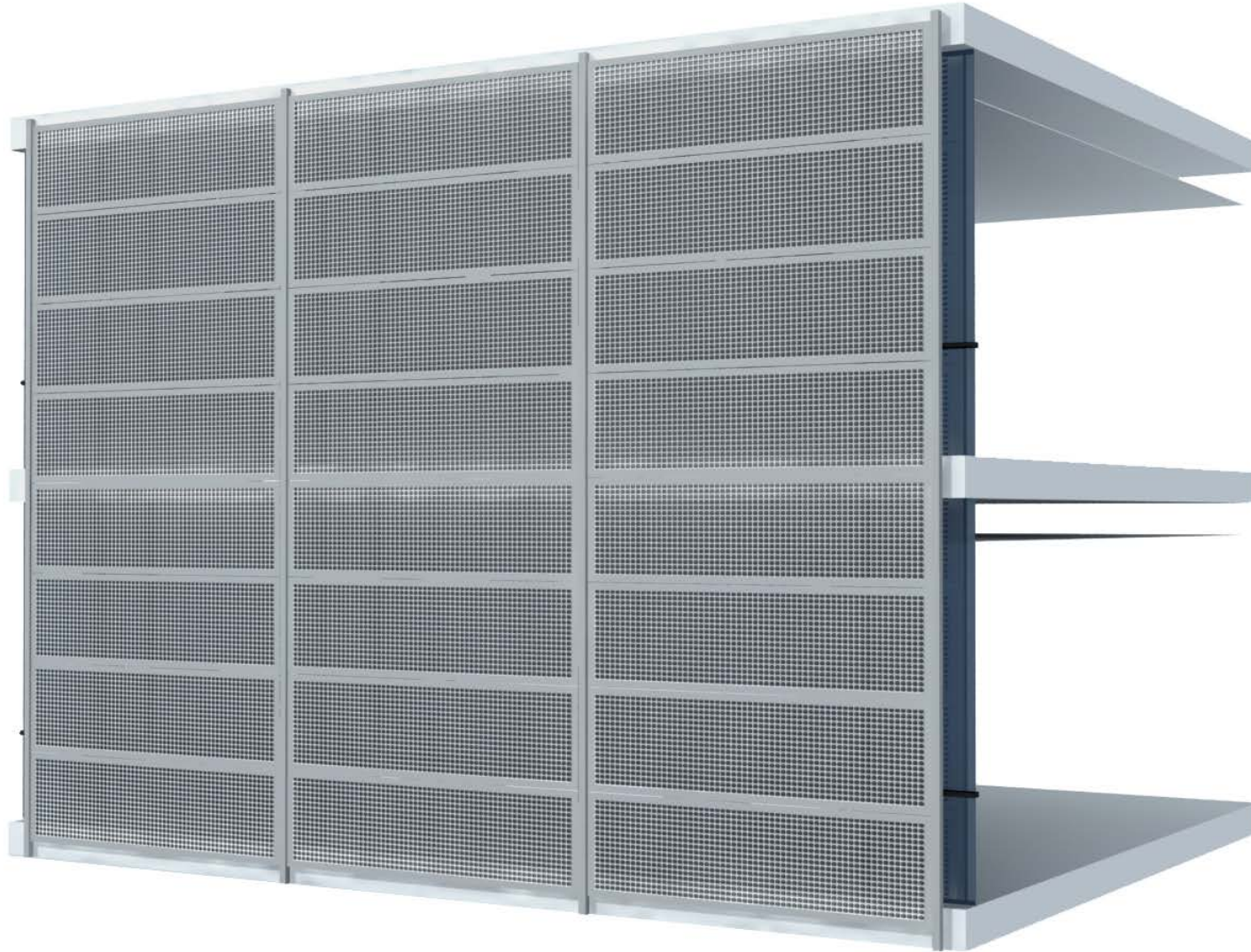
WEATHER PROTECTION

SOURCE: DIALOG



WEATHER PROTECTION

SOURCE: DIALOG



SUMMARY

OPPORTUNITIES FOR BUILDING RESILIENCE

- 1. PUBLIC HEALTH**
- 2. EDUCATION & TRAINING**
- 3. GOVERNANCE**
- 4. ECONOMY**
- 5. JUSTICE / PUBLIC ORDER / SECURITY**
- 6. BUILDING FABRIC & TRANSPORTATION**
- 7. ENERGY INFRASTRUCTURE**
- 8. FOOD PRODUCTION INFRASTRUCTURE**
- 9. C.I.T. INFRASTRUCTURE**
- 10. WATER AND WASTE INFRASTRUCTURE**

5 APPROACHES FOR BUILDING **RESILIENCE**

1. INCREASE URBAN SIZE AND DENSITY
2. LOW CARBON ENERGY PRODUCTION
3. LOCAL URBAN FOOD PRODUCTION
4. MODULARIZATION AND INTEGRATION OF C.I.T INFRASTRUCTURE
5. INFRASTRUCTURE AND BUILDING FABRIC HARDENING

“Reality is one of the possibilities I cannot afford to ignore.”

Leonard Cohen

THANK

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YOU!

DIALOGTM

