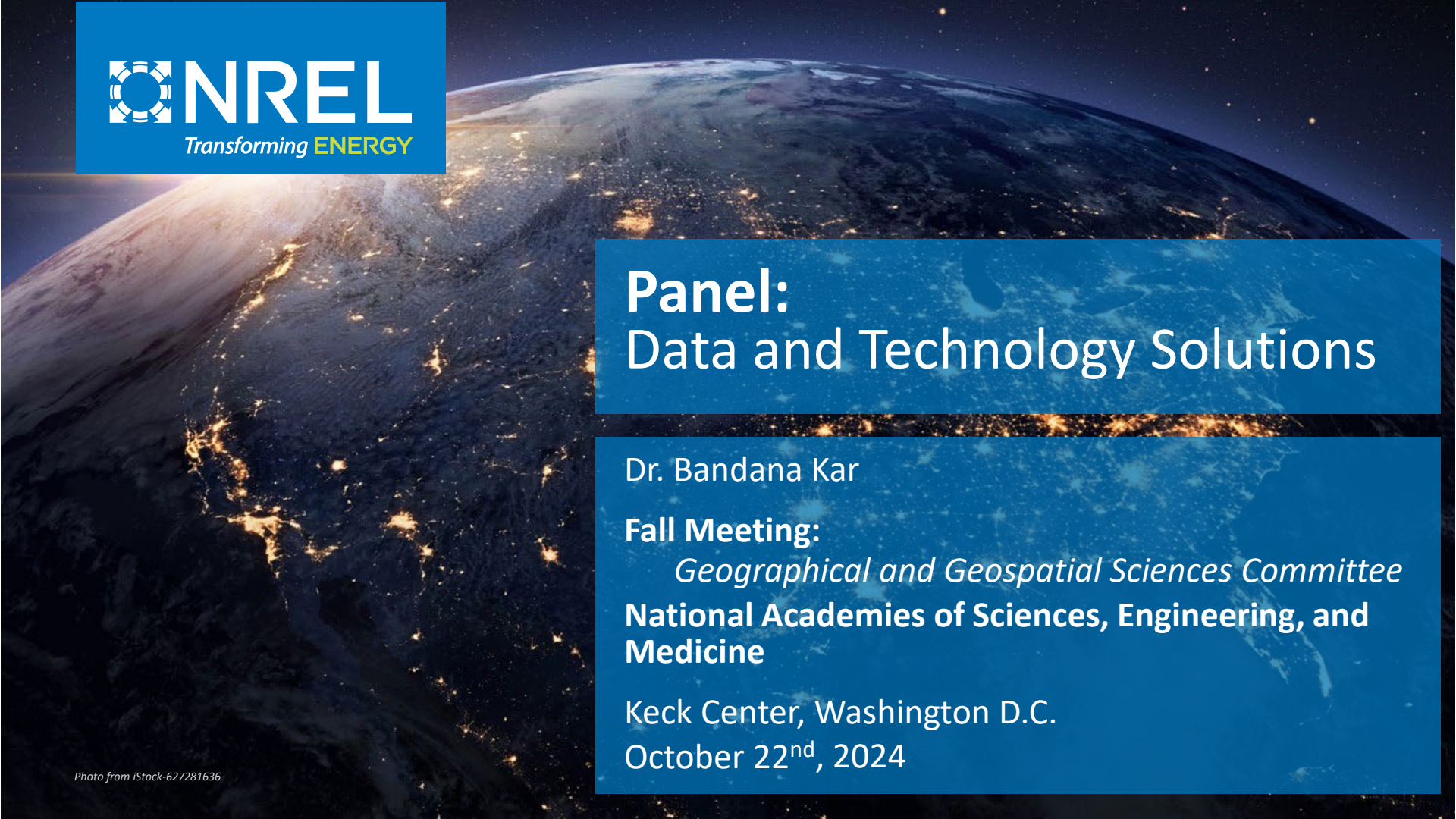


NREL
Transforming ENERGY

Panel:
Data and Technology Solutions

Dr. Bandana Kar

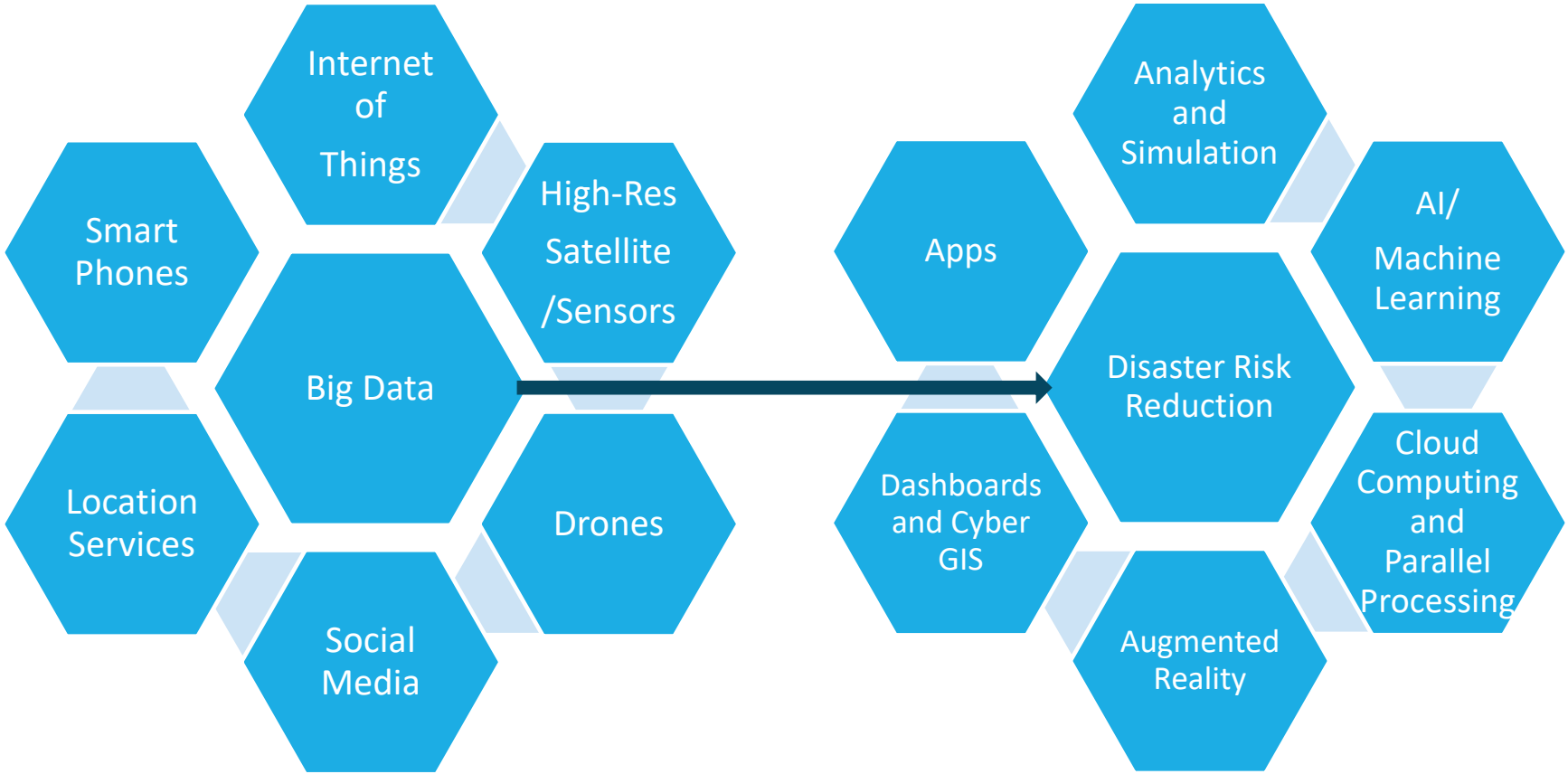
Fall Meeting:
Geographical and Geospatial Sciences Committee
National Academies of Sciences, Engineering, and Medicine

Keck Center, Washington D.C.
October 22nd, 2024

Photo from iStock-627281636

STATE OF SCIENCE, TECHNOLOGY AND INNOVATION – INDUSTRIAL REVOLUTION 4.0

IMPROVING THE SPEED OF LINKING INFORMATION TO RESPONSE

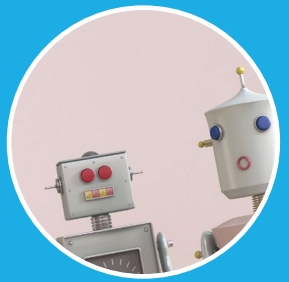


INDUSTRIAL REVOLUTION 5.0

EMPOWERING SOCIETY THROUGH CONVERGENCE OF TECHNOLOGIES

Digital Twin

Generative AI



Advanced Robotics/Bots

More Tools or A New Approach

GLOBAL INITIATIVE FOR FLOOD FORECASTING AND ALERTING (GIFT)

MODEL OF MODELS – AN ENSEMBLE MODEL

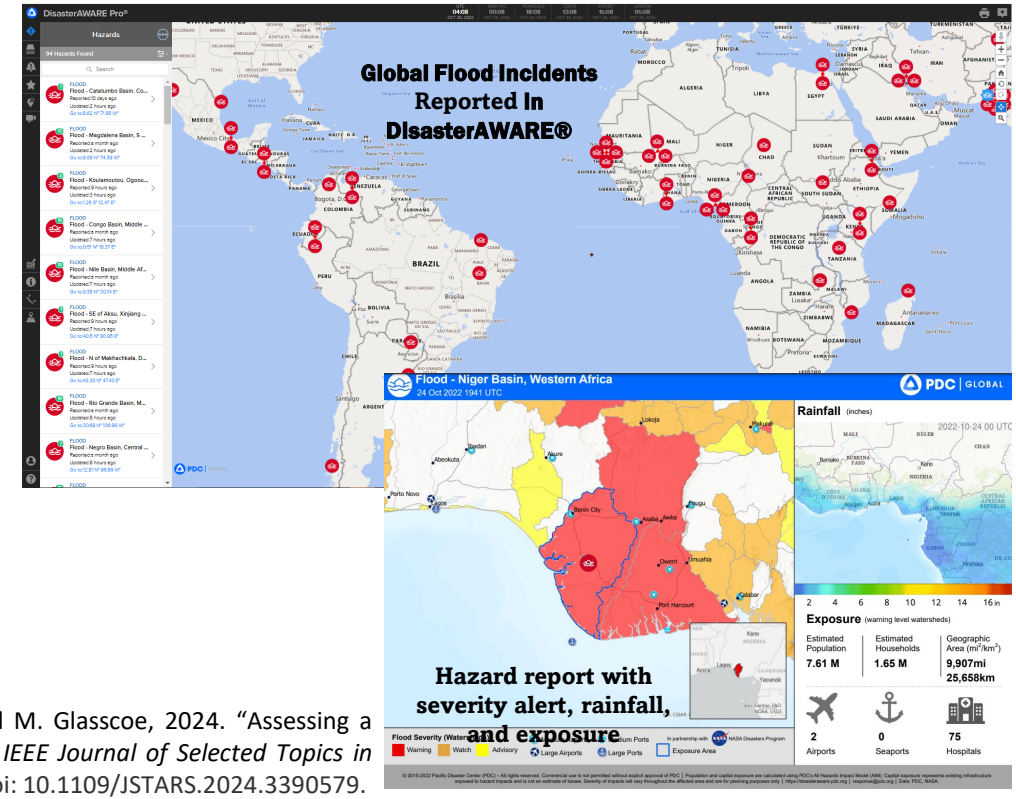
Funded by: ***NASA Disasters Program***

Project Goal

- *Model of Models (MoM) integrates open-source hydrologic model outputs with optical and SAR imagery derived outputs to forecast flood risk daily at sub-watershed level globally.*
- *Disseminate flood alerts and response products to global stakeholders - via PDC's DisasterAWARE®.*

Data and Models

- GloFAS, GFMS, HWRF flood models
- DFO MODIS and VIIRS



B. Kar, G. Schumann, M. Mendoza, D. Bausch, J. Wang, P. Sharma and M. Glasscoe, 2024. "Assessing a Model of Models Approach for Global Flood Forecasting and Alerting." *IEEE Journal of Selected Topics in Applied Earth Observation and Remote Sensing,* vol. 17, pp. 9641-9650, doi: 10.1109/JSTARS.2024.3390579.

MONITORING WIDE AREA POWER OUTAGE USING SATELLITE IMAGERY

Funded by: ***DOE-CESER Office***

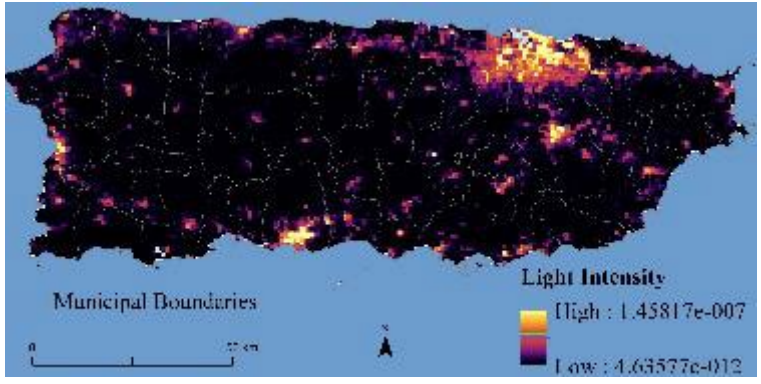
Project Goal

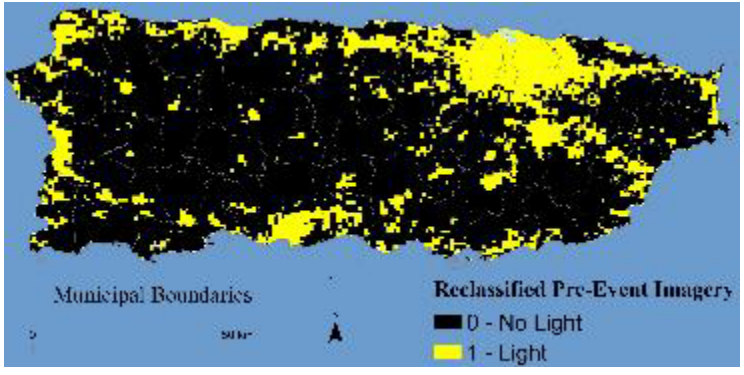
- *Monitor wide area power outage and impacted customers in near real-time.*
- *Integrated into EAGLE-I for situational awareness of DOE and federal agencies.*

Data and Models

- Visible Infrared Imaging Radiometer Suite (VIIRS) Day Night Band (DNB)
- American Community Survey Data
- LandScan (ORNL) Population Layer

Environment for Analysis of Geo-Located Energy Information (EAGLE-I)





SITUATIONAL-TEMPORAL AWARENESS TOOL FOR INTEGRATED OIL AND NATURAL GAS SYSTEMS (STATIONS)

Funded by: ***DOE-CESER Office***

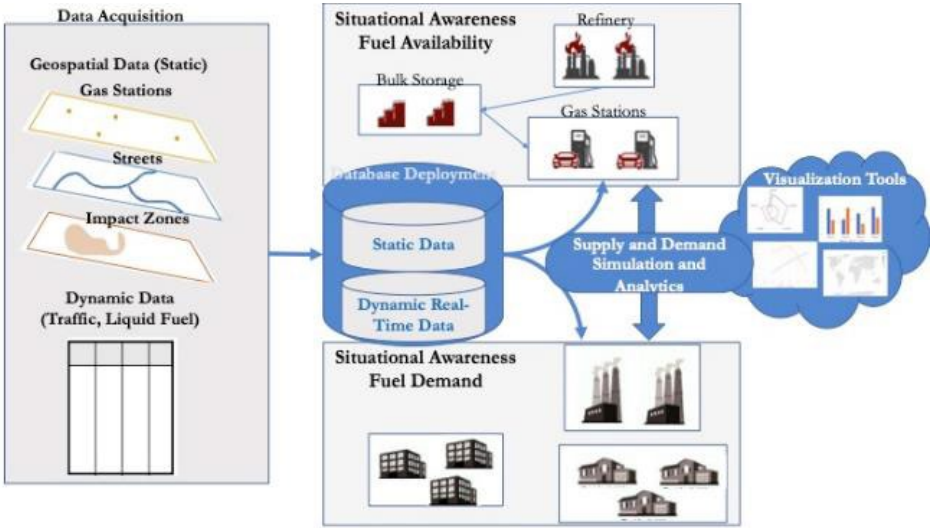
Project Goal: Provide situational awareness about liquid fuel availability and demand across the ONG Supply chain.

Objectives:

- *Prioritize locational deliveries for liquid fuel during extreme events*
- *Coordinate asset response among first responders*

Data:

- Gas station location, tank capacity, # of pumping stations
- Rack facilities
- Road network, Evacuation zone(s)
- Population distribution
- Near real-time hazard information



B. Kar, J. Brewer, O. A. Omitaomu, A. Iyengar, N. Roberts, and R. Hoesly. 2021. "Accessibility and Availability of Gas Stations for Liquid Fuel Supply During Severe Weather Events", In *Proceedings of the 2021 IISE Annual Conference.*

LIMITATIONS AND CHALLENGES OF THE PROJECTS

NASA/MOM

Data Format
- Varying spatial and temporal resolutions

Data Access & Coverage
- Public vs proprietary
- Global vs Regional

Event Types
- Coastal and riverine flooding vs
- Urban and glacial flooding

WAO/DOE-CESER

Data Type/Format
- Varying resolutions

Data Availability
- Real time vs daily vs annually

Model Usability
- Resource planning vs decision making

STATIONS/DOE-CESER

Data Type/Format
- Varying resolutions

Data Access/Coverage
- Public vs proprietary
- Real time vs hourly vs daily

Model Usability
- Resource planning vs decision making
- Continuous updating

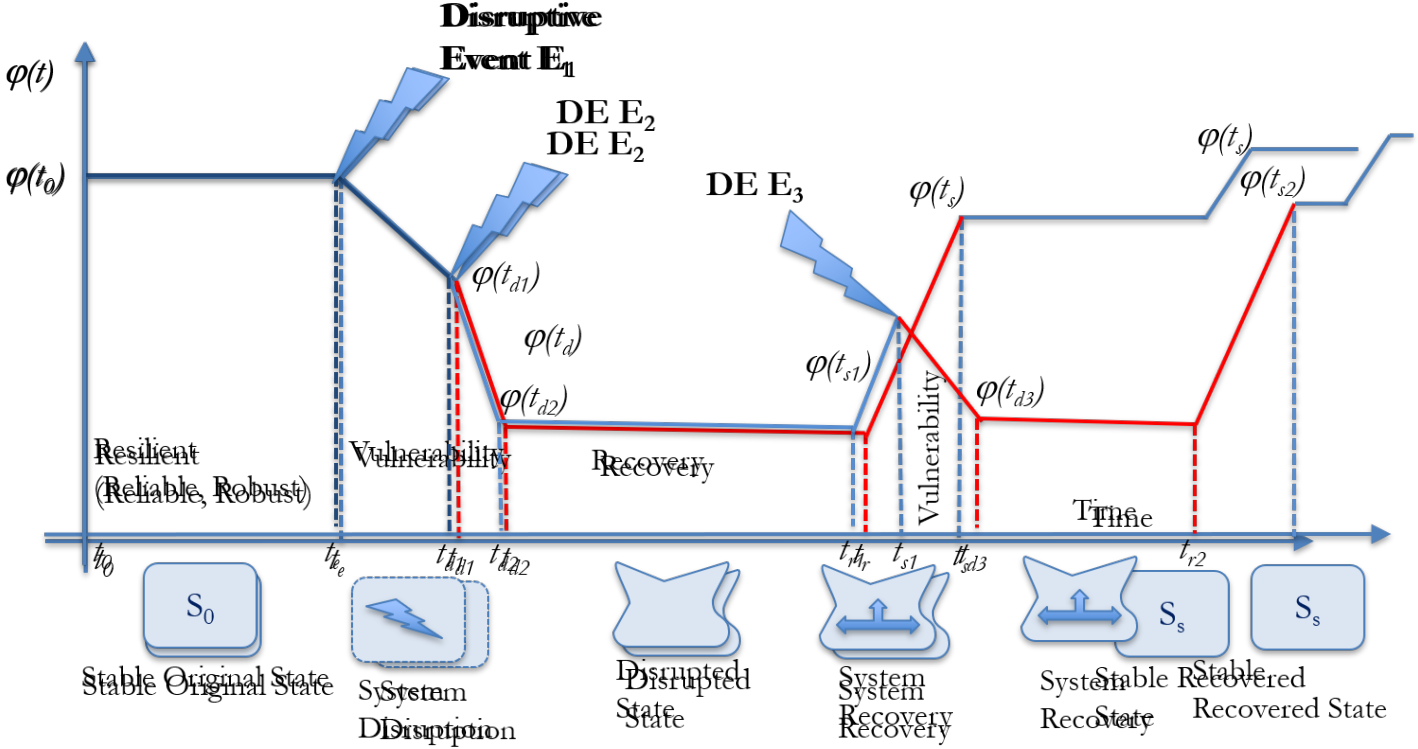
Continuing Challenges

MULTI-HAZARD APPROACH

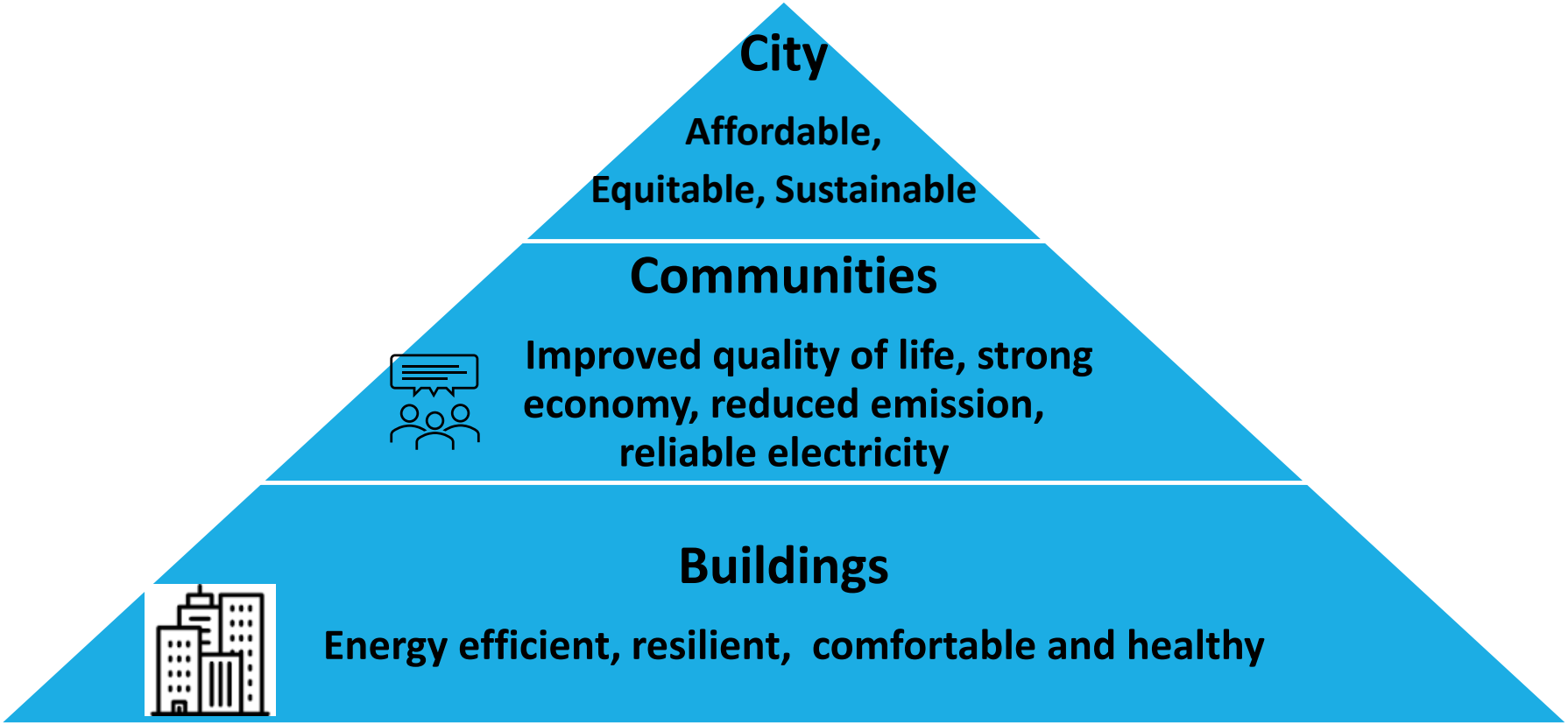
SEQUENTIAL / COMPOUNDING EXTREME EVENTS

Energy Infrastructure System Resilience (R) = $\int \varphi(t_d), \varphi(t_s)$

Recovery time t_s - $_{sd}$ = f(spatial location of upstream and downstream components, restoration of power flow)



MULTI-SCALAR APPROACH



CREATING PATHWAYS FROM DATA TO ACTION

Decision Ready Data	• Open data and open science • Data interoperability • Cyber security and data privacy
Decision Ready Information	• Transparent and ethical • Accurate and trustworthy • Open access
Action Oriented Outcomes	• Reliable and relevant • People and place based • Public – private partnerships

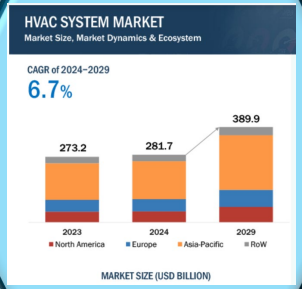
Science

Society

Stakeholder

Technology

Market



Policy

Standards

Workforce

ACKNOWLEDGMENT

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THANK YOU!
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