Climate Change, Sustainability Development and Emerging Technologies: Opportunity or Threat?

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Introduction

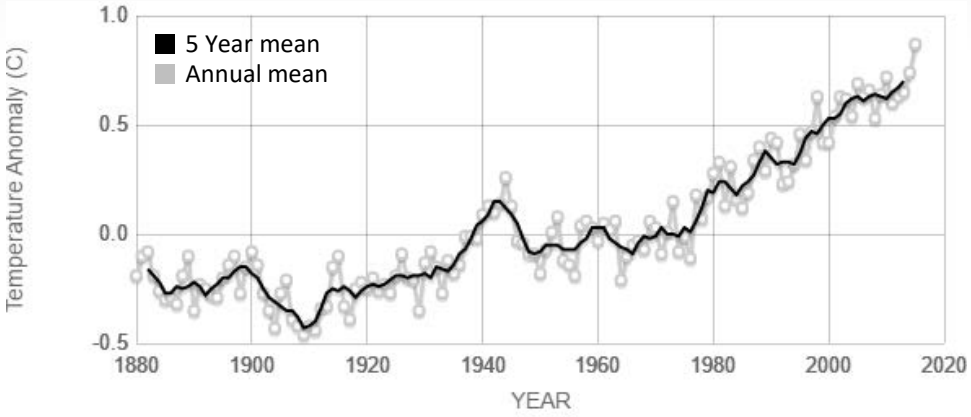
http://www.kyeonggi.com/news/articleView.html?idxno=820881

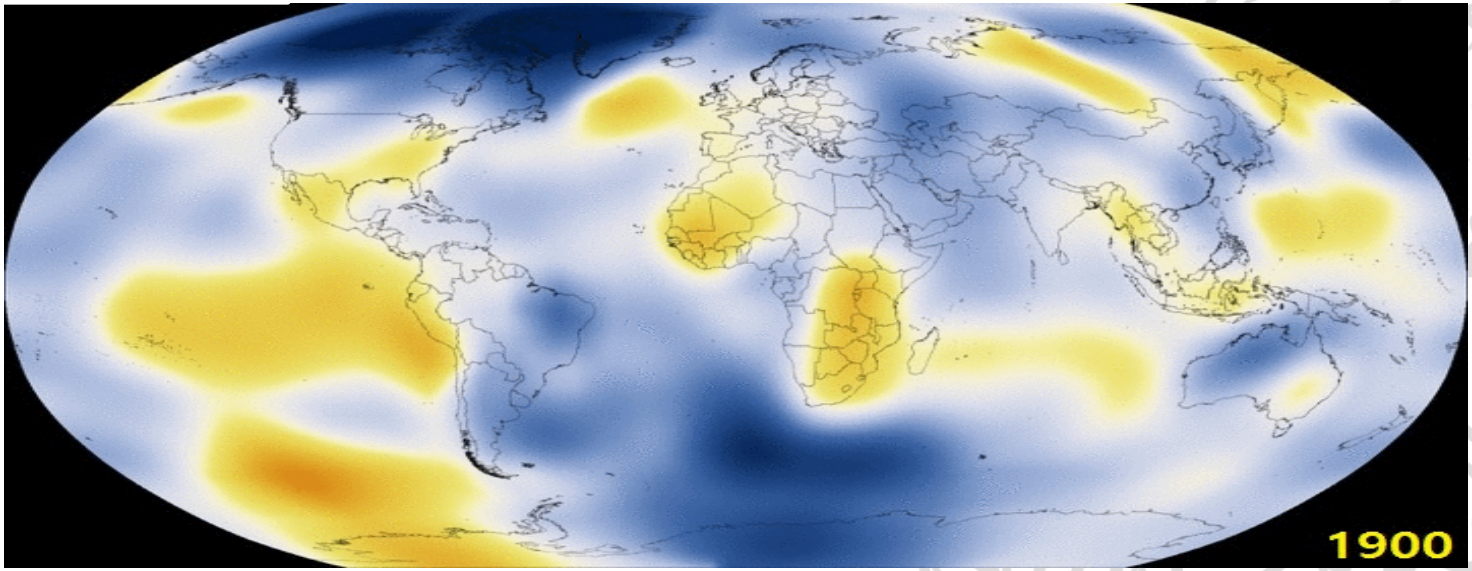
http://www.ksilbo.co.kr/news/articleView.html?idxno=561112

Issues

- Global warming and climate change
- Land use change, GHG emissions/water and trade
  - Carbon (and, perhaps, water) tax that needs to be levied on final demand of trade
  - One of the most serious causes of climate change is known as GHG emissions
  - Carbon dioxide (CO2) is the major cause
- New clean technology and public health
  - Transportation Sector contributes to producing huge CO2
- Economic approaches to measuring these issues
  - Macro/micro models

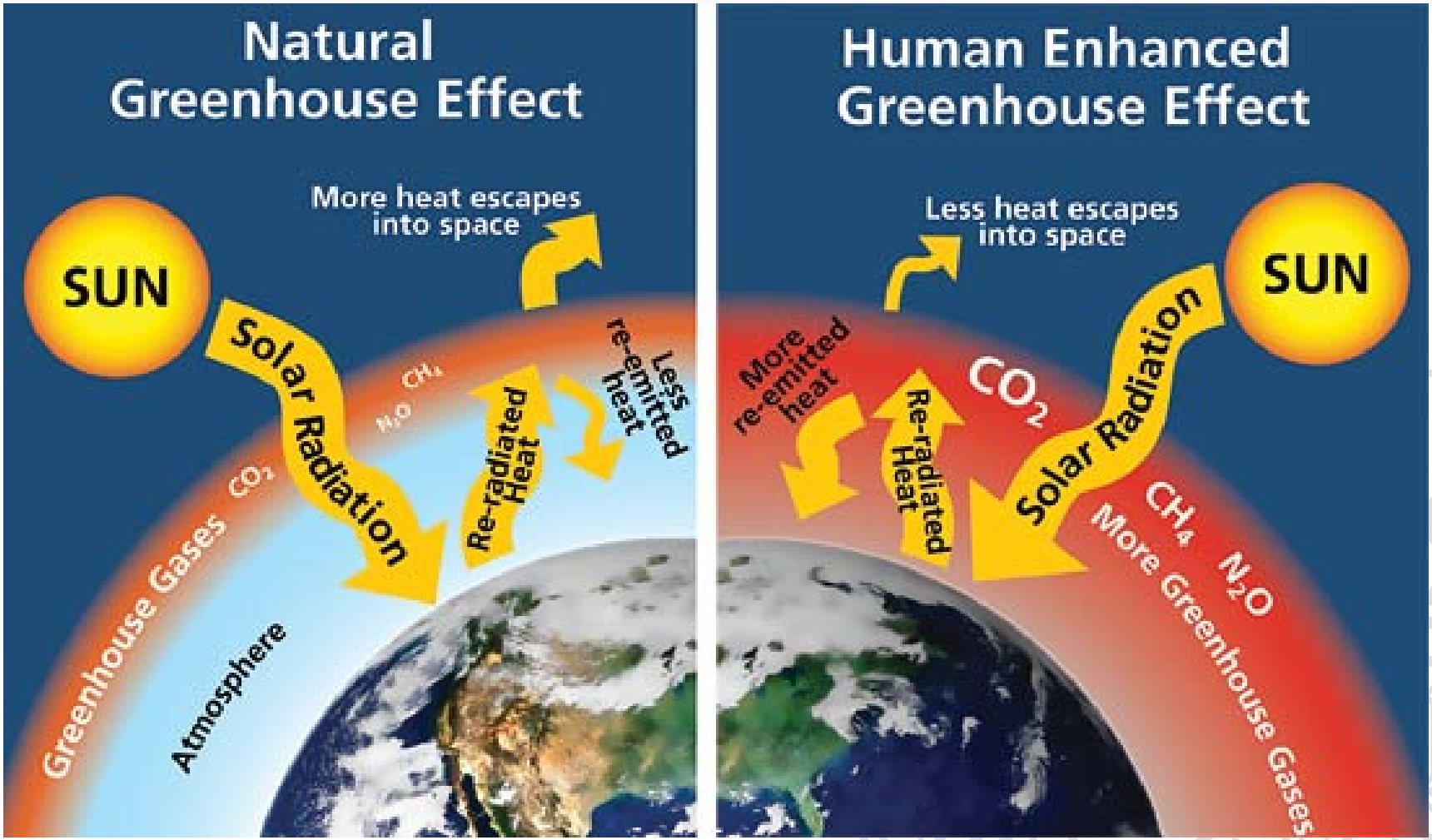
Global Warming





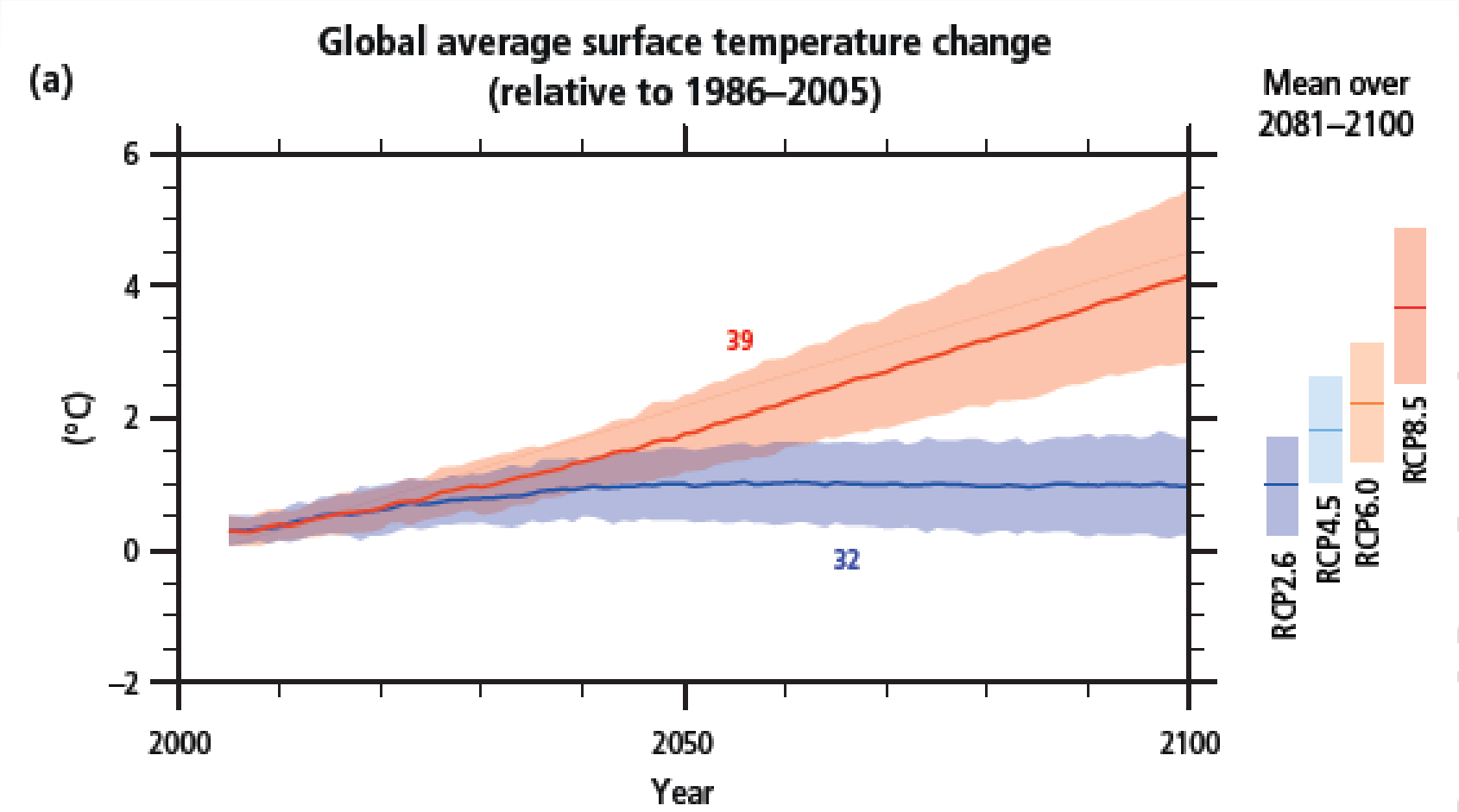
Source: NASA's Goddard Institute for Space Studies

Global Carbon Cycle



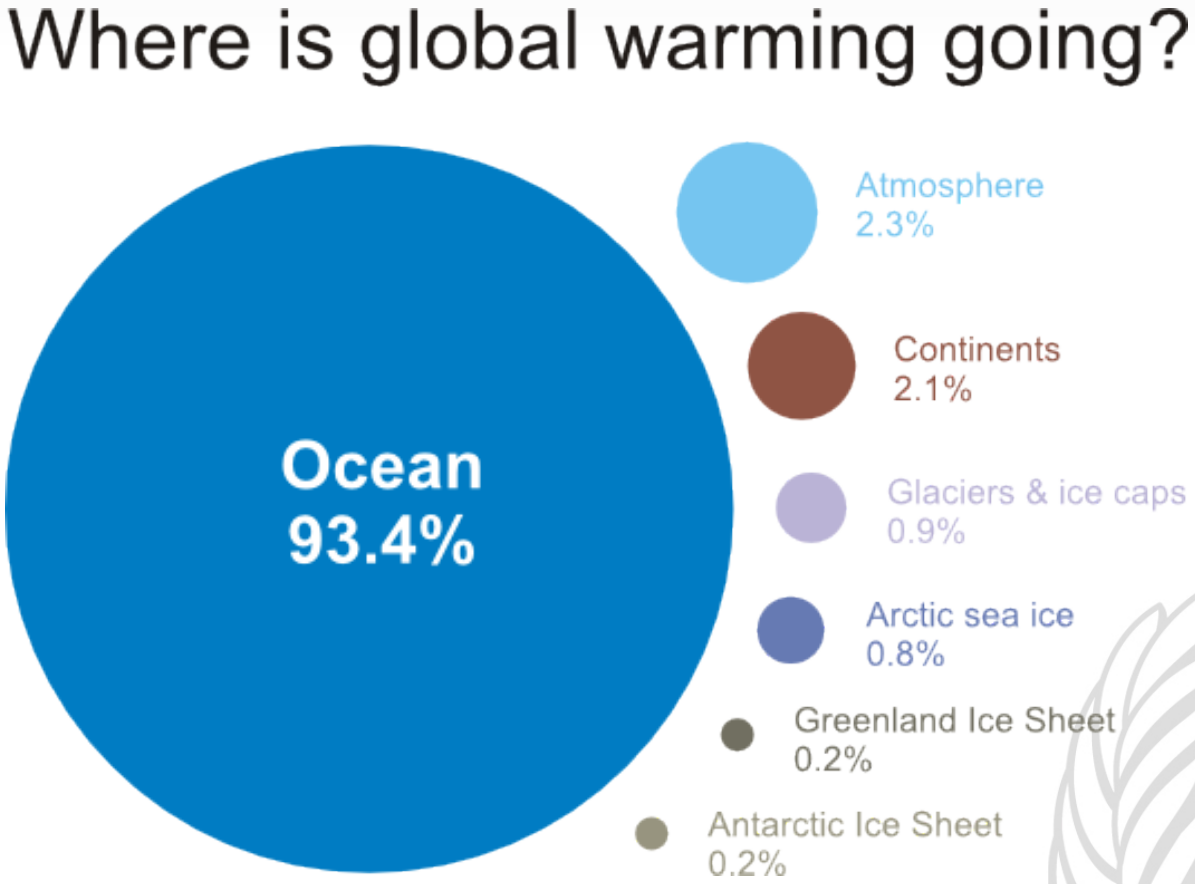
Source : https://www.nps.gov/grba/learn/nature/what-is-climate-change.htm, Will Elder, NPS

Global Temperature

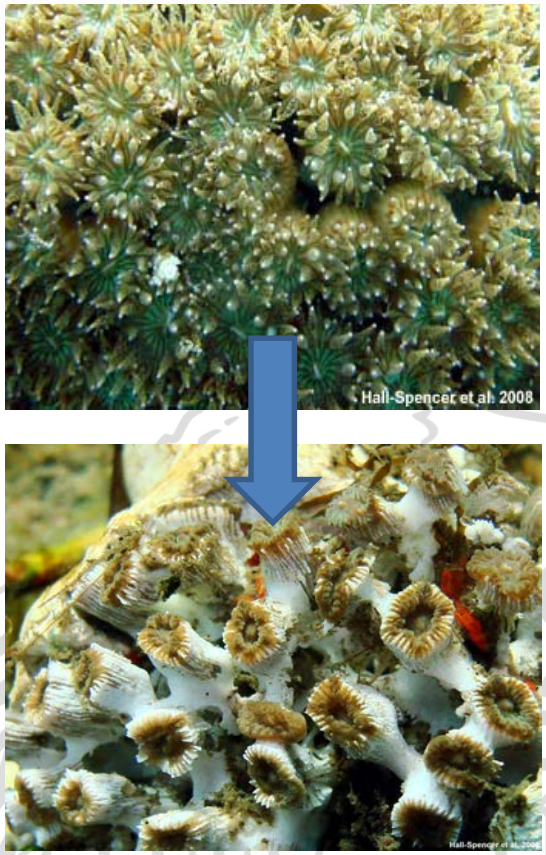


source: climate change 2014: Synthesis Report (IPCC, 2014).

Ocean problem



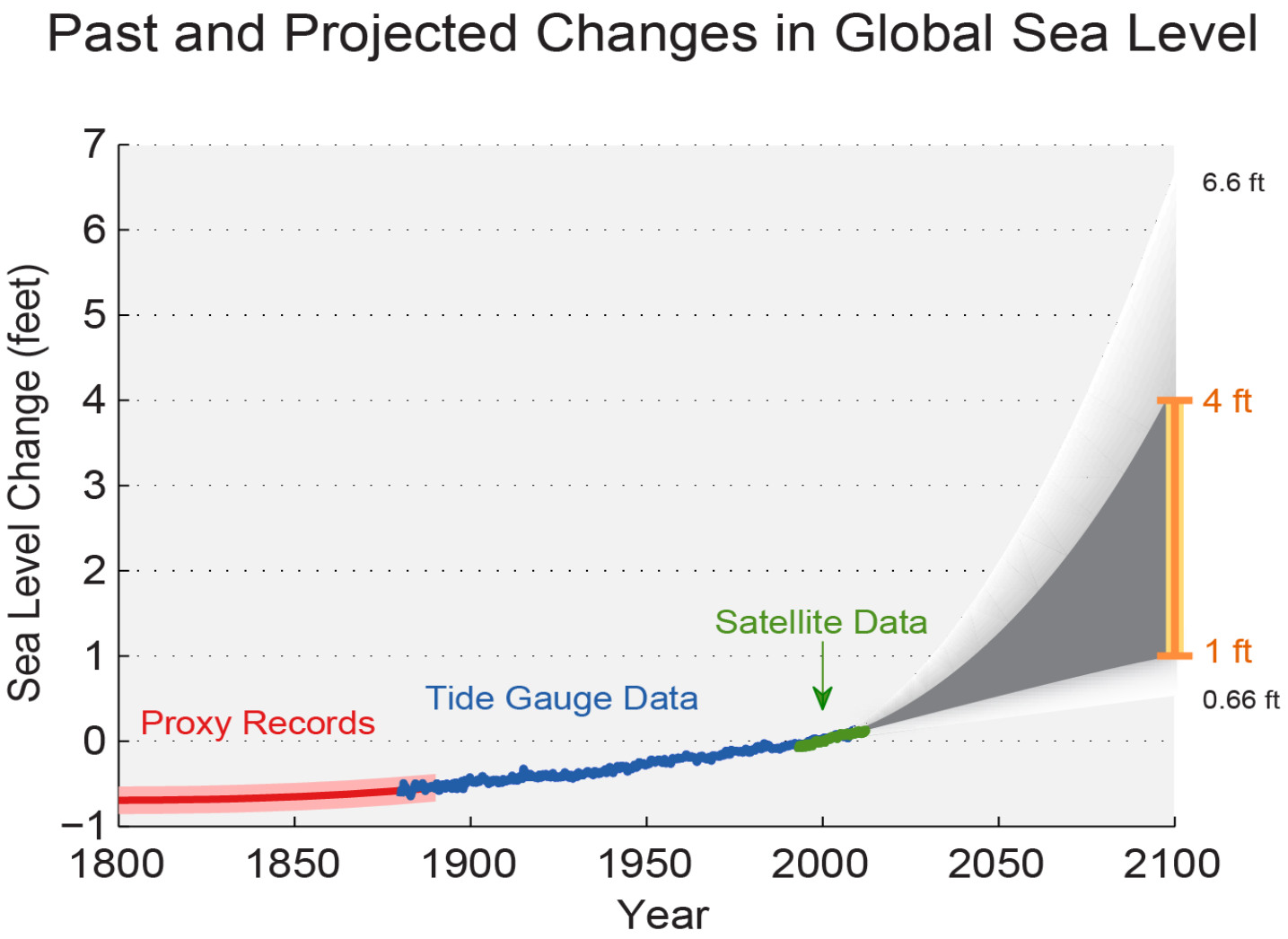
Source: John Cook, Infographic on where global warming is going, SkepticalScience.com



Ocean acidification

Source: http://www.teachoceanscience.net/

Sea Level Rise



Source: Parris et al. 2012 [5] with input from NASA Jet Propulsion Laboratory

Disasters

Natural disasters

- People live with hazards
- We do not (and perhaps can't) avoid disasters
- Volcanic eruption
- Earthquake & Tsunami
- Cyclone or Hurricane
- Tornadoes
- Floods & Drought
- Forest fire or Bushfire

Natural disasters (continued)

Man-Made disasters

- Man-made case studies in Korea (Richardson, 2014).

Event	Date	Deaths	Injuries
Collapse of Sampoong Department Store in Seoul	Jun. 25, 1995	502	938
Arson attack on a Daegu subway train.	Feb. 18, 2003.	192	148
hydrofluoric acid chemical accident in Gumi.	Sep. 27, 2012.	5	
Sinking of Sewol Ferry.	Apr. 16, 2014	304	

Compound disasters

- Natechs (Natural-hazard triggered technological accidents)
- Earthquake -> tsunami -> nuclear disaster -> industrial shutdown (Douglass, 2014)
- Network effects -> global supply chains (Douglass, 2014)
- Lightening or human activity -> Fire -> Undermine vegetation and soil -> mudslide stemming from heavy rain or earthquake

Source : Introduction to Emergency Manager, CRC Press, Brenda D. Phillips et. al.

Emerging security threats

- For many people, terrorism entered our consciousness on September 11, 2001.
- Pandemics and Bioterrorism
- Anthrax attacks through the U.S. mail infected 11 people with inhalational anthrax from which five died.
- Cyber terrorism
- Unknown programming errors, cascading losses of electrical power, and computer viruses continue to present future threats

Source : Introduction to Emergency Manager, CRC Press, Brenda D. Phillips et. al.

MERS (Middle East Respiratory Syndrome)

- Failure initial response
- High-dense society

Mission areas

Prevention: The capabilities necessary to avoid, prevent, or stop a threatened or actual act of **terrorism**. As defined by PPD-8, the term "prevention" refers to **preventing imminent threats**.

Protection: The capabilities necessary to secure the homeland against acts of **terrorism and manmade or natural disasters**.

Mitigation: The capabilities necessary to **reduce loss of life and property by lessening the impact of disasters**.

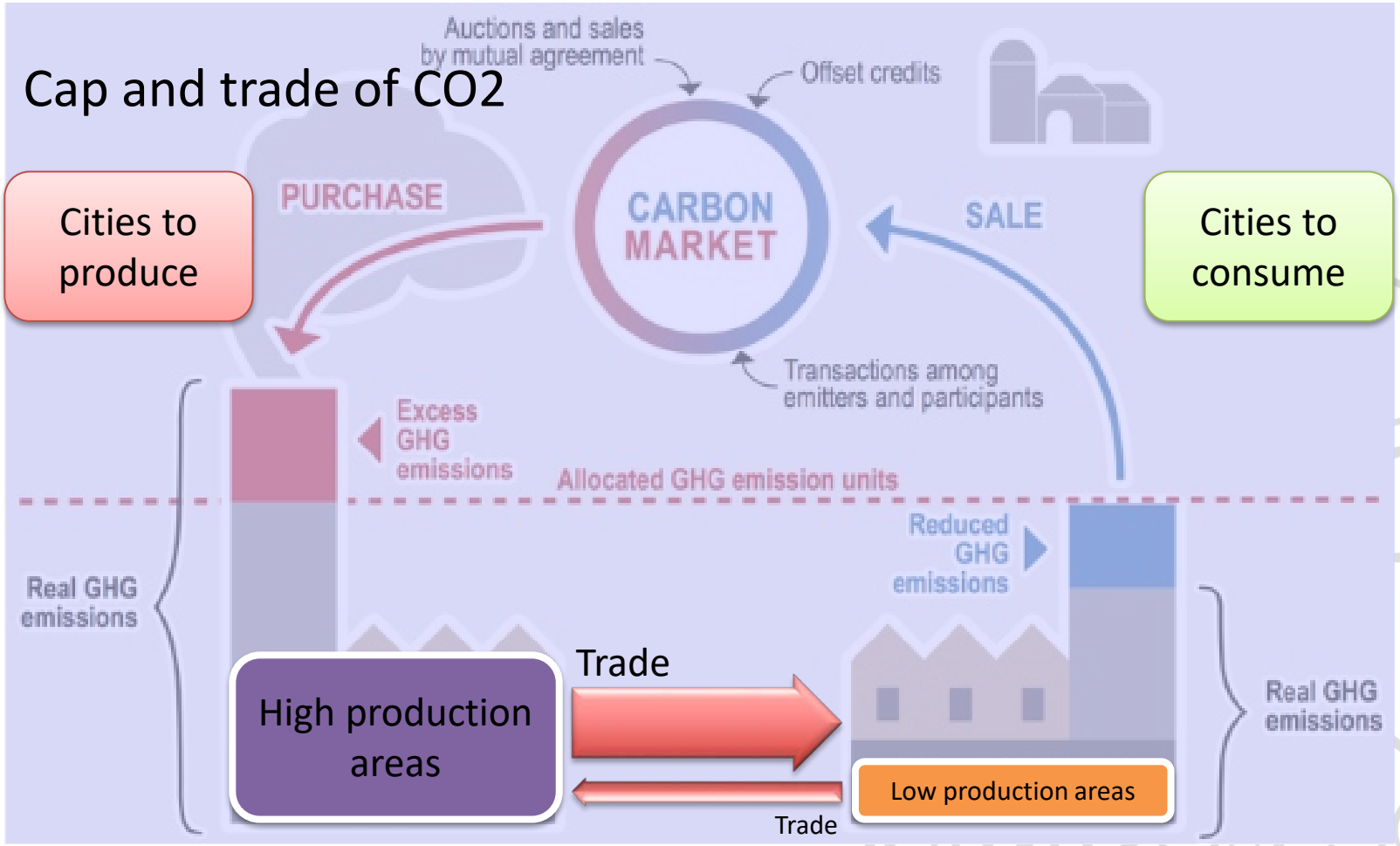
Response: The capabilities necessary to **save lives, protect property and the environment, and meet basic human needs** after an incident has occurred.

Recovery: The capabilities necessary to assist communities affected by an incident to **recover effectively**.

Source : IS-0001.a - Emergency Manager: An Orientation to the Position , www.training.fema.gov

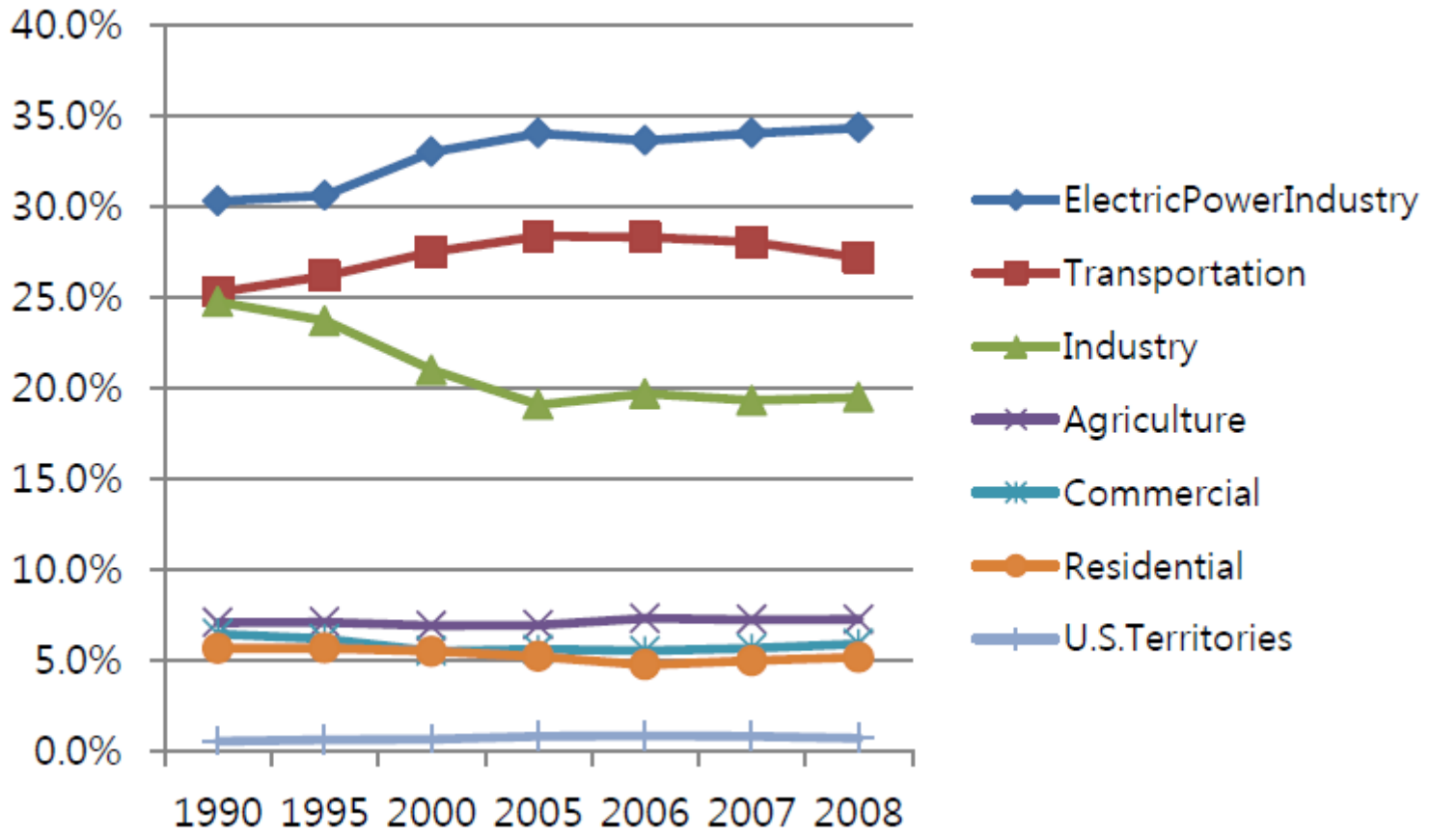
GHG and Air Pollution

Who are confronted with efforts to reducing the GHG emissions? Mismatching in producing GHG



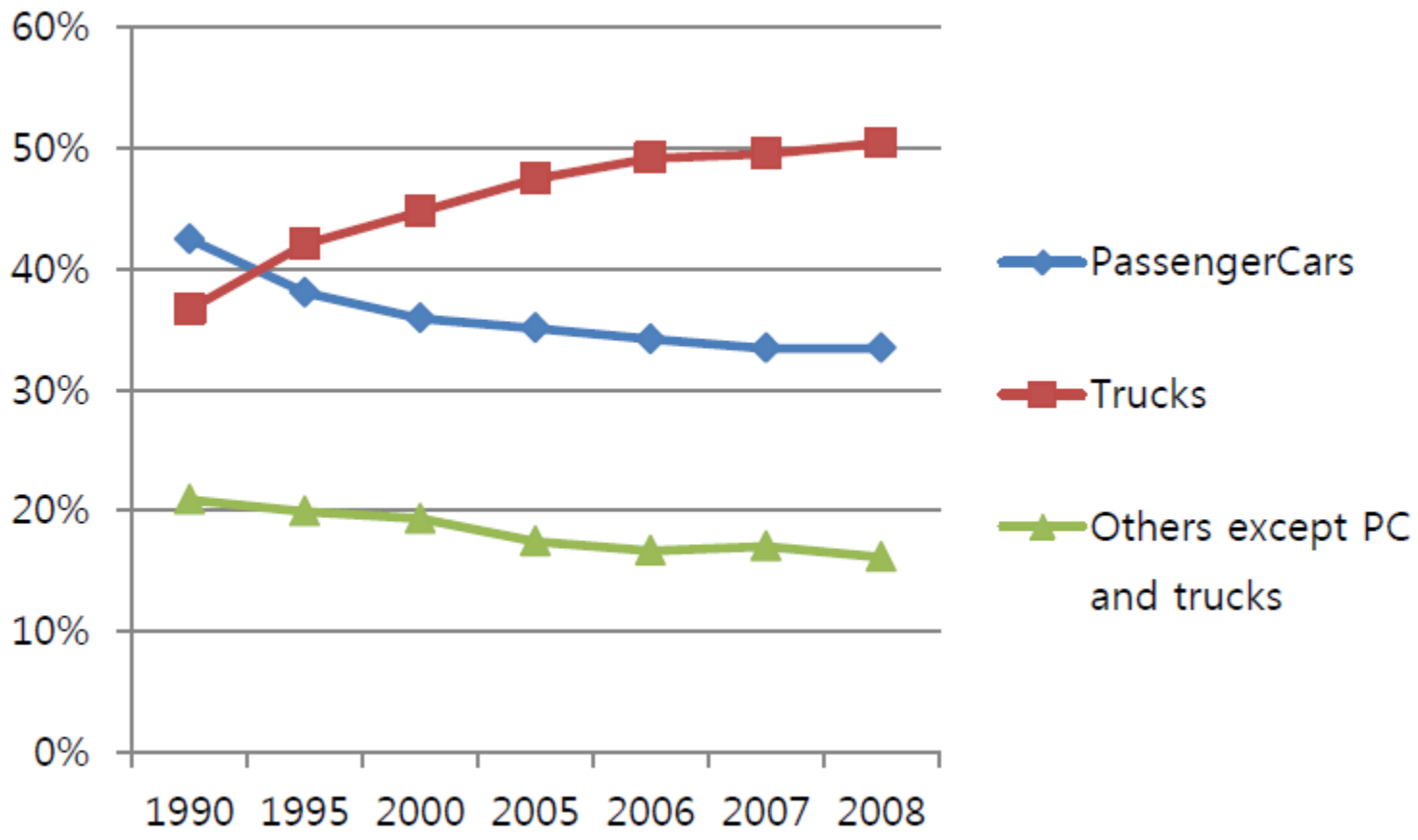
Source: http://www.oilsandsmagazine.com/news/2015/5/22/why-carbon-cap-and-trade-would-kill-future-oil-sands-growth

Where are GHG coming?



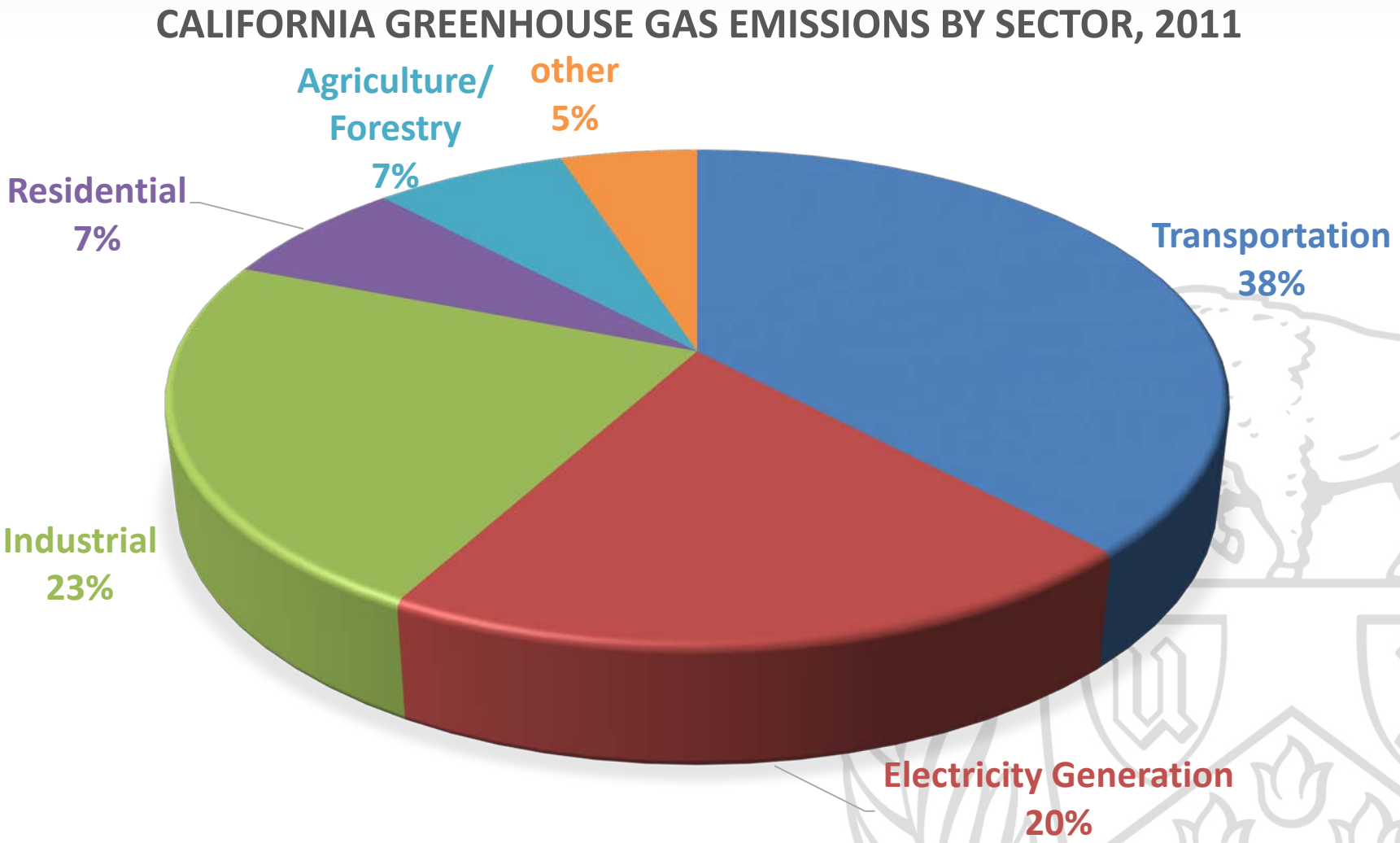
Source: GHGs emissions by economic sectors, 1990-2008 (EPA, 2010b; Cho et. al., 2012)

Where are GHG coming? (continued)



Source: GHGs emissions by transportation modes, 1990-2008 (EPA, 2010b; Cho et. al., 2012)

A Case Study (Southern California)

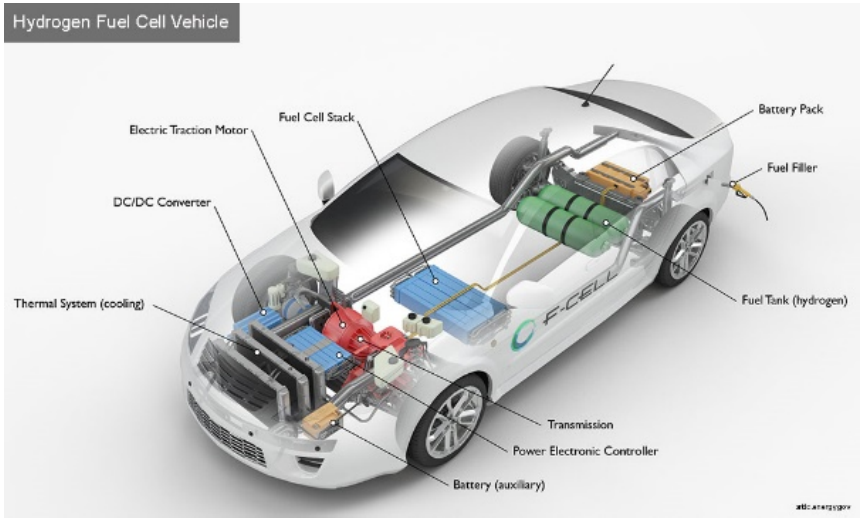


Effort to GHG mitigation

- Global efforts to mitigate climate change → the Kyoto Protocol to the UNFCCC in 1997
- Annex I Parties → reducing GHG emissions by at least 5% below 1990 emission levels
- President Bush (2002) → several plans to reduce GHG emissions by 18% up to 2012
- CABR → a Scoping Plan: reach the 1990 GHG emission levels by 2020 and 80% of the 1990 emission levels by 2050

Efforts to reduce GHG emissions from U.S. transportation

Transitioning to a hydrogen based transportation system



Mix of policies

- implementing a carbon constraint
- raising efficiency standards for automobiles
- blending low-carbon fuels with gasoline
- changing land-use patterns through urban design and planning

Highway vehicles should be the primary focus on policies to control GHG emissions, since they account for 72 percent of total transportation emissions

Source: Reducing Greenhouse Gas emissions from U.S. Transportation (David L. et al., 2003)

Adapting to emerging transportation technologies

- Drivetrain and vehicle categories can make the largest impact on fuel consumption
- Reduction in fuel consumption from emerging transportation technologies
  - ✓ Stop-and-start behavior hybrid vehicles offer benefits of 20 ~ 30%
  - ✓ Aerodynamic technologies offer benefits of 10%
- Technical improvements: motor, transmission, aerodynamics, light-weighting, etc.
- Technically improved new HDVs offer cost-effective reductions of 35% of CO2 emissions

Source: Reduction and Testing of Greenhouse Gas (GHG) Emissions from Heavy Duty Vehicles. (AEA, 2011)
Source: Marginal abatement cost curves for Heavy Duty Vehicles. (Arno Schroten et al., 2012)
Source: Strategy for reducing Heavy-Duty Vehicles' fuel consumption and CO2 emissions. (EU, 2014)

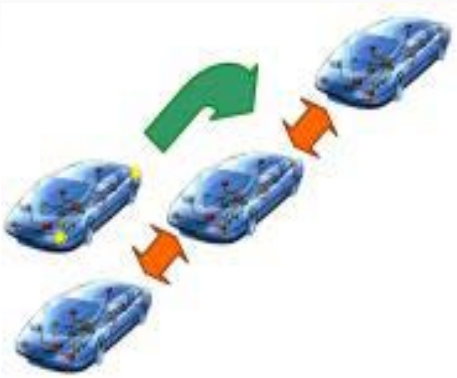
New and Emerging Technologies

Engine	Vehicle
• Dual Fuel Systems • Hydrogen Fuel Cells • Electric Vehicles • Stop/Start Hybrid • Mechanical Turbocompound • Bottoming Cycles • Controllable Air Compressor • Electric Engine Accessories	• Low Rolling Resistance Tyres • Single Wide Tyres • Automatic Tyre Pressure Adjustment • Aerodynamic Trailers • Aerodynamic Fairings (Cab, Chassis, Body & Trailer) • Lightweight Materials
Driveline	**ITS / ICT**
• Automated Transmission • Full Hybrid	• Predictive Cruise • Vehicle Platooning • Smart Alternator, Battery Sensor • Acceleration Control

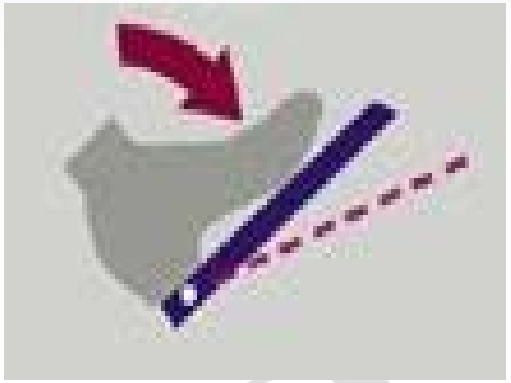
Source: Reduction and Testing of Greenhouse Gas (GHG) Emissions from Heavy Duty Vehicles (AEA, 2011)

New and Emerging Technologies (continued)

Dual Fuel Systems

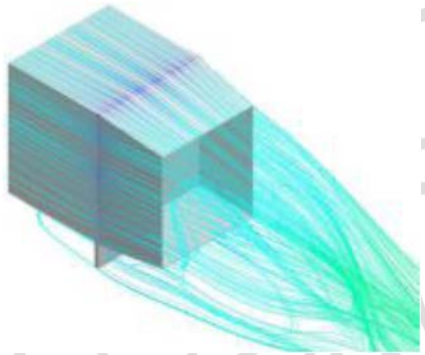


Vehicle Platooning



Acceleration Control

Cab Aerodynamic Fairings



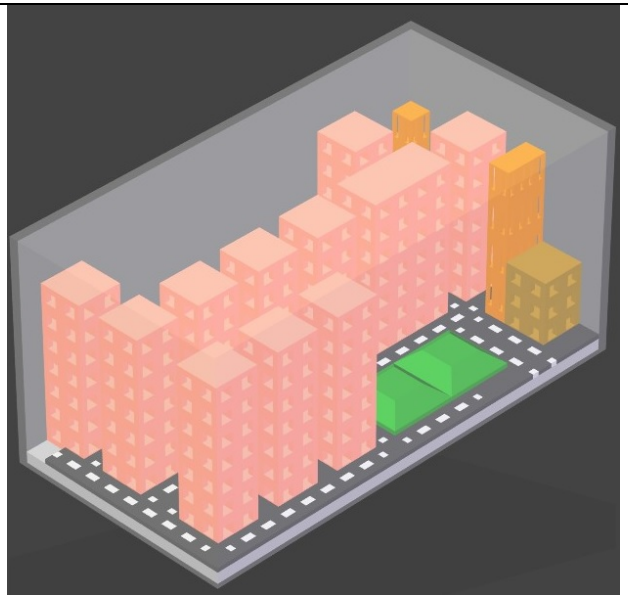
Trailer Aerodynamic Tail Extensions

Source: Reduction and Testing of Greenhouse Gas (GHG) Emissions from Heavy Duty Vehicles. (AEA, 2011)

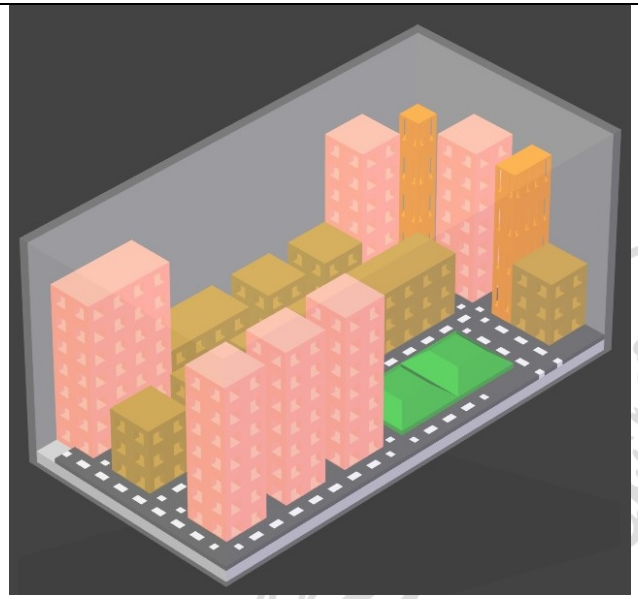
Measuring air pollution

- Air pollutants are mostly measured in the surface of urban space, but it is not clearly investigated how these air pollutants are distributed vertically as well as horizontally in the urban space.
- Considering a denser urban development shape, examining the air pollution distribution in the 3D space will support analyzing to what degree citizens are exposed to air pollutants and what type of building and urban designs reduce air pollutants, especially PM2.5.
- Develop a prototype, lab-based experimental model that contributes to connecting various air pollutants and urban forms in three-dimensional (3D) urban space.

Air Pollution Distribution and Urban Forms: Beyond Surface Measurement



Form 1: High-building urban form



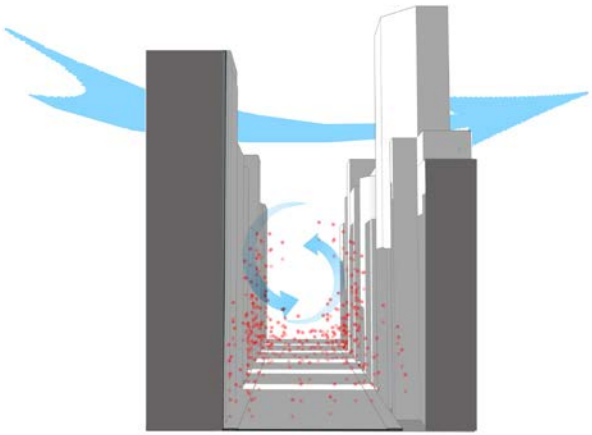
Form 2: Low-building urban form

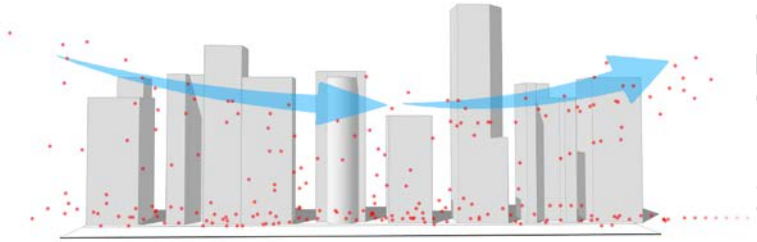
Figure 1. A lab-based experimental model that connects urban forms with air pollution distributions

Three Research Hypotheses

- Urban Forms
  - Using their dissimilar urban forms. Using airflow pattern and airflow direction in a street canyon, urban form effects can be tested on particulate matter dispersion (Figure 2)
- Urban Density
  - Both high- and low- to medium-density urban blocks are set up as an analysis setting where all the climate-related variables including wind speed, ambient temperature, humidity, and turbulent fluxes are controlled (Figure 3)
- Mitigation Factors
  - Incorporate contemporary urban greening solutions such as green roofs, living walls and street trees and vegetation in different layers of urban canopy (i.e., near surface, the intermediate, and the canopy boundary layers) to test the most effective strategies mitigating the PM2.5 distribution

Air Pollution Distribution and Urban Forms: Beyond Surface Measurement





Airflow direction perpendicular to building lines	Airflow direction in alignment with building lines

Figure 2. PM 2.5 dispersion in wind direction scenarios

Air Pollution Distribution and Urban Forms: Beyond Surface Measurement

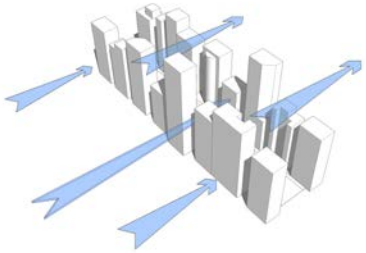
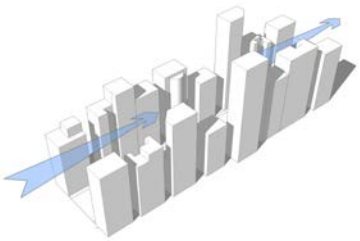
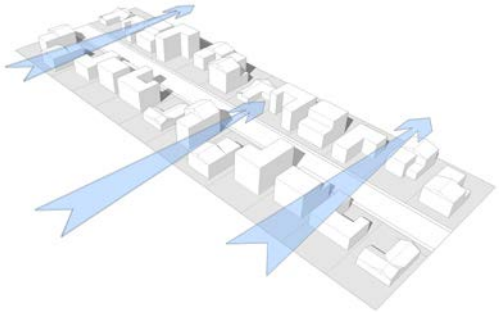
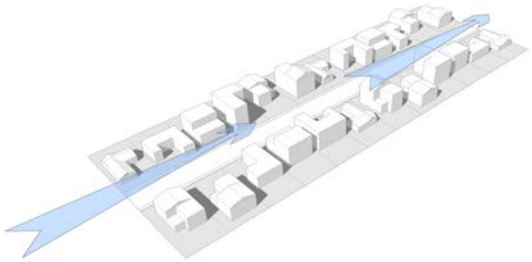
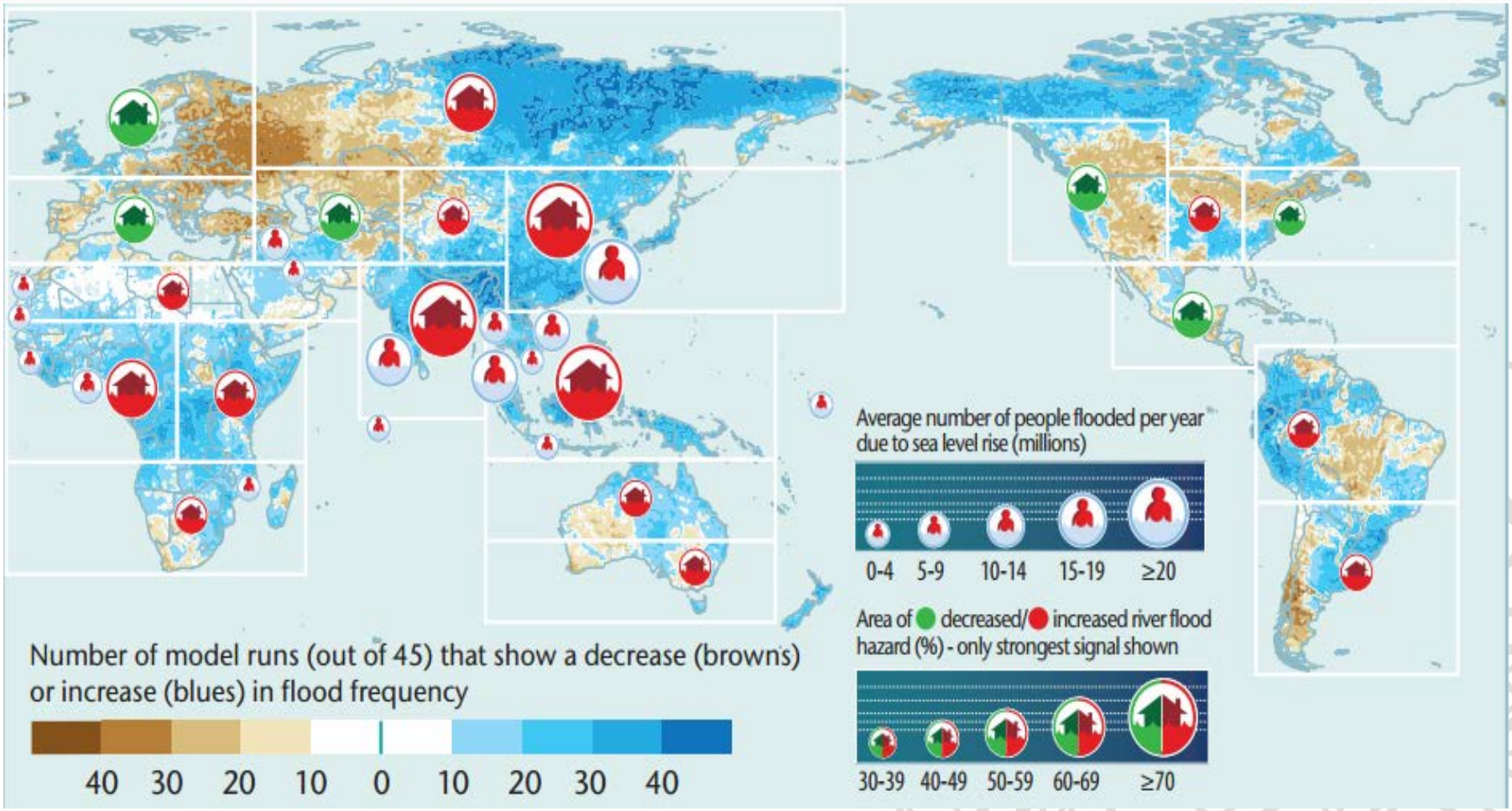
	
(a)Perpendicular wind flow direction in high density setting	(b)Parallel wind flow direction in high density setting
	
(c)Perpendicular wind flow direction in low density setting	(d)Parallel wind flow direction in low density setting

Figure 3. PM 2.5 dispersion, wind flow direction and density settings

Flooding and SLR

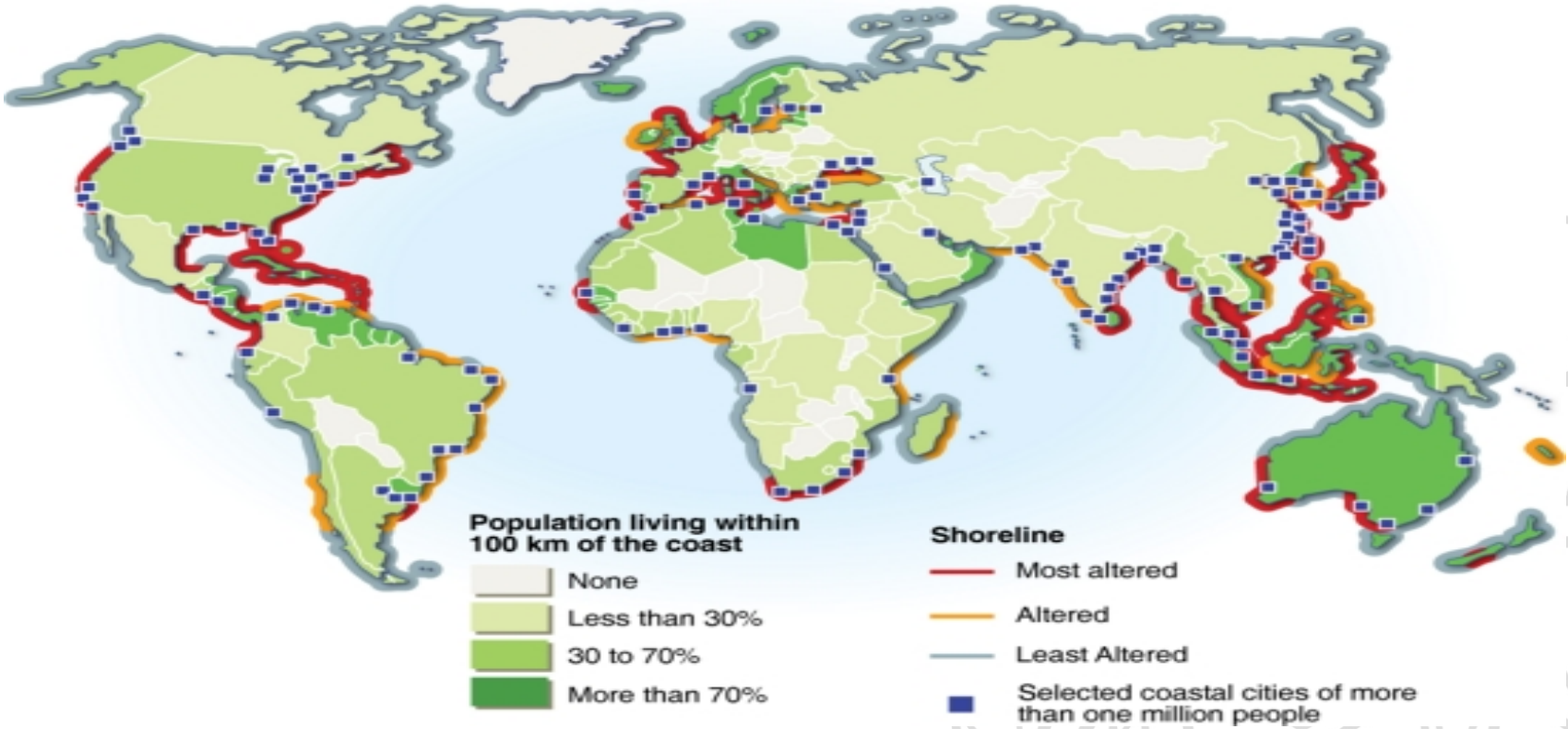
Increase of flooding



Source : What will the world look like in 2100?, http://globe-net.com/will-world-look-like-2100/

Coastal population and shoreline degradation

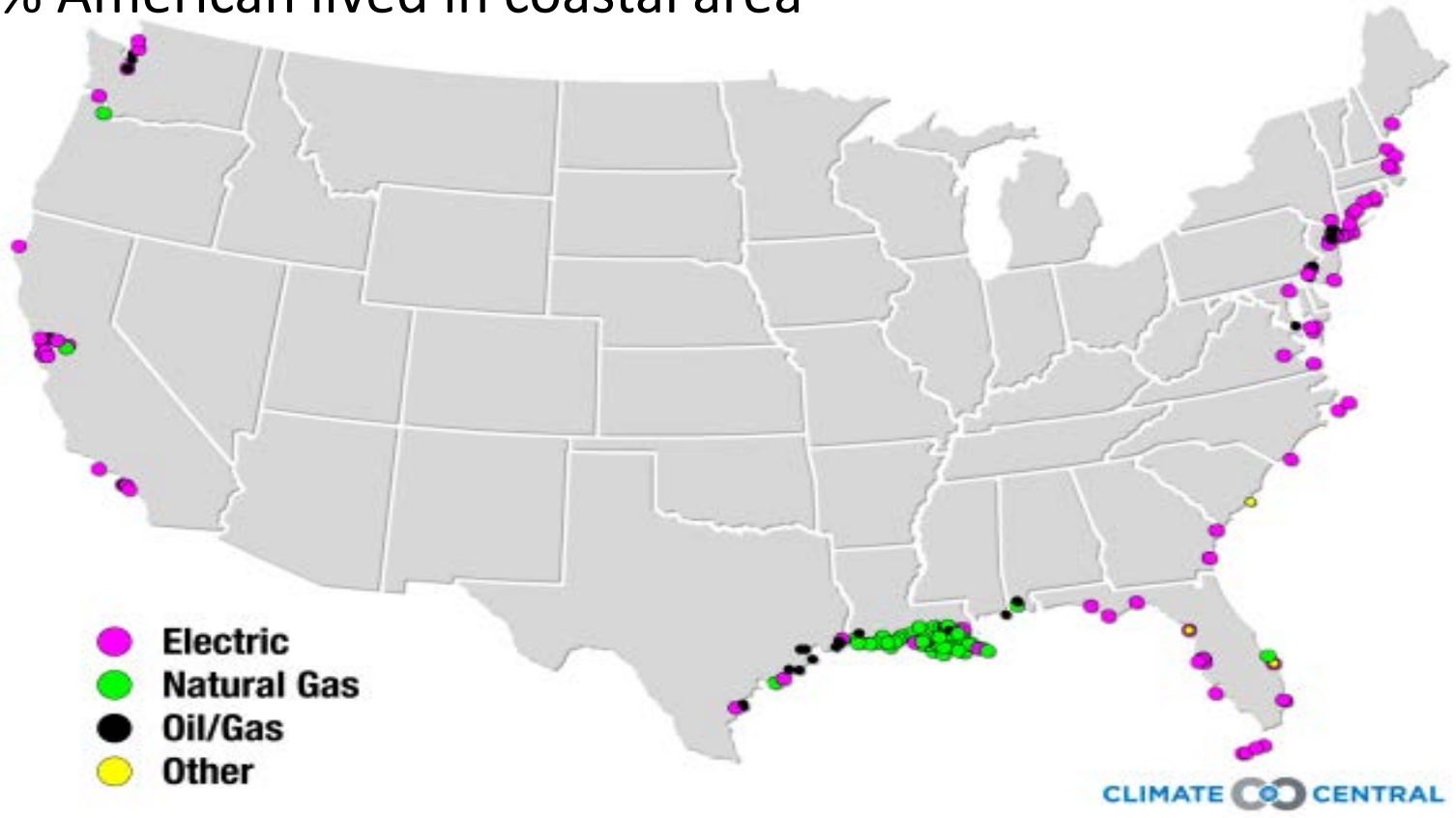
- 21 megacities of world's 33 megacities are located in coastal area.



출처 : Global Environment Outlook 4 (Philippe Rekacewicz, 2006).

Energy Infrastructure Threat from Sea Level Rise

- Energy facilities less than 4 ft above local high tide
- 40% American lived in coastal area



출처 : Sea level rise threats to energy infrastructure (climate central, 2012).

Coastal Infrastructure in Korea

Port of Busan

Incheon international airport

출처 : http://english.chosun.com/site/data/html_dir/2016/01/26/2016012601362.html
http://blog.naver.com/zerokim200/20137231584
http://www.ibtimes.co.uk/south-korea-approves-nuclear-power-projects-worth-7bn-1434264

Climate Change, Water, and California

- Increased water demand for surface and ground water to maintain natural ecosystems and support population and economic growth
- Challenges in sustainability of water supply in California related with global climate change trends toward higher temperatures, change in precipitation, and timing of snowmelt and runoff feeding California's rivers
- A comprehensive water management plan is required for the water system in California to be adaptable to global climate change

Results: Virtual water flows in Southern California

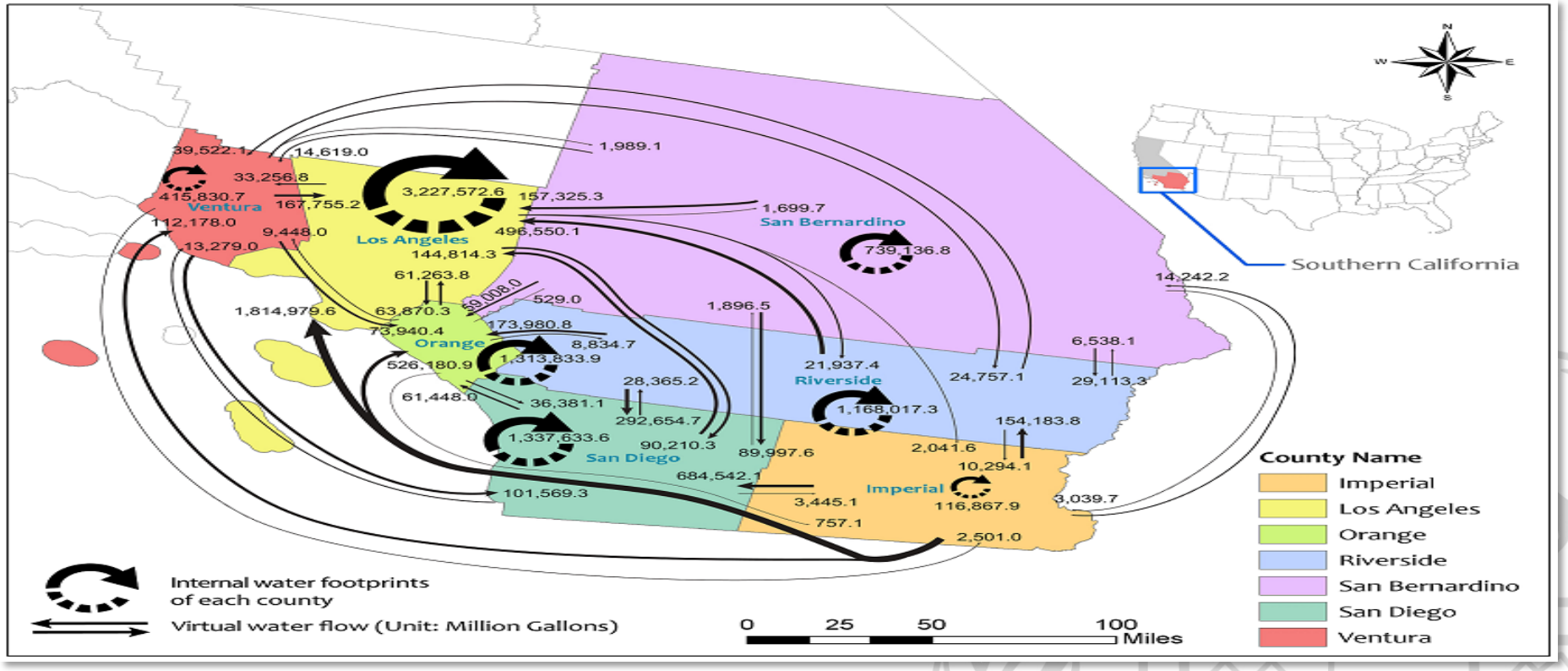


Figure 1. Water footprints and virtual water flows by county from the water SCI-MRIO
Note: Internal water footprints of each county represents domestic water use of each county.
Source: Authors modified a map obtained from U.S. Census Bureau-TIGER GIS Products (2015)

Results: Virtual water flows from California to other US states

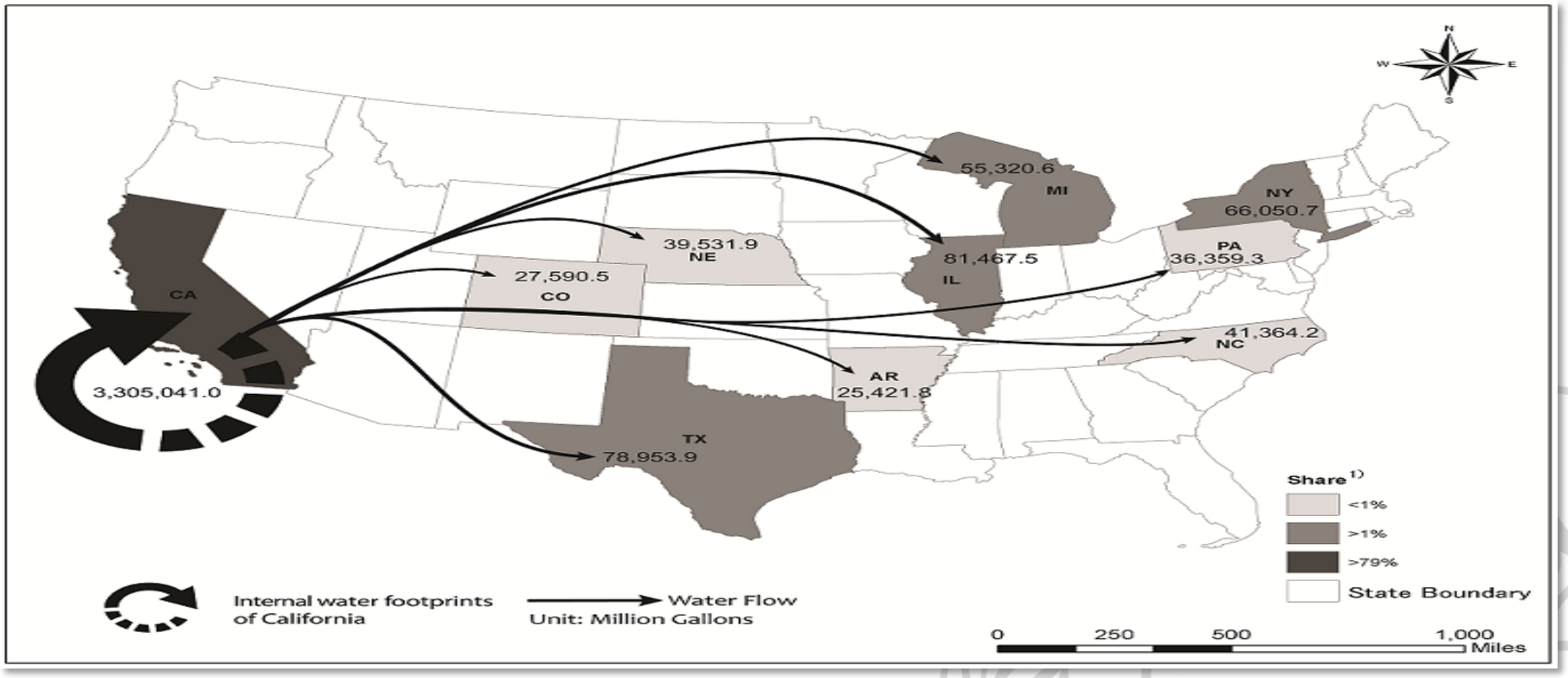
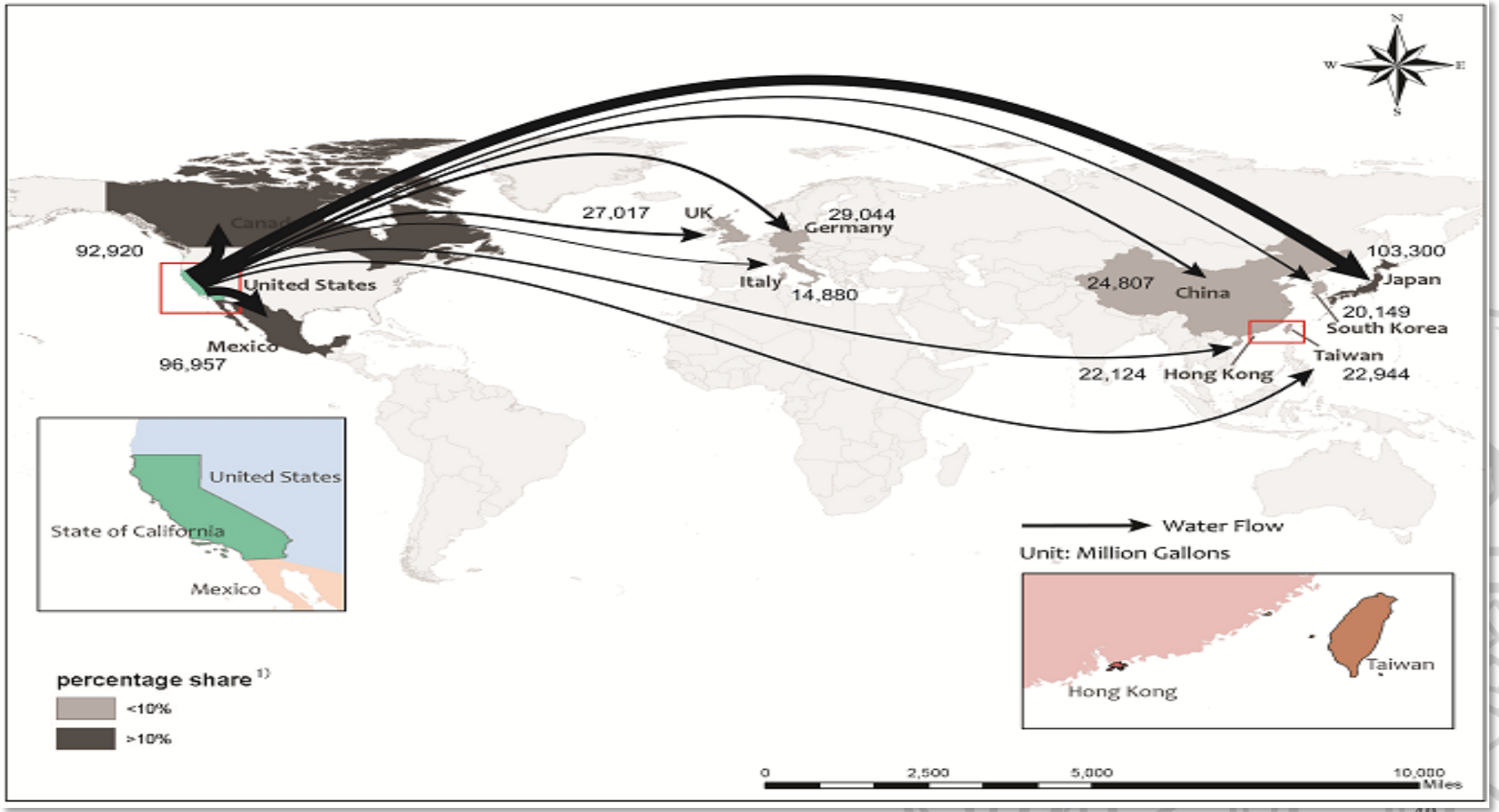


Figure 3. Water footprints and virtual water flows by state from California
Note: Water footprints and virtual water flows are estimated from the water NIEMO model.
Source: Authors modified a map obtained from U.S. Census Bureau-TIGER GIS Products (2015)

Results: Virtual water flows from California to abroad



ICT, big data and disasters

Using ICT to manage disasters in Korea

- Smart integrated control system
- Satellite image, CCTV, unmanned rotorcraft, weather intelligence, etc.

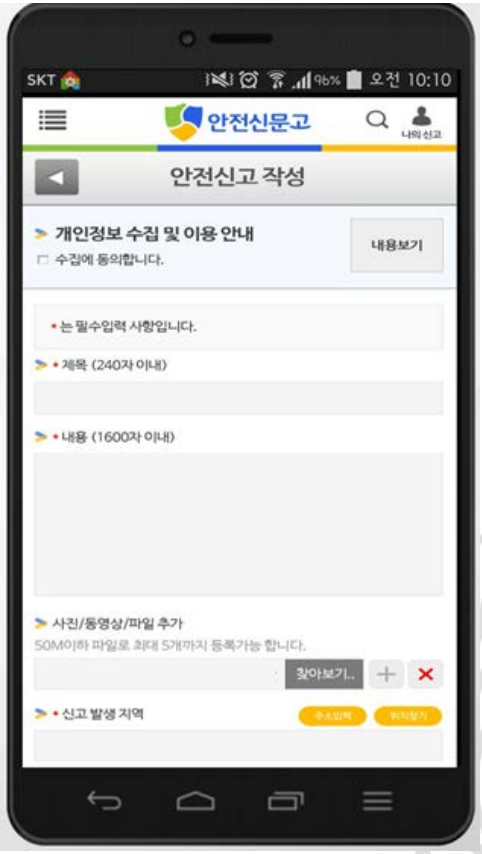
Using ICT to manage disasters

- CCTV integrated control system

- Auto-camera integrated control system??

Examples of using ICT

- Smart phone application (e.g., 안전신문고 in Korean)



Examples of using ICT

- Smart phone application (cont.)

Before

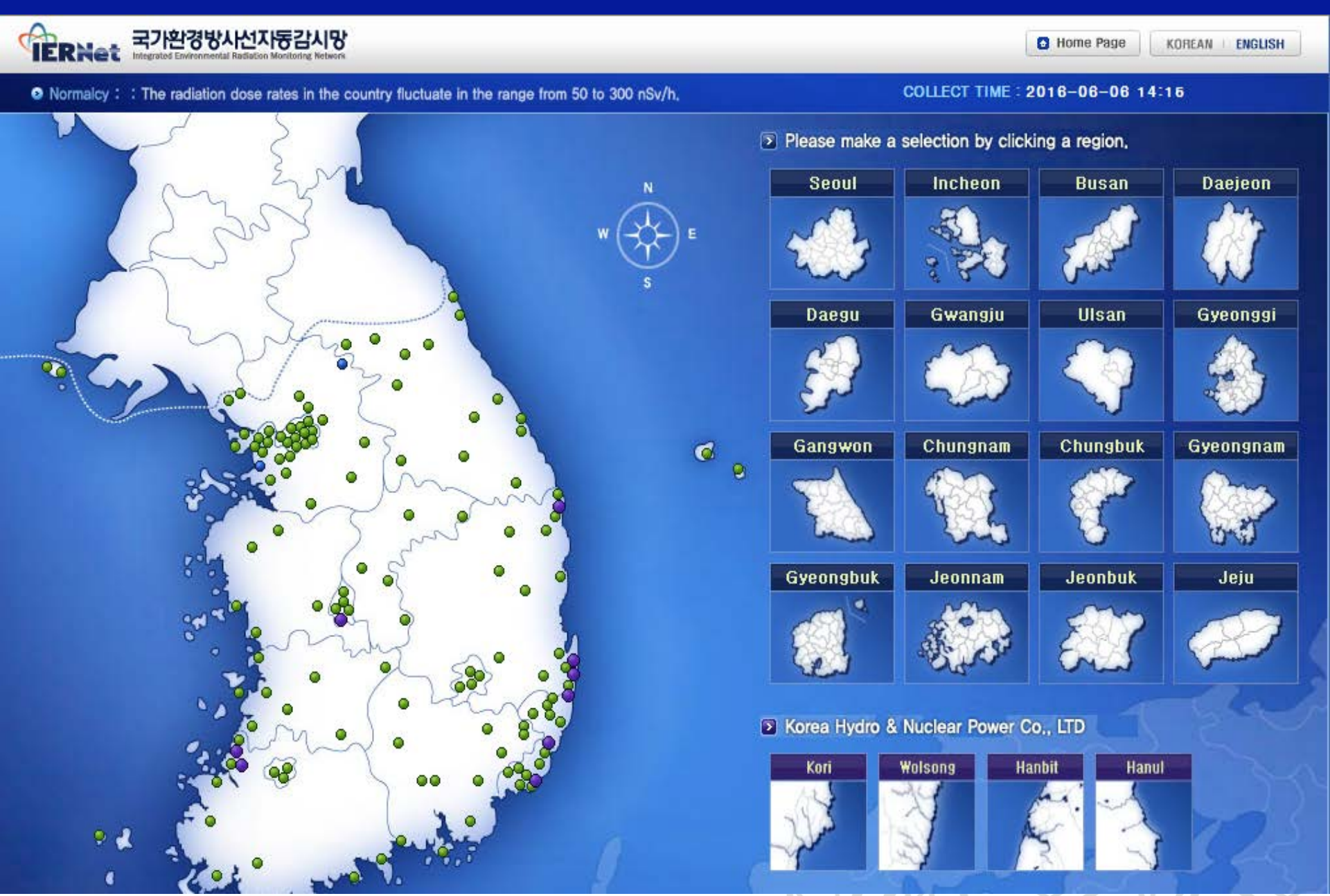
After

Examples of using ICT

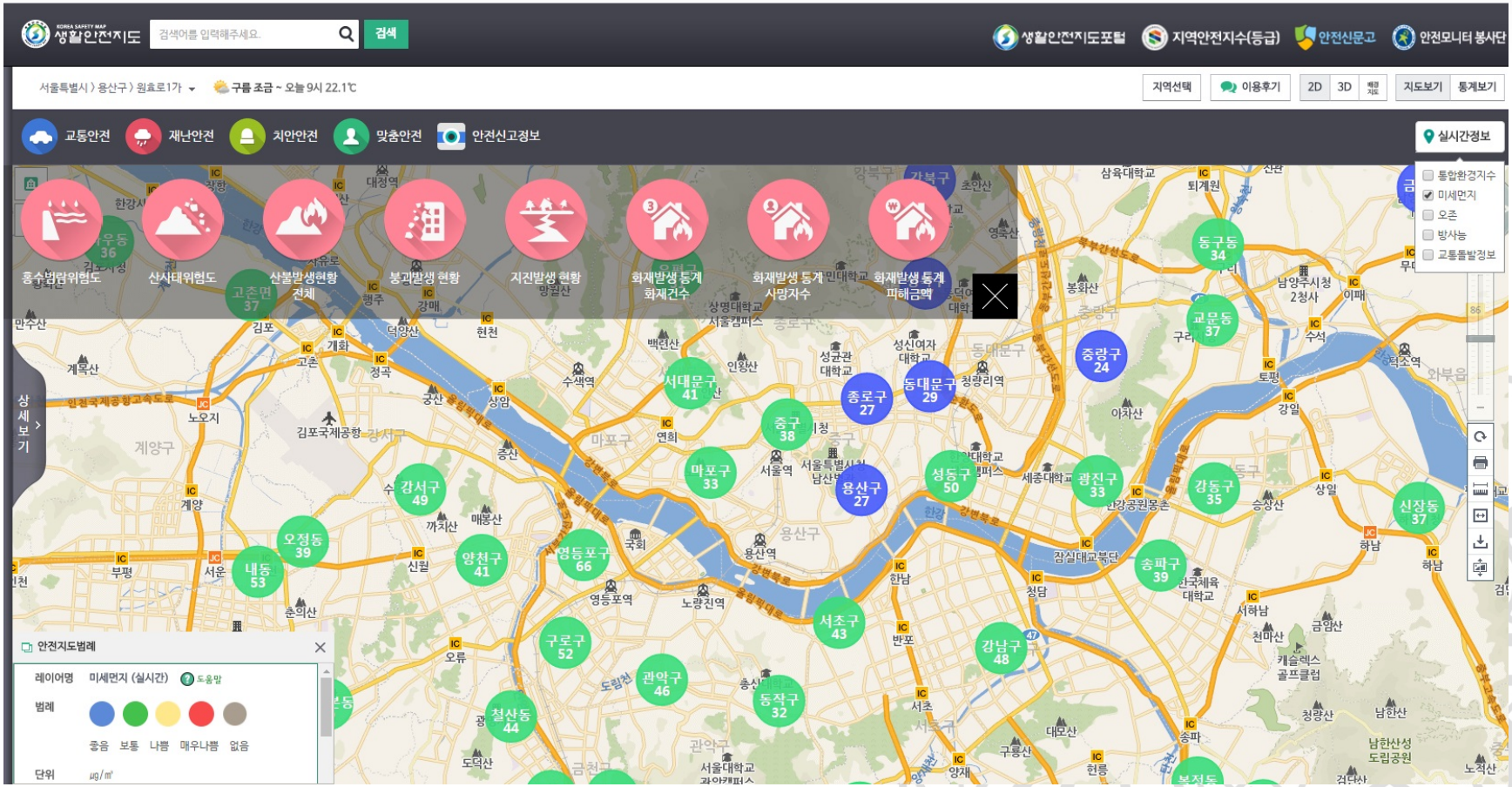
- SNS – twitter
- Seoul Disasters Information Service

IERNet to manage nuclear exposure

- IERNet = Integrated Environmental Radiation Monitoring Network
- Average dose rate per hour
- Wireless communication network -> collect, manage
- Realtime access


IERNet
국가환경방사선자동감시망
Integrated Environmental Radiation Monitoring Network
Home Page
KOREAN | ENGLISH
Normalcy : : The radiation dose rates in the country fluctuate in the range from 50 to 300 nSv/h.
COLLECT TIME : 2016-06-06 14:16
Please make a selection by clicking a region.
N
W
E
S
Seoul
Incheon
Busan
Daejeon
Daegu
Gwangju
Ulsan
Gyeonggi
Gangwon
Chungnam
Chungbuk
Gyeongnam
Gyeongbuk
Jeonnam
Jeonbuk
Jeju
Korea Hydro & Nuclear Power Co., LTD
Kori
Wolsong
Hanbit
Hanul

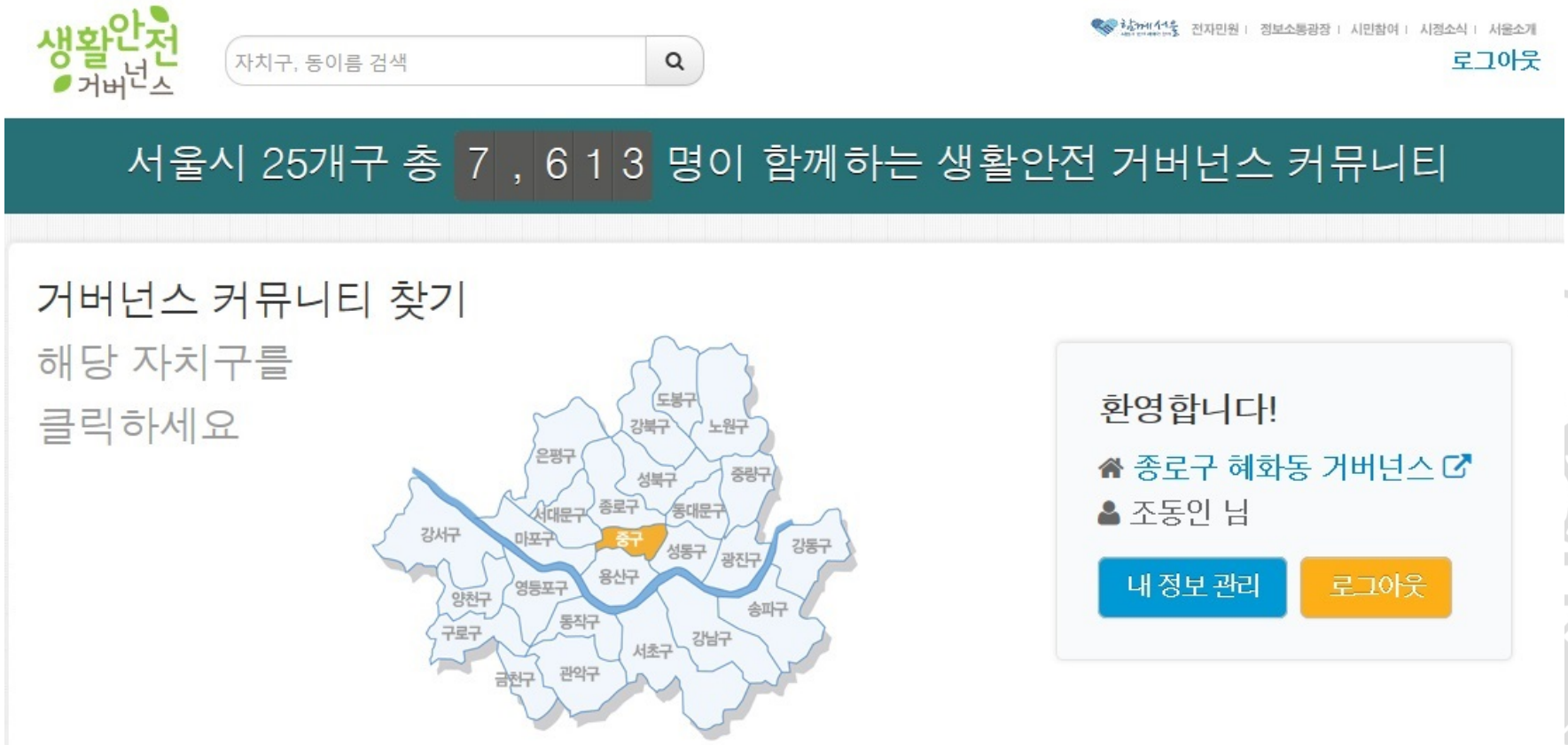
Safety map (fine dust, ozone, radioactivity, etc)



링크 주소 : http://www.safemap.go.kr/main/smap.do

Disaster governance by using ICT

- Life safety governance



종로구 혜화동

매니저 김태균 (hw7133)

회원수 32 명

활동지수 10761 점

알림방 | 수다방 | 활동일지 | 불편신고 | 자료실 | 안전제안 | 우수활동사례

건강 안전도시 혜화동 거버넌스가 책임진다

알림방 최신글

더보기

제목	날짜
혜화동 2015년7월 「안전점검의 날... NEW	2015-07-06
혜화동 화재발생시 국민행동요령	2015-06-18
서울시 서울시 메르스 진료 병원 및...	2015-06-18
혜화동 중동호흡기증후군(메르스,Me...	2015-06-16
혜화동 풍수해 대비 시민행동요령	2015-06-10

수다방 최신글

더보기

제목	작성자	날짜
무더울 땐 이렇게 하세요! NEW	김태균	2015-07-06
여름의 불청객 폭염 피해 예...	김태균	2015-06-03
벚꽃 아름다워요! NEW	김태균	2015-04-08
천고마비의 계절 NEW	박순옥	2014-09-18
풍요로운 한가위, 감사의 마... NEW	김태균	2014-09-04

최근신고리스트

더보기

* * * 2016-05-28

종로구 혜화동

[120문자접수/원본입니다] 명륜7길 43번지 앞 ... 더보기

담당자확인 | 접수완료 | 처리중 | 처리완료

* * * 2016-05-28

종로구 혜화동

공중선이 사람이 지나가면 머리에 다을 정도로 정리가 ... 더보기

담당자확인 | 접수완료 | 처리중 | 처리완료

* * * 2016-05-05

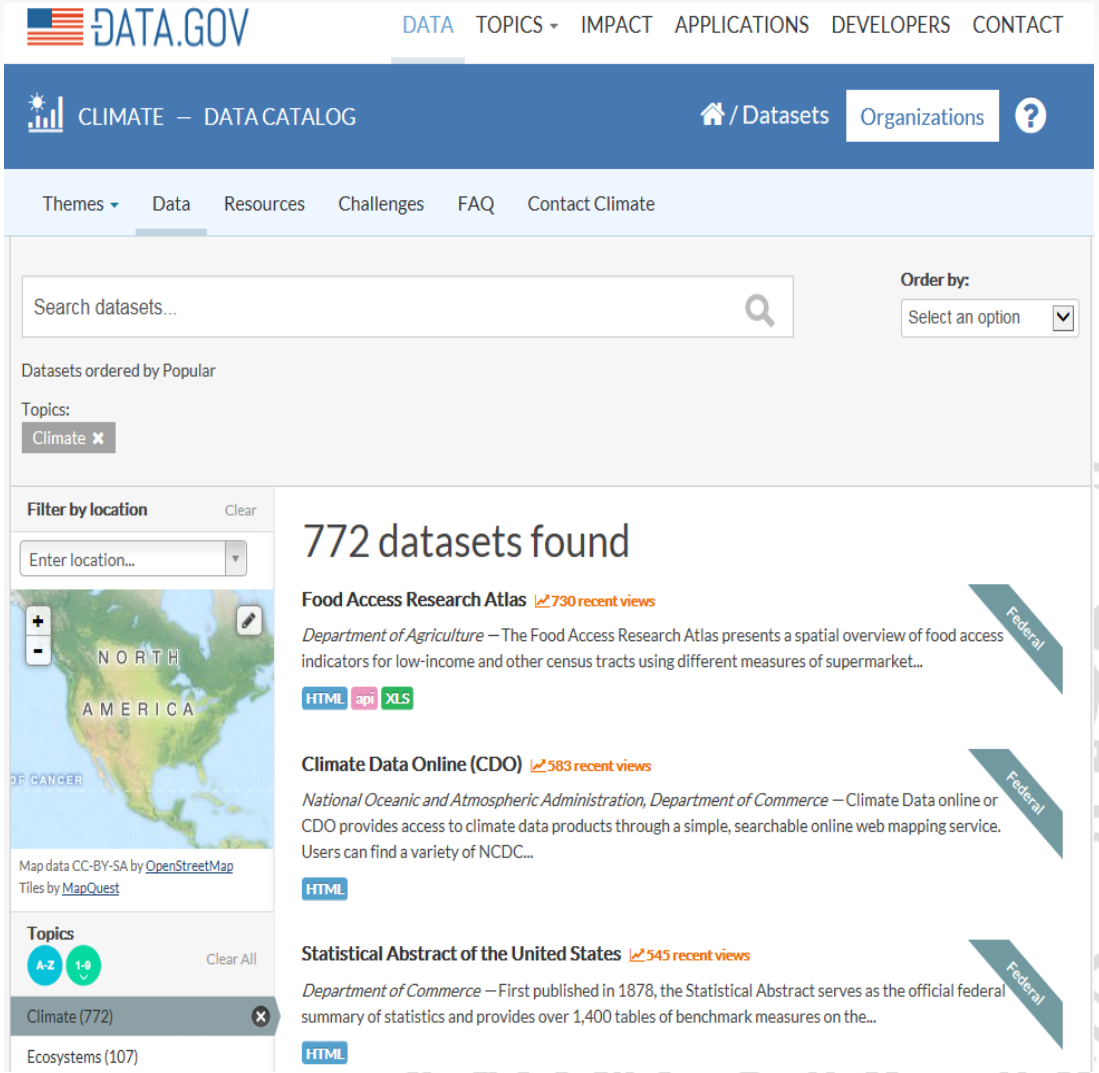
종로구 혜화동

도로파손 되어 신고합니다. 더보기

담당자확인 | 접수완료 | 처리중 | 처리완료

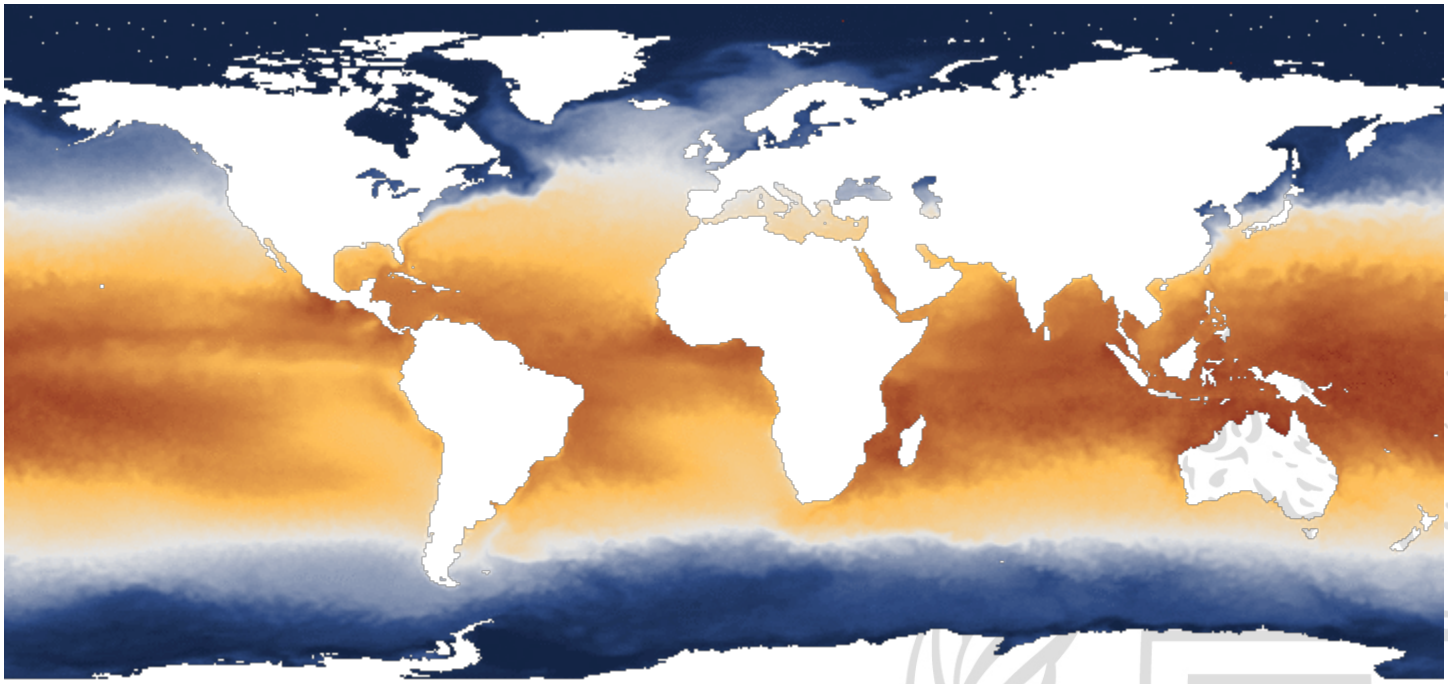
Climate change & big data

- Based on the President's climate action plan in the U.S.
- The new site, climate data released
- http://www.data.gov/climate/
- Other data included
  - Population growth
  - Social vulnerability
  - Environmental regulations



Climate data use: case 1 - NOAA

showing monthly shifts in sea surface temperatures around the globe



Source : white house brings together big data & climate change, climate central, march 19, 2014 (search data : September 26, 2015)
News Link : http://www.climatecentral.org/news/white-house-brings-together-big-data-and-climate-change-17194

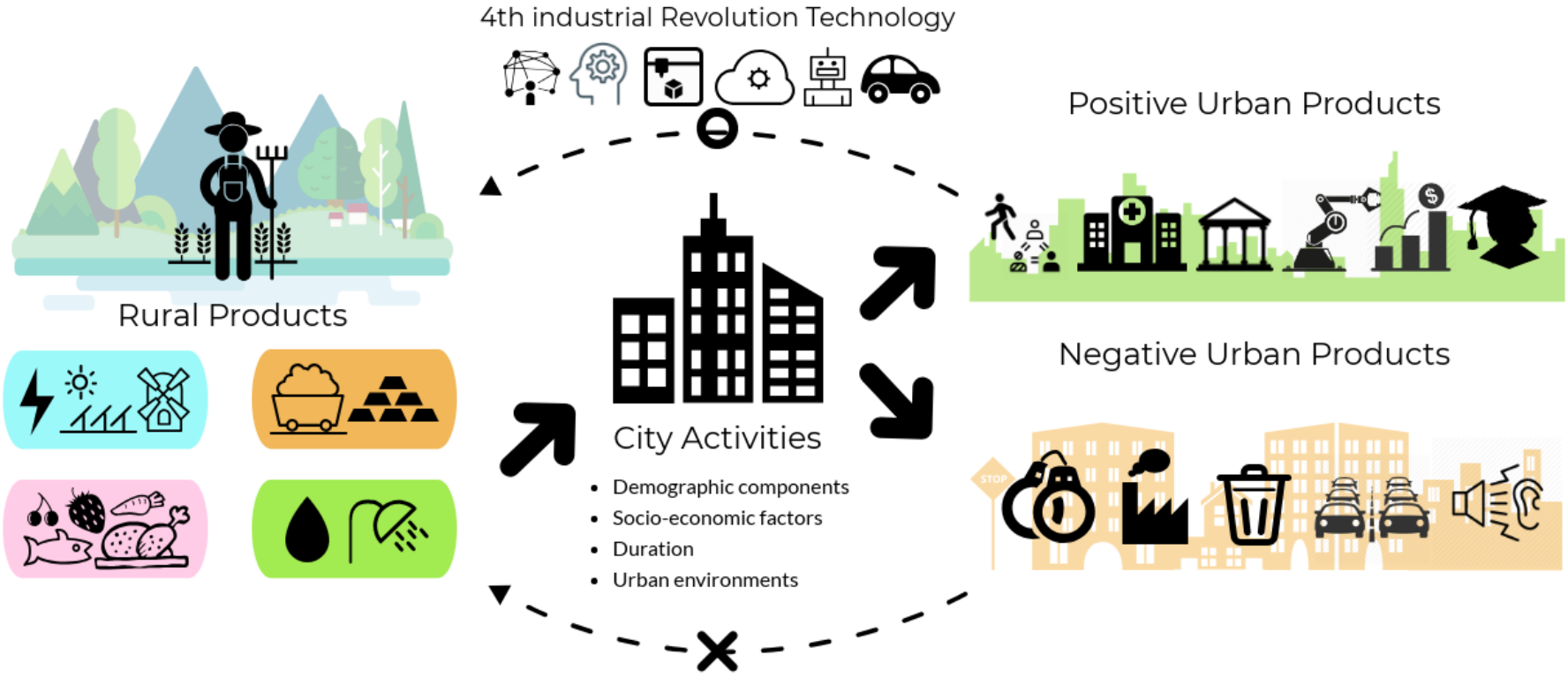
Climate data use: case 2 - EMC

in conjunction with the White House Climate Data Initiative

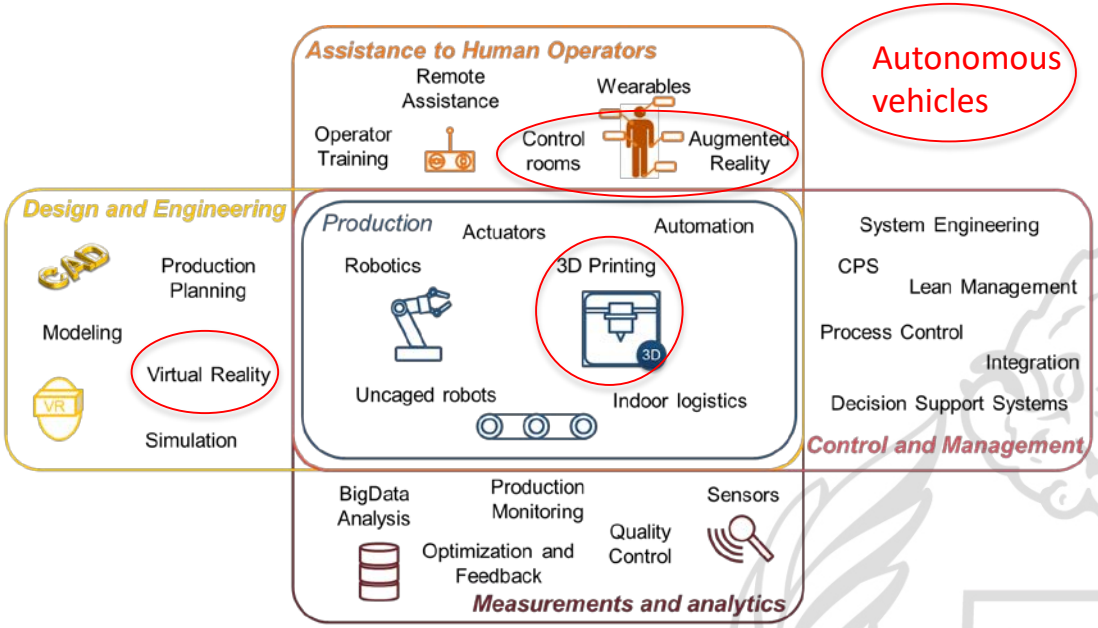
Source Link : http://www.emc.com/big-data/insights.htm

Implications to Korea

- While various world's leading institutes and companies are utilizing big data collaborating with federal/central and local governments located in their headquarters, it is very difficult to find how Korean governments are working for this big data information together with private sectors.
- Especially, there are rare to find articles to report this issue.
- Various insurance companies are receiving Hurricane information from AER (Atmospheric and Environmental Research) which also collaborates with the world's leading authorities on hurricanes and developing insurance goods.
- What status of your countries?


4th industrial Revolution Technology
Rural Products
Positive Urban Products
Negative Urban Products
City Activities
Demographic components
Socio-economic factors
Duration
Urban environments

Technology scope of the fourth industrial revolution



출처: https://www.iot-now.com/2016/10/20/53811-the-industrial-internet-towards-the-4th-industrial-revolution/; IDATE

강남구 도곡동 타워팰리스 vs 강남구 개포동 구룡마을 판자촌, 서울, 대한민국

출처: 경향DB

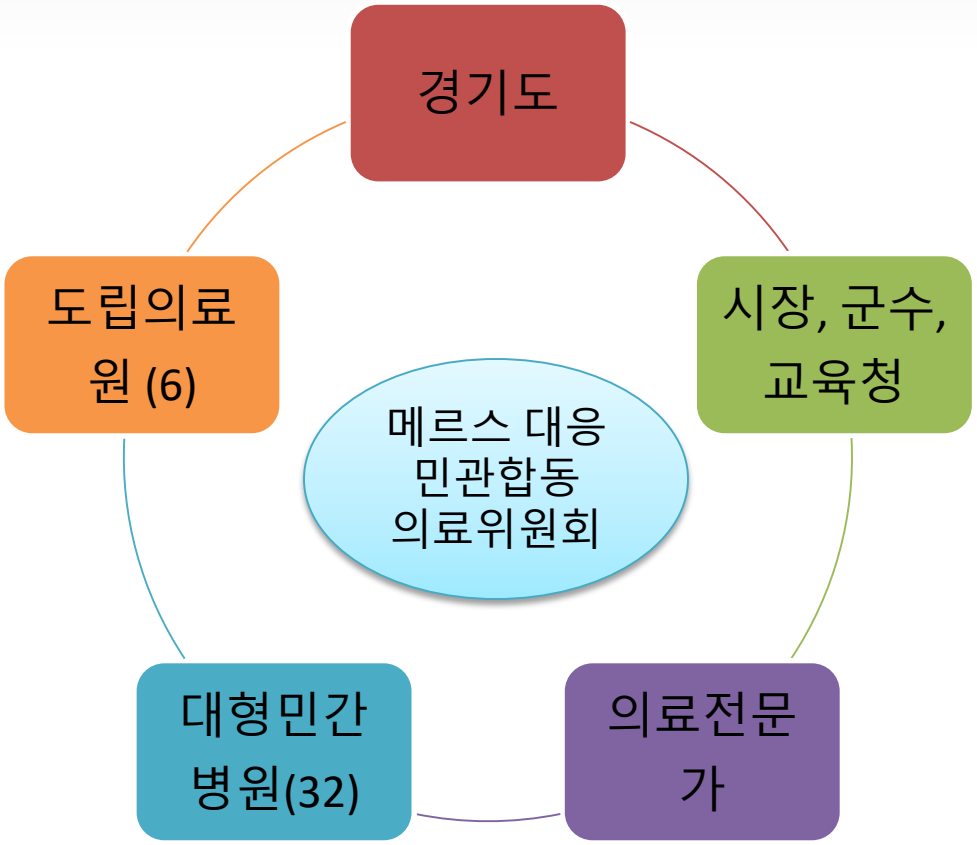
MASIPHUMELELE VS LAKE MICHELLE, Cape Town, South Africa

Source: http://www.unequalscenes.com/masiphumelele-lake-michelle

Collaborative governance in preparedness

- Bringing multiple stakeholders together in a common forum for consensus decision-making, often led by public agencies (Ansell and Gash, 2007)
- Collaborative governance models seek to overcome a massive, unpredicted disaster issue by engaging the stakeholders directly

Gyeonggi collaborative network for the MERS treatment



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(5개 도립의료원)
(32곳 대형민간병원)