Circular Economy and Carbon Neutrality: Global cases that we can pursue

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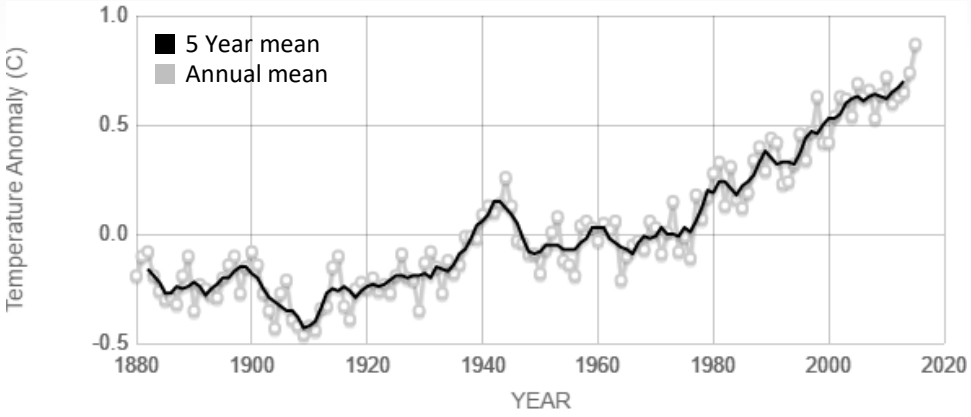
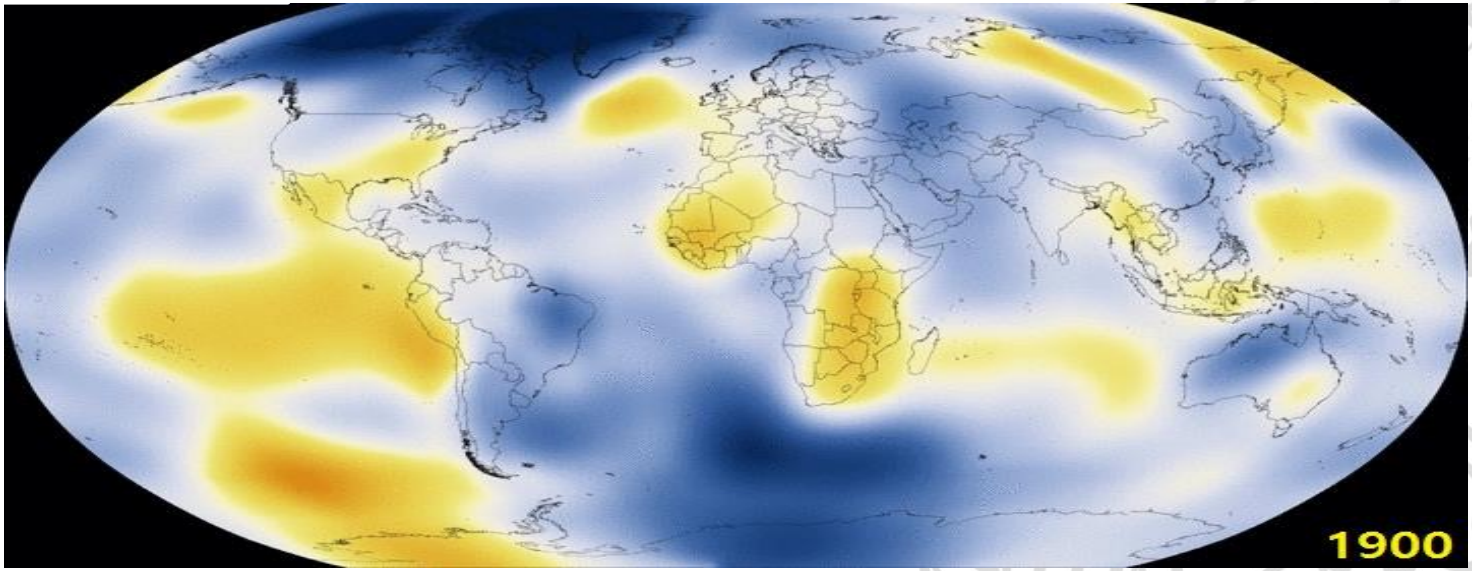
1. Global Warming and Assessment Report 6

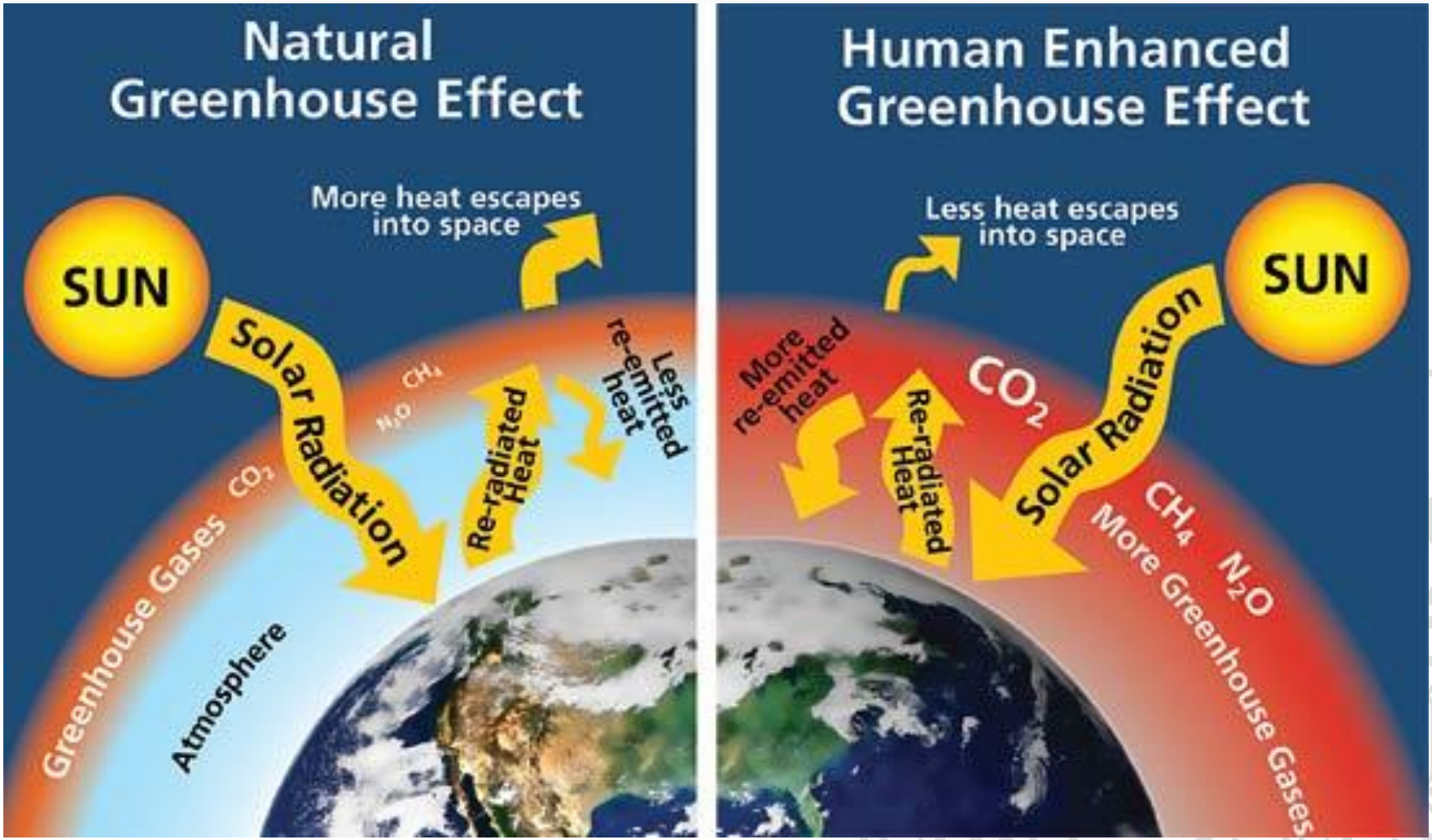
Global Warming





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 surface temperature change by AR6

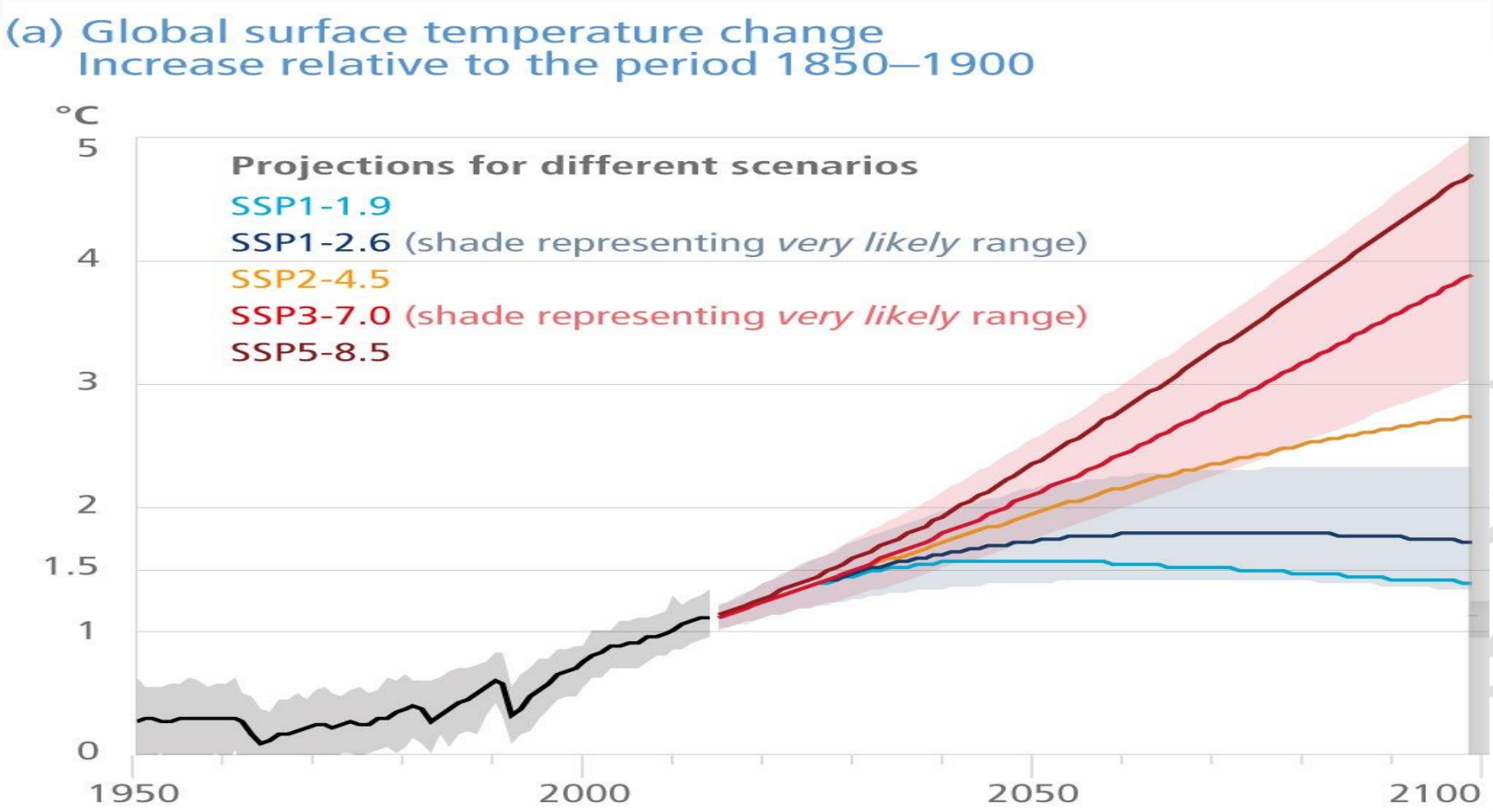


Figure 1: Global surface temperature changes in °C relative to 1850–1900

Source: https://www.ipcc.ch/

IPCC and AR6

- Assessment Report (AR) 6 is the latest report by the Intergovernmental Panel on Climate Change (IPCC) on the state of climate change and its impacts
- The report is divided into three working groups: Working Groups I to III (WG I, WG II and WG III)
- Each has its focus and findings according to IPCC (https://www.ipcc.ch/)

a. WG I: The Physical Science Basis

- Assesses the physical science basis of climate change, including the causes and drivers of climate change and its impacts
- Confirms that human activities, particularly the burning of fossil fuels, are the primary cause of global warming and climate change
- Notes that the world has already warmed by 1.1°C compared to pre-industrial levels, and that further warming is inevitable due to past emissions
- Emphasizes the need for immediate and significant reductions in greenhouse gas emissions to limit further warming and avoid the worst impacts of climate change.

b. WG II: Impacts, Adaptation, and Vulnerability

- Assesses the impacts of climate change on natural and human systems, including the risks and vulnerabilities associated with different levels of warming
- Highlights the disproportionate impacts of climate change on vulnerable populations and regions, including low-income communities, indigenous peoples, and small island states
- Underscores the importance of adaptation and resilience-building measures to address the impacts and reduce the risks of climate change.

c. WG III: Mitigation of Climate Change

- Assesses the options for mitigating climate change, including the technological, economic, and social factors that drive emissions reductions
- Emphasizes that it is still possible to limit warming to 1.5°C and avoid the worst impacts of climate change
- However, still highlights that it will require rapid, far-reaching, and unprecedented changes in all aspects of society, including energy systems, land use, and transportation
- Underscores the need for ambitious and coordinated global action to reduce emissions and transition to a low-carbon economy

Adaptation and Mitigation in AR6

- **Adaptation** as **the process of adjusting to the current and future effects of climate change**
- **Mitigation reducing the sources of GHG emissions and/or enhancing the sinks such as**
  - Reducing the GHG sources, e.g., increasing the share of renewable energies or extending a cleaner mobility system
  - Enhancing the GHG storage, e.g. increasing the areal size of forest

  (www.eea.europa.eu)

What should we consider toward global warming?

- Risk: the potential for adverse consequences for human or ecological systems, recognizing the diversity of values and objectives associated with such systems.
- Vulnerability: the propensity or predisposition to be adversely affected, encompassing a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt
- Resilience: the capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation

(cited from AR6 report accessed at https://www.ipcc.ch/)

What should we set for global standard (AR6)?

- Time periods
  - Pre-industrial period: the multi-century period prior to the onset of large-scale industrial activity around 1750.
  - Reference period: 1850–1900 used to approximate pre-industrial global mean surface temperature (GMST).
  - Modern period: 1995 to 2014 in AR6
  - Three future reference periods
    - presenting climate change projections, namely near-term (2021–2040), mid-term (2041–2060) and long-term (2081–2100)

(cited from AR6 report accessed at https://www.ipcc.ch/)

What should we set for global standard (AR6)?

- Scenarios
  - To explore and investigate climate futures, climate change projections are developed using sets of different input projections of
    - GHG emissions (CO2, methane (CH4), nitrous oxides (N2O) and halocarbons)
    - aerosols or aerosol precursor emissions
    - land use change, and
    - concentrations
  - Inputs are designed to facilitate evaluation of a large climate space and enable climate modelling experiments.
  - In AR5, the input projections were referred to as representative concentration pathways (RCPs)
  - For AR6, new sets of inputs are used and referred to as shared socioeconomic pathways (SSPs) scenarios

(cited from AR6 report accessed at https://www.ipcc.ch/)

Sustainable Development Goals (SDGs)

- SDGs are a call for action by all countries to promote prosperity while protecting the planet
  - recognizing that ending poverty must go hand-in-hand with strategies that build economic growth and address a range of social needs including education, health, social protection, and job opportunities
  - tackling climate change and environmental protection

(https://www.un.org/sustainabledevelopment/)

Climate Change Impacts and Risks - observed

- Ecosystems and biodiversity
- Food systems, food security and forestry
- Water systems and water security
- Health and well-being
- Migration and displacement
- Human vulnerability
- Cities, settlements and infrastructure
- Economic sectors

(referred to AR6 report accessed at https://www.ipcc.ch/)

Climate Change Impacts and Risks - Projected

- Observed impacts +
- Risks from sea level rise
- Compound, cascading and transboundary risks

Mitigation Responses in Sectors and Systems

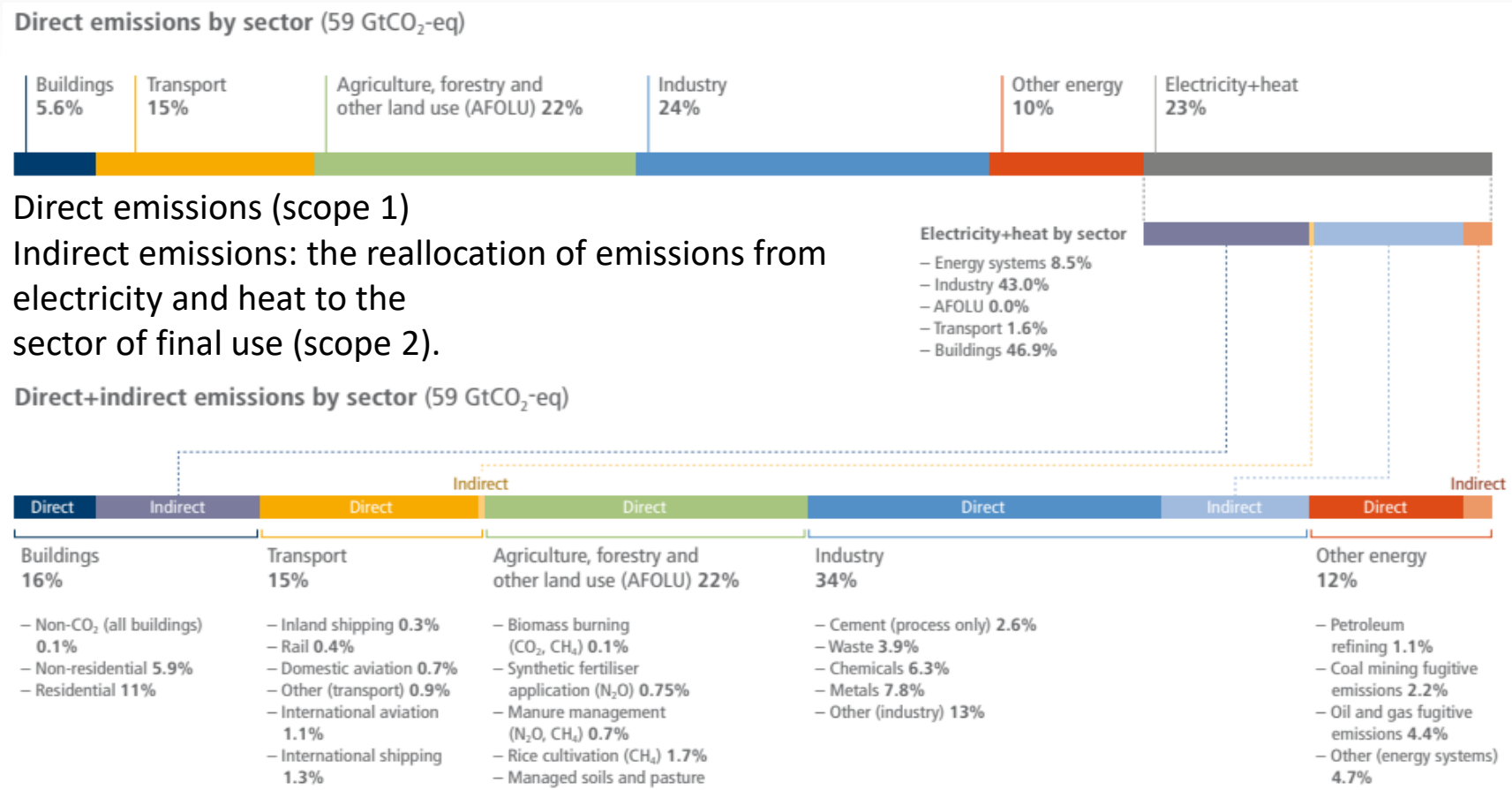
- Energies
  - The Transformation in Energy Carriers: Electrification and Hydrogen
- Urban Systems and Other Settlements
- Transport
- Buildings
- Industry
- Agriculture, Forestry, Other Land Uses, and Food Systems
- Carbon Dioxide Removal (CDR)
- Demand-side Aspects of Mitigation (e.g., Circular Economy)
- Mitigation Potential Across Sectors and Systems

Global transition to a low-carbon world – Sector issues

- Multiple low-carbon electricity generation and storage technologies have made rapid progress based on reduced costs, scale-up deployment, and improved performance but they are not are currently sufficient to meet stringent climate goals
- GHG emissions from coals has reduced since 2010 but still the global emission levels are not in the peak and regionally different.
- Deforestation has declined since 2010 but the long-term maintenance of the rates is challenging
- Electrification of public transport services have been introduced but the emission level remains roughly constant
- global transition from coal and biomass use in buildings towards modern energy carriers and efficient conversion technologies but a significant lock-in risk due to building's long lifespan
- CCUS, electricity and hydrogen for energy and feedstocks, and innovation in circular material flows but industry emissions continue to increase due to global demand in basic materials

Source: WGIII report from https://www.ipcc.ch/

Direct and indirect GHG emissions



Direct emissions (scope 1)
Indirect emissions: the reallocation of emissions from electricity and heat to the sector of final use (scope 2).

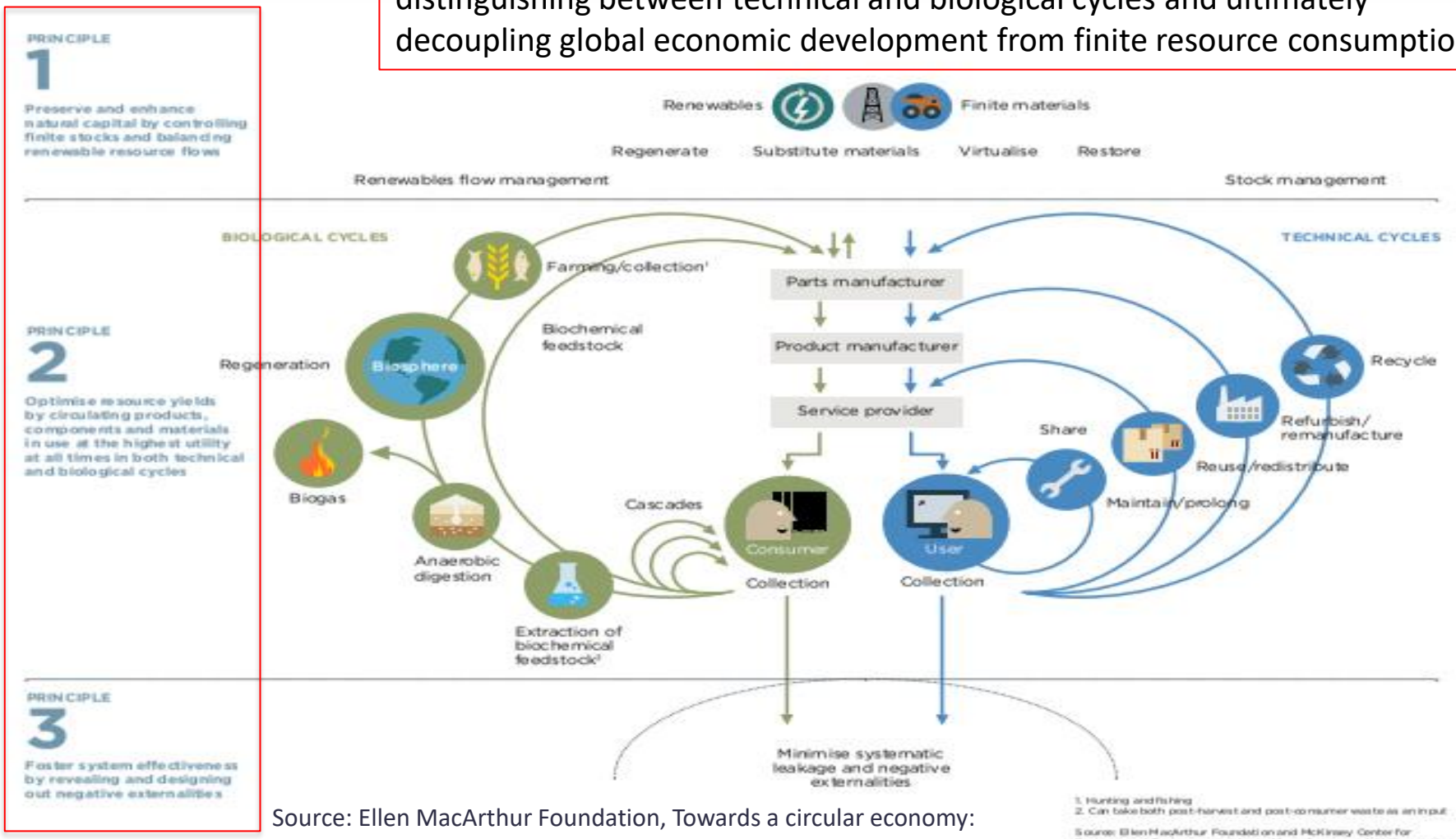
More comprehensive conceptualizations of indirect emissions including all products and services (scope 3)

Figure TS.6 | Total anthropogenic direct and indirect GHG emissions for the year 2019 (in GtCO2-eq) by sector and subsector

3. Definition of Circular Economy

What should we consider for Circular Economy?

Restorative and regenerative by design; aiming to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles and ultimately decoupling global economic development from finite resource consumption



Source: Ellen MacArthur Foundation, Towards a circular economy: Business rationale for an accelerated transition (2015)

Three main principles

- Principle 1: Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows
- Principle 2: Optimize resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles
- Principle 3: Foster system effectiveness by revealing and designing out negative externalities

Circular and Economy

- Circular vs. Linear
- Circular as Regenerative and Restorative
- Circular as a new economic value
  - No (minimal) waste
  - Diversity and balance
  - Transition (waste to price; full cost to reach social optimization)
  - New value-added
  - Renewable energy
  - Systems-thinking

Note: The main ideas combine Ellen MacArthur Foundation's report (2015) and the article of Park (2022): 지속 가능한 미래, '순환경제'에서 답을 찾아라 https://www.techm.kr/news/articleView.html?idxno=81381.

4. Case studies

10 Categorical cases

- Biodiversity
- Business
- Circular design
- Cities
- Climate
- Fashion
- Finance
- Government and Policy
- Food
- Plastic

Source: Case studies and examples of circular economy in action (ellenmacarthurfoundation.org)

What can we participate?

- Sharing economy: Fat Lama at London since 2016

  - Individual equipment that are unused can be effectively shared, based on a peer-to-peer sharing platform for technical equipment where lenders and borrowers join in a marketplace with insurance covered by Fat Lama.

  - Access to a wide range of high end equipment at an affordable rate with extra value-added from idle assets, generating a new market

Similar cases: Toronto Tool Library and Makerspace since 2012

What can we participate?

- Public procurement: Danish Environmental Protection Agency

- Public procurement: process where public authorities purchase goods and services from companies that use non-toxic chemicals, extended product lifespan, and the cycling of biological and technical materials.

- EUR 2 trillion about 19% of EU GDP and EUR 38 billion in Denmark, increasing demand for circular products and services, driving innovation, minimizing environmental degradation and saving public money, and considering the costs of the product's entire life cycle.

2050 Carbon Neutrality

Carbon zero (CZ) scenarios

- After reaching CZ, projecting the future Korea and sectoral transitions
- Guiding sectoral policies and transition periods

Considerations

- Technological innovations (low carbon process, increasing renewable energy efficiency etc.)
- Premise of perception and lifestyle change in citizens
- Considering complicated context in economic burden and benefits, food and energy security, and the historical roles in the global society
- Firm goals and principles, considering the need of periodic renewal according to the changes in circumstances
- Establishing highly feasible scenarios based on clear conditions and premises, objective data and scientific methodology

Safe and sustainable carbon-neutral Korea from the climate crisis

Net-zero 2050

<Table 1> 2050 Net-zero scenario: final GHG emission amount

	Sectors	Year 2018	Plan A	Plan B
GHG Emission reduction	Energy transformation	269.6	0	20.7
	Industry	260.5	51.1	51.1
	Building	52.1	6.2	6.2
	Transport	98.1	2.8	9.2
	AFOLU	24.7	15.4	15.4
	Waste	17.1	4.4	4.4
	Hydrogen	0	0	9
	Fugitive emission	5.6	0.5	1.3
	Total	727.7	80.4	117.3
Sink/removal expansion	Sink source	-41.3	-25.3	-25.3
	CCUS	0	-55.1	-84.6
	DAC	0	0	-7.4
	Total	-41.3	-80.4	-117.3
Net emission		686.3	0	0

(Unit: Million tons CO2eq.)

Circular Economy in Cities: 4Ps

- How to assess the effect?

-> Economic modeling

- What challenges in the future?

-> Collaborative governance model that works for a participating platform from citizens, private and public partners

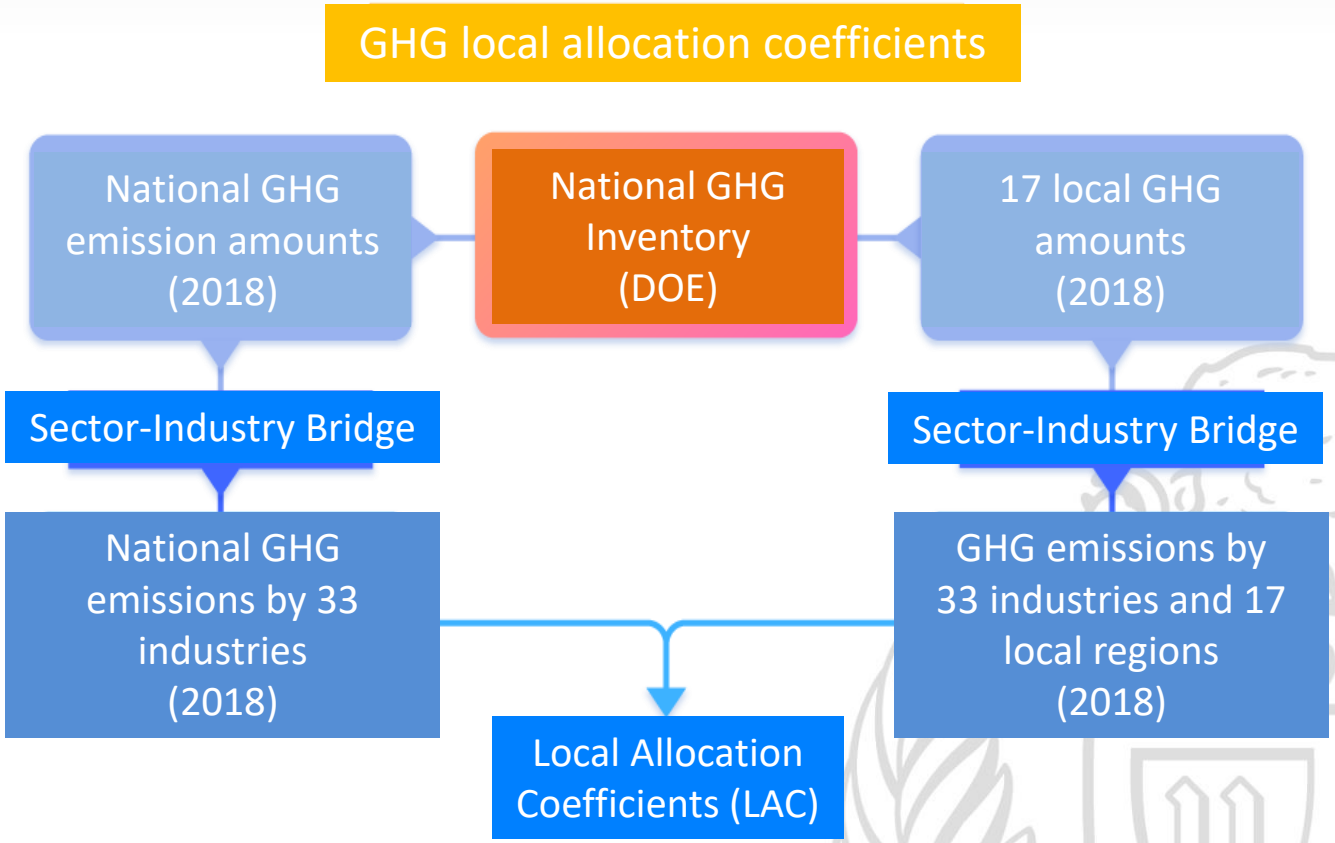
-> concentrating to a local agenda, where various technological revolution that can be prospectively adopted for mitigation and reaching carbon zero society

-> Reaching spatial justice based on hyper-connections that can generate unconstrained physical accessibilities (Harvey, 1973) and balancing regional gaps

-> Requiring local and central governments as well as other private firms and stakeholders as well as people to establishing collaborating partnership (PPPP: 4Ps) for future city and regional development strategies

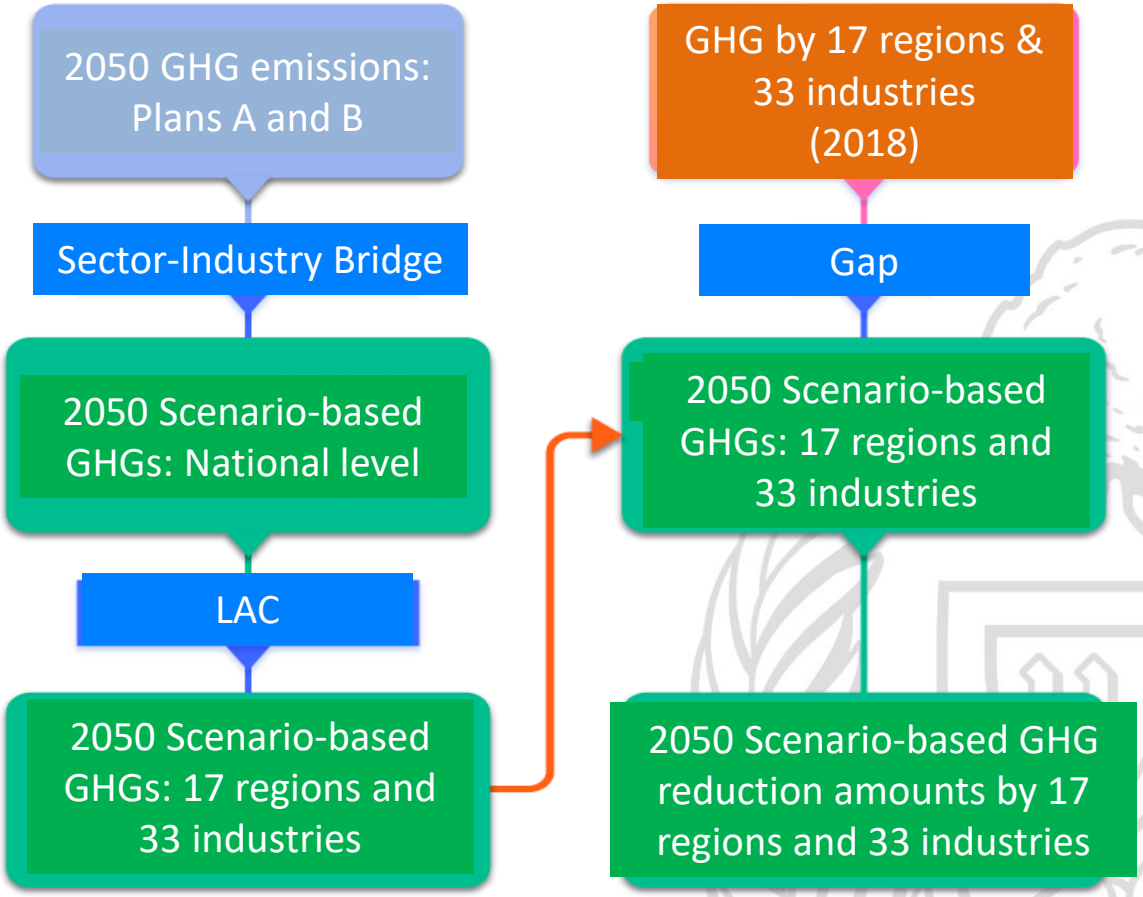
- Local economic assessment model needs

Approach:
Allocating GHG emissions by industry and local region



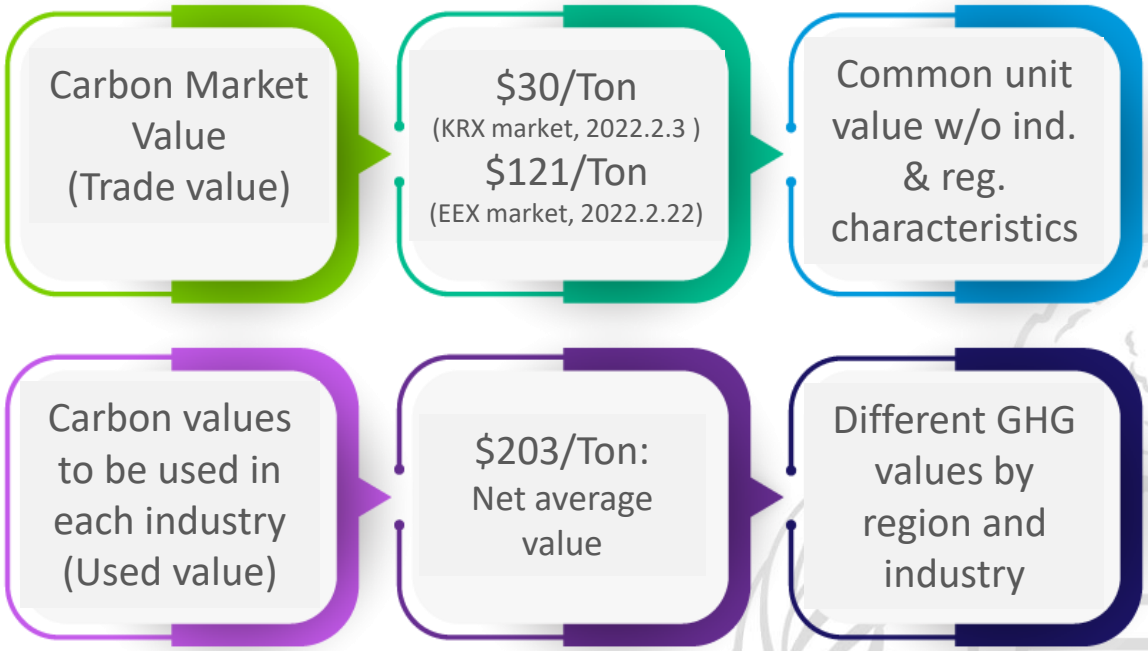
GHG reduction amounts by region and industry

GHG reduction allocation process



GHG values

Valuation process of GHGs



Results

❖ Regional Employment Impacts– Scenario B

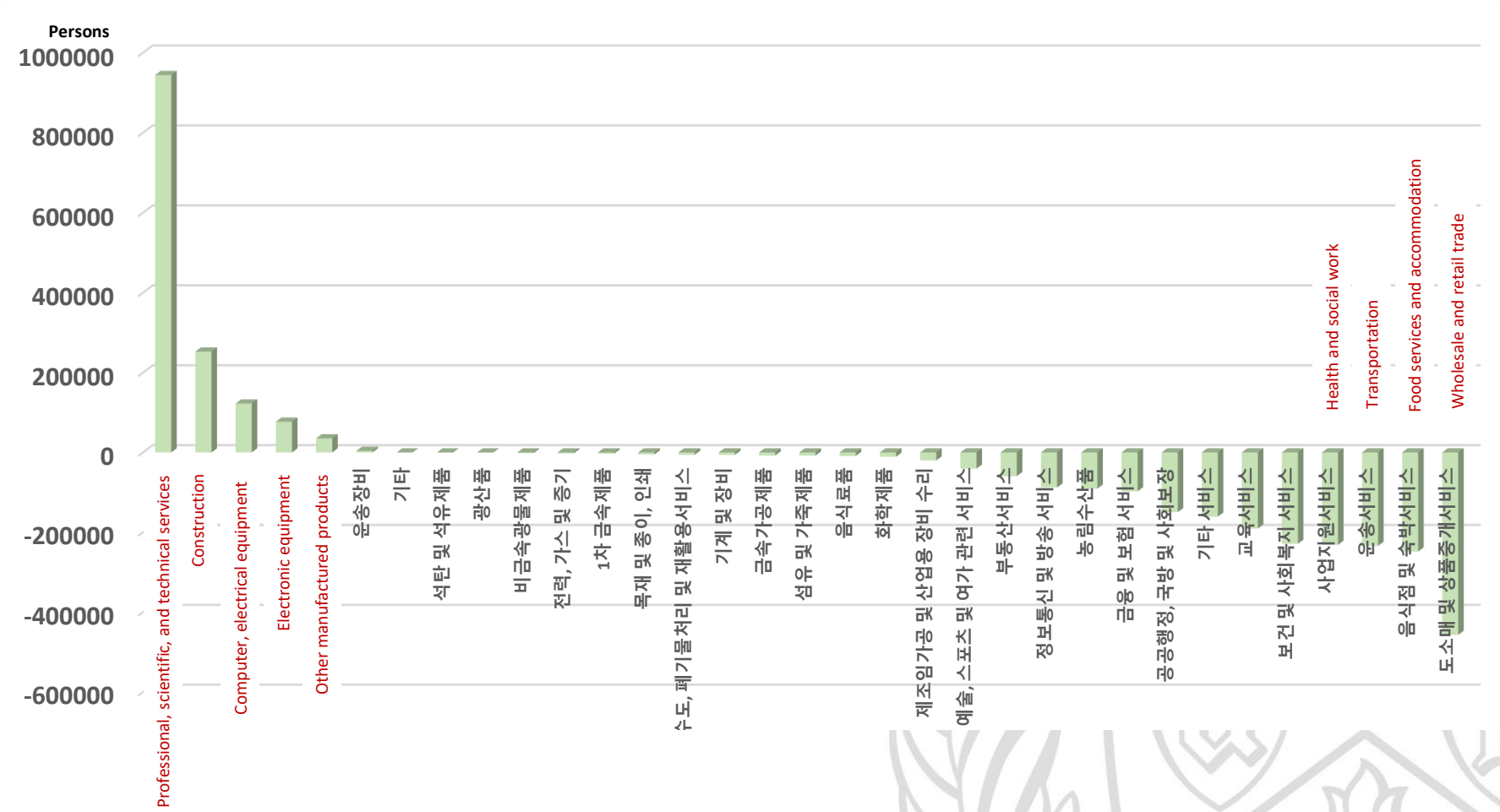
	NoAct	Net	
서울	-902,380	-222,979	75%
인천	-198,858	-30,969	84%
경기	-933,314	-205,848	78%
대전	-112,702	-39,571	65%
세종	-19,085	-1,945	90%
충북	-141,543	-35,791	75%
충남	-180,607	-9,533	95%
광주	-108,403	-22,430	79%
전북	-134,474	-37,985	72%
전남	-141,460	-19,692	86%
대구	-167,766	-53,187	68%
경북	-216,487	-65,889	70%
부산	-244,265	-71,041	71%
울산	-103,332	-8,903	91%
경남	-255,083	-54,382	79%
강원	-119,979	-27,253	77%
제주	-53,711	-15,638	71%
전국	-4,033,450	-923,037	77%

: Three largest effect regions of government investment

Unit: person

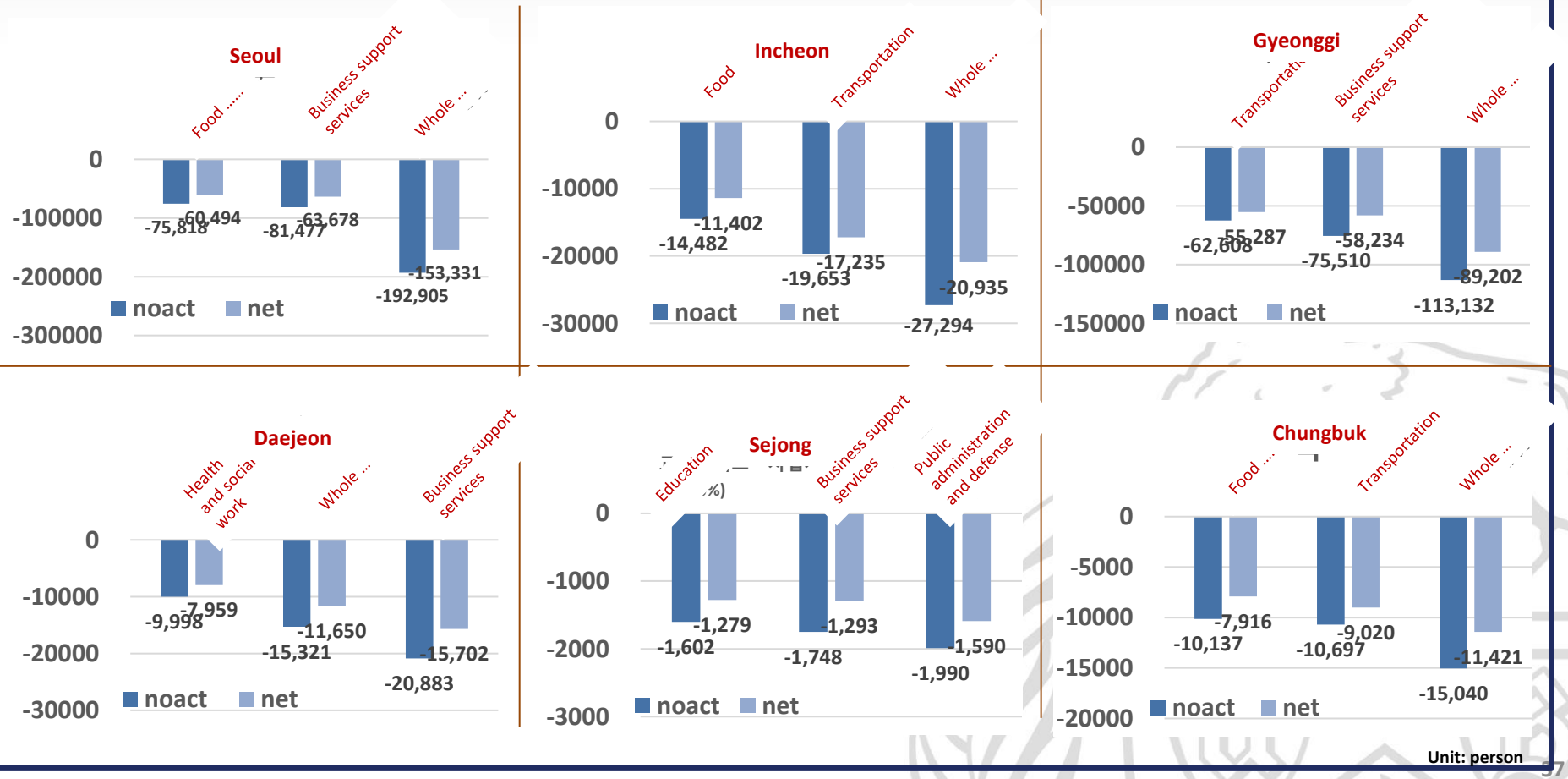
Results

❖ Net employment impacts – Scenario B



Results

❖ Regional impacts by major industries – Scenario B



Unit: person

Health and social work