

Theme: Low Carbon City Development

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HOW TO FORMULATE CARBON-FREE STRATEGY - THE CASE OF GAPADO ISLAND, JEJU, SOUTH KOREA -

Dai-Yeun Jeong

jeongdy@jejunu.ac.kr

Director of Asia Climate Change Education Center,
South Korea

Emeritus Prof. of Environmental Sociology
at Jeju National University, South Korea

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I . WHAT IS LOW CARBON?

1. Emergence Process of Low Carbon - Climate Change

(1) The Effects of Industrialization Advanced since the 18th Century

- o Positive benefits: improvement of
 - material/cultural affluence
 - convenience in everyday life
- o Negative side effects: environmental problems
- o Humans
 - committed a self-contradiction
 - a beneficiary and victim in that
“nature can exist without humans, but
humans can not survive without nature”



(2) Category of Environmental Problems

- o Local: impact on the geographic area around the source of pollution (eg. soil pollution, water pollution, etc.)
- o Global: impact at global level regardless of the source of pollution (eg. climate change, ozone depletion, acid rain, desertification, etc.)
- o Climate Change: the most serious environmental problem in terms of its impact on nature/society

(3) Source of Global Warming as the Cause of Climate Change

- o Source: natural factors and human-induced GHG emission
- o United Nations' point of view
 - Natural factor (interglacial epoch): 20%
 - Human-induced GHG: 80%
 - Impact of CO₂: 80%

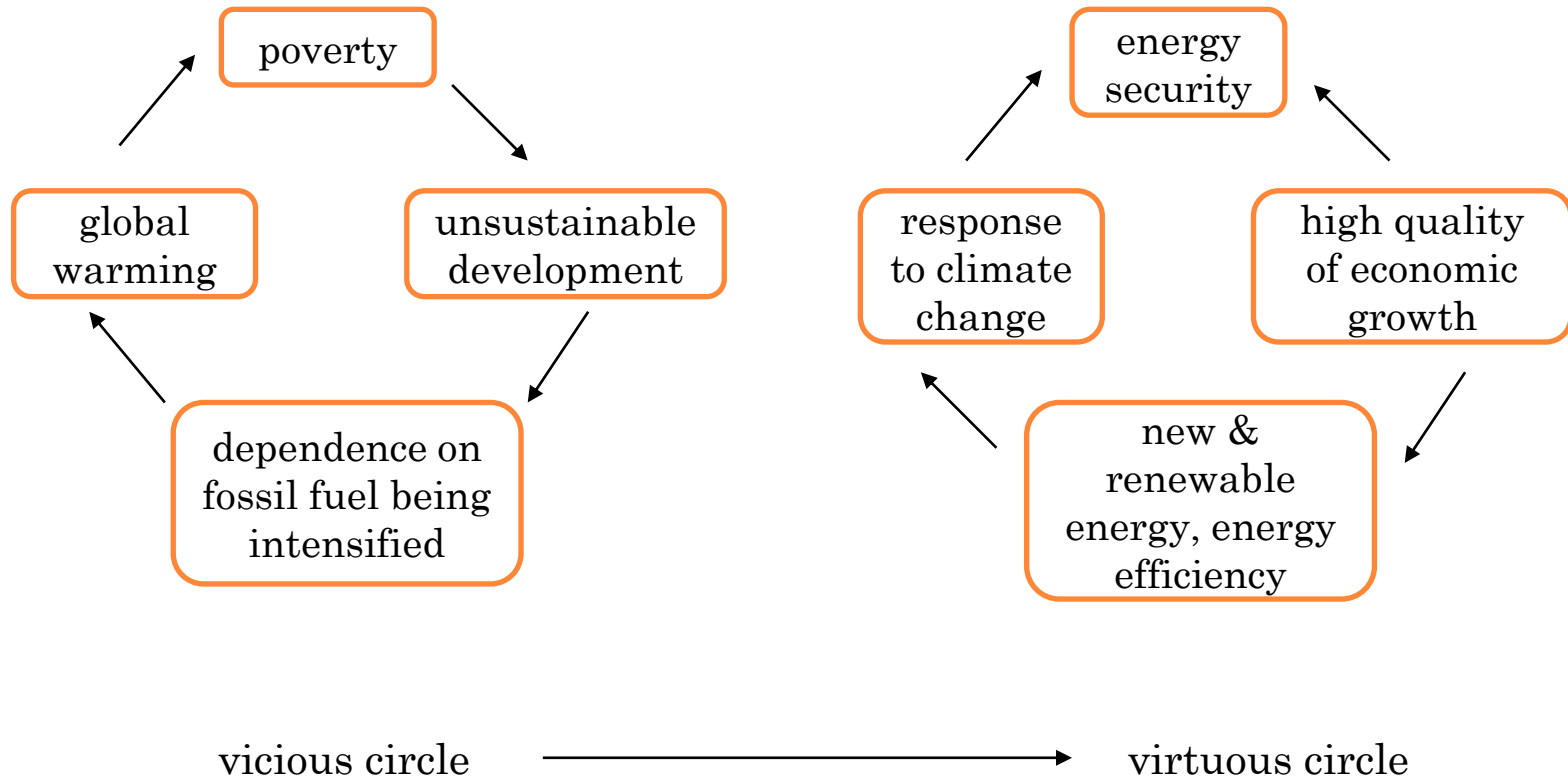


(4) Major Sources of GHG Emission

- o Production/distribution/consumption process (average at global level)
 - Industrial processing: 50%
 - Others: 20% (transportation, public sector, building, citizens' consumption process in everyday life, etc.)
- o Emission substance (average at global level)
 - Energy: 85%
 - Others: 15% (waste, livestock, etc.)
- o Major geographic source of CO₂: city
- o Resulted in the direction of future socio-economic development: low-carbon city



(5) Diagram of Shift from Vicious to Virtuous Circle



2. The Existing Approaches to Low Carbon

- o Different terminologies focusing on different strategies
 - Eco-city
 - Sustainable city
 - Green city
 - etc.
- o Examples of city-based initiatives
 - Johannesburg (South Africa)
 - Curitiba (Brazil)
 - Freiburg (Germany)
 - Stockholm (Sweden)
 - etc.



o International Awards

- Sustainable City Awards (Global Forum)
- The Global 500 Award (UNEP)
- The LivCom Awards
(The International Awards for Liveable Communities)
- EU Green Capital Award
- etc.

o Common characteristics

- Focusing on partial components of social, economic, or environmental sectors in the context of sustainable development
- Not a set of planning requisites for achieving a low-carbon city



3. Concept of and Approach to Low Carbon

(1) Concept of Low Carbon

- o Terminologies: low-carbon, carbon-zero, carbon-neutral, climate-neutrality
- o Low-Carbon
 - has its roots in the UNFCCC adopted in Rio in 1992
 - is generally used to describe forward-looking national economic development plans or strategies that encompass low-emission and/or climate-resilient economic growth, but no absolute level of reduction (eg. below 20%, on the way to zero, etc.)
 - also includes provisions to reduce vulnerability to the impact of climate change



o Carbon-Zero

- sources of CO₂ have to be converted to run on zero carbon emitting energies
 - no more carbon emissions being added to the atmosphere
 - natural carbon balance that existed before industrialization
- thus, 'actual carbon-zero' is not possible
- but, the best that we can achieve is
 - 'virtual zero emission' (at least a 90% reduction)
 - 'negative carbon emission' (artificial carbon sink by tree planting, carbon capture and storage, etc.)
- true carbon zero is
(virtual zero carbon) + (some negative carbon)



o Carbon-Neutral

- removing as much carbon from the atmosphere as we put in → achieving net zero carbon emission
- the overall goal is to achieve a zero carbon footprint
- approach to zero carbon footprint
 - carbon offset: eg. wind farm, solar park
 - buying enough carbon credits to make up the difference
 - industrial process such as production of carbon neutral fuel
 - reducing and/or avoiding carbon emission
 - unavoidable emissions are offset

o Climate Neutrality

- net change to atmosphere 0 ton
- through low-carbon, carbon-zero, or carbon-neutral



(2) Approach to Low Carbon/Carbon-Free/Carbon-Neutral

o Overall direction

- Minimizing the level of dependence on fossil energy use
- Using the sources of renewable energy
- Maximizing energy efficiency
- Sinking/removal/sequestration of carbon emitted

o Sectors to be included

- land-use
- green space
- water
- energy
- waste
- transportation
- ecology
- wind
- living environment



4. Agents Responding to Climate Change

(1) Government: climate change policy

- o adaptation measure
- o mitigation measure

(2) Commercial Enterprise: green management (eco-efficiency)

- o saving of resources and energy
- o improvement of resource and energy efficiency

(3) Citizen: environmentally friendly behavior in everyday life

- o quality of life: consumerism → environmentalism
- o saving of resources and energy

(4) Civil Organization: intermediate group

- o pressure group to government/commercial enterprise
- o educator to citizen

(5) United Nations: Climate Change Convention

- o climate change: a global environmental problem
- o cooperation and co-action among nations



II. INTRODUCTION TO JEJU AND GAPADO ISLAND

1. Jeju Island

(1) The Profiles of Nature

o Location





o Geological and Ecological Profiles

- Area: 1,800km² (1.0% of whole South Korea)
- Unique geological features as a volcanic island
- Source of rich biological diversity
 - overall, subtropical climate
 - rich biological diversity in both the terrestrial and marine
- Having earned triple crown from UNESCO
 - 2002: Biosphere Reserve
 - 2007: World Natural Heritage
 - 2010: Global Geopark
- Four Ramsar Wetlands
- 2011: a New 7 Wonder of Nature



(2) The Profiles of Socio-Economy

Sectors		Year	1998	2003	2008	2013
		Population	543,715	553,864	543,200	604,670
Tourists (million)		3.291	4.913	5.822	10.851	
GRDP (million USD)		4,608	6,786	8,833	11,978	
Industry Origin of GRDP	Primary Industry	24.2%	16.1%	17.6%	16.2%	
	Secondary Industry	16.2%	18.0%	12.1%	3.7%	
	Tertiary Industry	59.6%	65.9%	70.3%	80.1%	
	Total	100.0%	100.0%	100.0%	100.0%	
GRDP per Capita (USD)		8,617	12,252	16,261	19,809	



2. Gapado Island

- o Area: 0.9km² (0.05% of the entire Jeju Island)
- o 16 - 8m from sea level
- o Population: 245
- o Household: 126
- o Major industry: Fishery
- o Land use
 - Farmland (740,223m²: barley, bean, sesame)
 - Naked land (135,964m²)
- o Tourism resources: fishing, landscape, ancient ruins (dolmen, etc.)



III. 2030 CARBON-FREE STRATEGIES ON GAPADO ISLAND

1. Introduction to the Project

- o Promotion agent: Jeju Government in cooperation with
 - Korea Electric Power Corporation
 - Korea Southern Power Co. Ltd.
 - Shin Kobe Electricity
 - Woojin Industrial Systems Co. Ltd.
- o Vision: Environmental conservation by energy self-sufficiency
- o Goal: Carbon free island by 2030
- o A project included in World Environmental Hub
- o Project period: 19 years (2012 - 2030)
- o The process of establishing the strategies
 - Estimation of greenhouse gas emission
 - Introduction of governance system to decision-making process
 - Efficiency analysis of financial investment
 - Establishment of strategies



2. The Process of Establishing Strategies

(1) Estimation of Greenhouse Gas Emission (as of 2013)

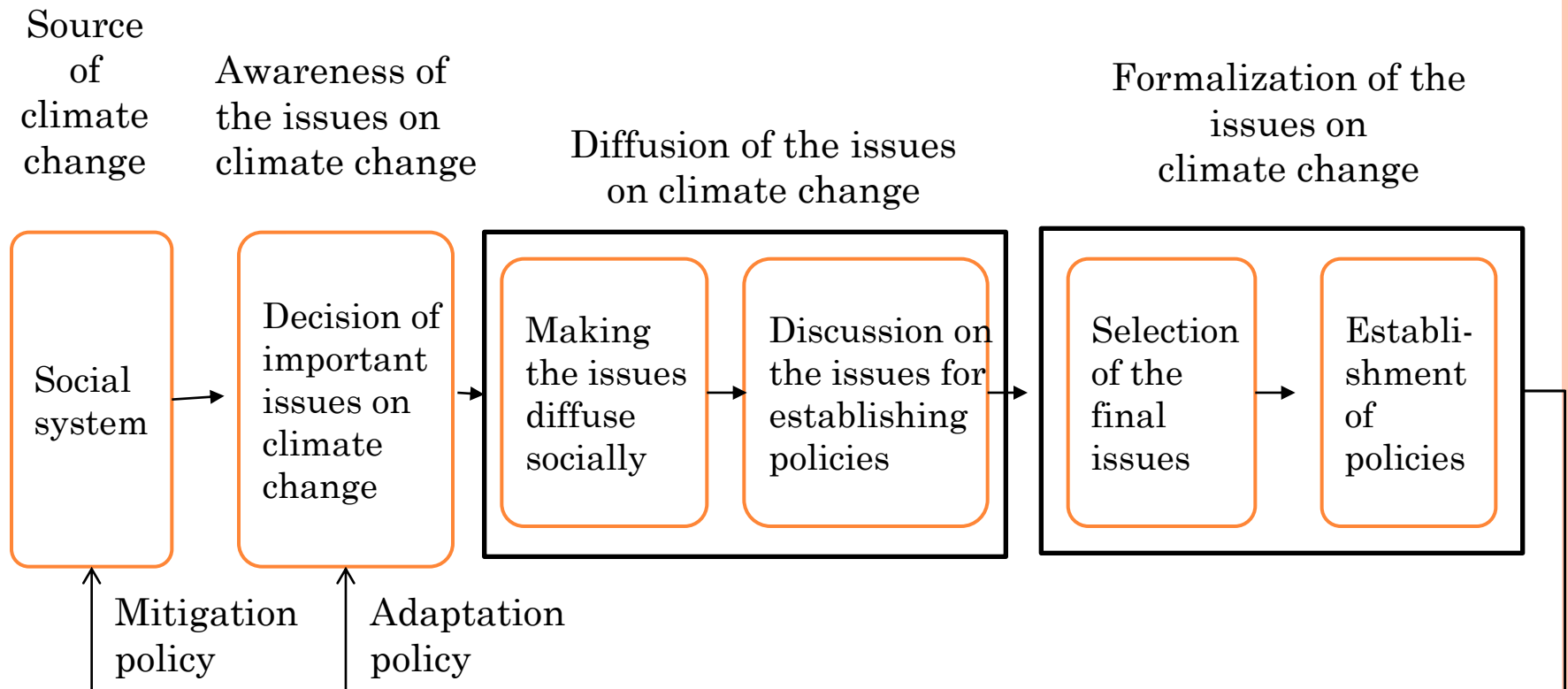
Source	Annual Supply	Consumer	Emission (CO ₂ -eq)
Thermal Power Generation	1,093MWh	Household, desalination, social facilities (school, etc.)	$1,092\text{MWh} \times 0.424\text{t} = 463\text{t}$
Diesel	2,880,000ℓ	30 fishing boats 5 agricultural machine	$2,880,000\ell \times 0.0028\text{t} = 8,064\text{t}$
Total			8,527t (A)
Source			Sink
Farmland			$1.63 \times 10 \times 74.0223\text{ha} = 1,207\text{t (B)}$
Net Emission			A-B=7,320t

IPCC default emission indicator

10: the coefficient of net production per ha (storage of organic in plant from photosynthesis)



(2) Introduction of Governance System to Decision-making Process



- o Purpose: Internalization of conflict
- o Major participants in governance system
 - Experts
 - Civil organizations
 - Residents
 - Stakeholders
- o Decision on what stage of decision-making process to invite the participants
 - Decision of important issues on climate change
 - Discussion on the issues for establishing policies
 - Selection of the final issues
 - Establishment of policies



(3) Efficiency Analysis of Financial Investment

Source of Alternative Energy	2010 Cost of Production (USD/kWh)	2010 Cost of Production (USD/kWh)	2035 Cost of Production (USD/kWh)
A	0.4319	0.2850	0.2635
B	0.1057	0.1592	0.1592
C	0.1502	0.1494	0.1449
D	0.2599	0.2350	0.2115
E	0.0544	0.0498	0.0443
F	-	0.1360	0.1292
G	-	0.0298	0.0224
H	0.3028	0.2897	0.2710
I	-	0.0623	0.0641
Average	0.2175	0.1552	0.1456

A: Sunlight Generation

B: Wind Power

C: Water Power

D: Biogas

E: Landfill Gas

F: Refuse Derive Fuel

G: By-Product Gas

H: Fuel Cell

I: Integrated Gasification

Combined Cycle

o Function: a guide for the decision of policy priority



o Other example: World Environmental Hub

Policy Implemented	Budget (million in USD)	Reduction Volume (ton)	Budget for Reducing 1 ton (USD)
Afforestation (6,500ha)	93	38,350	2,430
Supply of Clean Energy	104	227,372	460
Substitute of Traffic Signal with LED	3	9,735	310



(4) Establishment of Strategies

- o Turning the naked land into grassland
 - Carbon sink: $1.63 \times 12(\text{net production}) \times 13.5964\text{ha} = 266\text{t}$
- o Having constructing winder power (1,182.6MWh) in 2014
 - Supplying for households, desalination, and social facilities
 - Reduction of GHG: $1,182.6\text{MWh} \times 0.424 = 502\text{t}$
- o Substitute of diesel engine power with electricity (fishing boat and agricultural machine)
 - Fuel efficiency of electric vehicle: 17kW per hour
 - Fuel efficiency of fishing boat: 36ℓ(11 hours a day)
 - Electricity necessary for substitute of diesel engine power with electricity one: $2,800,00\ell / 36\ell \times 17\text{kWh} = 1,360\text{MWh}$



3. Roadmap for Promoting the Strategies

(1) Net Carbon Emission in 2013 (net emission: 7,320t)

- o Carbon emission(thermal power generation and diesel): 8,527t
- o Carbon sink (farmland): 1,207t

(2) Promotion: by 2015 (net emission: 6,552t)

- o Constructing wind power (1,182.6MWh) in 2014
 - Reduction: 502t
 - Budget: USD2.4 million
- o Turning naked land into grassland
 - Reduction: 266t
 - Budget: USD53,000

(3) Promotion: 2016-2017 (net emission: 6,552t)

- o Completing the construction design of wind power
 - Supply capacity: 1,360MWh
 - For substitution of diesel engine power with electricity one (diesel consumption: 2,880,000ℓ)



(4) Promotion: 2018-2019 (net emission: 6,552t)

- o Completion of wind power construction (1,360MWh)
- o Budget: USD4.00 million

(5) Promotion: 2020-2029 (toward carbon free)

- o Replacement of diesel engine power with electricity one
 - Cost: USD50,000 per engine power
 - Total cost (35 diesel engine power): $USD50,000 * 35$
=USD1.75 million

o Security of budget

- 30% from central government
- 30% from Jeju government
- 40% from private owner (USD20,000 per owner)

(6) Realization of carbon free island from 2030

- o A problem to be solved: economically poor private owners
 - If not replace
 - How to overcome this problem



IV. OVERCOMING THE CONSTRAINTS (CAPACITY BUILDING)

1. Internal Capacity Building

- o Increase in financial capacity
- o Development of advanced technology
- o Construction of cooperative network with
 - Enterprises: voluntary green management
 - Civil organizations: environmental movement
 - Mass media: public advertisement
 - Citizens: environmentally friendly behavior
- o Internal governance system in the process of decision-making
- o Change in current socio-economic system to a new one
 - Economy: production/distribution/market system
 - Citizens: lifestyle (purchase/consumption behavior)
 - Cultural ethos: consumerism → environmentalism



2. External Capacity Building

- o Climate change: A global environmental problem
- o Establishment of cooperative network with other domestic local/central governments and/or overseas countries
- o Sharing mutual understanding on
 - Seriousness of climate change
 - Necessity of collaborative response to climate change
 - Effectiveness of collaborative response to climate change, etc
- o Information exchange
 - The state of climate change
 - Data related to climate change
 - Data/information/education program necessary for climate change education, etc
- o Collaborative activities
 - Mutual personnel exchange of administrative/professional staffs
 - Collaborative research
 - Holding professional academic conferences on a joint base, etc



Thanks a lot for your listening

