Policy Measures to Promote Bio-plastics Industry

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A preparation for reducing CO2 emission in energy sector has been progressed in various areas. We have achieved many developments in renewable energy, nuclear energy, fission energy, hydraulic energy, etc. However, efforts or attentions to decreasing CO2 emission in material sector were not sufficient. Bio-plastics could be a one way to contribute to reduce green house gas (GHG) emission and it also can decrease the reliance on fossil fuel in material sector

Research Question I
- How effectively can bio-plastics industry contribute to reduce environmental negative externality (green house gas) ?

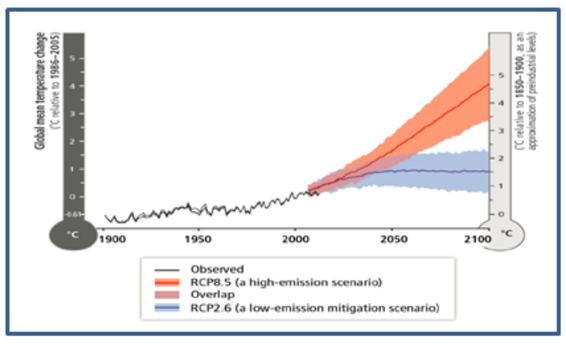
Research Question II
- [Government Driven Promotion] What is the reasonable amount of subsidy for bio-plastics industry in the social welfare's point of view?

Research Question III
- [Market Driven Promotion] How effectively can private sectors which do business with bio-plastics invade the conventional plastics market? (Based on consumer's purchasing intention)

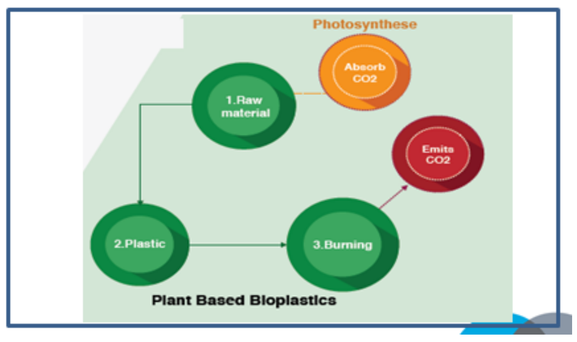
The necessity of bio-plastics upbringing policy

- ***Climate change issue & Carbon life cycle of bio-plastics :*** Due to human activity, concentration of CO2 in atmosphere keeps increasing. It aspects 'Global Mean Temp Rise'. Increasing magnitudes of warming increase the likelihood of severe, pervasive, and irreversible impacts. **Biobased plastics** use renewable or biogenic carbon as a building block. This biogenic carbon is captured from the atmosphere by plants during the growth process and converted into the required raw materials. cycled in a closed biogenic CO2 loop, referred to as being carbon-neutral

Global Mean Temp Rise



Carbon life cycle of bio-plastics



[Reference] IPCC WGII AR5 Summary for Policymakers

Research Question I
- How effectively can bio-plastics industry contribute to reduce environmental negative externality (green house gas) ?

Domestics bio-plastics market

Domestics bio-plastics market size

DEMAND by Type (Korea)	Demand(=Production + Net import)			
	2003	2008	2013	2018
Plastic Demand (ton, X 1000)	3,850	5,290	6,500	7,800
Share of bio-plastics (%)	-	0.076	0.231	0.513
Bio-plastics Demand(ton, X 1000)		4	15	40
By Type :				
Biodegradable		3	5	12
Polylactic Acid		1	2	5
Other bio-Plastics		2	3	7
Non-Biodegradable		1	10	28
Unit Price($/kg)	4.9	3.95	2.9	2.65
Korea Bioplastics Demand(m$)		15.8	43.5	106

* source : The Freedonia Group(2011), WORLD BIOPLASTICS

Quantifying environmental externalities reduction By bio-plastics in South Korea

Comparison of CO2 emission

Type of Polymer	Petro-plastics					Bio-plastics		
	LDPE	HDPE	PP	PET	PS	PHB	PLA	TPS
CO2 emissions (KgCO2 / Kg polymer)	1.7~3.0 (Avg.2.4)	2.5	1.7~3.0 (Avg.2.4)	2.0	2.2	2.6	0.5~1.8 (Avg.1.2)	1.14

Quantifying environmental externalities reduction By bio-plastics in South Korea

- **Assumption of CO2 Emission Reduction Calculation**: In order to calculate CO2 Emission Reduction by using bio-plastics, three assumptions are established.

1. **Using data of the Freedonia Group(2011) for bio-plastics 1 demand in South Korea**
2. **CO2 emissions reduction is difference between Petro-plastics and Bio-plastics.**
3. **Difference between Petro-plastics and Bio-plastics is average of Max and min value. (because lack of information on replacement and complexity)**
4. **Social cost CO2 emission is Carbon price (10,000원/tCO2) (한국 배출권거래제 최소 가격)**

Calculating CO2 emission reduction in domestic area thanks to bio-plastics technology

	Demand for Bio-plastics (ton)			Potential CO2 emission reduction (ton CO2 / ton Bio-plastics)				CO2 emission reduction by Bio-plastics (ton CO2)		
	2008	2013	2018	Type of Polymer	Max	Min	Average	2008	2013	2018
Biodegradable	3000	5000	12000	TPS	1.36	0.86	1.11	3330	5550	13320
Polylactic Acid	1000	2000	5000	PLA	1.3	0.8	1.05	1050	2100	5250
Other bio-Plastics	2000	3000	7000	PHB	-0.1	-0.6	-0.35	-700	-1050	-2450
Non-Biodegradable	1000	10000	28000	*PLA	1.3	0.8	1.05	1050	10500	29400
							Total	4730	17100	45520

Research Question II
- [Government Driven Promotion] What is the reasonable amount of subsidy for bio-plastics industry in the social welfare's point of view?

	2008	2013	2018
CO2 emission reduction by Bio-plastics (ton CO2)	4,730 ton	17,100 ton	45,520 ton
Environmental Externalities Reduction (KRW)	₩47,300,000	₩171,000,000	₩455,200,000
Environmental Externalities Reduction per bio-plastics (KRW/ton)	₩6,757.14	₩8,550.00	₩8,753.85

Research Question III
- [Market Driven Promotion] How efficiently can private sectors which do business with bio-plastics invade the conventional plastics market? (Based on consumer's purchasing intention)

Market selection and Expected cost analysis

- Water bottle price ₩1,000
- Bioplastic water bottle price ₩1,026
  - PET, 30g/bottle
  - PET $1,500/Ton, Bio-PET $1,900/Ton
  - ($1,900 - $1,500) / 1,000 * 30g * Uncertainty factor 2 = ₩26

- A laptop computer price ₩1,000,000
- Bio PC price ₩1,002,000
  - Polycarbonate 300g/computer
  - Polycarbonate $2,400/Ton, Bio-polycarbonate $3,800/Ton
  - ($3,800 - $2,400) / 1,000 * 300g * Uncertainty factor 4 = ₩1,848

- A set of food containers price ₩37,500
- Bioplastic food containers price ₩39,180
- Polypropylene(PP), 900g/set
  - Price of PP : ₩1,873/kg, PLA : ₩3,746/kg
  - PLA/PP 50% blending : (PLA/PP 50% ₩2,810 - ₩1,873) / 1,000 * 900g * Uncertainty factor 2 = ₩1,680

- A car price ₩17,000,000
- Bioplastic vehicle price ₩17,600,000
- Plastic using about 14~130kg
  - Plastic price $1,482/Ton, Bioplastic price double
  - (14+130) / 2 * 1,482 / 1,000 * Uncertainty factor 5 = ₩586,872

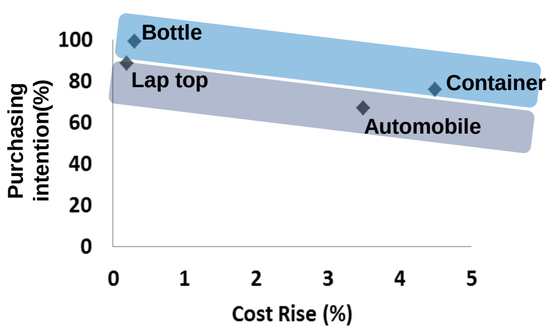
Consumer Survey

- CVM – Bidding Game for eliciting WTP
- Stepwise Multiple Regression

Demographics

- Female: 60, Male: 64
- Age: Min 21 ~ Max 64
- Program: Qualtrics

Survey Results



Mkt Seg.	Cost Rise (%)	Mkt Size (%)	Factor
Bottle	0.3	99.2	Well being/Climate
Container	4.5	75.8	Well being/Climate
Lap top	0.2	88.7	Well being/Climate/ New tech
Automobile	3.5	66.9	Well being / New tech

Conclusion
- CO2 emission reduction (2013) : 17100 ton CO2
- The reasonable amount of subsidy : about ₩8,550/ton.
- Market : Cost ➔ Low-end product (packaging) ➔ High-end product
- Most important factor affecting WTP is Well being.

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