

A green input-output model and social accounting matrix

Contributions to the IGEM

Dr. Xin Zhou

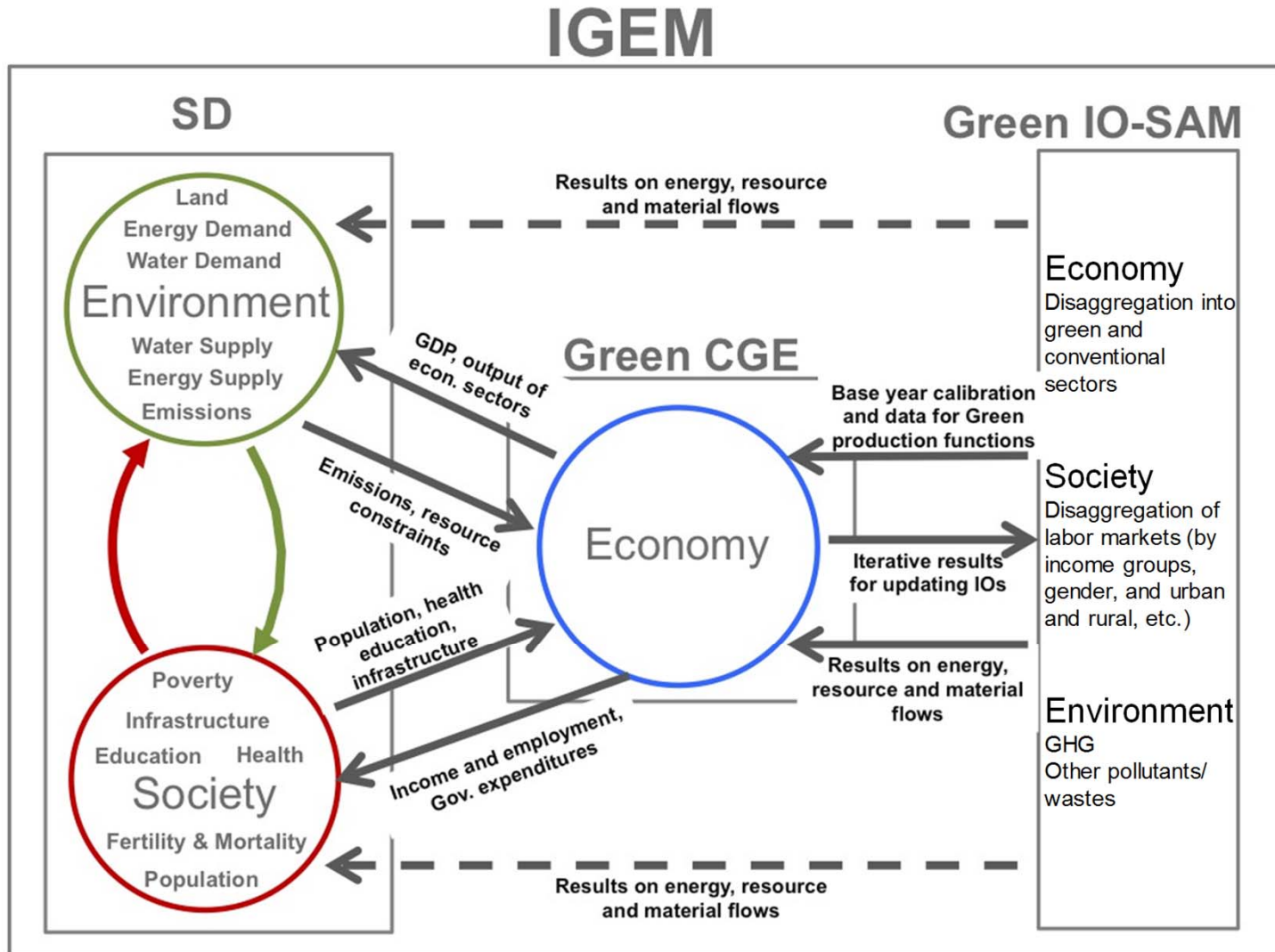
Principal Policy Researcher and Leader of Green Economy Area
Institute for Global Environmental Strategies (IGES)



***Technical Workshop on Designing an Integrated Green Economy
Modelling (IGEM) tool for informing green economy policy making
processes, 22 April 2016, UNEP, Geneva***

IGES
Institute for Global
Environmental Strategies

Overview: A green IO-SAM in the IGEM framework



Fundamentals of an input-output model

➤ The framework of an IO model

An IO model is an economic accounting framework which presents the inter-industry transactions in terms of monetary values of the flows of products from each of the producing sectors (as a seller) to each of the purchasing sectors (as a buyer).

		Purchasing sectors					Final demand				Total outputs (X)
		l	...	j	...	n	c	i	g	e	
Producing sectors	l	x_{ll}	...	x_{lj}	...	x_{ln}	c_l	i_l	g_l	e_l	X_l
	\vdots	\vdots		\vdots		\vdots	\vdots	\vdots	\vdots	\vdots	
	i	x_{il}	...	x_{ij}	...	x_{in}	c_i	i_i	g_i	e_i	X_i
	\vdots	\vdots		\vdots		\vdots	\vdots	\vdots	\vdots	\vdots	
	n	x_{nl}	...	x_{nj}	...	x_{nn}	c_n	i_n	g_n	e_n	X_n
Value-added (v')		v_l	...	v_j	...	v_n	v_c	v_i	v_g	v_e	V
Imports (m)		m_l	...	m_j	...	m_n	m_c	m_i	m_g		M
Total inputs (X)		X_l	...	X_i	...	X_n	C	I	G	E	

➤ The basics of an input-output analysis

$$X = AX + F \qquad X = (I - A)^{-1} F = BF$$

Input-output model, social accounting matrix and CGE

➤ Social accounting matrix

A Social Accounting Matrix (SAM) is a double-entry economy-wide data framework representing the economy of a nation with incomes located along its row and the expenditures along its column.

		Activity			Factor		Indirect Tax		Final Demand			External	Total								
		<i>I</i>	...	<i>n</i>	Capital	Labor	Domestic indirect tax	Import tariffs	Household	Government	Investment	Exports									
Activity	<i>I</i>	Intermediate inputs									Exports	Activity income (gross output)									
	⋮																				
	<i>n</i>																				
Factor	Capital	Value-added from capital services											Factor income								
	Labor	Value-added from labor services																			
Indirect Tax	Domestic indirect tax	Production tax											Tax revenue								
	Import tariffs	Import tariffs																			
Final Demand	Household				Factor income to households								Household income								
	Government						Government revenue from production taxes	Government revenue from import tariffs	Government revenue from direct taxes on households				Government income								
	Investment								Household savings	Government savings		External savings	Savings								
External		Imports											Foreign outflow								
Total		Activity costs (gross input)			Factor expenditures		Tax expenditure		Household expenditures	Government expenditures	Investment	Foreign inflow									

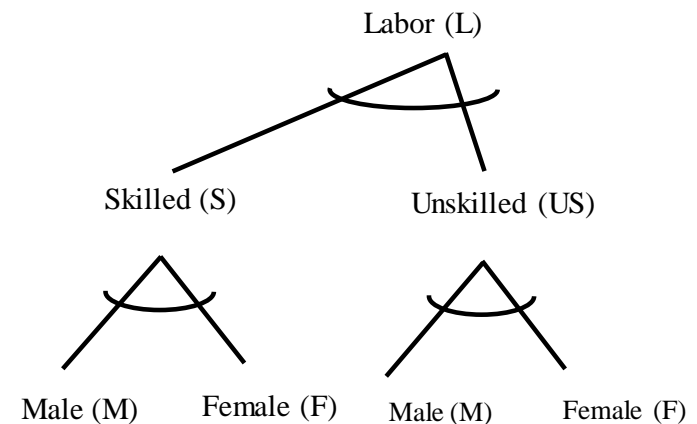
Features of a green IO-SAM

➤ Greenness: Green sectors vs. conventional sectors

*e.g. Renewable energy vs. fossil fuel-based energy
Recycling sector
Sustainable agriculture and forestry, etc.*

➤ Social inclusiveness: Disaggregated labour markets

*e.g. different income groups
gender groups
urban vs. rural, etc.*

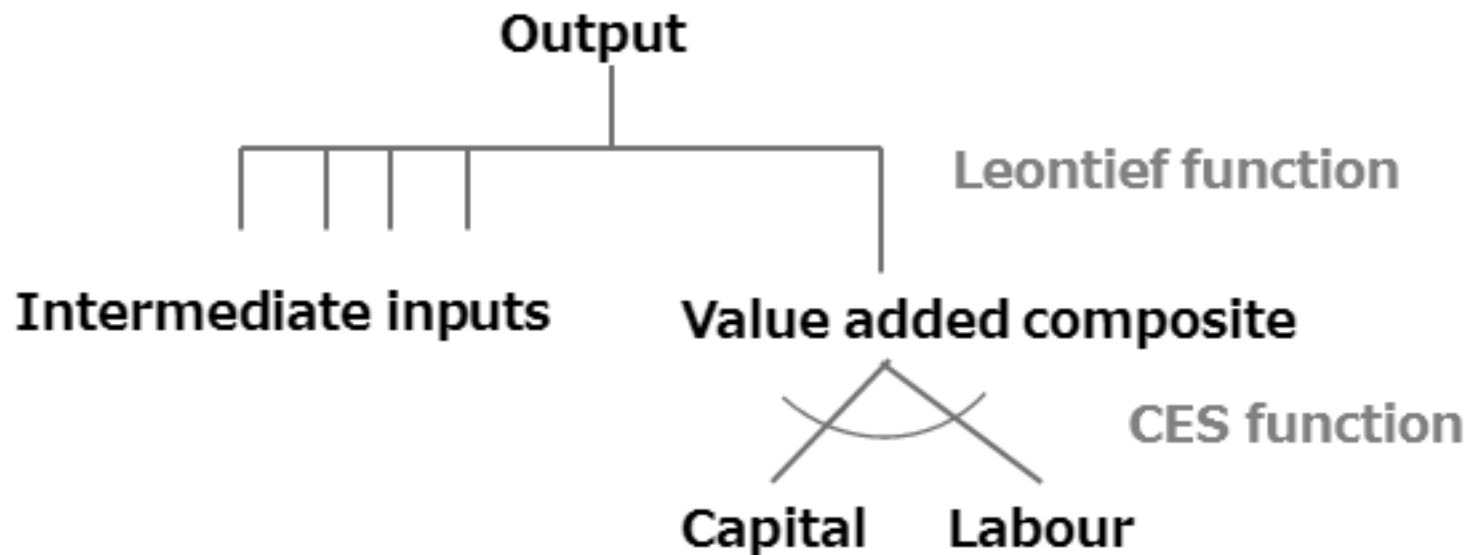


➤ Environmental extensions

e.g. Carbon footprints accounting from consumer perspective

Linking the green IO-SAM with the CGE

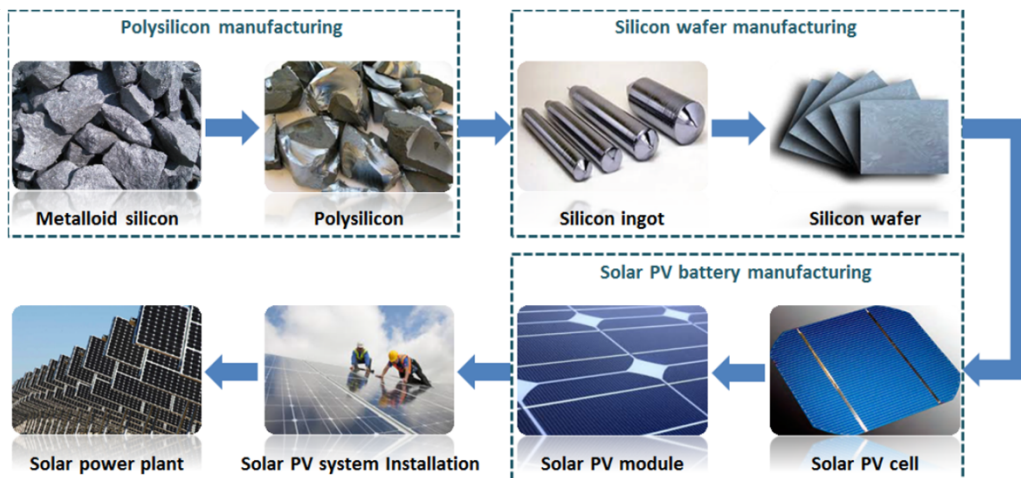
- **Green IO-SAM as the basic database for an empirical CGE**
 - IO-SAM is used to build the production function of different sectors including the green sectors;
 - The base-year SAM is used to estimate coefficients and exogenous variables;



Steps towards constructing a green IO-SAM

➤ Step 1: A green IO model

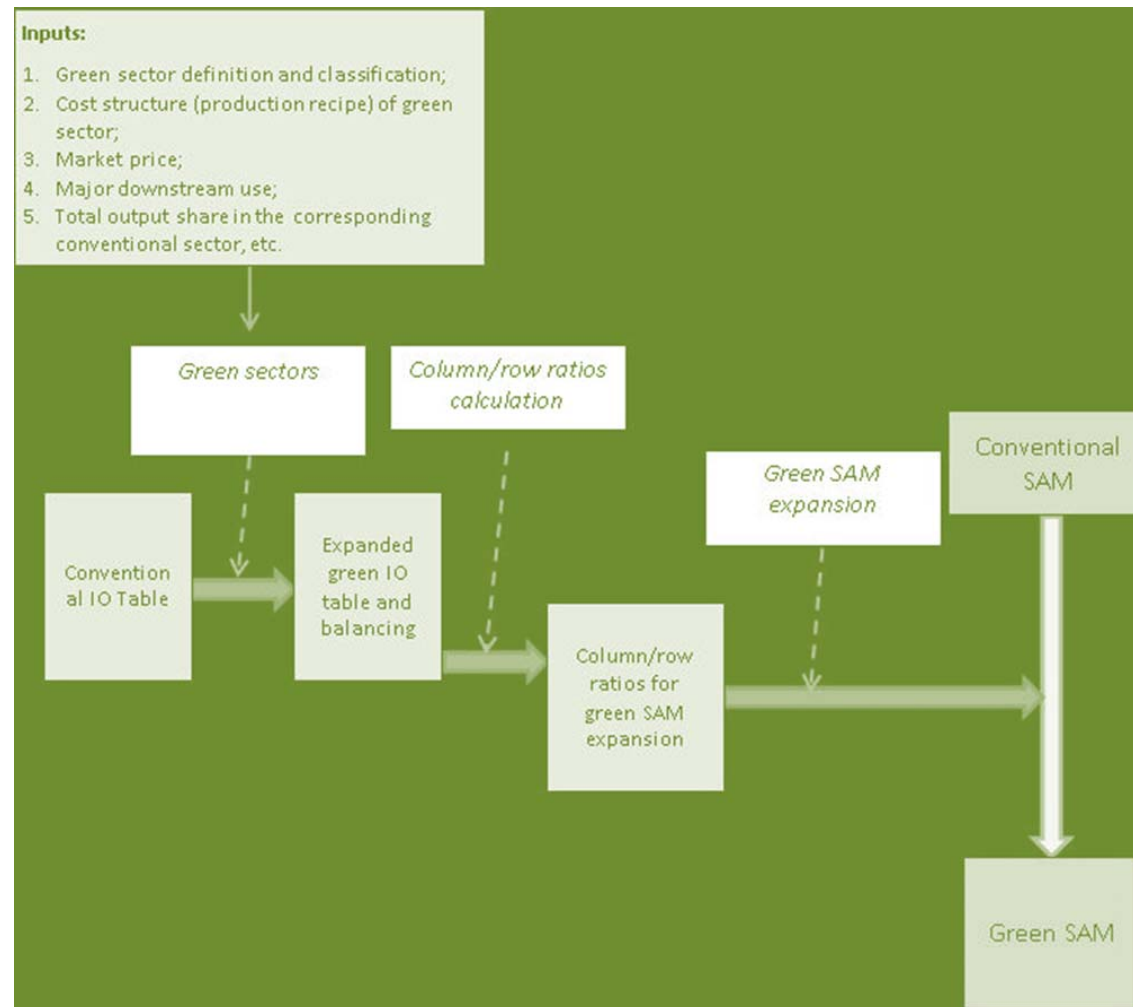
		Purchasing sectors						Final demand				Total outputs (X)
		1	...	j	...	n	$n+1$	c_1	i_1	g_1	e_1	
Producing sectors	1	x_{11}	...	x_{1j}	...	x'_{1n}	$x'_{1,n+1}$	c_1	i_1	g_1	e_1	X_1
	\vdots	\vdots		\vdots		\vdots	\vdots	\vdots	\vdots	\vdots	\vdots	\vdots
	i	x_{i1}	...	x_{ij}	...	x'_{in}	$x'_{i,n+1}$	c_i	i_i	g_i	e_i	X_i
	\vdots	\vdots		\vdots		\vdots	\vdots	\vdots	\vdots	\vdots	\vdots	\vdots
	n	$x'_{n,1}$	...	x'_{nj}	...	$x'_{n,n}$	$x'_{n,n+1}$	c'_n	i'_n	g'_n	e'_n	X'_n
	$n+1$	$x'_{n+1,1}$	...	$x'_{n+1,j}$	...	$x'_{n+1,n}$	$x'_{n+1,n+1}$	c'_{n+1}	i'_{n+1}	g'_{n+1}	e'_{n+1}	X'_{n+1}
Value-added (v')		v_1	...	v_j	...	v'_n	v'_{n+1}	v_c	v_i	v_g	v_e	V
Imports (m)		m_1	...	m_j	...	m'_n	m'_{n+1}	m_c	m_i	m_g		M
Total inputs (X)		X_1	...	X_i	...	X'_n	X'_{n+1}	C	I	G	E	



- ✓ Follows a supply chain approach;
- ✓ EGSS vs. greening the production and process

Steps towards constructing a green IO-SAM

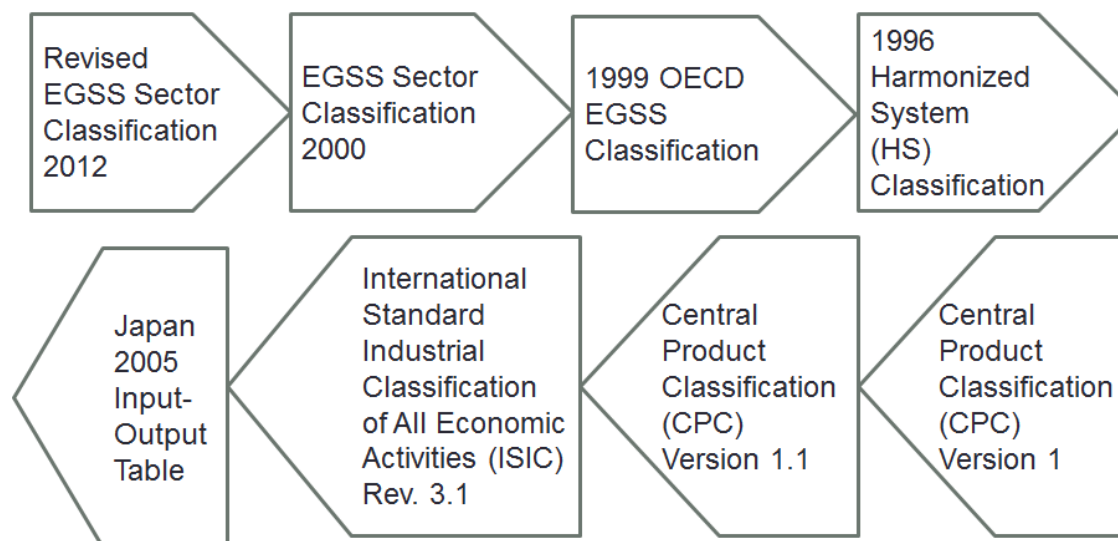
➤ Step 2: A green SAM



Steps towards constructing a green IO-SAM

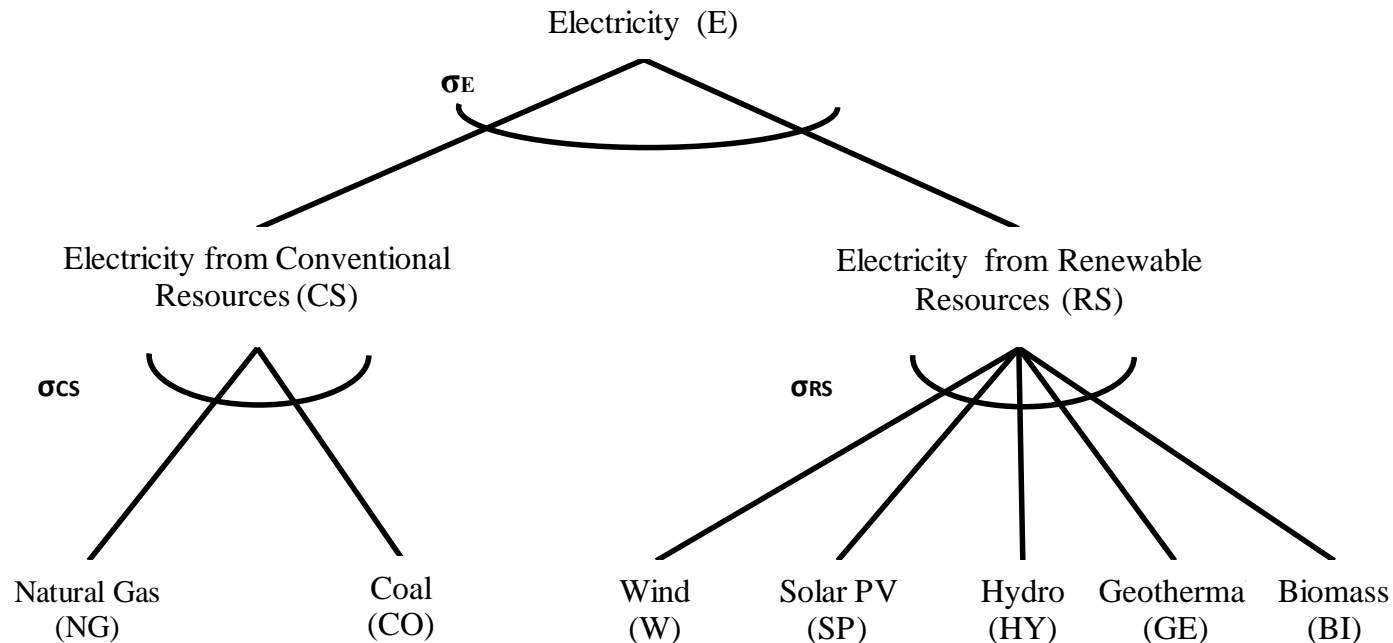
➤ Step 3: Mapping EGSS with corresponding IO sectors: Japanese case

- EGSS consists of activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. – by OECD/Eurostat (1999)
- MOEJ conducted annual surveys on the market size of environmental industry since 2000 following the 1999 OECD's EGSS classification.



A green IO-SAM for Mexican renewable energy simulation

- Construction of a renewable energy-expanded IO-SAM for Mexican renewable energy simulation
- CGE model, built upon the energy-expanded IO-SAM, can simulate the impacts of policy interventions, such as a FIT or RPS, on energy supply and demand as well as the economy-wide responses.



Mapping renewable energy with Mexican IO

- A renewable energy-expanded IO-SAM requires to present renewable energies and their associated production chains explicitly in relevant IO sector classification.
- In current Mexican IOs, either the industry by industry (262 sectors) or the product by product (814 products), there is no specific classifications related to renewable energies and associated production chains.
- Needs to map renewable energy with Mexican IO sector classification which is based on the NAISC.
- Use Japanese study (Zhou, et al., 2015) of the mapping of renewable energies with ISIC and the correspondence of ISIC and NAISC.

Mapping renewable energy sectors/EGSS with Mexican IO sector classifications



Thank you!

Contact: zhou@iges.or.jp

