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Pacific Region**

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# Climate Change, Trade, and Competitiveness:

## Climate Trade Performance of India, SAARC and Asia Pacific Region

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### Abstract

This paper examines trade performance of climate friendly goods using some trade indices for India and other Asian countries during 2002 - 2008. Climate friendly goods (CFG) are those goods which have less harmful to environment. Paper identifies India's performance in CFG trade with other Asian nations. Most of the countries in Asia are importers of climate friendly goods and technologies. The Comparative advantage analyses indicate that Hong Kong, China, and Japan have comparative advantage in the production of CFG goods and are net exporters of such products. The competitiveness measures also show that China, Hong Kong and Japan, and Asia Pacific region are major exporter of CFG during 2002-2008. Competitiveness of India, China and South Korea has improved in 2008. Pakistan, Sri-Lanka, and India prefer to trade in CFG regionally and have shown interest in production and trade of clean coal technologies (CCT). SAARC countries have developed expertise in the production of CCT. India and Pakistan enjoy comparative advantage in CCT trade. Few regions have comparative advantage in Solar Photovoltaic Systems (SPVS) and Energy Efficient Lighting (EEL). China is performing better than other in EEL. Japan, China, Malaysia and Macao show good in 2008 for SPVS. Japan, Philippines, China, Hong Kong and South Korea have a comparative advantage in production of *other climate friendly* items in 2008.

**Key Words:** Competitiveness, trade performance, Climate friendly goods, CFG, Clean Coal Technology, CCT, Energy Efficient Lighting, EEL, Solar Photovoltaic System, SPVS, Wind Energy, Wind Technology, Asia, India, SAARC, ASEAN, Asia Pacific, Japan, China, Sri Lanka, Pakistan, Thailand, Malaysia, Macao, Hong Kong, South Korea, RCA, cleaner technology, climate trade.

**JEL Classifications:** C<sub>13</sub>, F<sub>43</sub>, F<sub>64</sub>, O<sub>50</sub>, Q<sub>56</sub>

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## **Introduction**

*Climate Change* refers to any significant change in the climate over time. It is a significant shift of climate lasting for an extended period of time. The Intergovernmental Panel on Climate Change (IPCC) reaffirms the climate change and the average global temperature increased by 0.74°C during 1906–2005, and it is expected to increase more in future (see IPCC Reports, UNFCCC). Both year 2011 and 2012 produced a record number of extreme climate events including floods, heat waves, droughts, fires and snowstorms. Climate change is a new ‘Avatar’ that threatens to this modern civilization and challenges to the developmental activities in this century. Truly, the ‘climate change Avatar’ is a by product of industrialized nations - a result of accumulation of fossil fuel consumption in developed countries during industrialization which is the main cause of climate change in the world. Developed countries have contributed a lot to change the recent climate. Less Developed Countries (LDCs<sup>i</sup>) contribute negligible or little to cause climate change, yet face its harsh impacts and have the weakest capacity to adapt to these impacts (World Bank 2008). In this context, even there is lot of limitations or obstacles for developmental activity; climate change provides certain opportunity to grow with newly climate friendly products. Now, question arises as follow: Is there any trade competitiveness in Climate friendly goods in the world? How much is India facing competition in climate friendly goods (CFG) in SAARC and Asia region? Has India comparative advantage in any subcategory of climate goods? How much is the volume of trade opportunity for India in CFG? Who are the potential trade partners within Asia Pacific and in the world? This paper attempts to answer these with quantifying trade opportunities of CFG in India.

This paper examines the trade performance of climate friendly goods (CFG) for India and its trade partners using WITS data<sup>ii</sup> for the period 2002 - 2008. Trade performance is judged using some trade indices and indicators. Trade indices like Export and Import shares, Revealed Comparative Advantage index (RCA), and Competitiveness index for trade of CFG and its sub categories are calculated to form a policy opinion on India’s competitiveness, trade patterns, changing comparative advantage over time.

This study is organised as follows: Next section define climate friendly goods, trade analysis and its importance. Section 2 describes data and analyses climate trade performance, Section 3 evaluates competitiveness, and also provides trade performance of sub categories of CFG. Section 4 analyses potential trade opportunity of CFG in India and selected few SAARC members; and finally concluding remarks.

## Climate friendly goods and Trade

### 1.1 Climate friendly goods

*Climate friendly goods (CFG)* are defined as components, products and technologies which tend to have relatively less adverse impact on the environment. One of the subcategories of CFG is clean coal technology that aims to improve energy efficiency and reduce environmental impacts, including technologies of coal extraction, coal preparation and coal utilization. Wind technology another sub category of CFG focuses on wind energy generation and is composed of three integral components: the gear box, coupling and wind turbine.

This study has selected 64 such goods under 6 digit HS code (2002) by putting together various lists that have been defined by various international organizations<sup>iii</sup> recently. Following the World Bank (2008) this study divides these CFG into (i) Clean Coal Technologies (CCT), (ii) Wind Energy (WE), (iii) Solar Photovoltaic Systems (SPVS) and (iv) Energy Efficient Lighting (EEL). Besides these four sub groups the paper have also considered the fifth group as 'Other Codes' that consists of all HS codes not considered in the above four subcategories. This paper also performs the trade analysis for such subcategories.

### 1.2 CFG Trade Analysis and its Importance

The climate friendly goods are a subgroup and form a part of the broader group named environmental goods and services (EGS). An environmental good can be understood as equipment, material or technology used to address a particular environmental problem or as a product that is itself 'environmentally preferable' to other similar products because of its relatively benign impact on environment. Environmental services are provided by ecosystems or human activities to address environmental problems. EGS can also be classified as Environmental Goods comprising of pollution management products, cleaner technologies and products, resource management products and environmentally preferable products. EGS also has environmental services comprising of sewage services, sanitation and similar other services.

The EGS were first discussed as part of the liberalizing agenda in the DOHA round of the multilateral trading round in 2001. The countries had wanted the tariff and non-tariff barriers to go down for trade of such EGS as this may lead to adoption of cleaner and cost effective technologies by firms and country at large and possibly mitigate climate change and improve energy efficiency. Liberalization has followed three routes namely the list approach,

project/integrated approach and request for offer approach. Environmental Goods are always part of trade agenda but are subsumed within industrial or agricultural negotiations.

CFG (a subset of EGS) were discussed at the multilateral forums as countries wanted a smaller list to liberalize and where in negotiations could be easier done than concentrating on entire list of environmental goods. CFG constitutes low carbon growth technologies. For example WTO came out with a list of 153 goods for liberalization. Only 47 products were identified by the World Bank from 153 products list proposed by proponents of Environment Goods liberalization in the WTO. These 47 products comprised diverse products from wind turbines to solar panels to water saving shower but had dual usage problem as well for some products. Similarly OECD and ICTSD had their own lists of environmental goods and services. Free and liberal trade can make available such goods for countries that do not have access to these goods or where in domestic industry do not produce them in sufficient scale or at affordable prices. Additional market access can provide incentives to exporters to develop new products or technologies with less pollution that minimizes environmental impacts.

Global EGS industry was worth of 650 billion US dollars in 2008. Trade<sup>iv</sup> in EGS was estimated at roughly a tenth of that amount (Jha 2008). Most of the exporters of EGS are the developed nation but few developing countries are also becoming important players in heat and energy management equipment, noise and vibration abatement and in environmental services like air pollution control and solid waste management (Jha 2008, 2009). The preliminary findings do suggest that trade in CFG by India and other countries belonging to Asia.

## II

### **Data and Analysis of Climate Trade Performance**

Following the World Bank, ICTSD, APEC, OECD and UNESCAP this study has identified 64 climate friendly goods (CFG) under 6 digit HS code (2002). Various international organizations recently define and identify CFGs. CFG trade data (in value, 1000 US dollar) is taken from the UN COMTRADE data ([www.comtrade.un.org](http://www.comtrade.un.org)) for the year 2002 - 2008. This study considers CFGs as one category and estimates the above mentioned trade indicators for this category. The World Bank (2008) subgroups these goods further into clean coal technologies, Wind Energy, Solar Photovoltaic systems and Energy Efficient Lighting. The study besides these four sub groups have also considered 'Other Codes' as the fifth group which consists of all HS codes not considered in the four categories above. All these 64 CFG

items are considered as single trade items for the estimation of the trade gravity model in our earlier studies<sup>v</sup> (Dinda 2011, 2013, 2014).

## 2.1 Export Share of CFG Trade in India, SAARC and ASEAN Region

Export share is the ratio of country's total exports of the particular product to the World to country's total exports of all products to the World. The study has calculated the export share for countries and regional groups in Asia during 2002 - 2008. Table 1 give figures for export share along with the gross CFG exports to the World originating from countries and ranks during 2002- 2008. For example India's export share of 1.95 % in 2008 is calculated by taking ratio of gross CFG exports to World by India (354.98 million USD) to gross exports of all products to World by India (18185.92 million USD) and multiplied by hundred. China and Hong Kong have exports shares above the World average depicting good trade performance of such countries for CFG goods. ASEAN and SAARC region as a group's export share depict their relatively better performance. Similarly, for 2002 the study finds that Japan and Hong Kong performing better than the World average. Philippines and India are fifth and six positions in 2008 and have replaced Singapore and Malaysia from that position in 2002. South Korea and Thailand are ranked fourth and seventh in 2002 and 2008, respectively. India's export share figure was not significant in 2002, but India's CFG export performance has improved and captured the 6<sup>th</sup> position in Asia Pacific region in 2008. Over all, one finds that the share of CFG in world exports increasing for all countries and regions from 2002 to levels reached in 2008. There seems to be realization to trade cleaner technologies and goods by Asian countries and sub regions.

Table 1: Export Share of CFG in World Export for Countries and Regional Groups in 2002 and 2008

<b>Countries</b>	<b>Export Share 2002(%)</b>	<b>Countries</b>	<b>Export Share 2008(%)</b>
Japan	4.01	Japan	5.20
Hong Kong	2.56	China	3.41
China	2.27	Hong Kong	2.64
Korea, Rep.	2.06	Korea, Rep.	2.40
Singapore	1.65	Philippines	2.33
Malaysia	1.63	India	1.95
Thailand	1.59	Thailand	1.7
<b>Regions</b>		<b>Regions</b>	
ASEAN	1.63	ASEAN	1.58
SAARC	0.32	SAARC	1.73

## 2.2 Import Share

Table 2 provides the import share of CFG in countries and regions in 2002 and 2008. The findings show countries with ranks 1 to 10 in both 2002 and 2008. The 10 countries above world import average share of 2.4% in 2008 are Kazakhstan, South Korea, Azerbaijan, China, Vietnam, Pakistan, Thailand, Russia, Australia and Hong Kong in Asia Pacific region. The 10 countries above world import share of CFG goods of 2.2% in 2002 are Papua New Guinea, China, Thailand, Turkey, South Korea, Malaysia, Singapore, Russia, Australia and Hong Kong in Asia Pacific region.

Table 2: Import share of CFG for Countries in Asia Pacific Regional Groups in 2002 and 2008

<b>Countries</b>	<b>Import Share 2002 (%)</b>	<b>Country</b>	<b>Import Share 2008 (%)</b>
PNG	4.05	Kazakhstan	4.10
China	3.60	Korea, Rep.	3.90
Thailand	3.254	Azerbaijan	3.86
Turkey	3.252	China	3.34
Korea, Rep.	2.97	Vietnam	3.29
Malaysia	2.95	Pakistan	2.80
Singapore	2.73	Thailand	2.77
Hong Kong	2.30	Hong Kong	2.50
		India (22 <sup>nd</sup> Rank)	1.70
<b>Region</b>		<b>Region</b>	
ASEAN	2.93	ASEAN	2.34
SAARC	1.48	SAARC	1.8

The above are indications that most of the countries in Asia Pacific region are basically importers of CFG products from countries within regions. This paper confirms the above statement by looking at the regional group performance also. Import share of CFG increases in SAARC in 2008 while it declines in ASEAN.

## III

### Evaluation of Competitiveness

Competitiveness index is estimated as ratio of each country export of CFG to the world exports of CFG. Competitiveness in trade is broadly defined as the capacity of an industry to increase its share in international markets at the expenses of its rivals<sup>vi</sup>. The competitiveness index is an indirect measure of international market power, evaluated through a country's share of world markets in CFG. The index takes a value between 0 and 100 percent, with

higher values indicating greater market power of the country in question. Table 3 provides the results calculated competitive index for countries in Asia region in 2002 and 2008.

Table 3: Competitiveness Index for Export of CFG by member states and Regional Groupings, 2002, 2008

Country	Competitiveness Index 2008 (%)	Country	Competitiveness Index 2002 (%)
China	12.621	Japan	12.479
Japan	10.506	China	5.523
Korea, Rep.	2.622	Hong Kong	3.859
Hong Kong	2.526	Korea, Rep.	2.496
Singapore	1.356	Singapore	1.546
<b>India</b>	<b>0.917</b>	Malaysia	1.145
Malaysia	0.817	Thailand	0.809
Thailand	0.772	Russia	0.451
Turkey	0.462	Turkey	0.287
<b>Region</b>		<b>Region</b>	
ASEAN	3.3877	ASEAN	3.5004
SAARC	0.9446	SAARC	0.024

The figures in Table 3 show the most important economies in world export of CFG in 2008 and 2002. These are China, Hong Kong and Japan and ASEAN and SAARC as regions. India, China and South Korea's competitiveness has improved in 2008 from 2002 position.

### 3.1 Revealed Comparative Advantages in CFG for India and other Asian Countries

The study calculates two indices which indicate comparative advantage of countries in the CFG. Comparative advantage in some product means that country can produce the same product at lower relative cost and price in absence of trade. Since these prices are not observed, the researchers measure comparative advantage indirectly. There are several approaches to measure comparative advantage of countries.

The Michelaye index is defined as the difference of two shares. It is the share of one country's exports of the commodity of interest in its total exports and the share of the same country's imports of the same commodity in its total imports. The index takes a value between -1 and +1. A country is said to have a revealed comparative if the value is greater than zero.

The Revealed Comparative Advantage is defined as the ratio of two shares. The numerator is the share of a country's total exports of the commodity of interest in its total exports. The denominator is share of world exports of the same commodity in total world exports. The RCA takes a value between 0 and  $+\infty$  (infinity). A Country is said to have a revealed



comparative advantage if the value is more than one or exceeds unity. Revealed Comparative index is given in Table 5.

The Michelaye index has been calculated for India (Table 4) and other countries in Asia. It reveals that all countries except Japan, Hong Kong, Philippines and India, China and Macao all have negative figures in almost all years from 2002 to 2008. This reinforces the point made above that most of the members in the region do not have comparative advantage in the production of CFG. However, they may be importing regionally from some good performers (Hong Kong, Japan, Philippines, Macao, and China). Table 4 shows that India improves over time.

Table 4: Michelaye Index for CFG of India during 2002 – 2008.

Year	2003	2004	2005	2006	2007	2008
IND	-0.006	-0.005	-0.005	-0.0007	-0.002	0.0025

Table 5 displays the RCA in production of CFG in Asian countries during 2002-2008. Table 5 shows that RCA figures for Japan, China and Hong Kong have figures greater than one and have a comparative advantage in the production of these CFG products in 2008. Japan and Hong Kong have figures greater than one in 2002.

Table 5: Revealed Comparative Analysis of CFG for Selected Members and Regional Groups in 2002 and 2008

Country	RCA in 2008	Country	RCA in 2002
Japan	2.0014	Japan	1.7408
China	1.3133	Hong Kong	1.111
Hong Kong	1.0156	China	0.986
Korea, Rep.	0.9251	Korea, Rep.	0.8931
Philippines	0.896	Singapore	0.7180
<b>India</b>	<b>0.7507</b>	Malaysia	0.7077
Thailand	0.6532	Thailand	0.6905
Malaysia	0.6118	New Zealand	0.4781
Singapore	0.5971	Turkey	0.4671
Macao	0.5297	Sri Lanka	0.2578
Turkey	0.5212	Russia	0.2459
Vietnam	0.3463	Australia	0.2206
New Zealand	0.342	Fiji	0.1630
Sri Lanka	0.2361	Macao	0.0980
Kyrgyz Republic	0.1883	Papua New Guinea	0.0669
Armenia	0.16916	Bangladesh	0.0328
<b>Region</b>		<b>Region</b>	
ASEAN	0.6083	ASEAN	0.7081
SAARC	0.6648	SAARC	0.1376

Again we observe a rise of China. China had figure of 0.98 in 2002 while the figure in 2008 is 1.31. Any value of RCA greater than one indicates comparative advantage in the production of the good.

### 3.2 Trade Analysis of CFG subcategories for India and its Regional Groups

This section calculates Michelaye index, Revealed Comparative Advantage, Competitiveness Index for sub categories of CFG – viz., clean coal technologies, Wind Energy, Solar Photovoltaic systems, Energy Efficient Lighting, and ‘Other Codes’.

#### 3.2.1 Michelaye Index of CFG subcategories for Regional Groups

Michelaye index identifies the sectors in which an economy or a group has a comparative advantage. A country is said to have a revealed comparative advantage if the value exceeds zero. The Michelaye index takes a value between -1 and +1. Michelaye index is measured for selected nations, and SAARC for CFG and its sub categories. Solar Photovoltaic Systems (SPVS) and Energy Efficient Lighting (EEL) are two sub categories of CFG in which the region as a whole has comparative advantage. All figures are negative for CFG broad category for Asia Pacific region. However, the above analysis and this one has shown that most of the member nations in the region do not have a comparative advantage in the production of CFG but they are net importers of CFG. Therefore, the study identifies only positive value of the Michelaye index for those countries and regional groups for sub categories of CFG. The results indicate that China, Hong Kong, India, Japan, Macao, Malaysia, Philippines, Thailand and Vietnam performs better for some sub categories in terms of export pattern to its own import pattern. For example China, India, Japan, Macao, Thailand and Vietnam have positive Michelaye index for Energy Efficient Lighting in some if not all during 2002 - 2008 while Japan, India, Macao and Malaysia perform better in Solar Photovoltaic systems.

Table 6: Michelaye Index for CFG subcategories for SAARC during 2002-2008

Year	CCT	WE	SPVS	EEL	Other	CFG
2002	-0.0008	-0.0002	-0.001	-0.00031	-0.0094	-0.012
2003	-0.0005	-0.0009	-0.0006	-9.6E-05	-0.0057	-0.007
2004	9.99E-05	-0.0008	-0.0003	-9.9E-05	-0.0062	-0.0068
2005	0.00014	-0.0008	-0.0003	-0.00011	-0.0064	-0.007
2006	-0.00014	-0.0006	-0.00016	-0.00012	-0.003	-0.0039
2007	-0.0004	-0.0009	-0.00024	1.01E-05	-0.004	-0.0052
2008	-0.0002	-0.0011	0.0011	3.44E-05	-0.0005	-0.0007

Table 6 displays the Michelaye index for SAARC during 2002-2008. CFG sub categories Clean Coal Technologies, Solar Voltaic Systems and Energy Efficient Lighting show some positive values for some years (2008) indicating that SAARC as a region are net importers of CFG and sub category goods from the rest of the world. The positive values indicate the changing trade pattern of these countries in SAARC towards producing and exporting cleaner technologies.

### 3.2.2 Michelaye Index of CFG and its subcategories for India

This section provides the Michelaye index for CFG subcategories for selected and identified countries in Asia Pacific region. The paper has identified those countries which show positive values in some years for sub categories. For convenience and comparison purpose CFG results are reproduced.

Table 7: Michelaye Index for India during 2003-2008

Year	CCT	SPVS	WE	EEL	Other	CFG
2003	-0.00048	-0.00051	-0.0012	-4.71E-05	-0.0045	-0.00589
2004	0.00018	-0.00015	-0.0009	-6.75E-05	-0.00443	-0.00482
2005	0.00021	-8.782E-05	-0.0009	-9.71E-05	-0.0047	-0.00525
2006	-9.5E-05	8.3266E-05	-0.0007	-9.51E-05	-0.00013	-0.00079
2007	8.68E-05	5.0074E-05	-0.001	4.55E-05	-0.00164	-0.00225
2008	0.00031	0.001405	-0.0012	5.62E-05	0.00212	0.00251

Table 7 shows that Michelaye index for India is positive for CFG, CCT, SPVS, EEL and for other codes in 2008. The trade pattern of India seems to be changing from the earlier years for trade of CFG goods. This may reflect the continuing and good economic performance of liberalizing and maturing India.

### 3.2.3 Revealed Comparative Advantage (RCA) in CFG Categories for India, SAARC, and Asia Pacific nations in 2002 and 2008.

Table 8 indicates that the Revealed Comparative advantage index for Energy Efficient Lighting is greater than one for China, Sri- Lanka and Macao in 2008 while it was greater than one for China and Thailand in 2002. This indicates that the share of EEL exports in the total exports of each of these countries is greater than the World share of EEL in Worlds total exports. The greater than one RCA figure for China in 2008 are also reflected in the alternative Michelaye index for China which is positive. This reconfirms that China is performing better than other is such technologies. The same happens with Macao in 2008

reconfirming that Macao has a revealed comparative advantage in 2008 and is reflected in its export pattern. Asia Pacific as a group has values of RCA greater than one in 2008 and 2002 indicative of its strong performance.

Table 8: RCA in EEL for countries and Regions in 2008 and 2002

Country/ Regional Groups	RCA in Energy Efficient Lighting 2008	Country Regional Groups	RCA in Energy Efficient Lighting 2002
China	6.019017	China	5.529182
Sri Lanka	1.92231	Thailand	2.989666
Macao	1.264191	Sri Lanka	0.796008
Thailand	0.978966	Japan	0.592959
Hong Kong	0.91824	Korea, Rep.	0.558382
<b>India</b>	<b>0.479794</b>	Hong Kong	0.311097
Vietnam	0.219344	Turkey	0.220703
Korea, Rep.	0.142065	Bangladesh	0.204511
Japan	0.142036	Macao	0.163152
Turkey	0.125991	Russia	0.119411
<b>Region</b>		<b>Region</b>	
Asia Pacific	1.905811	Asia Pacific	1.524726
ASEAN	0.283114	ASEAN	0.892303
SAARC	0.486879	SAARC	0.480014

Table 9 shows RCA in Solar Photovoltaic systems in 2008 and 2002 for member nations and regional groupings in Asia Pacific region. Japan, China, Malaysia and Macao show greater than one value in 2008 while Malaysia, Japan, Thailand, New Zealand and Hong Kong had greater than one figures in 2002. The Figures show the rise of China and Macao in 2008 to levels reached in 2002. All regional groups ASEAN and Asia Pacific regions show greater than one figure for SPVS in 2008. In the year 2002 only ASEAN and Asia Pacific had values greater than one.

Table 9: RCA in Solar Photovoltaic Systems for countries and Regions in 2008 and 2002

Countries/ Regions	RCA in Solar Photovoltaic Systems in 2008	Countries/ Regions	RCA in Solar Photovoltaic Systems in 2002
Japan	2.20	Malaysia	3.57
China	2.07	Japan	2.84
Malaysia	1.92	Thailand	2.00
Macao	1.28	New Zealand	1.29
Hong Kong	0.98	Hong Kong	1.19
Thailand	0.94	Singapore	0.80
Singapore	0.80	China	0.54
<b>India</b>	<b>0.73</b>	Korea, Rep.	0.43
Korea, Rep.	0.51	Australia	0.21
Vietnam	0.40	Turkey	0.20
Australia	0.29	Russia	0.16

Sri Lanka	0.27	Sri Lanka	0.06
<b>Region</b>		<b>Region</b>	
Asia Pacific	1.28	Asia Pacific	1.41
ASEAN	1.03	ASEAN	1.99
SAARC	0.64	SAARC	0.03

Table 10 gives the figures for RCA for clean coal technologies. Pakistan and Singapore are the only countries in 2008 who have secured more than one figure in RCA. India is close at third with value of 0.85. It seems that SAARC countries have developed expertise in the production of CCT. It is also notable that no country in the Asia Pacific region had a comparative advantage in clean coal technologies in 2002. Also, no regional group has comparative advantage in the production of clean coal technologies. Maybe the world community at large need to rethink and review the policies related to clean coal technologies. Asia Pacific and ASEAN are already showing impressive export performance in relation to its import profile.

Table 10: RCA in Clean Coal Technologies for Nations and Regionals 2002 and 2008

Country/ Regional Groups	RCA in Clean Coal Technologies in 2008	Countries/ Regional Groups	RCA in Clean Coal Technologies in 2002
Pakistan	1.339	Japan	0.87
Singapore	1.117	Turkey	0.48
<b>India</b>	<b>0.847</b>	Singapore	0.20
Japan	0.829	Russia	0.18
New Zealand	0.491	Australia	0.11
Turkey	0.234	China	0.09
Russia	0.210	Malaysia	0.086
Australia	0.177	New Zealand	0.05
Thailand	0.157	Hong Kong	0.04
Hong Kong	0.067	Thailand	0.03
Malaysia	0.057	Korea, Rep.	0.027
Korea, Rep.	0.047	Sri Lanka	0.001
China	0.047	Papua New Guinea	0.0002
<b>Region</b>		<b>Region</b>	
Asia Pacific	0.31	Asia Pacific	0.296
ASEAN	0.50	ASEAN	0.123
SAARC	0.86	SAARC	0.0005

Table 11 indicates that only Japan has a comparative advantage in the production of Wind technology both in 2002 and 2008.

Table 11: RCA in Wind Energy for countries and Regions in 2002 and 2008

State/ Regions	RCA in Wind Energy in 2008	State/ Regions	RCA in Wind Energy in 2002
Japan	2.04	Japan	2.58
Turkey	0.57	China	0.59
China	0.47	Singapore	0.40
Korea, Rep.	0.46	Turkey	0.35
<b>India</b>	<b>0.38</b>	Korea, Rep.	0.25
Singapore	0.33	Russia	0.19
Thailand	0.22	Hong Kong	0.18
Australia	0.20	New Zealand	0.16
New Zealand	0.19	Thailand	0.14
Hong Kong	0.15	Australia	0.13
<b>Region</b>		<b>Region</b>	
Asia Pacific	0.587	Asia Pacific	0.89
ASEAN	0.202	ASEAN	0.22
SAARC	0.329	SAARC	0.0006

Table 12 shows that Japan, Philippines, China, Hong Kong and South Korea have a comparative advantage in production of ‘Other codes’ in 2008 while Japan and Hong Kong got values greater than one in 2002. None of the groups have RCA advantage in 2008 and 2002.

Table 12: RCA in Other Codes in 2008 and 2002 for countries and Regions

Member Nation/Regional Groups	RCA in Other Codes in 2008	Member Nation/Regional Groups	RCA in Other Codes in 2002
Japan	1.99	Japan	1.58
Philippines	1.11	Hong Kong	1.16
China	1.08	Korea, Rep.	0.99
Hong Kong	1.07	China	0.96
Korea, Rep.	1.06	Singapore	0.71
<b>India</b>	<b>0.75</b>	Thailand	0.67
Thailand	0.65	New Zealand	0.52
Turkey	0.61	Malaysia	0.49
Singapore	0.59	Turkey	0.47
Malaysia	0.57	Sri Lanka	0.3
<b>Region</b>		<b>Region</b>	
Asia Pacific	0.95	Asia Pacific	0.99
ASEAN	0.61	ASEAN	0.63
SAARC	0.66	SAARC	0.16

It should be noted that the considerable improvement in RCA in other CFG items in China, South Korea and Philippines in 2008 from 2002.

### 3.2.4 Competitiveness Index for Trade in CFG Categories of India, SAARC, and Asia Pacific Region in 2002 and 2008

Competitiveness index shows the share of exports of one product by a country in World Exports of the same product. The higher value indicates an improvement in its competitiveness in relation to other countries. The values vary from zero to 100 indicating an ideal situation of full competitiveness. The ratio shows the countries international profile with respect to a product traded internationally.

Table 13 gives the index for member nations and Regional Groupings in Asia Pacific region for EEL. China, Hong Kong and Thailand are ranked one, two and three for 2008 while China, Japan and Thailand are ranked in the same serial in 2002. What is notable is the big gap between the figures of China and the second ranked nation in 2008 and in 2002. China got figure of 57.84% in 2008 while the second ranked nation got figure of 2.28 %. In 2002 China got the figure of 30.96 while it was only 4.25 for second ranked Japan. Asia Pacific and APTA as regions perform better than other regional groups as far as competitiveness is concerned.

Table 13: Competitiveness Index for Trade in EEL of Nations and Regions in 2002 and 2008

Country/ Regional Groupings	Competitiveness Index 2008(%)	Country/ Regional Grouping	Competitiveness Index 2002(%)
China	57.84	China	30.97
Hong Kong	2.28	Japan	4.25
Thailand	1.16	Thailand	3.50
Japan	0.75	Korea, Rep.	1.56
<b>India</b>	<b>0.59</b>	Hong Kong	1.08
Korea, Rep.	0.40	Solomon Islands	0.85
<b>Region</b>		<b>Region</b>	
Asia Pacific	63.85	Asia Pacific	42.78
ASEAN	1.58	ASEAN	4.41
SAARC	0.69	SAARC	0.08

Table 14 shows the competitiveness index in SPVS for member states and regional groups. China, Japan, Malaysia are ranked one, two and three in 2008 while the ranking for 2002 is Japan, Malaysia and Hong Kong. Asia Pacific holds the top rank in 2008 and 2002.

Table 14: Competitiveness Index for Trade in SPVS of Nations and Regions in 2002 and 2008

Country/ Regional Groupings	Competitiveness Index 2008(%)	Country/ Regional Grouping	Competitiveness Index 2002(%)
China	19.85	Japan	20.33
Japan	11.55	Malaysia	5.78

Malaysia	2.57	Hong Kong	4.15
Hong Kong	2.44	China	3.06
Singapore	1.83	Thailand	2.34
Korea, Rep.	1.45	Singapore	1.72
Thailand	1.10	Korea, Rep.	1.19
<b>India</b>	<b>0.89</b>	New Zealand	0.32
<b>Region</b>		<b>Region</b>	
Asia Pacific	42.85	Asia Pacific	39.53
ASEAN	5.73	ASEAN	9.83
SAARC	0.90	SAARC	0.006

Table 15 shows the competitiveness index in trade in CCT of nations and regions. Japan, Singapore and India are ranked one, two and three in 2008. The ranking was Japan, China and Singapore in 2002. Asia Pacific is at top rank in 2008 and 2002.

Table 15: Competitiveness Index for Trade in CCT of Nations and Regions in 2002 and 2008

Country/ Regional Groupings	Competitiveness Index 2008(%)	Country/ Regional Grouping	Competitiveness Index 2002(%)
Japan	4.35	Japan	6.22
Singapore	2.54	China	0.51
<b>India</b>	<b>1.03</b>	Singapore	0.44
Russia	0.66	Russia	0.32
China	0.45	Turkey	0.29
<b>Region</b>		<b>Region</b>	
Asia Pacific	10.32	Asia Pacific	8.30
ASEAN	2.80	ASEAN	0.61
SAARC	1.22	SAARC	0.00008

Table 16 provides the Competitiveness Index in Trade in the wind energy (WE) for countries and selected regional groups in 2002 and 2008. Japan, China and South Korea are ranked one, two and three, respectively; and corresponding the ranking are Japan, China and Singapore in 2002. Asia Pacific is at the top rank in 2008 and 2002.

Table 16: Competitiveness Index for Trade in WE of countries and Regions in 2002 and 2008

Country/ Regional Groupings	Competitiveness Index 2008(%)	Country/ Regional Grouping	Competitiveness Index 2002(%)
Japan	10.73	Japan	18.29
China	4.50	China	3.28
Korea, Rep.	1.31	Singapore	0.86
Singapore	0.74	Korea, Rep.	0.69
Turkey	0.50	Hong Kong	0.62
<b>India</b>	<b>0.466</b>	Russia	0.34
Hong Kong	0.38	Turkey	0.21
<b>Region</b>		<b>Region</b>	
Asia Pacific	19.67	Asia Pacific	0.0004



ASEAN	1.13	ASEAN	1.69E-05
SAARC	0.47	SAARC	1.77E-09

Table 17 provides the Competitiveness Index in Trade in OC of countries and Regions in 2002 and 2008. Japan, China and Hong Kong are at top ranking in 2002 and 2008. Again Asia Pacific performs better than other groups.

Table 17: Competitiveness Index for Trade in OC of Countries and Regions in 2002 and 2008

Country/ Regional Groupings	Competitiveness Index 2008(%)	Country/ Regional Grouping	Competitiveness Index 2002(%)
Japan	10.45	Japan	11.31
China	10.36	China	5.39
Korea, Rep.	2.999	Hong Kong	4.017
Hong Kong	2.65	Korea, Rep.	2.77
Singapore	1.34	Singapore	1.54
<b>India</b>	<b>0.92</b>	Malaysia	0.799
Thailand	0.766	Thailand	0.784
<b>Region</b>		<b>Region</b>	
Asia Pacific	31.97	Asia Pacific	27.80
ASEAN	3.38	ASEAN	3.12
SAARC	0.95	SAARC	0.03

#### IV

##### Estimation of trade opportunity

Using the gravity model<sup>vii</sup>, this paper also investigates the potential trade opportunity of CFG for SAARC and Asian countries within the region and/or inter-regions especially with the European Union (EU), North America (the USA and Canada) and rest of the world. This study provides evidence on trade opportunity of CFG in India, SAARC and Asia Pacific (for details, see Dinda (2013, 2014)). It also provides certain insights regarding potential trade opportunities of climate friendly goods, and this paper may assist policy makers to form appropriate policy on *climate change and trade opportunity*. Following the standard gravity model, this paper investigates a new direction of potential trade opportunity in climate smart and/or environment friendly goods. This study is based on Dinda (2011, 2013, and 2014) and provides certain insights regarding trade opportunity of CFG in Asia.

Following Baldwin (1994), Nilsson (2000) and Egger (2002), many Asian countries are far below the expected trade performance as the literature defines the term potential trade gap<sup>viii</sup> (Dinda 2014). Intraregional demand for CFG is also very high<sup>ix</sup>. Now this paper will discuss the potential trade opportunity of CFG for India, Pakistan, and Sri Lanka in SAARC region. Figures (Fig 1 – 6) display the potential trade gap between home and partner countries. Bar lines are the standardised trade gaps in Figures 1 - 6.

**India** has the potential to increase its trade opportunity of CFG. Within the Asia Pacific region (Fig1), India can increase CFG export to Pakistan, Mongolia, Bangladesh, Armenia, Kazakhstan, Azerbaijan, Japan, Vanuatu, Russia, China, Kyrgyz Republic, New Zealand, Hong Kong, Korean Republic, Indonesia, Iran, Philippines, and Georgia, etc. India’s most important and encouraging CFG trade partners in Europe (Fig 2) are Luxembourg, UK, Latvia, Cyprus, Greece, Hungary, Slovenia, Slovakia, Austria, Finland, Ireland, Poland, Spain, Lithuania, Bulgaria, Romania, Denmark, Sweden, France, Italy and Czech Republic. India has trade potential to increase trade of CFG with Canada. India’s estimated CFG exports potential is \$4.976 billion US dollar within the Asian region and \$1.01 billion USD with the EU. India’s export potential trade of CFG is higher in the Asian region than the EU. India has strong trade opportunity of CFG with Pakistan, Bangladesh, China, Japan, Russia, and South Korea and the estimated potential export of CFG to these countries is nearly \$4.9 billion USD. India’s CFG export potential to Pakistan and Bangladesh alone is \$4.4 billion USD. India can explore this potential trade and may revise the east look policy, and can also stimulate to control climate change in the region. India’s CFG potential top trade partners in the EU are UK, France, Italy, Poland, Greece and Austria and the potential trade is nearly \$1 billion USD. India has the potential to increase its export of CFG to Asia and EU approximately more than \$6 billion USD.

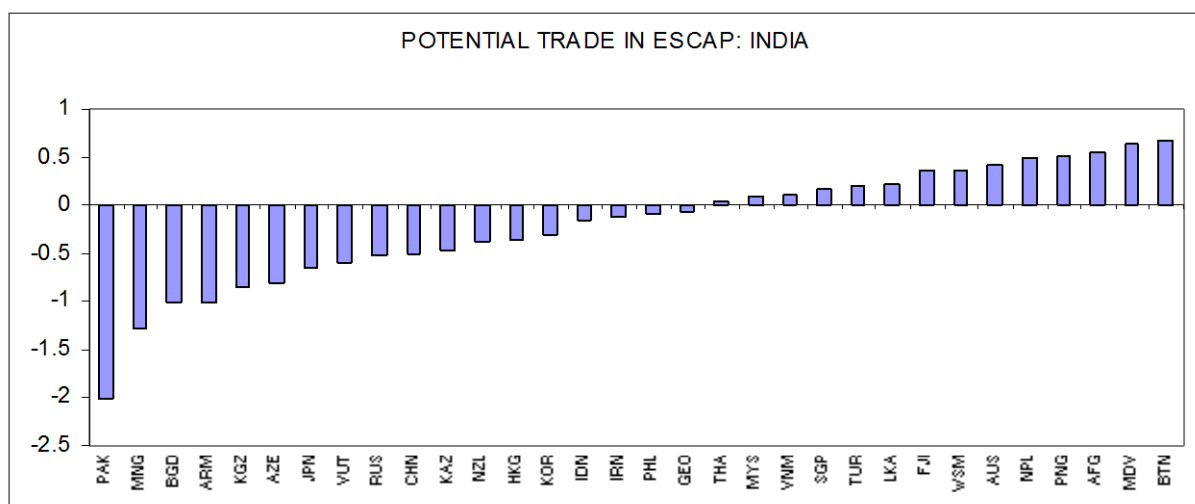


Fig. 1: India's Trade Opportunity in Asia Pacific region in 2008

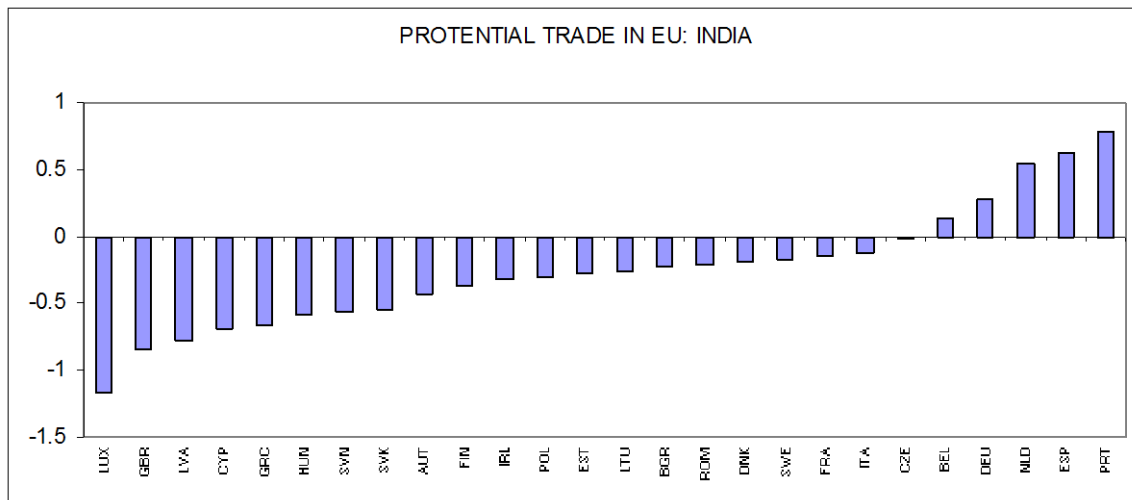


Fig. 2: India's Trade Opportunity in European Union in 2008

**Pakistan** has a great potential to increase its trade potential particularly in CFG. Within Asia Pacific region (Fig 3), Pakistan has strong trade potential in CFG export to Russia, India, Viet Nam, Kazakhstan, Korean Republic, Nepal, Indonesia, Japan, Malaysia, China, Kyrgyz Republic, Hong Kong, Bangladesh, Australia, Singapore, Iran, New Zealand, Thailand, Azerbaijan and Turkey. Pakistan has a great trade potential in CFG trade with developing countries. The most important and encouraging Pakistan's CFG potential trade are with European Union (Fig 4), especially Ireland, Portugal, Hungary, Cyprus, Romania, Slovak Republic, Poland, Austria, Lithuania, Spain, Sweden, Italy, Czech Republic, France, UK, Denmark, Germany, Finland, Belgium, Greece and Netherland. Pakistan has trade potential to increase CFG trade of 17.5 million US dollar with the USA and Canada. The estimated Pakistan's CFG exports potential are 893.39 million US dollar within Asia Pacific region and 65.79 million USD with EU. Pakistan's export potential trade in CFG is more within Asia Pacific than any other region. Pakistan has the strongest trade partner in terms of export potential with India and estimated export of CFG to India is nearly 838.7 million USD. Pakistan should explore this potential trade and can stimulate to control climate change in the region. Pakistan's CFG potential trade top partners in EU are UK, Germany, France and Italy, and potential trade is nearly 55.49 million USD. Pakistan has potential to increase its export

of CFG to ESCAP and EU members, and the US and Canada approximately more than 976 million USD.

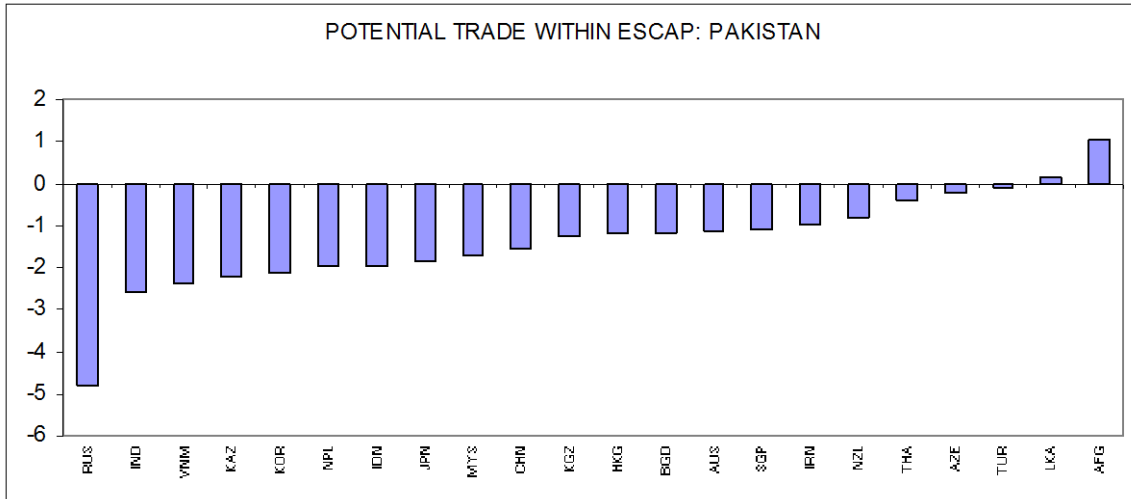


Fig. 3: Pakistan’s Trade Opportunity in Asia Pacific region in 2008

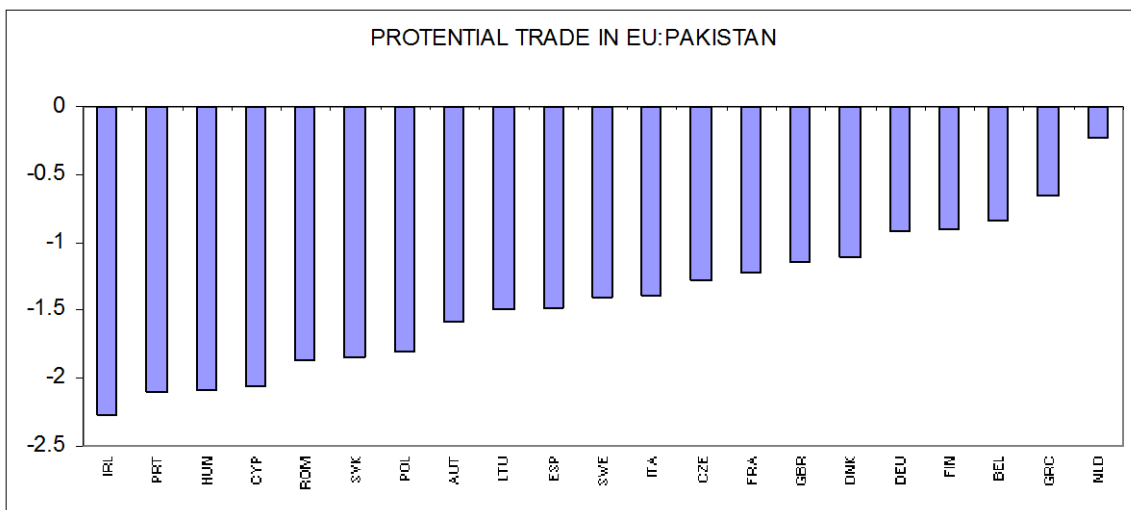


Fig. 4: Pakistan’s Trade Opportunity in European Union in 2008

**Sri Lanka** can increase its potential trade of climate friendly goods. Within Asia Pacific region (Fig 5), Sri Lanka has strong potential export of CFG to Philippines, Indonesia, Iran, Malaysia, Mongolia, Thailand, Pakistan, Singapore and Kazakhstan. Sri Lanka can also increase the CFG trade with Canada. The most important and encouraging Sri Lanka’s CFG

potential trade are with European Union (Fig 6), especially Cyprus, Austria, Denmark, Latvia, Hungary, Romania and Spain. The estimated Sri Lanka's potential exports of CFG are 425 thousand US dollar within Asia Pacific region and 177 thousand US dollar with EU. Sri Lanka has potential to increase export of CFG within Asia Pacific and EU.

There is a huge variation in the potential trade gap among nations. One of the major reasons is the variation of tariff rates between countries. Other reasons may be lack of awareness and knowledge, insufficient technology, lack of skilled labour for production of CFG, lack of trade facilitations etc.

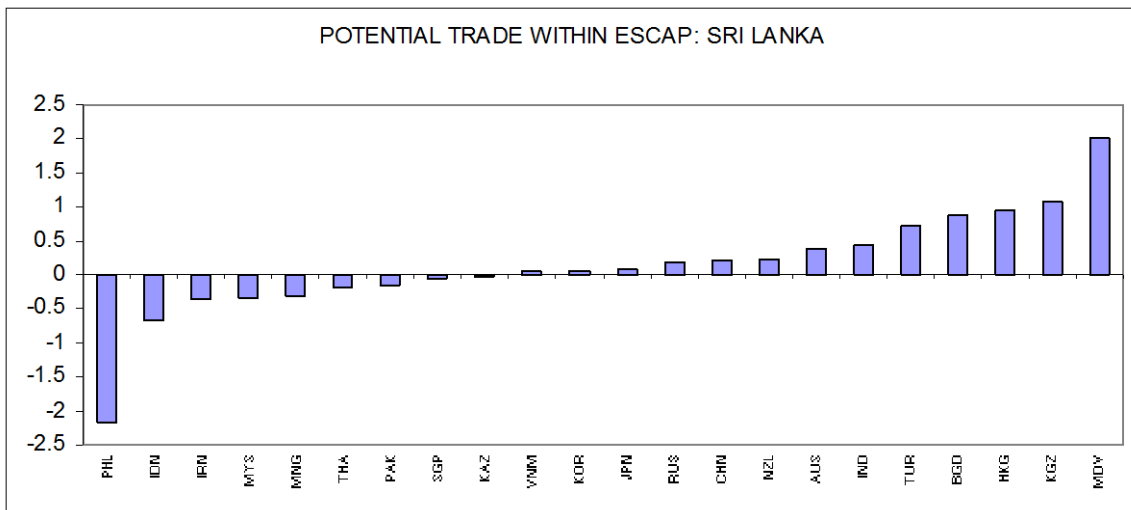


Fig. 5: Sri Lanka's Trade Opportunity in Asia Pacific region in 2008

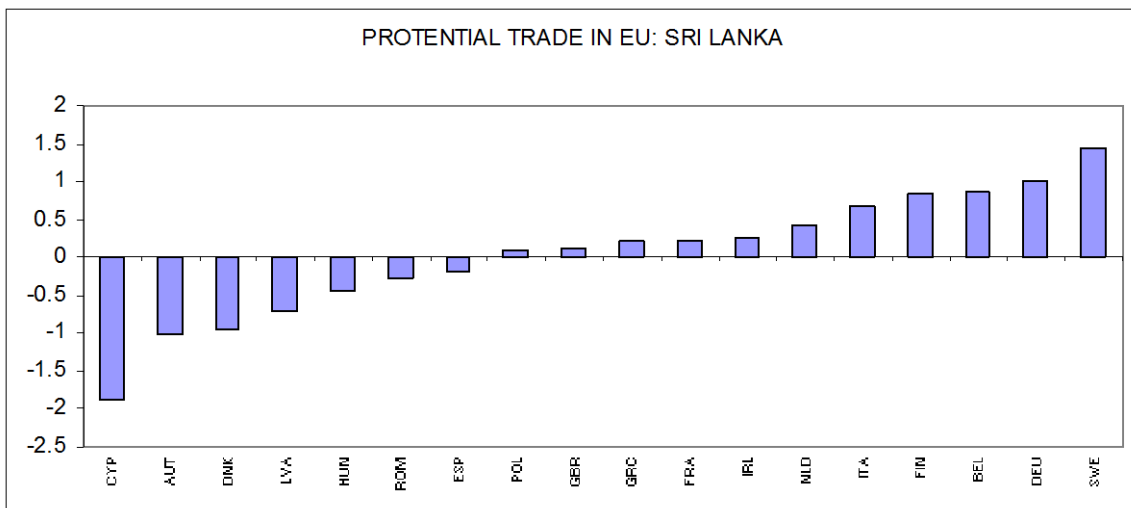


Fig. 6: Sri Lanka's Trade Opportunity in European Union in 2008

## **Conclusion**

This paper examines the trade performance of climate friendly goods which are less harmful to environment. This study evaluate trade through assessing some trade indices such as Export and Import Shares, RCA, Competitiveness for India as well as Asian countries and some regional groups for trade of CFG and its sub categories for years 2002 - 2008. Analysis of the Export and Import shares of CFG indicate that all are importers of such technologies from the Asia region and some of them are importing from the rest of the world.

The Comparative advantage indicates that Hong Kong, Japan and China (in 2008 only) have comparative advantage in the production of CFG goods and are also net exporters of CFG. Major countries in the region do not have comparative advantage in the production of CFG. The competitiveness index shows that China, Hong Kong and Japan and Asia Pacific region are significant contributors of CFG export in the World. Competitiveness of India, China and South Korea has improved during 2002 - 2008.

Some SAARC members such as Pakistan and Sri-Lanka and India (2002) prefer to do trade in CFG regionally. SAARC have shown interest is production and trade of clean coal technologies. RCA results show that Pakistan and Singapore have only comparative advantage in clean coal technologies (CCT) in 2008. India is close to them. It seems that SAARC countries have developed expertise in the production of CCT. Now, the policy makers should rethink and review the policies related to clean coal technologies.

As per Michelaye index for sub categories of CFG, SPVS and EEL have comparative advantage in Asia region. Thailand, Vietnam and Macao perform better in terms of their export pattern during 2002-2008. ASEAN does better in terms of export pattern to its own import structure for the sub category SPVS only. China is performing better than other in EEL. Japan, China, Malaysia and Macao show greater than one RCA values in 2008 for SPVS. Japan has a comparative advantage in the production of Wind technology. Japan, Philippines, China, Hong Kong and South Korea have a comparative advantage in production of 'other' items in 2008. ASEAN as a group has regional bias towards its own region for all codes except SPVS in 2002 and 2008. SAARC as a group has regional bias for EEL in 2002 and 2008 but CCT in 2008. The above analyses provide the actual position of each country with respect to trade of CFG and its sub categories.

Gravity analysis helps us to understand the above observed trends. Applying gravity model this paper measures potential trade gap in CFG for India, Pakistan, and Sri Lanka; and have identified corresponding their trade partners. More detail study is needed on CFG trade

opportunity in SAARC and the World. This study has some limitations in terms of detail disaggregated updated information. More depth study is required using goods specific tariffs, size of the economy, endowments, policy, transparency, regulations or infrastructure matter, socio-political and cultural distances. This is our next research agenda.

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<sup>i</sup> See, UN Special report (2003), Khatun (2010), Coondoo and Dinda (2002), World Bank (1992, 2008).

<sup>ii</sup> Trade statistics uses World Integrated Trade Solution (WITS) data base where in UN commodity trade data is used for estimating the various indices. For comparison purpose the study reflects figures for 2002 and 2008



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mainly and for some regional groups like SAARC and ASEAN. All countries of ASEAN, APTA and SAARC fall under Asia Pacific region, and we have taken Asia Pacific as one region for our analysis.

<sup>iii</sup> The list is arrived by defining concordance series from series of list given by the World Bank, ICTSD, WTO, APEC and the OECD.

<sup>iv</sup> CFG exports to the world were worth 38 billion dollars out of total World Exports of 1488 billion USD in 2008 with World export share of CFG working out to be 2.5 % in the year 2008. This share has varied between 2.3 % in 2002 to 2.8% in 2009. World imports of CFG were worth 38 billion USD out of total World Imports of 1557 billion US % in 2008 with World Import share of CFG working out to be 2.4% and this share has varied from 2.2 % in 2002 to 2.68 % in 2009.

<sup>v</sup> It should be noted that this study was initiated at UNESCAP Bangkok. This paper is based on data set that also used in UNESCAP report (APTIR 2011) and other papers also. Our part of trade performance analysis results is very similar to the work of UNESCAP's report (2011).

<sup>vi</sup> See UNASIA PACIFIC Handbook, Trade Statistics in Policy Making, 2007

<sup>vii</sup> See, Anderson (1979), Anderson and Wincoop (2004), Baldwin and Taglioni (2006), Tinbergen (1962), Deardorff (1995), Frankel et al. (1997)

<sup>viii</sup> This trade gap suggests that they could increase the export of CFG. These countries could increase their potential export trade of CFG nearly \$7.35 billion USD. Among these countries, India (\$4.2 billion USD) is on top, followed by Russia (\$1.51 billion USD), Pakistan (\$0.98 billion USD), Hong Kong China (\$0.59 billion USD), Azerbaijan (\$6.7 million USD), and Bhutan (\$1.86 thousand USD), etc. These major countries have huge untapped potential trade of CFG. Intra and inter region groupings are done according to the partner country belonging to Asia, the EU, America, etc., it identifies individual trade partners of the reporting country.

<sup>ix</sup> Actual intraregional imports were \$61.2 billion USD in 2008, and the potential import gap was around \$20 billion USD. Truly, Asian countries were net importers of CFG in 2008. This result also supports the World Bank (2008). Some countries were unable to fulfil its import demand during the crisis period in 2008, but these countries were capable of increasing their potential import trade of CFG nearly \$19.84 billion USD only through intraregional trade. The major import potential countries are the Korean republic (\$15.78 billion USD), Pakistan (\$2.79 billion USD), Armenia (\$7.37 million USD), and Bangladesh (\$1.26 billion USD), etc.