CARBON IMPLICATIONS OF THE COMPREHENSIVE AND PROGRESSIVE AGREEMENT FOR TRANS-PACIFIC PARTNERSHIP

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is the true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that the thesis may be made electronically available to the public.

ABSTRACT

The Comprehensive and Progressive Trans-Pacific Partnership (CPTPP), formerly known as the Trans-Pacific Partnership (TPP), is the largest multilateral free-trade agreement consisting both developed and developing economies of Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore and Vietnam. The trade agreement first signed in 2016, was deemed ambitious for its signatories not only because the agreement would create new markets for free-trade, but also because it included provisions addressing intellectual property rights, labor standards and the environment. After the US withdrew from the partnership in 2017, a revised version of the TPP agreement was signed by the remaining eleven member states in March 2018.

The new agreement retains all thirty chapters from the previous version but suspends twenty-two of its provisions. Though the agreement (both old and new versions) goes beyond most free-trade agreements by addressing protection of ozone layer, biodiversity, wildlife trafficking etc., yet it fails to explicitly mention carbon-dioxide emissions or climate change. In its 'Environment' chapter, the agreement encourages member countries to "transition to a low emissions economy" and pursue goals of the various multilateral environmental agreements (MEAs) they are a part of, like the Montreal Protocol for the protection of ozone layer.

The aim of the research was to assess the carbon implications of the CPTPP agreement by studying the amount of carbon dioxide embodied in trade across ten carbon-intensive sectors from 2017-2035 between member countries using the multi-region input-output (MRIO) tables. This was mainly done in two steps. At first, the consumption-based CO_2 emissions were calculated with the help of emissions multiplier which was determined using MRIO analysis. Then the estimated consumption-based emissions and COP21 commitments as percentage trade share among the CPTPP member states were compared to find out the quantity of emissions needed to be reduced by these countries in order to accomplish their Paris Agreement goals. The result of the input-output analysis shows that consumption-based carbon-dioxide emissions due to trade liberalization in the region increase for all parties of the agreement. The changes in emissions when compared to the respective country's Paris Agreement targets it is observed that CPTPP member states are unable to achieve them by 2030. This thesis also delves into the environmental provisions of the CPTPP agreement, connections and linkages between the Sustainable Development Goals (SDGs) and the nationally determined contributions for the Paris Agreement to understand the implications of rising emissions in accomplishing the COP21 commitments for each country and their sustainable development goals on climate action and partnership between countries. Analysis reveals that environmental pressure increases as a result of increased production, consumption and trade, and the effect of such an increase and the environmental provisions of the treaty have an opposing outcome on the SDG 13 and SDG 17 for the trade partners.

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INTRODUCTION

The two most important multilateral issues for policy makers in the present year have been trade and climate change due to rising global temperature. Climate change and trade are connected in many ways and so it is imperative to link these two agendas together. Liberalizing trade can increase and decrease emission depending on the carbon content of manufactured goods. Trade activities have genuine environmental impacts and therefore trade measures are crucial for achieving climate goals. Such efforts in reducing the carbon footprint by restricting or controlling market access can be viewed as a protectionism and the World Trade Organization (WTO) does not allow protectionist attempts in limiting trade (Asselt & Brandon, 2018).

The disagreement between the proponents of free trade and environmentalists regarding the impact of trade on environment has culminated in introducing innovations to the environmental provisions in multilateral trade agreements. The aim of these provisions in most cases is to establish a balance between economic development and environmental protection. In order to ensure sustainable economic development, international law requires that activities relevant to pursuing economic development should also promote sustainability (Spence, 2011). According to Rogers and his colleagues (2008) economic development is fostered by trade liberalization and its balance with environmental quality and social equity establishes sustainable development. The concept of sustainable development started gaining prominence after the United Nations Conference on the Human Environment explored the relationship between quality of life and environmental quality. It was defined in the Brundtland report in 1987 as the "development that meets the needs of present without compromising the ability of future generation to meet their own needs" (Brundtland, 1987, p. 16).

Since then, the definition of sustainable development has evolved to include the goal of "socially inclusive and environmentally sustainable economic growth" (J. D. Sachs, 2015,p.3). The international community undertook a series of activities dedicated to establishing environmental protection and sustainable development. In 1988, the Intergovernmental Panel on Climate Change (IPCC) was formed to assess the most up-to-date scientific, technical, and socioeconomic research in the field of climate change. In 1992, the Earth Summit was held in Rio de Janeiro where action plans on Agenda 21, Convention on Biological Diversity, the Framework Convention on Climate Change, and non-binding Forest Principles were agreed upon. The next year, UN Commission on Sustainable Development held its first meeting with the objective of following-up on the efforts and projects carried out by the UN Conference on Environment and Development (UNCED) for enhancing international cooperation and intergovernmental decision-making capacity. The Millennium Development Goals (MDG) were adopted in 2000 at the UN's Millennium Summit. The Summit was the largest gathering of world leaders to date where they pledged to achieve by 2015 a set of goals for fighting poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. This was followed by the 2002 World Summit on Sustainable Development in Johannesburg where the notion of "partnerships as a non-negotiated approach to sustainability" was promoted. The Kyoto Protocol came into force in 2005 that contained legally binding commitments for developed countries, party to the protocol, to reduce greenhouse gas emissions and for developing countries to establish the Clean Development Mechanism. In 2012, the United Nations Conference on Sustainable Development (UNCSD) agreed on efforts towards a greener economy through a sustainable framework of clean energy, better jobs and nondiscriminatory use of natural resources (Creech, 2012). Finally, Agenda 2030 with seventeen non-binding Sustainable

Development Goals (SDGs) was put forward by the UN General Assembly in 2015. The same year, countries all over the world in the Paris Agreement (COP21) agreed to work towards an ambitious goal of bringing down the average global temperature well below 2^0C above pre-industrial levels and limiting the increase in temperature to 1.5^0C.

The SDGs require urgent actions by both developed and developing countries by forming a global partnership to end poverty, improving health and education, reducing inequality, preserving oceans and forests and boosting economic growth while addressing climate change. SDG 13 emphasizes on taking urgent climate action which directly refers to the COP 21 - Paris Agreement as being an instrument of tackling the impacts of climate change. SDG 17 focuses on strengthening the means of implementation and revitalizing the global partnership for sustainable development. This refers to the fact that trade liberalization can have both positive and negative effects on sustainable development and hence the contribution of multilateral trading system to this effect must be enhanced (SDG Knowledge Platform, 2016).

Trade being an indispensable medium of growth and development, inclusion of environmental objectives in trade deals started first during the late 1990s and grew particularly in the 2000s, with the purpose of promoting environmental quality, preventing market failures and externalities resulting from increased pollution and finally to ensure mutual supportiveness of trade and environmental policies. An empirical analysis on the effectiveness of environmental provisions in trade agreements mentions that the rationale behind incorporating environmental provisions in regional trade agreements is four-fold: (i) to contribute to the overarching goal of sustainable development; (ii) to ensure a level playing field; (iii) to enhance environmental cooperation of shared interest, and (iv) to pursue global environmental objectives (Martínez-Zarzoso, 2018).

Typically, such environmental provisions have binding or non-binding commitments; recent negotiated agreements mostly have non-binding commitments that are comparatively weaker when considered from an environmental perspective. Non-binding commitments are favored because they are easier to negotiate leaving room for flexibility that may ultimately lead to stronger binding commitments. The provisions contain commitments to domestic environmental regulations, relationship to other multi-lateral environmental agreements, commitments to environmental goods and services, and corporate social responsibility; and dispute resolution and consultation (IISD, 2016). Anecdotal evidence suggests that provisions like these contribute to reinforcing domestic environmental regulations, establishing co-operation mechanisms to improve environmental law and enforcement, and improving public participation and awareness regarding environmental objectives etc. (Martínez-Zarzoso, 2018).

However, there is limited and conflicting empirical evidence regarding the impact of trade agreements on the environmental performance of countries party to an agreement, with a few notable exceptions. In the context of Regional Trade Arrangements (RTAs) there seems to be consensus that RTAs lead to improved environmental quality. For example, Ghosh and Yamarik (2006) find that such agreements reduce the amount of environmental damage by increasing trade and promoting economic development. Baghdati and colleagues (2013) investigate the relationship between trade agreements with environmental provisions and the level of emissions; they find that when environmental provision are included, emissions decrease. On the other hand, Martínez-Zarzoso (2018) find RTAs with or without environmental provisions lead to improved environmental quality.

On national levels the results of the impact of Free-Trade Agreements (FTAs) on the environment are mixed. On the one hand, it has been argued that FTAs increase negative environmental impacts. For example, a report on the developments in the regional trade agreements and the environment published in the 2014 OECD Trade and Environment Working Papers finds that the economic impact of the Deep and Comprehensive Free Trade Area (DCFTA) between the EU and Morocco results in a slight increase in emissions in the EU and globally, with emissions within Morocco remaining unchanged. In the context of the North American Free Trade Agreement (NAFTA), a 2004 study finds that CO_2 emissions increased due to the rise in trade of electricity among the three member countries (Audley, Papademetriou, Polaski & Vaughan,2004). They argue that increased productivity and income levels as a result of NAFTA would lead to a vicious cycle of growth due to expanding domestic consumption. The researchers also observe that the impact of NAFTA particularly on Mexico's environment is negative compared to the economic gains experienced by the country as a result of the growth in trade (Audley et al., 2004) . Conversely, others have argued that FTAs lead to enhanced environmental performance. For example, Grossman and Krueger (1991) explore the environmental impact of NAFTA and estimate that Mexico experience economic growth due to free trade with the US and Canada, and that growth spurs better environmental protection. Finally, in the context of the Trans-Pacific Partnership (TPP; while United States was still a partner), George (2014) argues that "any additional pressure on the environment created due to increased trade and investment in the TPP countries is expected to be countered by measures related to strengthening environmental laws and conservation activities, as well as new investment in environmentally-preferable technologies and higher standards of environmental performance" (p.15). A study conducted by Nemati, Hu & Reed (2016) on the relationship between free trade agreements and greenhouse gas (GHG) emission find that the environmental effect depends on the nature of the agreement. That is, when the agreement is between only developed or only developing countries then there is no indication of environmental damage but when such an agreement takes place between developed and developing countries then there occurs an increase in greenhouse gas emissions.

A common feature across the studies focusing on the RTAs discussed above can be attributed to their use of SO_2 and NO_x as measuring these gases employ a cost-effective sampling method, which is most effective for more local-level environmental impacts (UK-AIR, 2012). In contrast, the mixed results of the effects of FTA on environmental quality can be attributed to variance in not only which gases were being measured to assess environmental quality, but also the challenges of accurately attributing GHG emissions due to the uncertainties in the estimation methods (Milne & Grubnic, 2011). Greenhouse gases like methane, nitrous oxide, ozone, chlorofluorocarbon and hydrofluorocarbon, mostly carbon-dioxide, are responsible for global warming due to anthropogenic causes, and there lies a question of territorial boundaries- who should be responsible for these emissions: producers or consumers? So measuring or estimating the emissions require data accuracy which is dependent on data availability. This involves making lengthy and arduous inventories of GHG emissions occurring at the local and regional level. Quantifying carbon emissions is difficult and because there is no known 'right answer', the methods employed for estimating such emissions lack accuracy (Barnett, Barraclough, Becerra, & Nasuto, 2012).

Activities recorded to create GHG inventories include emissions occurring to meet domestic needs from the public and private sectors, and households like fuel consumption of a power plant, local cement production, electricity consumption within a territory etc. (Bader & Bleischwitz, 2009). This kind of emission accounting is necessary to understand the source of GHG emissions and to have a premise for carrying out climate change mitigation actions. Since 1995 the Intergovernmental Panel on Climate Change (IPCC) have released guidelines to create national GHG emission inventory and the United Nations Framework Convention on Climate Change (UNFCCC) requests member countries to report their annual territorial emissions according to those guidelines. But these inventories do not include the emissions that occur during internal transportation and ignore the emissions embodied in international trade and global value chains as well (Fan, Hou, Wang, Wang, & Wei, 2016; Chen et al., 2018). This creates an issue in fully comprehending the targets needed to achieve the Paris Agreement commitments. It also fails to fairly address the problem of CO_2 emission externality. Taxes imposed to account for environmental harm currently focus on the origin of emissions and not where it is consumed thereby disregarding the impact trade between local and international markets has on overall CO_2 emissions (Fernández-Amador, Francois, & Tomberger, 2016). For instance, studies show that production-based GHG emissions following the IPCC 2007 guidelines for EU decreased over the years but when their emissions embodied in trade and consumption are considered, it is observed to be higher than domestic production emissions. Further analysis shows that production emissions decreased as carbon-intensive activities were outsourced to meet rising consumption and living standards within the EU. This offshoring of production to meet local consumption which is not captured by production-based emission accounting, cannot be an acceptable strategy to meet the global GHG emission reduction obligation outlined in the Paris Agreement (Chen et al., 2018).

Consumption-based emission accounting better captures the emissions embedded in international trade needed to meet domestic demand of goods and services for consumption. According to Fan and others (2016), this method estimates carbon emissions according to the principle "people who consume, bear the responsibility"; meaning that even if the consumers are not directly involved in producing the carbon dioxide emissions, they should take responsibility for emissions occurring during the production of the goods they purchase. The inventories used for estimating consumption-based emissions connect local emission patterns to final production in a given region and ultimately to emissions associated to final consumption at the final destination (Fernández-Amador et al., 2016). Other features of this method include better mitigation options, adoption of cleaner production and policies etc. and hence is a better alternative to production-based emission accounting (Fan et al., 2016).

Literature on consumption-based emission primarily focus on emissions linked to consumption for a specific country/region for individual years or comparative analysis among several countries for a given time period (Fan et al., 2016) using either process model (product life cycle) or input-output model (Barnett, Barraclough, Becerra, & Nasuto, 2012). Input-Output analysis is commonly used as it simplifies connecting international trade to emissions (Lenzen, Pade, & Munksgaard, 2004). The basic model of input-output analysis was first introduced by economists Leontief and Ford in 1970 to denote inter-industrial relationships. But this model can also be extended into a multi-regional model to define trade flows between regions and track CO_2 emissions between partner economies (Lenzen et al., 2006). This is done by using matrices of intermediate demand, final demand and environmental accounts. Multi-regional input-output analysis uses different databases and software like WIOD(Dietzenbacher, Los, Stehrer, Timmer, & de Vries, 2013), OECD, Eora(Lenzen, Moran, Kanemoto, & Geschke, 2013), and Global Resource Accounting Model (GRAM), GTAP(Andrew & Peters, 2013) and MATLAB respectively.

The main objective of this research is to use multi-regional input-output model to study the consumption-based CO_2 emission embodied in trade within the member states of the Comprehensive and Progressive Agreement for the Trans-Pacific Partnership (CPTPP) and study the impact of this free trade agreement on the sustainable development and climate objectives of the region. The eleven participating countries in the trans-pacific agreement make up about 14% of the global GDP making it the third largest free trade area in the world. The agreement entered into force on 30th December 2018 for the first six signatories: Mexico, Japan, Singapore, New Zealand, Canada and Australia. This agreement is the largest multi-lateral free-trade agreement into effect that combines the most number of both developed and developing countries as trade partners. CPTPP is also different to other mega free trade deals such as, the Regional Comprehensive Economic Partnership (RCEP) of five developed members and eleven developing countries and no separate considerations for environment, labor standards or food safety (Hermes, 2016). Besides lowering tariffs, CPTPP also has provisions addressing intellectual property rights, labor standards and the environment. The environmental provisions of the agreement are aimed at ensuring environmental protection as trade gets liberalized and preventing parties from diminishing their national environmental standards in order to promote trade or attract investment (Government of Canada, 2018).

But there has been concerns regarding the impact of such a significant trade agreement on the environment and sustainable development of the region. Studies on this topic argue that a free trade agreement as big as the CPTPP without any proper GHG provisions would aggravate the existing severe climatic conditions. In his paper on the influence of the TPP agreement on environmental performance Vincent (2014) observes that environmental protection is not concern for many of the parties that are looking to strengthen their economies through this treaty, remain short-sighted about the effects on environment and thus enforcement of the non-binding environmental provisions of the agreement would remain an issue as the countries continue to attempt in retaining their economic advantage. A study on the environmental impacts of the trans-pacific agreement while the US was still a part of it, using the Global Trade Analysis Project (GTAP) software, shows that the treaty is likely to increase global GHG emission as well as emissions within the member states; according to the research the growth in GHG emissions is due to non-CO_2 emissions (Akahori, Sawauchi, & Yamamoto, 2017). A more recent study quantifying the economic outcome of the revised TPP (CPTPP) by Ciuriak, Xiao & Dadkhah in 2017 estimates, using the same software as the previous study, that the full effect of the implementation of the agreement would take place by 2035 and the region would experience significant economic gains through greater exports, increased GDP and welfare effects. Both studies use the GTAP database which uses the computable general equilibrium model for the estimations.

Building up on the above mentioned study carried out by Ciuriak and his colleagues this thesis attempts to determine the environmental impacts of CPTPP using Multi-Regional Input-Output (MRIO) analysis. MRIO analysis is accepted to be the best approach to determining consumption-based emissions. Consumption-based emissions using MRIO modelling can provide essential insights into carbon leakage and changes in global production strucutre (Deloitte, 2015). Focus is on ten carbon-intensive sectors for ten out of eleven participating countries; Brunei is excluded as the estimations carried out by Ciuriak and colleagues leave out Brunei from their calculations. Instead of GTAP, MATLAB is used in the research to estimate the consumption-based CO_2 emissions in the region for the time period of 2017-2035 using the Eora database that consists of a MRIO model of input-output tables with matching environmental and social satellite accounts (Lenzen et al., 2013).

With global temperature rising year after year, to prevent the worst possible consequences of climate change countries have to take “unprecedented” actions to bring down their emissions in half by 2030 as reported by a top UN backed scientific panel emphasizing the fact that without any effective international action the effects of global warming would only intensify over time (Dennis & Mooney, 2018). Though most countries are committed to fighting climate change, their Paris pledges are not sufficient enough to control the increasing level of warming and in the context of the current situation there needs to be more aggressive activities related to tackling the effects of climate change**.** According to researchers annual carbon dioxide emissions need to go down almost by half within 2030 to meet even the safest climate change target. But the upward trend in economic growth and emissions is making it difficult to keep the rise in check (Dennis & Mooney, 2018)**.** So the thesis studies the impact of trade liberalization in the trans-pacific region on their climate commitments and sustainable development. For this purpose the result obtained from the input-output analysis is compared to the Paris Agreement targets. The individual commitments outlined by the CPTPP countries in the Paris Agreement are also analyzed to determine the inconsistencies present in achieving those targets as well as their sustainable development. Finally, the environmental provisions of the CPTPP agreement is studied to understand which aspects of its contents may promote or act as a hindrance in establishing sustainability in the region.

Studies on consumption-based CO_2 emissions are gaining importance as this accounting method is able to determine and allocate responsibility of emissions to both producers and consumers. This study contributes in understanding how focusing on consumption-based approach instead of the popular production-based method can facilitate more accurate emission reduction targets and ultimately establish better and fairer market mechanisms. There has been studies on the misalignments in the SDGs and Paris commitments but this research goes beyond further to analyze these inconsistencies as well as the environmental provisions of a free trade agreement in understanding the potential impact on the environment. The research would be of importance to policy makers, business leaders as well as in academia since it attempts to highlight the significance of consumption-based emissions in understanding the issue of climate change and in establishing effective measures to tackle its impacts. This study would also encourage and mobilize the idea that trade agreements are essential in establishing concrete and binding obligations to environment.

Thus, the main research questions of the thesis are:

- What are the carbon implications of the CPTPP for its member countries?
- How does the estimated emissions resulting from trade affect sustainability and climate objectives of the countries in the region?
- How effective are the environmental provisions of the agreement in addressing climate change and sustainable development of the member parties?

The following chapter of the thesis discusses in details the past studies conducted on this topic, an analysis on the relationship between trade, environment and sustainable development, existing measures like market mechanisms centered on production-based emissions to combat climate change and a brief prelude to the significance of adopting consumption-based emission methods. The rest of the sections detail the methodology used in the study, results obtained, discussion and finally conclusion.

Literature Review

This chapter presents the relevant literature to the concepts of climate change, sustainable development and the relationship between trade and environment. First, it highlights the connection between climate change and sustainable development, and how the Paris Agreement is instrumental in addressing the two. This leads to the discussion on the seventeen SDGs with particular attention on the goals in focus of this research: SDG 13 on climate action and SDG 17 that focuses on building partnership. The chapter also emphasizes the relationship between trade, the SDGs and the Paris Agreement national commitments. The most important contribution of this thesis is understanding the significance of consumption-based emissions. The section on the relationship between trade and climate policies underlines the difference between the conventional production-based and the more practical consumption-based emission accounting methods. Lastly, this chapter introduces CPTPP, the free trade deal studied in the thesis.

Trade and sustainable development complement each other because both strive to attain the same goal of enhanced human well-being. Human well-being depends not only on personal wealth but also preservation of environmental services that support long-term economic development (IISD, 2016). However, increased human activity leave detrimental impacts on the environment. Thus, trade and investment require alignment with environmental objectives (IISD, 2016). While trade-related elements are frequently mentioned in individual country contributions, the major emitters do not have a strong focus on trade or trade related measures to foster climate protection. The most mentioned trade related elements in the nationally determined contributions remain international market mechanisms (Brandi, 2017).

Human activities are the major cause of anthropogenic forcing which refers to the accelerating rate of climate change. Carbon dioxide is the most potent GHG with the fastest growing emission levels. Seventy-seven percent of the anthropogenic greenhouse effect in 2004 was caused by CO_2 emissions mostly resulting from fossil fuel burning, industrial processes and deforestation. This upward trend in emission and global temperature would continue unless compelling changes are made in current policies, laws and sustainable development practices (Tamiotti et al., 2009). Expansion of trade and trade liberalization leave a huge impact on the environment as free trade agreements entail considerable rise in domestic and international production of goods and services, and transportation leading to GHG and other pollution. Nemati and colleagues (2016) study three free trade agreements namely, Southern Common Market (MERCOSUR) consisting of four developing economies of South America, NAFTA between USA, Canada and Mexico, and Australia-United States Free Trade Agreement (AUSFTA). Using panel unit roots, cointegration and fully modified OLS the researchers study the long term relationship between GHG emissions, trade and other economic factors like income and energy consumption. The results indicate that for trade agreements between only developed or developing countries like AUSFTA and MERCOSUR there occurs no significant overall increase in world GHG emissions. However, for a free trade deal between developed and developing countries like NAFTA implementation of the treaty leads to an increase in world GHG emissions (Nemati et al., 2016).

Trade liberalization usually affects the environment on three levels: scale, composition and technology. There has been numerous studies on these three impacts of free trade on the economy and environment of countries involved. On a general note, the technique and composition effect of trade has a positive impact on the environment and scale effect has the opposite. A study conducted by Andreoni and Levinson gives evidence that due to free trade, growth in consumption generates more pollution but its abatement becomes efficient as income for the countries grow (2001). The impact of trade liberalization on four environmental indicators including CO_2 emissions was studied by Cole and Elliott (2003). The CO_2 emission data covered 32 countries for the time period between 1975-95 and results show that growth in trade contributes to increased production and consequently emissions without any significant advancement in emission-reduction technologies (Cole & Elliott, 2003).

Trade agreements have gradually started adding environmental provisions; 85% of all preferential trade agreements at present have environmental provisions with numbers from 2015 showing that each such agreement consists of about 60 different environmental provisions on average (DIE, 2017). Empirical studies on the impact of these provisions on environmental performance remain limited. Baghdati and colleagues (2013) study the influence of trade agreement as a trade policy variable on carbon dioxide pollution levels. They hypothesize that the effect on pollution is different for regional trade agreements with and without environmental provisions. Their results indicate that trade agreements that include provision for the environment foster convergence for CO_2 emission which indicates that CO_2 emissions continue until per capita emissions of participating countries become equal (Baghdadi, Martinez-Zarzoso, & Zitouna, 2013). Another study on the relationship between trade and environment conducted by Ghosh and Yamarik (2006) finds that parties of a regional trade agreement experience less environmental damage due to increased trade and per capita income.

Empirical evidence of the contribution of environmental provisions on environmental quality among members of regional trade agreements shows that there exists a statistically significant relationship between trade agreements with or without environmental provisions and improved environmental quality. In this research suspended particulate matter less than 2.5 microns (PM2.5), sulphur dioxide (SO_2) and nitrogen oxide (NO_x) are used as proxies for environmental quality. The main reasons for using these indicators in this study by the researcher are data unavailability, issues of representativeness and relevant literature. Positive relationship between environmental quality and trade agreements exist for both SO_2 and NO_x but the similar thing could not be said for PM2.5. The magnitude of the effect for SO_2 and NO_x is somewhat larger for trade deals with provisions on environment than without them. In this research other environmental indicators including CO_2 emission data are not used because these levels cannot be measured physically but are estimated in national inventories which makes it difficult for country-level analysis (Martínez-Zarzoso, 2018).

The North-American Free Trade Agreement (NAFTA) has been termed as the most innovative agreement because of its exceptional considerations for the environment (Morin, Dür, & Lechner, 2018); a number of studies have been conducted focusing on the impact of this agreement on environment. In 1991, Grossman and Krueger studied the relationship between air quality (SO_2 and smoke) and economic growth as a result of the implementation of NAFTA. Using computable general equilibrium models comparable results from other studies, they find that NAFTA may not be as detrimental to Mexico as perceived. They conclude on the note that economic growth in Mexico could create political pressure for environmental pressure and influence a change in private consumption patterns (Grossman & Krueger, 1991). The researchers were unable to comment on the air quality as environmental monitoring was unsystematic during the time this study was conducted. Contrary to what was expected by Grossman and Krueger, research conducted on the same topic by Audley and others in 2004 shows that environmental degradation is greater than economic gains as a result of the enactment of NAFTA. They also maintain that the environmental record of NAFTA is mixed since neither exceptional environmental benefits nor destructive environmental consequences for the parties came to be true, as predicted (Audley et al., 2004).

The Trans-Pacific Partnership (TPP) was envisioned as a significant trade deal for the trans-pacific region. Studies have been conducted on the environmental impact of the treaty on the region as a whole. Vincent (2014) argued that there is no direct provision regarding GHG emissions reduction or any enforcement measures to safeguard compliance of any other provisions directed at environmental protection. The author suggests that the TPP, like NAFTA would fail in promoting and enforcing environmental protection. He also mentions that climate change is a major concern for the TPP parties because of the rise in GHG emissions due to trade liberalization. As a free trade deal without any requirements for offsetting GHG emission, the treaty would likely negatively impact the climate conditions. One of the suggestions put forward by the author to ensure sustainable development and environmental standard for the TPP parties is to implement carbon taxes or border carbon adjustments applied to both imports and exports; the purpose for this is to help parties offset their economic burden stemming from varying carbon tax regimes across the borders. The author feels that the environment chapter of the agreement would not have the "desired effect without enforcement mechanisms" even though it provides a big opportunity for member countries to commit to environmental protection. He concludes that as economic benefits increase for each new member of the partnership, it motivates each party to put into effect their own environmental regulations and agreements, and create stronger ones (Vincent, 2014).

Akahori, Sawauchi & Yamamoto (2017) studied the contribution of TPP on GHG emissions using the GTAP model. The GTAP model uses Computable General Equilibrium (CGE) analysis to estimate the shifts in economy due to changes in policy, technology and other external factors. This is the only research to date which examines the environmental impacts of the TPP with past studies mostly concentrating on analyzing and quantifying the economic impacts of TPP. Akahori and colleagues use the GTAP CO_2 and non-CO_2 database to determine the effect of this trade agreement on GHG emissions. The CO_2 emissions are obtained as the product of the amount of fuel consumption and emission coefficients. Post-TPP CO_2 emissions are calculated by multiplying initial CO_2 levels for each sector by changes in corresponding sector-wide fuel consumption from GTAP results. The researchers find that the agreement is expected to increase the total amount of GHG emissions in all member countries as well as globally. The results indicate that the increase in GHG emissions is because of the growth in non-CO_2 emissions (0.71%) compared to CO_2 emissions (0.04%). The study also estimates that Japan experiences the largest increase in CO_2 emissions among the TPP member states (Akahori et al., 2017).

A more recent study using the updated GTAP database and model was used by Ciuriak and his colleagues in 2017 to assess the economic implications of the newer version of TPP which is now known as CPTPP. The authors estimate the changes in income and exports for ten partner countries for the year 2035; this is the year for which the estimations can be considered to reflect a permanent change in trade and economic output across the thirty-three sectors studied in the research. They find that real GDP for the CPTPP would grow by about 0.075% creating economic welfare benefits of about US$13.47 billion by 2035. The researchers suggest that gains for these eleven countries remain significant and even greater without the US in the agreement. They conclude on the notion that, "If there is a real option for the Eleven to suspend the controversial issues while proceeding with the conventional trade liberalization agenda on a provisional basis, the Eleven should seize it." (Ciuriak et al., 2017). Based on the work of Ciuriak and colleagues on the quantification of trade under the

CPTPP, this research aims to determine the environmental impact of this free trade agreement on the countries and the region as a whole.

This is different from typical production-based emission accounting method which is used for measuring and creating emission inventory as defined by the IPCC and was previously used in the Kyoto Protocol. According to the production-based method, emissions are allocated based on country boundaries and emissions that are embedded in international trade are overlooked (Glen P. Peters & Hertwich, 2008). The estimated environmental outcome is further studied to understand how successful the environmental provisions of CPTPP are in establishing environmental protection and sustainable development.

The next sub-section discusses how climate change and sustainable development are linked to each other. The Paris Agreement, an important mechanism in tackling climate change as well as environmental sustainability is also introduced in this part.

Climate Change and Sustainable Development

Changes in earth's weather pattern, a few million years ago, was a result of several natural occurrences like biotic processes, variation in solar radiation, volcanic eruptions and plate tectonics. But after the industrial revolution changes in the climatic condition were primarily due to human activities like burning of fossil fuel and cutting down of trees that release a great amount of gases like carbon dioxide, methane and others. Over time these gases have accumulated over earth's atmosphere creating a "thick, heat- trapping blanket" ("What is climate change?", 2017) and creating what is known as greenhouse effect. The greenhouse effect refers to warming of the earth as a result of various greenhouse gases, mainly carbon dioxide insulating and disturbing the atmospheric balance that keeps the planet's climate stable. Anthropogenic causes have increased the average global temperatures by 0.7^{o}C since 1900 with the northern hemisphere growing warmer than any point during the last 1,000 years ("What is climate change?," 2017).

Gases like carbon dioxide, methane, ozone, nitrous oxide, and hydrofluorocarbon etc., commonly known as the greenhouse gases absorb the energy radiated by earth thereby trapping and preventing the loss of heat into space ("What Is Climate Change?", 2018). This ultimately raises the temperature of the planet further resulting in extreme weather events. This drastic change in climate patterns is referred to as global warming or climate change. The impacts of climate change is not only confined to severe environmental degradation but its effect is also felt across the economy and society and as such the impacts are connected. Thus, deterioration or improvement across any one aspect would influence the others ("What Is Climate Change," 2018). So to tackle the effects of climate change it is only practical to address GHG emissions, particularly emissions of carbon dioxide, the most potent of all GHG.

The Sustainable Development Agenda and the COP 21 - Paris Agreement are the two important environmental agendas in the present time that primarily intend on combating climate change. The SDGs aim to achieve sustainability in economic, social and environmental aspects whereas the Paris Agreement intends to bring down the global GHG emissions by 2030. So, both these agendas have the common objective of environmental protection and climate action. A number of studies focus on the interaction between the SDGs as well as on the connections and misalignments between them.

A study on the relationship between the SDGs conducted by Pradhan and colleagues in 2017 finds that the agenda of sustainable development depends to a great extent on how the synergies among the goals are leveraged, the trade-offs negotiated and minimized through better strategies. This paper synthesizes the connections and trade-offs between the goals using time-series correlation analysis. The results reflect that there exists more synergies than trade-offs among the goals which indicates a strong basis for successfully implementing Agenda 2030 (Pradhan, Costa, Rybski, Lucht, & Kropp, 2017). They found that goal on good health and well-being (SDG 3) have more "synergistic co-benefits" whereas goal regarding responsible consumption and production (SDG 12) have trade-offs with other goals. One interesting inference of the study is that goals related to higher human development and socio-economic standards are in conflict with environmental goals.

An analysis of the SDGs by Swain quantifies the inconsistencies existing between the goals. As mentioned by the author, past studies conclude that there exists potential inconsistencies between socio-economic and environmental sustainability goals. One of the studies mentioned in this paper finds that incompatibility in the sustainability goals for business-as-usual scenarios result from growth and increased consumption, i.e. GDP per capita negatively affect CO_2 emissions (Swain, 2018). The results of the analysis also indicate that economic growth and consumption are the main reasons behind the inconsistencies in environmental objectives and socio-economic development. Another inference of the study is that for sustainable development developed countries should concentrate on their social and environmental policies, and developing countries on their economic and social policies. Another study on the nature of the inconsistencies of the sustainability goals conducted by Spaiser and colleagues using dynamic system models find that such discrepancies exist as economic growth and consumption are used to measure development. The results of the research show that CO_2 emission has a negative impact on development that is, classic development and ecological sustainability are in conflict. Quantification of the nature of these inconsistencies indicate that economic growth fosters socio-economic goals while limiting the environmental ones (Spaiser, Ranganathan, Swain, & Sumpter, 2017).

According to a report published by the UNDP, Agenda 2030 and the Paris Agreement have set a new path for countries towards sustainable development. The report states that sustainability goals consist of targets that have the potential to help attain the nationally outlined contributions of the Paris Agreement and so it is important that they are in coherence in order to "reduce duplication and increase efficiency-maximizing resources, technical capacity, information, and expertise sharing" (UNDP, 2017a). There are mainly two tools that help in determining the links and connections between the SDGs and the national contributions for the Paris Agreement. One such tool has been developed by Climatewatch, an online platform that aims to assist policymakers, researchers and other relevant stakeholders with data and visual depictions of climate progress for different countries. One of the features of this tool is that it contains an extensive mapping of the connections between the goals and national contributions (Nilsson & et al., 2017). Another similar tool has been developed by the German Development Institute (SDSN) and the Stockholm Environment Institute (SEI) which provides visualizations of the performance of SDGs of individual countries. The tool was developed using analysis of more than 7000 climate related activities included in the national contributions through the lens of sustainable development which assist in determining how these outlined contributions facilitate in attaining the SDGs (DIE-GDI, 2017).

The Paris Agreement

The Paris Agreement was prompted by the rise in global temperatures resulting from anthropogenic causes and the failure to reach a collective understanding of the issue (Freedman, Freedman, & Stagliano, 2015). It is the first comprehensive climate agreement, signed on the 21st session of the Conference of Parties in 2015 (COP21) and entered into force in 2016 bringing all countries to work towards an ambitious goal of bringing down the average global temperature well below 2^0C above pre-industrial levels and limiting the increase in temperature to 1.5^0C. When first initiated the deal was hailed as a 'major leap for mankind' as it was a result of not only two weeks of negotiations but more than 23 years of international endeavors under the UN to build shared actions to address concerns for the increasing temperatures. Since 1992, governments around the world had been making promises of taking steps to fight global warming but efforts pledging measures that would avoid dangerous warming were met with conflict and disagreements, refusal of biggest emitters to take part, ineffective agreements and ignored treaties. Then in 2015 when the Paris talks commenced it was considered as a make-or-break for the UN process because if they failed, collective global efforts would be left without any concrete means of combating climate change (Harvey, 2015).

The Paris Agreement intends on the long-term goal of achieving "a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century" (Article 4). The agreement aims to strengthen the ability of countries to mitigate and adapt to the impacts of climate change. Its objective is to assist all countries (developed, developing, and vulnerable) in reaching their climate objectives, supporting appropriate financial flows, technology sharing and an enhanced capacity building. Through a robust transparency framework the agreement provides for enhanced transparency of national actions. Its focus is primarily on developed countries' assistance to developing states in combating climate change, fostering green economies and increasing access to sustainable energy (Watters, 2015). Under international law, it is a binding agreement in spite of having some non-binding elements (Bridgeman, 2017). The binding provisions are mostly reporting and procedural in nature (Martin, 2016c) and does not contain any legally binding provisions that would require any domestic legal action by participating countries (Clémençon, 2016).

At the core of the COP21 commitments lies the voluntary pledges called the Nationally Determined Contributions (NDCs) which are the national efforts defined by individual countries to reduce their domestic territorial greenhouse gas emissions to certain levels by 2030 and adapt to the impacts of climate change. It is legally binding for countries to submit their NDCs and update them every five years but it depends on each country to set their own goals and thus non-binding in nature (Arellano & Roberts, 2017). Parties are obliged to "[d]evelop, periodically update, publish and make available to the Conference of the Parties ... national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol" (Tamiotti et al., 2009). Each country has its own set of mitigation measures to adapt to the impacts of climate change. IPCC guidelines only takes into account production-based emissions that excludes emissions from imported items; this method is used in accounting for individual country GHG emissions in order to set their domestic targets. Each country has a base years as a reference for the reduction levels. For the CPTPP member countries the NDCs are shown in Table 1 below:

Country	**NDCs**
Australia	26% below 2005 levels
Canada	30% below 2005 levels

Chile	30% below 2007 levels
Japan	26% below 2013 levels
Malaysia	35% below 2005 levels
Mexico	25% below 2013 levels
New Zealand	30% below 2005 levels
Peru	20% below 2010 levels
Singapore	36% below 2005 levels
Vietnam	36% below 2005 levels

Source: (UNFCCC, 2016)

Table 1:COP21 Commitments for CPTPP Parties

According to Raymond Clémençon in his paper titled "The Two Sides of the Paris Climate Agreement: Dismal Failure or Historic Breakthrough?", he states that the agreement has set an ambitious goal on the principle of "fair and equitable burden sharing" and refrained from imposing any legally binding emission reduction targets. He writes that the Paris Agreement address the issue that inherently lies with the current economic system which continue supporting the fossil fuel sector to steer economic growth for the short to medium term (2016). He also expresses that this agreement fails to engage in the disparities that exist between international climate and trade liberalization objectives that countries carry out simultaneously without any coordination. Being such an exemplary global agreement on GHG emission reduction, it ignores to define any emission peak year, emission reduction timeline, any specific plans or strategies to phase out fossil fuel subsidies or to discontinue construction of new coal-fired power plants. The author observes that the overall reduction target of the Paris Agreement by 2030 is not achievable in the absence of government intervention (Clémençon, 2016).

Implementation of the Paris Agreement is critical for attaining the SDGs as it contributes as a roadmap for climate actions aiming to reduce emissions and build climate resilience (Martin, 2016a). The next section presents the timeline of how the SDGs came about as concerns for climate change and environmental degradation intensified over time. These goals are a combination of seventeen different broad and interdependent goals covering economic, social and environmental development issues to be achieved by 2030. Each of the 17 goals have their own indicators and targets in order to establish sustainable development. It also talks about the SDG index that help countries in tracking their progress towards achieving the SDGs. For the purpose of this thesis the indices help in understanding the actual and current conditions of the development goals of the CPTPP countries.

Sustainable Development Goals

The need to create and support sustainable development emerged from the four fundamental themes of peace, freedom, development and environment. Over the years, efforts of different international commissions were directed towards connecting these themes together which led to the understanding that pursuit of one of these aspirations were dependent and contingent upon the other themes. As stated by Gro Harlem Brundtland, former Prime Minister of Norway, in the report titled 'Our Common Future' (1972), *"But the "environment" is where we live; and "development" is what* *we all do in attempting to improve our lot within that abode. The two are inseparable."* (Kates, Parris, & Leiserowitz, 2005, p.10)**.**

Following the publication of the report, the UNCED in Rio de Janeiro (Earth Summit), 1992 adopted the first agenda for environment and development, and declared Agenda 21 with the aim of acting internationally on development issues. The Summit acted as a platform for member states to collaborate and cooperate on issues related to environment and sustainable development (SDG Knowledge Platform, 2016). In 2012, UNCSD, also known as Rio+20, was held as a 20-year follow up to UNCED, the outcome to which led to suggesting seventeen goals directed at reconciling economic, social and environmental objectives. The goals were proposed to continue the progress achieved through the eight Millennium Development Goals (MDGs) that focused on poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women (WHO, 2018). The SDGs cover development issues like poverty, hunger, health, education, climate change, gender equality, water, sanitation, energy, urbanization, environment and social justice. Another significant accomplishment of this summit was an agreement on the Climate Change Convention that led to the Kyoto Protocol and later the Paris Agreement.

The following year a UN working group was created to identify targets and indicators for the seventeen SDGs. In September 2015, the General Assembly adopted the 2030 Agenda for Sustainable Development serving as a common 'blueprint for peace and prosperity for people and the planet, now and into the future'. The seventeen SDGs, at the core of Agenda 2030, require immediate actions by all countries (developed and developing) in a global partnership. The UN member states recognize that climate change, ending poverty, health and education, reduced inequality, economic growth, preserving wildlife and oceans go hand-in-hand (SDG Knowledge Platform, 2016). These goals aim to create a more inclusive, equitable, safe and sustainable world by 2030 ("The Global Goals," 2018) but are not legally binding. Nonetheless countries are expected to take leadership and implement their own national framework for achieving these seventeen goals (Martin, 2016b) by 'respecting national policies and priorities' with 'each Government setting its own national targets' (Swain,2018). The targets are defined globally and applicable for all countries based on their priorities, context and needs (UNDP, 2017a).

Source: Global Compact Network Canada

Figure 1: The Seventeen Sustainable Development Goals (SDGs)

For the thesis only SDG 13 on climate action and 17 on partnership for the goals are considered in order to understand how liberalization of trade in the trans-pacific region would facilitate building partnership and affect the environmental and economic sustainability for the parties.

SDG13 with five targets and eight indicators focuses on taking urgent action to combat climate change and its impacts. Increasing GHG emissions and global temperatures are causing an escalating change in the climatic conditions and weather patterns that could result in catastrophic repercussions unless immediate collective actions are taken. Rising levels of greenhouse gases in the atmosphere is fuelling severe natural disasters like hurricanes, floods, droughts and even migration. Over the past 30 years natural disasters rose three times and economic losses due to such occurrences increased five times; more than 24 million people were displaced by natural events in 2016 alone (UNDP, 2017b). Actions to protect the people and planet include education, innovation, regulating emissions and developing renewable energy. International commitment and cooperation is also required to address immediate needs, prepare for future events and reduce the risks to people and property (UNDP, 2017b). SDG 17 is based on strengthening partnerships over the world in order to accomplish all other sixteen SDGs including climate action. Establishing multi-stakeholder partnerships to share knowledge, expertise, technology, and financial support is deemed vital to overall success of the SDGs. Targets for this goal emphasize on developing international partnership in finance, technology, trade, capacity building and other systemic issues to establish social, economic and environmental sustainability by 2030. Investments and support among global partners is needed to ensure technological advancement, fair trade and market access, especially for developing countries (The Global Goals, 2018a).

SDG Index

The UN Statistics Commission suggested over 230 indicators to track the progress of the SDGs. Not all of the indicators are well-defined or have adequate necessary information for all UN member countries. A 2017 paper on indicator preferences finds that countries prefer to report on the progress of their socioeconomic indicators (health, education, gender equality, decent work, and economic growth, infrastructure) but reporting on environmental goals (SDG 12-15) and international partnership (SDG 17) are found to be relatively weak (Bizikova & Pinter, 2017). It is observed that countries struggle to fulfill the whole range of official SDG indicators (J. Sachs, Schmidt-Traub, Kroll, Durand-Delacre, & Teksoz, 2017).

The Sustainable Development Solutions Network (SDSN) and Bertelsmann Stiftung, a German independent organization, for the first time in 2016 prepared a global unofficial SDG Index and Dashboards to complement the official SDG indicators in order to guide countries in understanding their positions regarding the accomplishment of SDGs by 2030 and thus help governments identify their priorities. The SDG indices are used to monitor performance of each country towards fulfilling their SDGs. The index also helps countries to assess their present state of progress relative to other countries at a given income level or in a given geographic region. A set of indicators based on the most recent published data, published by official data providers (World Bank, WHO, ILO, others) and other organizations including research centers and non-governmental organizations, for each of the 17 SDGs is used to create the SDG Index. Every indicator for each of the SDG ranks from best (100) to worst (0) and finally average of the scores for all indicators for each SDG produces country scores for each of the 17 goals. The overall SDG index for each country is the arithmetic mean of the country scores on each of the 17 SDGs. SDG index between 0 and 100 reflects the country's position towards accomplishing the 17 goals (J. Sachs, Schmidt-Traub, Kroll, Durand-Delacre, et al., 2017). Recent SDG index and dashboards also include international spillover effects and global responsibilities to project a fair and realistic condition needed to fulfill Agenda 2030. These new indicators are included as the goals themselves are interrelated and require global collective action to create sustainability. Though the goals seem to be relevant for countries on a national level(Sachs et al., 2017), trans-boundary activities affect society, environment and economy of neighboring and partner countries. Hence, international spillover indicators of the SDG index reflect the externalities created when actions of one country impose costs on another country that are not projected in market prices, and therefore are not "internalized" by the actions of consumers and producers. An important environmental spillover is the consumption-based carbon dioxide emissions and an attempt at internalizing such an externality include corrective taxation such as the carbon tax (Sachs et al., 2017).

This thesis considers the most recent SDG indices for goals 13 and 17 for the CPTPP countries in order to observe the status of CPTPP parties in their efforts in achieving these goals. The indices reveal how close the countries are in realizing their climate objectives and forging partnerships. The present state of the SDGs as reflected by these values when compared to the results obtained from the input-output analysis reflect how free trade affects the current conditions for attaining SDG 13 and 17 in the region.

As seen from the SDGs and implicitly from the Paris Agreement, trade plays an indispensable role in linking the SDGs to the individual country COP21 commitments. Trade agreements aim to facilitate international commerce and free trade contributes in improving the overall economy of the countries part of such an agreement. These agreements create better prospects particularly for developing countries and emerging economies by strengthening their markets access, economy, income level and living standards (Solarin, Al-mulali, & Sahu, 2017). Therefore, these treaties become important channels for attaining the SDGs for both developed and developing worlds.

The following section sheds light on how trade is fundamental to establishing sustainable development and climate change commitments. It also discusses how trade policies and agreements over the years have prioritized environmental protection and sustainable development; the reasons for including environmental provisions in trade agreements and their types are also examined in this section.

Trade, SDGs and NDCs

International trade is based on the exchange of goods and services in forms of imports and exports of goods produced in countries with respective comparative advantage. Production as well as transportation of such goods result in increased emissions. Increasing emissions of carbon dioxide and other GHG is the prime cause of climate change.

A post-2015 cost-benefit analysis by the Open Working Group of the Copenhagen Consensus Center bringing in more than 40 top economists, NGOs, international agencies and businesses was aimed at identifying goals with the greatest benefit-to-cost ratio for the SDGs. The report aims to assist the international development community to determine targets that produce the most social benefits relative to cost. All costs and benefits including improved health and environmental impacts are considered in this working paper. The purpose of the analysis is to help countries identify targets that are needed to be prioritized in order to achieve social, economic and environmental benefits (Lomborg, 2014). The result of this cost-benefit analysis shows that trade liberalization would result in social, environmental and economic benefits for every dollar spent in implementing the targets of the SDGs (Copenhagen Consensus Center, 2014).

The analysis of the SDG targets uses five categories of rating:- phenomenal (benefits are 15 times greater than the costs), good (benefits are 5 to 15 times greater than the costs), fair (benefits are 1 to 5 times greater than the costs), poor (benefits are smaller than costs or targets poorly specified) and uncertain (benefits and costs of the actions are not well known or there is not enough knowledge of the policy options) (Lomborg, 2014). The cost benefit analysis of the targets of SDG 13 and 17 (targets relevant to technology, capacity building, trade and systemic issues) are shown is Table 2 below:

Targets	Rating
SDG 13: Climate Action	
13.1 Strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries	Good
13.2 Integrate climate change measures into national policies, strategies, and planning	Fair
13.3 Improve education, awareness raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning	Uncertain
SDG 17: Partnership for Goals	
17.6 Enhance North-South, South-South and triangular regional and international cooperation and access to science, technology and innovation, and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, particularly at UN level	Phenomenal
17.7 Promote development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favorable terms, including on concessional and preferential terms, as mutually agreed	Fair
17.9 Enhance international support for implementing effective and targeted capacity building in developing countries to support national plans to implement all SDGs, including through North-South, South-South, and triangular cooperation	Uncertain
17.10 Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the WTO including through the conclusion of negotiations within its Doha Development Agenda	Phenomenal
17.11 Increase significantly the exports of developing countries, in particular with a view to doubling the LDC share of global exports by 2020	Good
17.12 Realize timely implementation of duty-free, quota-free market access on a lasting basis for all least developed countries consistent with WTO decisions, including through ensuring that preferential rules of origin applicable to imports from LDCs are transparent and simple, and contribute to facilitating market access	Good
17.13 Enhance global macroeconomic stability including through policy coordination and policy coherence	Uncertain
17.14 Enhance policy coherence for sustainable development	Uncertain
17.16 Enhance the global partnership for sustainable development complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise,	Uncertain

technologies and financial resources to support the achievement of SDGs in all countries, particularly developing countries	
17.19 Build and develop measurements of progress on sustainable development that complement GDP based on exiting initiatives and support statistical capacity in developing countries by 2030	Uncertain

Source: (Lomborg, 2014)

Table 2: Cost-Benefit Analysis of SDG 13 and SDG 17

Climate change affects both economy and development. Changes in climate patterns lead to increased poverty, migration, vulnerability and reduced well-being and economic productivity. It would also aggravate the impacts currently experienced and addressed by the SDGs, and if not addressed would pose threat in the future. Thus, the SDGs and the Paris Agreement together aim to coordinate the common aim of the global community in striving towards proper and adequate actions towards climate change, its mitigation and adaptation (Raymond, 2017). The need to understand the connection between the SDGs and the Paris accord is important because:

- NDCs guide countries to align their climate activities with the SDGs.
- Target for Climate Action (SDG 13) complement the NDCs.
- Synergies and trade-offs motivate countries to achieve their objectives and implement both agendas more efficiently.

SDG 13 assumes that the UNFCCC is the main body that negotiates the global climate change response and the goal does not set any particular targets and measures to mitigate or adapt to the challenges of climate change thereby handing the task over to the Paris Agreement (mainly because the SDGs and the COP21 were being held around the same time). Nationally determined contributions for all signatories of the Paris Agreement inherently connect to SDG 13 but only 6% of all activities directly match this goal. The NDC activities mostly connect to targets of integrating climate change measures into national policies, strategies and planning, and improving education, awareness-raising and human and institutional capacity on climate change mitigation and adaptation (Spaiser et al., 2017). This goal addresses energy efficiency, environmental investments, GHG emissions and risks & opportunities due to climate change ("SDG 13," 2015). Targets 13.1 and 13.3 focus on strengthening resilience, capacities and increasing awareness of countries in order to adapt to climate-related hazard and natural disasters. Target 13.2 emphasize integrating climate change measures in their national policies, strategies and planning. This aligns with the NDCs outlined in the Paris Agreement to face the effects of climate change, bring down GHG emissions and build climate resilience.

SDG 17 is crucial for implementing the Paris Agreement as climate change requires financial resources, new technologies, capacity building, climate-friendly trade policies and policy coherence along with international cooperation all of which are a part of this goal. The overall aim of such partnership is to enhance North-South and South-South collaboration by supporting national plans like the NDCs to achieve all other SDG targets. The goal connects to around 7% of all NDC activities. These activities are mostly associated to the targets of 17.3 ("Mobilize additional financial resources for developing countries from multiple sources"), target 17.6 (enhanced North-South, South-South and triangular cooperation on and access to science, technology and innovation and enhanced knowledge sharing) and target 17.9 (enhanced international support for capacity building in developing countries). For developing countries financial assistance, capacity building, research and innovation are the most common climate related activities linked to SDG 17. As many national commitments of the Paris Agreement are contingent upon international cooperation, its success depends on the support provided (Spaiser et al., 2017).

Framework for the Paris Agreement is built on the assumption that climate action should not include any "arbitrary or unjustifiable discrimination or a disguised restriction" on international trade. But the nature of the nationally outlined climate mitigation and adaptation measures of this agreement is bottom-up implying that international trade cannot interfere with governments' actions in achieving the ambitious Paris climate goals (Helble & Shepherd, 2017). Hence the Paris Agreement impacts trade indirectly. For example, countries would be able to establish a global green economy if the NDCs are successfully implemented. As the agreement does not impose on the parties actions needed to meet the objectives, the countries are at a liberty to formulate the NDCs based on their national priorities. This provides prospects for unilateral actions that would affect trade and investment (Cosbey, 2016).

Trade Policies and SDGs

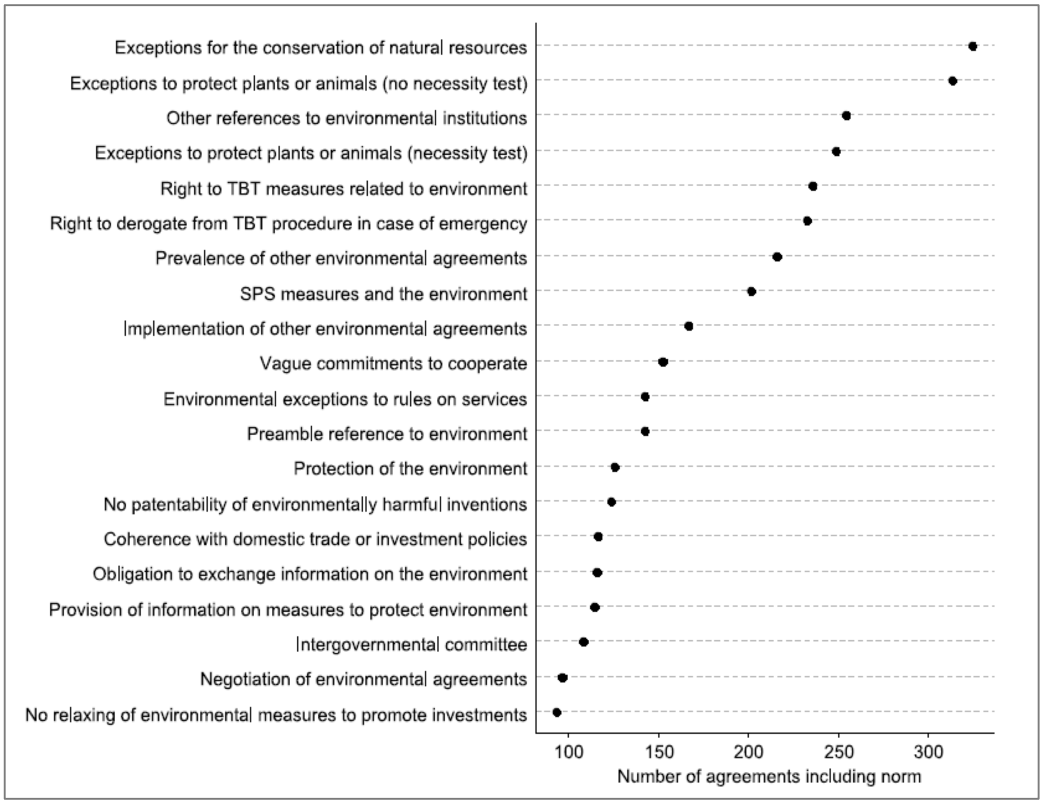
Multiple SDGs and targets reference trade policy and relevant measures, like in Goal 2 (zero hunger), Goal 8 (decent work and economic growth), Goal 9 (industry, innovation and infrastructure), Goal 10 (reduced inequalities) and Goal 17(partnership for the goals) (Hoekman, 2017). Trade has the ability to influence climate action by promoting environmental-friendly products and technology such as clean energy and energy efficient know-how. Zero tariff trade also has the potential to drive climate change mitigation. On the contrary, national measures undertaken to address climate change at times affect trade flows and multilateral trade rules. These issues require thorough understanding of climate-trade nexus and trade-offs to prevent international business from stifling and from climate action being undermined (Brandi, 2017).

Trade having such an important role in establishing the SDGs and climate change being one of the pillars of sustainable development, these two aspects have not been directly connected in SDG 13 (climate action). Also, trade and its associated policies focus on "business-as- usual" scenarios; business-as-usual scenario refers to the assumption that future development trends follow past trends with no changes in policies taking place (IPCC, 2018). This reflects a commercial motive behind linking trade to SDGs, the primary focus being on exports (especially from developing countries) and not on trade i.e. imports and exports (Hoekman, 2017). Moreover, it is to be noted that SDG 13 itself is less detailed than other SDGs specifically regarding reduction of GHG emissions, mitigating climate change and its impacts. According to an Asian Development Bank's working paper, it is stated that this gap is due to the fact that these goals and targets were being outlined around the same time as countries were negotiating the Paris Agreement on climate change (Prag, 2017). International trade has a major influence on the pattern of GHG emissions worldwide. Its impact on environment can be attributed to the scale, composition and technique effects, to the embedded CO_2 in export and imports and thus to carbon leakage. The ambitious Paris treaty is a testament to international cooperation for tackling climate change. The term "trade" is not mentioned in the treaty or in its supplementary technical decision. But the COP21 commitments require that international trade regulations do not create hindrances for governments in enforcing legislation for achieving the climate objectives (Prag, 2017).

Trade policies can play a crucial direct and indirect role in attaining the SDGs. Trade regulations help in reducing trade costs, increasing market integration and introducing new technology etc. (González, 2018). In recent years, trade agreements have adopted several environmental provisions along with the inclusion of labor standards. Prior to the 1970s, there were only a few such agreements that included considerations for the environment. This scenario changed 1990 onwards after the US-Mexico dispute over dolphins. In 1991 the United States' restriction on tuna products from countries that did not abide by certain dolphin protection standards was deemed by Mexico as an unnecessary barrier to trade and the country resorted to General Agreement on Tariffs and Trade (GATT) dispute settlement procedure. This incident created huge public demand for incorporating sufficient comprehensive environmental provisions in trade deals. This was clearly reflected in NAFTA's environmental side agreement as this agreement became one of the first free trade agreements to contain innovative and exceptional provisions regarding the environment; it may have also indirectly affected the entire trade regime (Morin et al., 2018).

Provisions regarding climate and environment in trade agreements are mainly of three types. The first kind is the general environmental provisions; this includes introductory references to the environment and the significance of addressing climate change, reference to the parties' needs to guarantee higher levels of environmental protection by safeguarding and enforcing respective environmental laws and not weaken them to attract further investment(Colyer, 2012; Das, Droege, Mehling & van Asselt, 2016). These general provisions indicate in improving and maintaining environmental laws, their enforcement, and promoting corporate environment leadership (Colyer, 2012). They also mention the necessity of abiding by the multilateral environmental agreements the countries are party to. Secondly, provisions call for cooperation on environmental issues especially between developed and developing countries in order to encourage and support trade and investment in environment- related sectors, like trade liberalization in environment-friendly goods and services. Other cooperative actions include increasing the capacity of environmental monitoring and enforcement by bundling and strengthening capacity through training and facilities. The other common elements of environmental provisions in a free trade agreement are public participation and institutional arrangement for ensuring implementation of environmental provisions (Colyer, 2012). Thus trade agreements help advance climate objectives by creating synergies and prevent a race to the bottom (Droege, van Asselt, Das, & Mehling, 2016).

A research conducted in 2017 on the assessment of the reasons behind countries including environmental provisions in their trade agreements. The database used for the research is called Trade and Environment Database (TREND) that contains dataset of 308 environmental items in 630 post-1947 trade agreements. According to the research, three main reasons stand out; the foremost being the response to electoral pressure from public who value environmental protection. The other reason for governments to incorporate such provisions is to appease the protectionist pressure since ensuring high standards of environmental regulation in other countries reduces competition for local firms. The paper states that some environmental provisions have the likelihood of restricting trade. Hence provisions requiring higher environmental standards in developing countries, for example, might reduce the competitiveness of its industries in the international market. Lastly, lower compliance cost acts as a major motivation for countries in adopting environmental provisions in their trade agreements. The reason for this as stated by the researchers is that governments who favor domestic environmental protection would go for treaties which include provisions on environment. Further analysis using the datasets shows the most common provision across a wide range of agreements is the conservation of natural resources followed by protection of life and health of plants and animals (Morin et al., 2018).



Source: Morin et al., 2018

Figure 2: Most Widely Used Environmental Norms in Trade Agreements

Inclusion of environmental provisions do not necessarily promise higher environmental standards or protection. The effectiveness of the provisions lie on the level of their ambition, depend on how much they are binding on the participating parties, degree of enforcement and on the extent of cooperation among the parties (Prag, 2017)**.** NAFTA is the first trade agreement to include "legally binding" environmental provisions. A study on this agreement shows that air pollution across Mexico reduced after it came into force as a result of investments and new technologies that helped to improve energy efficiency of production processes. But as industrial pollution remained reasonably high even eight years after the treaty was adopted this improvement could not be relayed as the effects of environmental provisions in the treaty. The study concludes on the note that it is difficult to distinguish the impacts of environmental provisions of NAFTA as other economic factors remain unchanged (UNCTAD, 2016).

Many countries (accounting for 58% global emissions) in the Paris Agreement favor an economical and efficient method of decarbonization by using carbon pricing instruments like carbon tax and cap-and-trade system (Narassimhan, Gallagher, Koester, & Alejo, 2017). Unlike carbon tax, the cap-and-trade system is not effective in reducing carbon emissions (Clémençon, 2016) and leads to carbon leakage due to resource reshuffling. It also comes in conflict with partners in trade that do not have a price on carbon (Narassimhan et al., 2017)**.** A study on the performance of the cap and trade program during the timeline of Kyoto Protocol shows that GHG emission reduction was possible because of the introduction of new techniques, regulations along with cap and trade. The paper states that cap and trade was certainly not the best mechanism to achieve reduction targets (Freedman et al., 2015). Furthermore, the phenomenon of carbon leakage acts as an incentive for countries to meet their national emission reduction targets by offshoring carbon-intensive production process. Thus making it difficult to design effective environmental policies without fully realizing the actual distribution and balance of the environmental impacts of trade. Significant improvements in emissions is possible when policies regarding technology, industry structure and trade are combined (Wang, Zhao, & Wiedmann, 2019).

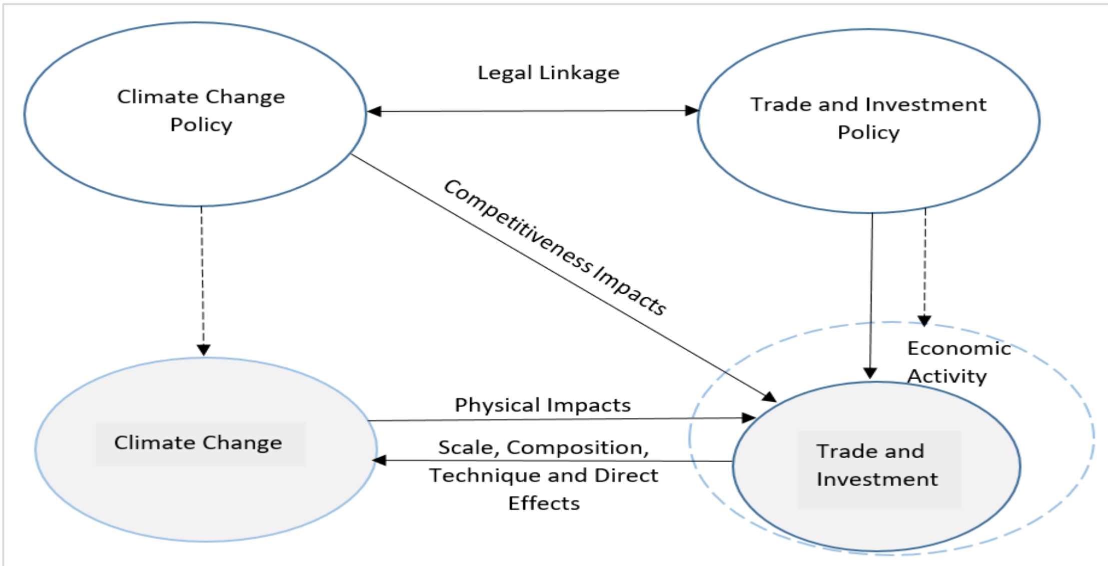
Present and future human welfare and development affects and is affected by both trade and climate. A flourishing environment fosters economic growth and well-being. The following section outlines how trade policies, particularly free trade agreements and climate policies influence and are relevant to each other. Moreover, it provides a detailed account of the existing policy instruments to combat climate change that are basically formed around the production-based accounting method, limitations of the production-based approach and, finally the importance and significance of the consumption-based method in rectifying these shortcomings.

Relationship between Trade and Climate Policy

Though both trade and climate agendas acknowledge and favor each other's mandate by citing protection and preservation of the environment, sustainable development, and minimization of restrictions on international trade respectively; these regimes have matured over the years independently without taking advantage of their shared objectives and possible synergies. Possible conflicts in economic growth and environmental protection have barred countries from developing mutually supporting trade and climate agendas. Trade regimes have been seen to be reluctant to include environmental considerations in absence of directives from the UNFCCC as it could be perceived as "green protectionism" particularly by developing countries (World Bank, 2010). On the other hand, besides "promoting sustainable development" the UNFCCC also emphasizes on "open economy" that would support and promote an open international economic structure to induce sustainable economic development. The framework also iterates one of the main principles of WTO agreements which states that measures for combating climate change should not create a means of unjustifiable, indiscriminate or a disguised restriction on international trade (Cosbey, 2007).

According to the Stern review on the economics of climate change released in 2006, the costs of climate action are less than the costs of inaction; failure to engage in such issues creates a loss in GDP by approximately 20% globally, and the effects are disproportionately experienced by poorer countries. As such, the goal of multilateral trade in attaining environmental protection and sustainable development becomes impossible (Cosbey, 2007). Recent regional agreements have thus started including detailed environmental provisions but there is no concrete indication to its contribution in encouraging positive environmental effects (World Bank, 2010). To achieve the Paris Agreement commitments it is essential for countries to focus on clean technology. Trade liberalization can greatly impact on sharing innovative techniques on efficient and clean energy use, and developing this market. Free trade can also help reduce trade barriers on environmental goods and environmental provisions on such agreements can encourage parties in creating conditions for diversified and decarbonizing economic activities. Though the agreement does not specifically mention trade, it would affect trade structure nonetheless due to greater interactions between climate and trade elements to attain respective climate objectives and spillover effects of trade (competitiveness and carbon leakage) ultimately necessitating synergies between both trade and climate policies (Brandi, 2017).

The relationship and interdependence of trade, trade policies, climate change and its related policies is shown in the figure below:



Source: Cosbey, 2007

Figure 3: Trade and Climate Change Linkages

The most direct way free trade affects the environment is through increased transportation of goods. Trade liberalization through enactment or change in a trade policy also impacts the scale, composition and technique of the economic structure thus affecting the environment. Expansion of trade beyond borders increase the scale of economic activities through increased production and consumption consequently raising the standard of living. This results in greater emissions thereby negatively impacting the climate pattern (Cosbey, 2007). Free trade also has an effect on the composition of goods and services produced inside a territory. This change in composition of the economic structure depends on the comparative advantage (availability of land, labor, capital, natural resources etc.) of the trading partners leading to relocation of CO_2-intensive industries. Literature shows that composition effect on climate change could be both positive and negative. The technique effect, on the other hand, positively affects the environment as trade liberalization facilitates dissemination of clean and efficient technology across borders leading to subsequent reduction in emissions from production processes (Cosbey, 2007).

The impact on trade due to climate change is termed as physical impact. This happens due to altering trade patterns as climate change might cause a shift in the comparative advantage of countries. This impact would be more pronounced in locations where comparative advantage lies in its geography or climatic conditions. For example, regions that are greatly dependent on agriculture for their economy might see a reduction in production and exports as a result of rising temperature and changing weather patterns. Changing climate might also increase the vulnerability of certain elements of global trade, like supply and distribution chain, and transportation. This would affect the trade-related infrastructure and increase trade costs making developing countries more vulnerable than their developed partners (Tamiotti et al., 2009).

Trade laws follow the WTO standard at the multilateral level, at the regional level countries abide by trade agreements and at the national level by domestic regulations and policies. UNFCCC formulates laws regarding the environment and climate, and various national policies are undertaken to achieve those obligations. Though the UNFCCC and the WTO agreements do not mention trade in particular or specify climate change, both frameworks encourage mutual cooperation for attaining shared interests. Article 3.5 of the UNFCCC states that "Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade." The WTO recognizes that the relationship among its members should encourage each other in achieving sustainable development objectives: "while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so..." (Brandi, 2017).

In the paper titled "Trade and Climate Change Linkages" published in 2007, Aaron Cosbey states that UNFCCC along with its Kyoto Protocol are basically economic agreements that are pursuing to change the ways of production and consumption. And, so climate related policies affect competitiveness of countries' production system in two main ways. Primarily, competitiveness might be affected when climate regulations put countries at a disadvantage compared to their foreign trade partners. In such situations, industries shift their operations in locations were environmental regulations are lax thus leading to carbon leakage. This, then, leads to affecting the competitiveness of domestic industries operating within the jurisdiction since local environmental policies and their implementation might affect productivity in those industries. Free trade also risks affecting the competitiveness by creating a non-tariff trade barrier or higher production costs through asymmetric regulatory regimes (Bonnett, 2017).

Existing Measures to Combat Climate Change

In attempts to mitigate and adapt to the effects of global warming various climate change agreements and policy instruments are in practice across the globe. To reduce the impacts of climate change on global economy and to advance development of trade and environmental protection countries have put in place various price, market and financial mechanisms (Tamiotti et al., 2009). Different countries have different reduction goals and are at different positions in achieving their targets and as such the carbon prices are different across countries (Whalley, 2009).

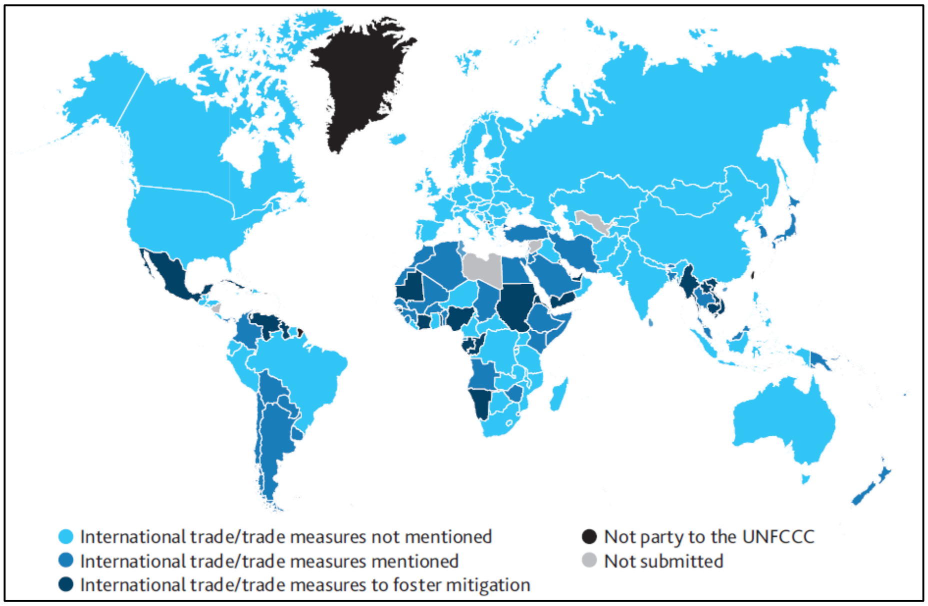
In economic terms, climate change brought about by GHG emissions is a negative externality that requires internalizing environmental costs. Hence, putting a price on carbon dioxide emissions has become a popular policy response among many countries, and is done mainly in two ways- internal tax on GHG emissions (carbon tax) and emissions trading scheme (cap-and-trade). These policies affect the domestic prices of traded goods and certain aspects of international trade. National carbon taxes are levied on the carbon content of fossil fuels (directly proportional to the amount of CO_2 released from their combustion). The tax rates vary across countries but most countries set the rates to influence the taxpayers in achieving the environmental objectives. Similar to the carbon tax is the energy tax that is imposed based on the energy content of the sources. Energy taxes are effective when imposed on oil and gas sectors as oil and gas have greater energy content than coal; whereas a coal produces more CO_2 than oil and gas (Tamiotti et al., 2009). Among the CPTPP countries, only Japan has been successful in implementing carbon tax on a national level. Australia introduced carbon pricing in 2011 in order to control emissions and sustain economic growth by developing clean energy technologies. Despite a 1.4% reduction in emissions after the introduction of carbon tax, it was finally repealed in 2014 due to increasing energy prices for households and industries ("The Carbon Tax in Australia," 2016). New Zealand abolished its carbon tax in 2005 and enacted a national emissions trading scheme in 2008.

An emissions trading scheme allows countries to put a cap on allowable CO_2 emissions and trade these emissions at a price defined by the market. Primarily, the objective of such a mechanism was to help Annex I countries (industrialized countries and the EU) of the Kyoto Protocol in reducing emission by trading emissions internationally. Japan, Mexico, Chile and Vietnam are considering implementing ETS in the following years. Japan already has a regional scheme in Tokyo, like Canada which has ETS in its province of Quebec and is scheduled for Manitoba and Ontario. The Paris agreement has encouraged countries in implementing emissions trading scheme as actions for combating climate change. Support for international carbon markets is reflected in its features of voluntary cooperation through 'internationally transferred mitigation outcomes' (ITMOs) and a UNFCCC-governed mechanism to support mitigation and sustainable development; more than half of the NDCs support similar schemes (Santikarn et al., 2016).

The need for international emission trading scheme originated from concerns regarding competitiveness and carbon leakage. Border tax adjustment is one such measure to address such concerns. The report "*GATT Working Party on Border Tax Adjustments"* defined border tax adjustments as a tax on imported products, corresponding to a tax borne by similar domestic products; and/or the refund of domestic taxes when the products are exported (Santikarn et al., 2016). Similarly, Border Carbon Adjustment (BCA) is a tax imposed on imports to match taxation on domestic products for carbon emissions during their production (Panezi, 2015). The WTO court has not yet taken a stance for or against the application of BCAs (Panezi, 2015) and no countries have yet implemented such a border measure. But major complications in implementing these border measures is in assessing emissions embedded in exports, and the source of emissions based on the nature of goods and location of production. As a particular product is resourced and manufactured as a final product at different places, hence a tax determined solely based on the country of production is not practical and thus requires alternate methods for tax calculation (Santikarn et al., 2016). Besides, border tax adjustment and tariffs, sharing and expanding technical standards as well as technological know-how, management practices and resource efficiency initiatives have the ability to influence trade and consumption patterns (T. Wiedmann & Lenzen, 2018).

Forty-five percent of the parties to the COP21 – Paris Agreement commitments have related trade to their emission reduction targets. Majority of the countries favor reducing trade barriers to develop renewable energy technology. Some countries also suggested regulations to control trade based on environmental grounds like a ban on imports of inefficient and old vehicles or regulate trade of wood. But these measures are not supported by the top emitters or the top exporters of CO_2. Countries like Brunei, Vietnam, Macedonia and Brazil etc. refer to the use of standards or labelling to regulate emissions. Only Mexico makes a direct reference of border carbon adjustment in reaching its conditional emission reduction target of 40% (Panezi, 2015).

Other trade related elements mentioned in the NDCs are fossil-fuel subsidies reform, investment in renewable energy and international market mechanisms. While some countries, like in the EU, are intending on rejecting such market mechanisms majority of the parties are planning on using them to reach their conditional reduction targets. If such market instruments are operationalized, several low-income countries would be willing to sell some type of mitigation unit while countries like Japan, Norway, Switzerland and Turkey be interested in buying those (Brandi, 2017). Of the CPTPP member states, Chile, Japan, Malaysia and Singapore have mentions of trade or trade-related elements in their NDCs; Mexico and Vietnam mention international trade; and Australia, Canada, Peru and New Zealand have no reference of international trade in their NDCs (Panezi, 2015).



Source: Pauw et al. (2016)

Figure 4: Trade Elements Mentioned in NDCs

The NDCs formulated by the CPTPP member parties are based on the IPCC guidelines regarding GHG inventories that record emissions occurring within national territories (Eggleston et al., 2006). National CO_2 accounts use the principle of producer responsibility as agreed in International Climate Change negotiations (Fan et al., 2016). This method of accounting does not reflect the actual scenario of emissions taking place globally according to source and use. The NDCs till now have failed to link trade elements to climate protection but there is considerable scope for achieving the commitments by major emitters and exporters of embedded carbon by such incorporation (Brandi, 2017). The conventional approach to accounting for emissions considers only what is produced within a country's boundaries to meet their domestic demands but ignores the emissions produced elsewhere to meet rest of their internal demands. Such an accounting method disregards the concept of carbon leakage (Fan et al., 2016) in international trade.

The existing measures of carbon tax and other schemes like cap-and-trade are based on production emission accounting that record emissions resulting from domestic production, regardless of whether it is to serve domestic or overseas markets (Deloitte, 2015). This kind of accounting method adopted by the UNFCCC charges the producer country for causing pollution but the method actually limits full understanding of the overall impact of emission due to global trade which creates issues like carbon leakage, loss in competitiveness and inefficient incentives for abatement. Inefficient incentives for abatement occurs when production of energy efficient and low emission technology is restrained because of their relative emission intensive manufacturing process compared to emissions taking place when those goods are used (considering the total lifecycle emission with respect to alternatives) (Deloitte, 2015). Consumption-based emission accounting has the capacity to address all these issues if considered for building CO_2 or GHG inventories instead.

Emissions embodied in international trade are a substantial growing component of global emissions. Consumption emissions accounting reveal a country's carbon footprint, the degree to which a country relies on external production to serve domestic demand (Deloitte, 2015). Accounting for CO_2 emissions on the basis of where it is consumed has the potential to rest the debate on who should bear the responsibility for pollution. Consumption-based accounting along with mechanisms like carbon tax and cap-and-trade has the possibility to create comparative advantage that takes into environmental factors along with the conventional economic measures like capital, labor, firms etc. (Glen P. Peters & Hertwich, 2008).

A study by Peters and Hertwich (2007) explains this using the example of a harmonized global tax, independent of country, applied based on the carbon content of fossil fuel which is applied throughout the international production process and ultimately paid by the consumer at a higher price, the price being determined by the embedded use of fossil fuels during the whole production process. Thus the comparative advantage would be built upon labor, capital and also carbon embodied in consumed products, including imports. This could impact the competitiveness of the industry or sector positively in two ways, as stated in the study mentioned above. Firstly, domestic and foreign producers face the same environmental legislation for example, emission commitment or carbon tax. Secondly, when several countries compete for the same export market then environmental performance based on such comparative advantage acts as a standard. Since carbon pricing facilitates investment in low emissions technology (CPLC, 2016) therefore depending on the relative price of carbon, consumption-based inventories could encourage environmental performance and help clean domestic industries to expand (Glen P. Peters & Hertwich, 2008). This improvement in the efficiency of national emissions regulation would 'level the carbon playing field' in trade with international partners as the domestic consumption-based carbon tax or emission trading scheme is combined with border tax adjustment (BTA)(Cendra, 2006).

Consumption-Based Emissions

One major impact of trade liberalization on climate change is the possible occurrence of carbon leakage that is defined by the shift in domestic production to reduce territorial emissions, which consequently increases emissions in the countries involved in trade with the party. International trade and climate policies ignore the importance carbon embodied in trade flows that pose potential emission mitigation issue. Carbon leakage was observed during the time Kyoto Protocol was being put into action in 2005 with the intention of bringing down national emissions of the signatories. Though implementation of the Protocol across some countries showed a decrease in emissions occurring within their boundaries, a thorough analysis in the pattern of such reduced emissions revealed a contrasting picture. A study conducted by Rahel Aichele and Gabriel Felbermayr using annual carbon footprint data for the years of 1995 to 2007 for 40 countries showed that the binding Kyoto commitments brought down local emissions by 7%, on average, but the carbon import ratio increased by about 14% suggesting actual carbon footprints remained unchanged as carbon-intensive manufacturing was relocated elsewhere neutralizing domestic production (Aichele & Felbermayr, 2015). Carbon leakage occurs not only when domestic manufacturing is replaced by foreign production but also when increased domestic demand for goods is produced in foreign regions (Glen P. Peters & Hertwich, 2008). It is also interesting to note that when international trade is take into consideration countries with lower income require higher consumption of carbon emissions and are among the different carbon-importing countries that also include wealthy economies (Steinberger, Roberts, Peters, & Baiocchi, 2012).

One of the pressing issues in climate regimes have been regarding the question of who should bear the responsibilities of reducing GHG emissions and how such responsibilities should be shared. The UNFCCC believes in the principle of "common but differentiated responsibilities and respective capacities" (Droege et al., 2016). Production-based accounting for emissions is hence traditionally used in climate policies to set global emission reduction targets which does not take into consideration the emission occurring outside borders and those that are embedded in trade. CO_2 emissions embodied in international trade went from up 4.3 $GtCO_2$ in 1990 (20% of global CO_2 emissions) to 7.8 GtCO2 in 2008 (26% of global CO_2 emissions) which shows that it is essential to capture actual carbon footprints reflecting the total (direct and indirect) carbon pollution over global commodity chains (G. P. Peters, Minx, Weber, & Edenhofer, 2011). In order to meet the Paris Agreement commitments it is necessary that countries share their burden of global emissions (Mir & Storm, 2016). Studies show that experts urge countries engaged in international and free trade to assume responsibility for their share of emissions (Chen et al., 2018).

Consumption-based emissions take into account emissions that are occurring outside the national boundaries to meet local needs, and it precisely reflects the amount of emissions required to maintain a country's standard of living (Ritchie & Roser, 2018). Studies have showed that accounting for emissions using such a method has the potential to mitigate global air pollution, improve environmental justice, cost-effectiveness and provide a suitable and less misleading indicator for evaluating local climate action plans. Besides addressing carbon leakage, this method aids in improving mitigation options and encouraging sharing of technical know-how (Mi et al., 2016). In consumption-based emissions accounting, emissions embodied in exports are excluded and emissions embedded in imports are added:

Consumption = Production + Imports– Exports

In this way the emissions required to produce a country's exports are allocated to the destination country and therefore, each country is responsible according to the emissions caused by the production of its imports (Peters & Hertwich, 2008). International trade has been exploited to decrease production costs and in the same way it can be used to act towards reducing global GHG emissions. Considering the impact of international trade in the process of determining emissions based on where they are finally being consumed has the potential to introduce effective climate action measure like economic sanctions and encourage different other emission mitigation approaches (Peters & Hertwich, 2008). As consumption-based emission accounting include imports, the focus of emission reductions falls where the cost is minimum and encourage production at locations where environmental impacts are minimized together with other costs. According to Peters and Hertwich, "Even if not implemented directly into emission commitments, consumption-based GHG inventories offer additional insight into a country's environmental profile."(2008).

Consumption-based approach has arguments both in favor and against its use as a tool in a larger, international, context. According to Afionis and others (2017) issues related to consumption-based accounting include technical complexities due to the requirement of complex datasets, mitigation effectiveness and political acceptability. Though some researchers feel that consumption-based approach may not be effective in international policy making (Wiedmann & Lenzen, 2018), the method enables understanding of carbon footprint leading to different new insights. Apart from addressing the issue of carbon leakage, consumption-based accounting also reflects the condition of the international supply security and dependency and provides a fairer depiction of global environmental and social impacts. So it has the ability in forming fundamental programs on resource efficiency, green economy etc. (Wiedmann & Lenzen, 2018). Using global footprint for assessing social impacts presents the opportunity to understand the trade implications in both developed and developing countries, which in turn can facilitate in devising policies and strategies to implement the SDGs. Implementation of the SDGs require inclusion of footprint indicators for accurate national sustainability assessments. At present only SDG 8 on sustainable economic growth has a consumption-based indicator: material footprint. An indicators like this has the potential to reveal progress of attaining the goals, particularly, goals regarding resource use, inequality and international cooperation (Wiedmann & Lenzen, 2018).

An attempt to understand or quantify carbon footprint, that is, to account for the full amount of GHG emissions caused directly and indirectly by an activity or emissions accumulated over the life stages of a product consumption requires significant application of the economic input–output analysis (Wiedmann, 2009), which is at present one of the most widely used methods for analyzing consumption-based emissions. The input-output analysis uses a framework that helps to determine the interdependence of different industries in an economy (Miller & Blair, 2009) and assess the probable impacts of industrial structure on import, export, CO_2 emission, energy consumption, air, water and land use etc. (Mi et al., 2016). Such an analysis has the capability to track the impacts of international trade flow and can also be used for forecasting and projection applications (Wiedmann, Wilting, Lenzen, Lutter, & Palm, 2011).

The input-output model was first developed by economist Wassily Leontief for the purpose of inter-industry analysis. The input-output model consists of a system of linear equations, each one describing the distribution of an industry's product throughout the economy. A number of extensions to the basic input-output (IO) model have been developed over the years to include supplementary details of economic activities or to associate the IO models to other kinds of economic analysis tools (Miller & Blair, 2009). The environmental extension was added to the model in 1970 to identify and connect carbon emissions embodied in trade across sectors within a country (single region input-output model) or among countries (multi-regional input-output model). Thus the multi-regional input-output (MRIO) model allows to analyze all direct and indirect linkages between consumption, value added along the production chains and emissions associated with production and trade in different regions of the world (Wiebe, Gandy, & Lutz, 2016). According to an article on the methodological and data requirements for MRIO analysis, "For consumption-based accounting of GHG emissions in global carbon footprint analyses, MRIO has already become the norm" (Weidmann et al.,2011, p. 1983). Initially IO analysis was used to determine environmental footprint at the national level but with the introduction of MRIO tables it became possible to calculate the same occurring as a result of international trade. IO analysis is the most popular method used for determining consumption-based emission as computations performed for such an analysis help to calculate the multipliers that reflect the consumption-induced response along with the industrial response to such changes (*Overview of Some Alternative Methodologies for Economic Impact Analysis*, 2012).

Like any other free-trade agreement the primary purpose of CPTPP is to establish trade liberalization across the region. It aims to create an open economy in the Asia-Pacific region generating further economic growth and employment, reducing poverty and increasing wellbeing for consumers, farmers, workers and businesses (Direcon, 2018a). The agreement acknowledges the role environment has on trade liberalization and thus contains provisions that support sustainable development and environmental protection. But there lacks a comprehensive set of actions regarding climate change which some experts argue is not the purpose of a trade agreement (O'Connor, 2018). The next section sets the background for the Comprehensive and Progressive Agreement for the Trans-Pacific Partnership.

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership

The Trans-Pacific Partnership (TPP), one of the largest multilateral free-trade agreement, consisting of Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, United States of America and Vietnam, covering 40% of global GDP was first signed in 2016. The agreement heavily backed by the US aimed to merge all these economies to a single combined market by removing more than 18,000 tariff lines and lowering transaction costs among the member countries, enhancing economic growth and creating job opportunities. Such a regional free-trade agreement is noteworthy because of the parties involved and also for the expansive scope that encompasses market access and regulatory coherence (Droege et al., 2016). The different provisions of the trans-pacific agreement included labor and environmental standards, copyrights, patents and other legal protections. It is one of the agreements that had a higher level of environmental commitment than any other trade agreement (Cheng, 2015). But this agreement never came into force as the United States withdrew from it on the ground that jobs would be outsourced from America to partner developing countries creating "potential disaster for the country" (BBC, 2017). Withdrawal of USA from the TPP significantly reduced the economic size of the trade agreement from 40% to 13.4% of global GDP which is equal to approximately USD13.5 trillion.

Though TPP was fundamentally based on typical American free trade agreement template, pursuing such an agreement without the key player was perceived advantageous by other members of TPP because of three major reasons. Firstly, TPP provided the member countries with scope to boost their economic presence and strengthen domestic market structure to become more efficient, productive and competitive in global markets. Secondly, even without the US the real income gains for the other member parties were substantial and finally, the agreement helped establish new guidelines and remedies supporting international trade that were not prevalent when the world trading rules were updated last (Schott, 2018). Thus, the remaining eleven member countries agreed to revive the agreement in 2017 and signed an agreement renaming it as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) in March 2018 making it the third largest free trade agreement in the world following NAFTA and the European Single Market.

The new treaty retains most of the TPP provisions by reference, but suspended 20 provisions, at least temporarily, which the member parties opposed while the United State favored. These provisions could be reinstated at a later time when and if USA or other countries want to join the partnership, but presently no member country is required to implement the suspended provisions at the national level (Asian Trade Center, 2017; Schott, 2018).

The 20 suspended provisions include (Government of Canada, 2017):

- Express Shipments (Article 5.7.1f)
- Investment Agreement and Investment Authorization (Article 9.1, 9.19.1-19.3, 19.22.5, 19.25.2, Annex 9-L)
- Express Delivery Services (Annex 10-B, paragraphs 5 and 6)

- Minimum Standard of Treatment in Article 11.2 (sub-paragraph 2(b), footnote 3 and Annex 11-E)
- Resolution of Telecommunications Disputes (Article 13.21.1d)
- Conditions for Participation (Article 15.8.5)
- Further Negotiations (Article 15.24.2)
- National Treatment (Article 18.8: footnote 4, last two sentences)
- Patentable Subject Matter - Article 18.37.2 and 18.37.4 (Second Sentence)
- Patent Term Adjustment for Unreasonable Granting Authority Delays (Article 18.46)
- Patent Term Adjustment for Unreasonable Curtailment (Article 18.48)
- Protection of Undisclosed Test or Other Data (Article 18.50)
- Biologics (Article 18.51)
- Term of Protection for Copyright and Related Rights (Article 18.63)
- Technological Protection Measures (Article 18.68)
- Rights Management Information (Article 18.69(
- Protection of Encrypted Program-Carrying Satellite and Cable Signals (Article 18.79)
- Legal Remedies and Safe Harbors (Article 18.82 and Annexes 18-E and 18-F)
- Conservation and Trade (Article 20.17.5 – suspend "or another applicable law" and footnote 26)
- Transparency and Procedural Fairness for Pharmaceutical Products and Medical Devices (Annex 26A -Article 3 on Procedural Fairness)

This agreement opens up free trade opportunities for some of its member states that previously did not have any trade treaties with each other. For Canada, the agreement is a new partnership with Australia, Brunei, Japan, Malaysia, New Zealand, Singapore and Vietnam (Gervais, 2018); and for Chile it creates leadership prospects in open trade in the Asia-Pacific region (Direcon, 2018).The agreement would come in full effect after 60 days when ratified by at least 50% of the participating countries (six of the eleven participating countries). The treaty finally came into force on 30th December, 2018 after Australia became the sixth nation to ratify the deal in October (McGregor, 2018). Mexico was the first party to ratify the agreement in June 2018 followed by Japan, Singapore, New Zealand and Canada.

The CPTPP brings together four (Australia, Malaysia, Mexico and Peru) of the seventeen countries recognized as being mega-diverse supporting more than 70% of the biological diversity on earth. The countries in this trans-pacific partnership are also key exporters and consumers of natural resources. The chapter on environment in this agreement intends to promote sustainable development by boosting trade, encouraging implementation of domestic environmental laws and policies, and addressing trade related environmental challenges to establish better environmental protection (DFAT, 2018).

Based on the literature present on the relationship and influence of trade, environment and sustainable development this research aims to determine the impact of the estimated changes in carbon dioxide emissions on the member countries of the CPTPP and define how such changes resulting from trade affect sustainability and climate objectives of the countries in the region. The thesis also attempts to understand the effectiveness of the environmental provisions of the agreement in addressing climate change and sustainable development of the member parties.

The following chapter details the methods, data and analysis used to determine the consumption-based CO_2 emissions for the CPTPP member states. Input-output analysis using MATLAB gives the CO_2 multipliers that represents the amount of carbon dioxide embodied in trade for these countries. The thesis projects the amount of CO_2 that would be embedded in exports within the region for the period from 2017-2035. Furthermore, it also maps out the method in understanding the existing condition and future implications of such emissions by considering the COP21 commitments as a percentage of CPTPP exports.

METHODS, DATA, AND ANALYSIS

This chapter describes the methods and databases used to determine the changes in the levels of consumption-based CO_2 emission in the trans-pacific region. To determine CO_2 emissions occurring from exports for meeting domestic demands for goods from various economic sectors, emission multipliers are calculated. This section discusses the methods used to calculate emission multipliers by analyzing the input-output tables for each of the countries of CPTPP and also how the changes in emissions can be used to determine the levels to which the emissions need to be reduced in order to realize their Paris Agreement targets.

Input-output analysis assists in determining multipliers to understand the effects of change in the output of an industry on imports, income, emission or output of other industries or sectors. That is, the multipliers are a measure for predicting the total impact on all sectors of an economy when there is a change in demand in any one of its sectors (Liskova, 2015). In this research, CO_2 emission multipliers were calculated using multi-regional input-output analysis to find the amount of CO_2 generated inside as well as outside the national territories across different sectors to produce one unit of output in a particular sector. These multipliers when used with the export values gave the total amount of CO_2 embodied in consumption of goods from respective sectors.

The input-output analysis assumes that (Gretton, 2013):

- a particular product is produced by the same technology in each sector: a fixed input structure in each sector;
- all sectors use inputs in fixed proportions ;
- each sector exhibits constant returns to scale in production;
- unlimited labor and capital available at fixed prices, thus any change in the demand for productive factors will not change cost ; and
- no other constraints, such as the balance of payments or the actions of government, on the response of a sector to any stimulus.

This method uses input-output tables that depict the intermediate use and final demands of goods and commodities across different countries. Intermediate use refers to the use of domestic production and exported items. The final demand includes household and government organization consumptions. The domestic production and exports to other regions make up the transaction matrix for the input-output analysis. The rows denote output and columns denote input to the regions; total input=total output. The matrix on territorial emissions provides the amount of emissions occurring from each sector within the country.

Output

Input

	Intermediate use		Final demand		Total Output
	Country A	Country B	Country A	Country B	
	Sector	Sector	Sector	Sector	
Country A Sector	Use of domestic output	Exports from A used by B	Use of final output	Exports from A to B of final products	Intermediate +final use by A= X_A
Country B Sector	Exports from B used by A	Use of domestic output	Exports from B to A of final products	Use of final output	Intermediate +final use by B= X_B
Value added	Value added by A	Value added by B			
Total Input	Intermediate use + value added by A= X_A	Intermediate use +value added by B= X_B			

Final Demand Matrix, F

Transaction Matrix, T

Source: Aslam et al., 2017

Figure 5: An Input-Output Table

Using the input-output tables, transaction and final demand matrices were constructed and used to determine the final output for each sector of the member countries to derive the emission multiplier, m.

Emissions multiplier, m= E*L

Here, E is direct emission, E= Q/X; where Q= territorial emissions, X= total output

X=T+Y = AX+Y = LY;

Leontief Inverse, L= $(1\text{-}A)^{-1}$

Here, A is the coefficient matrix which denotes the coefficients of intermediate goods needed to produce one unit of gross output. The Leontief inverse gives the total output that is required both directly and indirectly to produce one unit of good for final demand. That is, this matrix indicates quantities from different sectors needed to produce one unit in a particular sector. In other words, the carbon dioxide emissions multiplier, for instance, for the Canadian agricultural sector shows the amount of CO_2 emitted across different sectors of Canada and its trade partners to produce only one unit of agricultural product in Canada.

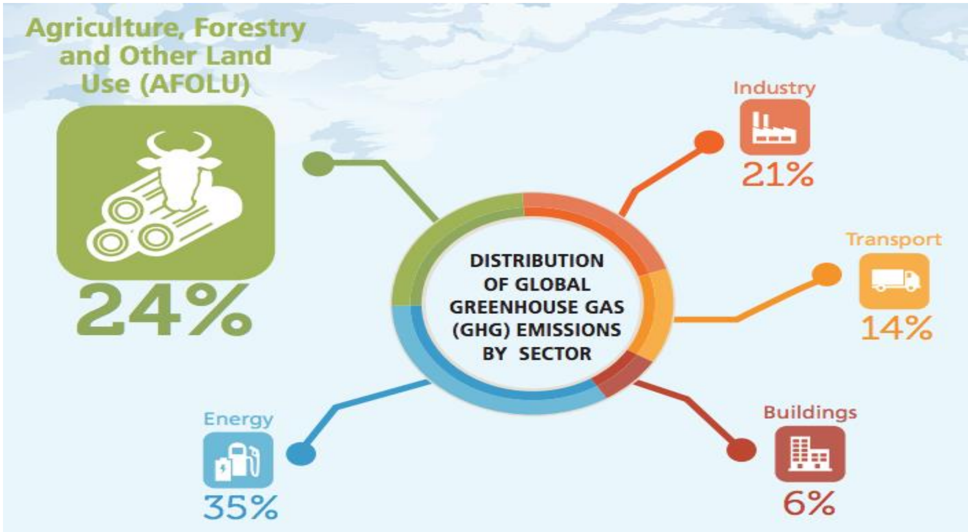
Multi-regional input-output (MRIO) analysis was conducted for the ten partner countries of the CPTPP. The framework consists of respective national input-output tables that represent the relationship across sectors showing flow (input and output) of intermediate and final demand for goods and services; the tables are characterized by the dollar value of intermediate and final exports and imports by sectors and countries (Aslam, Novta, & Rodrigues-Bastos, 2017). The MRIO tables used for analyzing the CPTPP parties' input and output across economic sectors is from the Eora global supply chain database that provides a time series (1995-2015) of high-resolution input-output tables with corresponding environmental and social satellite accounts for 190 countries. The database contains tables on intermediate demand, final demand and emissions tables in both basic price and purchaser price (Lenzen et al., 2013). Basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable excluding any transport charges. Use of basic price is recommended for environmental extension analysis as tables valued at basic prices indicate higher stability over time since they are not affected by potential major changes in taxes or margins (Lenzen et al., 2004).

The thesis, furthermore, used trade percentage within the CPTPP region to determine the share of CO_2 emissions the countries need to bring down in order to fulfil the Paris Agreement targets. The trade shares for the base years and 2017 were obtained from the World Integrated Trade Software (WITS). The WITS was developed by the World Bank in collaboration with the United Nations Conference on Trade and Development (UNCTAD) and in consultation with organizations such as International Trade Center, United Nations Statistical Division (UNSD) and the WTO to access information regarding trade and tariff (WITS, 2017). Here the base years refer to the years that individual countries based on their circumstances and capacities, use to refer their GHG emissions reductions in order to reach the goals by 2030. For example, Canada has pledged to reduce its GHG emissions to 30% below 2005 levels by 2030.

As the thesis aims to understand and highlight the impact of the trans-pacific treaty on the CO_2 emissions, changes in the consumption-based emissions of CPTPP member countries are compared to their territorial emission reduction outlined in the Paris Agreement commitments. To obtain the territorial GHG emissions for 2017, projected GHG emissions in 2030 and targets set for 2030 a number of sources and databases were used, namely: Climate Action Tracker (CAT), an independent source tracking the progress towards the goal of Paris Agreement; Emissions Database for Global Atmospheric Research (EDGAR), an emissions database and Climate Watch, an online climate data platform. These values were then compared with the consumption-based CO_2 emissions calculated using input-output analysis for the years of 2005, 2007, 2010, 2013 (base years for COP21 commitments) and 2017. The pattern of the changes in the values for both production and consumption emission revealed the implications of trade on CO_2 emissions for the ten countries of the trans-pacific treaty.

Determining CO_2 Emission Multipliers

Ten carbon-intensive sectors for ten countries of the partnership were considered for the calculations over the time period of 2017-2035. The sectors were namely, agriculture, mining, forestry and wood/wood products, chemicals, metal products, electrical & machineries, transport equipment, other manufacturing, energy (fuel) and transport. These sectors were considered since most anthropogenic CO_2 emissions occur from these sectors. According to the Food and Agriculture Organization (FAO), 94% of global carbon-dioxide emissions mainly occur from the sectors of Agriculture, Forestry and Other Land Use (AFOLU), energy, industry and transport (FAO, 2016). For this research agriculture, mining and forestry were considered as separate sectors and the industrial sector was disintegrated into various manufacturing sectors like chemicals, metal products, electrical equipment & machineries, transport equipment and miscellaneous manufacturing. Appendix 1 shows in details the sectors and the percentage changes occurring within those sectors.



Source: FAO, 2016

Figure 6: Sector-wide CO_2 Emissions across the World

The thesis expands on the work by Ciuriak and colleagues (2017) which quantifies and assesses the economic outcomes of CPTPP on the member countries. In their paper titled "Quantifying the Compressive and Progressive Agreement for Trans-Pacific Partnership" published in 2017 the researchers use the GTAP V9 database to estimate the impacts on sectors of economy, overall trade, GDP and economic welfare of the countries from 2017 to 2035. The time period of 2017-2035 has been considered by the authors to be reflective of the long term impacts of the implementation of the treaty. The latest version of GTAP used by Ciuriak and colleagues provides data till 2011; they convert these values to 2017 trade numbers using the change in US GDP deflator over the period of 2011-2017 (Ciuriak et al., 2017). GTAP is primarily a multiregional, multi-sector computable general equilibrium model that assumes perfect competition and constant returns to scale; it recently incorporated IO analysis to the model. In the GTAP model, it is assumed that emission coefficients remain unchanged as trade liberalization takes place and CO_2 emission levels change by the same proportions as fuel consumption. CO_2 emissions post-implementation of the treaty is then obtained as the product of the initial CO_2 levels and corresponding change in fuel consumption estimated from the GTAP model results (Akahori et al., 2017).

Consumption-based CO_2 emissions were determined to understand the changes in emissions over the years occurring for Australia, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore and Vietnam. Brunei one of the partner countries of CPTPP was not considered. The changes in exports and emissions resulting in 2035 can be inferred as the permanent change in the level of trade outcome and economic output reflecting reasonable estimates of medium to longer impacts of trade liberalization in the area (Ciuriak et al., 2017). CO_2 multipliers were used in calculating the carbon- dioxide embodied in trade; these multipliers indicate the amount of CO_2 embodied in per unit output of trade among the countries. To determine the emission multipliers for each of the 10 sectors for ten different countries, multi-regional input-output analysis was conducted.

For this thesis, the GTAP derived long term changes in exports among the CPTPP member countries were used for further calculation. The Eora26 database was also used, in order to access the individual country input-output tables and environmental accounts. Even though both GTAP and Eora have their own consumption-based emissions accounts, input-output analysis was done with the help of MATLAB to get the emissions multiplier using Eora database for mainly two reasons: the latest available database for territorial CO_2 emissions in GTAP V9 is for 2011 and its environmental extensions allocate emissions from fossil fuel burning to territorial emissions but allocates international transportation to consumers (Owen, 2015).

Matrix manipulation was performed using MATLAB in order to obtain the CO_2 multipliers for 2017 and 2035. The multipliers were then used along with the available export data from the aforementioned paper to project consumption-based CO_2 emissions for 2035. Carbon dioxide multipliers, following the same process using MATLAB, were determined for the years of 2005 for Australia, Canada, Malaysia, New Zealand and Singapore; 2007 for Chile; 2010 for Peru and Vietnam; and, 2013 for Japan and Mexico as these are the base years in the Paris Agreement targets.

The latest available data in Eora26 database is 2015 and so the CO_2 multipliers for this year were assumed to remain constant from 2017 till 2035. The total CO_2 emissions for the year 2035 was calculated by multiplying the 2017 emission multiplier with respective country 2035 export values estimated by the GTAP model. The export values for the base years were taken from the Eora database. Due to lack of adequate available data other assumptions for calculations include the proportion of the ten sectors remaining constant through 2017 to 2035 as 61.61% of total exports in all the ten countries and was assumed to be equal for all ten countries (Table 3). This was done to keep the proportion of the ten selected sectors considered for analysis consistent with the thirty-three sector analysis used by Ciuriak and colleagues in their research (2017). The sector proportion for the year 2035 was obtained as 61.61% by dividing the dollar value of exports across the ten sectors to that of the thirty –three sectors considered by Ciuriak and colleagues in their research (Appendix 1).

The export values for each of the ten sectors of the CPTPP countries was obtained as the product of proportion of the particular sector and the total amount of exports occurring from those sectors. For example, exports across the Canadian agriculture sector for the years 2017 and 2035 is the product of the proportion of the agriculture sector and the total amount of Canadian exports across the ten sectors for the respective years (Table 4).

COP21 Commitments as Percentage Share of CPTPP Exports

To determine the consumption-based CO_2 emissions for the base years, gross export values were obtained from Eora database for the respective years. Gross exports were calculated by adding all rows of the transaction matrix (T) and final demand matrix (F) and subtracting the corresponding country-sector values of goods that were used to meet demands in the particular country (Aslam et al., 2017). For example, gross export in Canadian mining sector will be the sum of all its exports except the goods from this sector used in production across other sectors in Canada and the final demand in the country's mining sector.

To understand the actual existing condition and future implications we find out how much of emissions need to be reduced by each of the CPTTP participating countries to accomplish their Paris Agreement goals, the percentage of trade share among each other was used. These percentage values for the base year as well as 2017 were obtained from the WITS website. The proportion of export among each of these countries for base years and 2017 multiplied by the respective Paris Agreement targets showed the amount of territorial emissions needed to be reduced from those years to reach the COP21 commitments.

The export proportions for 2035 were obtained as the product of the export share in 2017 and the percentage change in exports that occur as the CPTPP is implemented, the values for which were used from the paper "Quantifying the Compressive and Progressive Agreement for Trans-Pacific Partnership". These were then again multiplied by the COP21 commitments to estimate the level of emissions that would go down by 2035 if the countries continue to follow their NDCs after 2030.

The subsequent chapter elaborates on the results obtained from the calculations performed using the methods in this part. The results show the percentage change in exports and emissions for the eleven nations for the year 2035, the percentage change in consumption-based CO_2 emissions for ten carbon-intensive sectors from 2017- 2035. It also presents results for the emissions under the Paris Agreement and the commitments within this agreement as a percentage of CPTPP exports.

RESULTS

This chapter presents the results obtained from the input-output analysis and calculations performed to determine the share of COP21 commitments of the CPTPP parties.

The estimated values of percentage change in exports and dollar value of exports for the CPTPP countries for the year were obtained from the paper by Ciuriak and colleagues (Appendix 2). Using these values the sector proportions for 2017 and 2035 were calculated:

Sector	Proportion in 2017	Proportion in 2035
Carbon-intensive		
Agriculture	9.92%	11.92%
Mining	1.52%	1.48%
Forestry & wood	6.03%	5.70%
Chemical	10.62%	10.02%
Metal products	6.24%	5.84%
Electrical & machinery	20.46%	19.38%
Transport equipment	1.39%	1.31%
Other manufacturing	1.56%	1.50%
Energy/fuel	7.07%	7.75%
Transport	35.19%	35.09%
Total	**61.61%**	**61.61%**
Non-carbon intensive	**38.39%**	**38.39%**
Total	**100%**	**100%**

Table 3: Proportion of Sectors in 2017 and 2035

Next, the total value of exports from the ten sectors for the years 2017 and 2035 were obtained as the product of the proportion (61.61%) and the estimated changes in exports across the economy occurring due to CPTPP (Appendix 2). The export values for the years when combined with the CO_2 multipliers derived from MATLAB help determine the emissions occurring from the carbon-intensive sectors during those years.

The following Table 4 shows exports and its associated consumption-based CO_2 emissions for the years 2017 and 2035 as well as the estimated percentage change in consumption-based CO_2 emissions in Australia. The first two columns denote the sectors and their respective CO_2 multipliers. As mentioned earlier, the CO_2 multipliers are kept constant over this time period during which trade liberalization takes place in the region. The next columns show the values of exports (USD) and CO_2 emissions (Mt) for 2017 and 2035 respectively. The last column indicates the percentage change in consumption-based CO_2 emissions from 2037 to 2035 across the sectors. The same operations are performed for the rest of the member countries of CPTPP except for Brunei (Appendix 3).

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.000145584	7017288.03	1.021	8445540.55	1.229	20.35%
Mining	0.000099020	1073818.68	0.106	1048228.91	0.103	-2.38%
Wood and Forestry	0.000186920	4266893.03	0.797	4040325.37	0.755	-5.31%
Chemical	0.000633649	7515276.04	4.762	7098765.43	4.498	-5.54%
Metal Products	0.000260194	4411816.92	1.147	4139840.77	1.077	-6.16%
Electrical & Machinery	0.000113137	14474825.42	1.637	13733125.6	1.553	-5.12%
Transport Equipment	0.000096006	984469.21	0.094	928810.430	0.089	-5.65%
Other Manufacturing	0.000124217	1107010.01	0.137	1061497.63	0.131	-4.11%
Energy	0.008787495	4998391.69	43.923	5493250.26	48.271	9.90%
Transport	0.001612592	24892430.34	40.141	24858947.73	40.087	-0.13%
Total		**70742219.43**	**93.769**	**70848332.76**	**97.797**	**4.30%**

Unit of CO_2 Multiplier: kt/USD

Table 4: Estimated Changes across the Australian Carbon-intensive Sectors from 2017-2035

Table 5 below shows the percentage change in exports from 2017-2035 for the partner countries in CPTPP. The column denotes the total percentage change in exports are the estimated changes due to the implementation of CPTPP taken from the paper by Ciuriak and colleagues (2017). The total percentage change in emissions in the right most column represents the increase in consumption-based CO_2 emissions from the ten most carbon-intensive sectors during the same time frame, these values are tabulated from the tables presented in Appendix 3. The rows indicate the changes taking place for the CPTPP partner countries. Exports from Vietnam to rest of the parties within the region increase by 6.83% and its consumption-based CO_2 emissions go up by 8.35%. Chile's exports drop by 0.09% but its CO_2 emissions embedded in imports increase by 0.99%.

Country	Total % change in exports	Total % change in emissions
Australia	0.15%	4.30%
Canada	4.88%	6.02%
Chile	-0.09%	0.99%
Japan	3.40%	5.78%
Malaysia	1.66%	3.98%

Mexico	3.12%	5.34%
New Zealand	6.56%	8.10%
Peru	0.46%	1.91%
Singapore	0.50%	4.32%
Vietnam	6.83%	8.35%

Table 5: Total Percentage Change in Exports and Consumption-based CO_2 Emissions from 2017-2035

The percentage change in consumption-based CO_2 emissions across the ten most carbon-intensive sectors for the CPTPP member countries are summarized in Table 6. The columns and rows denote the changes across countries and sectors respectively. It is evident that for all countries CO_2 emissions embodied in trade across the agriculture sector increased over time. For New Zealand, consumption CO_2 emissions grows across each sector except for metal products. Vietnam is the only country within the partnership whose CO_2 emissions embedded in imports is seen to be highest with no reduction across any sectors.

Country/ Sector	**AUS**	**CAN**	**CHL**	**JPN**	**MLY**	**MEX**	**NZL**	**PER**	**SGP**	**VNM**	**Average**
Agriculture	20.35%	26.04%	20.06%	24.26%	22.17%	23.92%	28.06%	20.73%	20.77%	28.38%	**23.47%**
Mining	-2.38%	2.23%	-2.62%	0.78%	-0.91%	0.51%	3.86%	-2.08%	-2.04%	4.13%	**0.15%**
Wood/Forestry	-5.31%	-0.84%	-5.54%	-2.24%	-3.88%	-2.50%	0.75%	-5.02%	-4.98%	1.01%	**-2.85%**
Chemicals	-5.54%	-1.08%	-5.77%	-2.48%	-4.12%	-2.74%	0.50%	-5.25%	-5.21%	0.76%	**-3.09%**
Metal Products	-6.16%	-1.73%	-6.39%	-3.12%	-4.75%	-3.38%	-0.16%	-5.87%	-5.84%	0.09%	**-3.73%**
Electrical & Machinery	-5.12%	-0.64%	-5.35%	-2.05%	-3.69%	-2.31%	0.95%	-4.83%	-4.79%	1.20%	**-2.66%**
Transport Equipment	-5.65%	-1.20%	-5.88%	-2.59%	-4.23%	-2.86%	0.38%	-5.36%	-5.32%	0.64%	**-3.21%**
Other Manufacturing	-4.11%	0.42%	-4.34%	-1.00%	-2.67%	-1.27%	2.03%	-3.81%	-3.78%	2.28%	**-1.62%**
Energy/fuel	9.90%	15.09%	9.64%	13.47%	11.56%	13.16%	16.93%	10.24%	10.28%	17.23%	**12.75%**
Transport	-0.13%	4.58%	-0.37%	3.11%	1.37%	2.83%	6.26%	0.17%	0.21%	6.53%	**2.46%**

Table 6: Estimated Country and Sector-wide Percentage Change in Consumption-based CO_2 Emissions from 2017-2035

Emissions under the Paris Agreement

To determine the base year consumption-based CO_2 emissions of the CPTPP member countries similar method of multiplying the CO_2 multiplier with the export values was used. Table 7 shows the CO_2 multipliers, exports and consumption emissions for Australia for the year 2005, its base year for the Paris Agreement. Appendix 4 tabulates similar data for rest of the parties.

Australia	**CO_2 Multiplier**	**Exports (USD)**	**Consumption Emissions (Mt)**
Agriculture	0.002086183	790006.15	1.648
Mining	0.001634441	12194663.96	19.931
Wood and Forestry	0.002903213	1641628.21	4.765
Chemical	0.002815318	3674217.37	10.344

Metal Products	0.004041474	3422146.39	13.830
Electrical & Machinery	0.001629266	2387182.24	3.889
Transport Equipment	0.001485752	966590.41	1.436
Other Manufacturing	0.002187581	315943.29	0.691
Energy	0.018995114	36571.74	0.694
Transport	0.004432471	2570586.73	11.394
Total			**68.625**

Table 7: Consumption-based CO_2 Emissions for 2005

The resulting consumption-based emissions for the base years used in the Paris Agreement determined using the same input-output analysis in order to compare the changes that take place during those years and 2017-2035 (Table 8). The columns in the table indicate the base years as well as the consumption-based CO_2 emissions for those years, years 2017 and 2035 respectively. It is seen that consumption-based CO_2 emissions increase for all partner countries over the years except for Chile for which the values fall in 2017 from 2007 and does not significantly increase in 2035.

Country	Base year	Base year (Mt)	2017 (Mt)	2035 (Mt)
Australia	2005	68.63	93.77	97.80
Canada	2005	48.35	1657.01	1756.70
Chile	2007	19.26	10.50	10.60
Japan	2013	234.22	1802.33	1906.59
Malaysia	2005	113.96	1933.39	2010.43
Mexico	2013	97.48	1096.45	1155.10
New Zealand	2005	8.79	542.04	585.95
Peru	2010	2.40	42.27	43.08
Singapore	2005	65.92	109.25	113.97
Vietnam	2010	20.65	12276.13	13301.10

Table 8: Consumption-based CO_2 (Mt) for base years, 2017 and 2035

COP21 Commitments as Percentage Share of CPTPP Exports

In order for the CPTPP member states to fulfill the COP21 commitments, trade shares within the CPTPP region were determined. The following Table 9 shows trade shares for base years, 2017 and 2035, the COP21 commitment targets and the amount of emissions need to be brought down in their respective base years and 2017 to reach those targets by 2030. Due to unavailability of 2017 export share data for Vietnam, its 2016 value has been used instead. The export share for the countries in 2035 is the product of the percentage change in exports (column 2 of Table 5) and 2017 export share of the countries (column 4 of Table 9). The eighth column shows the percentage of CO_2 emissions needed to be reduced to reach the same targets beyond 2030.

Here the export share is multiplied with the targets for each country; the share of commitments goes down on an average in 2017 as the export shares between partners drop from base year numbers but increase by 2035 as full implementation of the treaty takes place.

Country	Base years	Base year share	2017 share	2035 share	Commitments	CPTPP share: base year	CPTPP share: 2017	CPTPP share: 2035	% change in emissions
AUS	2005	34.16%	18.62%	18.65%	26.00%	(-)8.88%	(-)4.84%	(-)4.85%	4.30%
CAN	2005	3.78%	4.93%	5.17%	30.00%	(-)1.13%	(-)1.48%	(-)1.55%	6.02%
CHL	2007	19.03%	16.77%	16.75%	30.00%	(-)5.71%	(-)5.03%	(-)5.03%	0.99%
JPN	2013	12.18%	13.22%	13.67%	26.00%	(-)3.17%	(-)3.44%	(-)3.55%	5.78%
MLY	2005	30.69%	30.75%	31.26%	35.00%	(-)10.74%	(-)10.76%	(-)10.94%	3.98%
MEX	2013	4.86%	5.36%	5.45%	25.00%	(-)1.22%	(-)1.34%	(-)1.36%	5.34%
NZL	2005	38.74%	30.28%	32.27%	30.00%	(-)11.62%	(-)9.08%	(-)9.68%	8.10%
PER	2010	19.54%	11.55%	11.60%	20.00%	(-)3.91%	(-)2.31%	(-)2.32%	1.91%
SGP	2005	25.51%	22.20%	22.31%	36.00%	(-)9.18%	(-)7.99%	(-)8.03%	4.32%
VNM	2010	22.42%	16.58%	17.71%	8.00%	(-)1.79%	(-)1.33%	(-)1.42%	8.35%
Average						**(-)5.74%**	**(-)4.76%**	**(-)4.87%**	**4.91%**

Table 9: COP21 Commitments as Percentage Share of CPTPP Exports

It is seen that the CPTPP partners need to bring their domestic GHG emissions down by 4.87% by 2035 on an average in order to meet their Paris Agreement commitments. But consumption-based emission estimates (column 10 of Table 9) indicate that as a result of this treaty being implemented, instead of going down the consumption of CO2 by member states increase by almost 5%.

The following chapter on 'Discussion' contains analysis of the results gathered in this section and consequently discusses the impact of CPTPP on the sustainabel development goals related to climate change and international partnership which is then followed by the misalignments present in the SDGs and COP21 commitments in achieving climate objectives for the CPTPP member states. The section also focuses on the *Environment* chapter of the agreement to comprehend the gaps that may impede the countries from attaing their development goals as well as the Paris Agreement objectives.

DISCUSSIONS

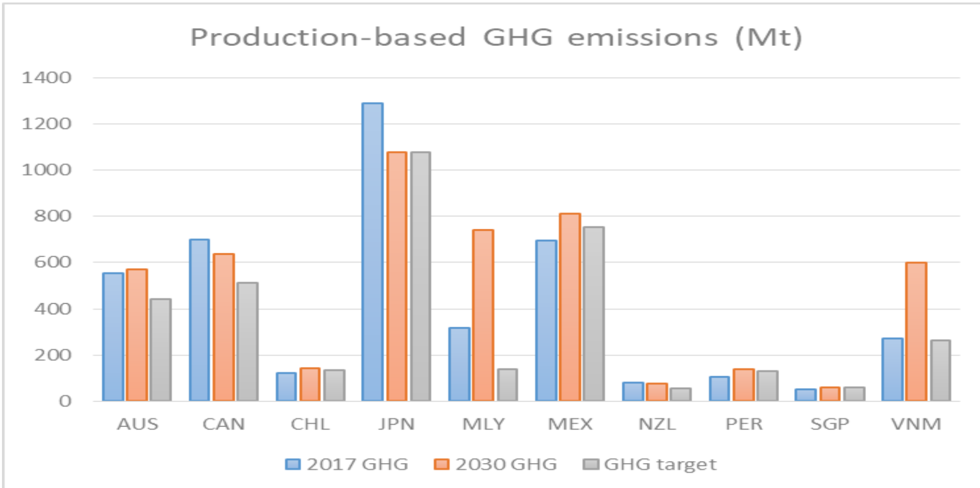
This chapter provides answers to the research questions stated at the onset of the study. Based on the analysis of the results obtained from calculating the consumption-based CO_2 emissions and its comparison to the production-based emissions, the estimated outcome shows that there occurs a percentage increase in emissions as CPTPP is implemented. This change impacts climate action and partnership in the region which is studied using SDG index and past trend for these goals. Moreover, a look into the links and misalignments in the SDG and COP21 commitments of the member parties shows how implementation of the treaty would affect the progress towards sustainable development and climate objectives in the region. Finally, the contents of the *Environment* chapter of CPTPP are studied to gauge the kind of influence this agreement has on establishing sustainable development in the region. This section also comments on the ways forward, limitations of the research and the scope that exists for further research on the similar topics.

Interpretation of Results

From Table 9, it is seen that countries need to bring their domestic GHG emissions down on an average in order to meet their Paris Agreement commitments. But consumption-based CO2 emission is estimated to increase by 4.91%. Thus a major finding of the thesis is that as CPTPP is operationalized in the region the emissions do not go down which is in contrast to the intention of the Paris Agreement. As seen from Table 5, it is evident that consumption-based emissions across agriculture, mining, energy sectors, the primary sectors that are greatly dependent on natural resources, increase on an average from 2017-2035. On the other hand, manufacturing sectors like metal products, electrical and machineries, miscellaneous manufacturing and transport equipment project an average decrease in such CO_2 emissions; the same pattern of emissions embodied in imports for partner countries is seen to be evident across the forestry and chemical sectors. But when the change in emissions across all ten sectors is considered for individual countries it is seen that overall there is an increase in CO_2 emissions embedded in trade for the CPTPP region.

Literature reveals that for sectors that are mainly dependent on natural resources (in this case, agriculture, mining and energy) only a few countries have the capacity to meet their materials needs with domestic resources and only through international trade can such consumption needs be fully satisfied (Wiedmann et al., 2015). From the results, it is obvious that open trade in the CPTPP region causes a shift in consumption pattern across the carbon-intensive sectors leading to an overall increase in footprint levels, particularly across the sector of agriculture. The agriculture sector is the most significant economic sector globally and over the years it is projected that pressure on natural resources used in this sector will grow substantially. Research finds that with increasing population, increased income and lifestyle a change in the trend in food habits and diet will lead to greater crop and meat production and consumption (Lettenmeier, Gobel, Liedtke, Rohn, & Teitscheid, 2012). The changes in agricultural practices is directly reflected in the material footprint which indicates environmental degradation through unsustainable transformation of landscape and rapid waste generation (Hoekstra & Wiedmann, 2014), in other words, GHG emissions.

When production-based emissions under the current Paris Agreement NDCs are considered (Appendix 5), as seen in Figure 7, then it is observed that CPTPP countries are unable to reach their intended targets by 2030. This refers to the fact that the NDCs in place are not sufficient enough to reach the goals. Within the CPTPP region except for Canada, Japan and New Zealand the production emissions in 2030 for all other partner countries is projected to be higher than their 2017 levels.



Source: CAT, EDGAR, Climate Watch, Low-Carbon Asia Research Project

Figure 7: Production-based GHG Emissions (Mt) in 2017 and 2030

From calculations in Table 4, it is seen that consumption-based CO_2 for these three countries increase by 6.02%, 5.78% and 8.10% respectively from 2017-2035 as the trans-pacific treaty is implemented. One of the reasons for decreased territorial emissions from Canada, Japan and New Zealand could be attributed to the emissions embodied in their imports from their CPTPP partner countries. Table 6 show that Canada, Japan and New Zealand apparently shift some of their production overseas (in this case, their CPTPP partners) leading to carbon leakage as their territorial emissions decrease and consumption emissions grow significantly over 2017-2035.

The CPTPP creates new opportunities for Canada in Australia, Brunei Darussalam, Japan, Malaysia, New Zealand, Singapore and Vietnam- countries with which it did not previously have any FTAs (Government of Canada, 2018)**.** It is one of three countries of the partnership whose consumption-based CO_2 increase in the mining sector. This could be due to the fact that over the recent years the sector has taken a dip due to falling investments in the sector and shifting of global demands to other international markets like Australian mining (Government of Canada, 2018)**.**

On the other hand, CPTPP agreement would create new markets with New Zealand for Japan, a global economic power and one of the top ten territorial CO_2 emitters of the world (AFP, 2018; Ritchie & Roser, 2018). Its economy experienced a shift from manufacturing to service; electrical and mechanical equipment, transport equipment and other manufacturing still remaining the key export sectors. Inadequate farmlands, insufficient food production for its population, scarce resources and raw materials and poor competition in energy intensive industries (Columbia University, 2009) are the main reasons behind Japan's growing imports from international partners.

As the treaty gets implemented New Zealand builds new zero-tariff relationships with Canada, Mexico, Peru and Japan resulting in higher standard of living, wages (O'Connor, 2018) and consumption CO_2 emissions. Except for metal products manufacturing embedded emissions increase for every sector, significantly across agriculture and energy, in total 8.10% across ten sectors the second highest among the member countries. The CPTPP is estimated to benefit consumers in New

Zealand by importing cheaper goods and products like electrical and mechanical machineries, transport equipment, plastic, agricultural products etc. (O'Connor, 2018).

The production-based GHG emission values as depicted in Figure 7, also indicate that the highest increase in territorial emissions occur for Malaysia, followed by Vietnam, Mexico and Peru. The NDCs for these countries do not help in curbing down the increasing territorial emissions. Malaysia is one of the top ten global net exporter of CO_2. Its CO_2 emissions embodied in imports grow across agriculture, energy and transport sectors during 2017-2035. A 2014 study on the CO_2 emission patterns in the Malaysian economy finds that its export sector is the largest producer of such emissions caused by the use of CO_2-intensive technologies and foreign demand for CO_2-intensive products (Chik & Rahim, 2014). Malaysia has transformed from an agriculture-based economy to manufacturing and till October 2016 the country imported more food and agricultural products than it exported such items despite having adequate land and natural resources (Radhi, 2017).

Vietnam is Southeast Asia's fastest growing middle class with a population of over 95 million and an important market for international trade (Mah, 2018) but it is the country with lowest income level in the CPTPP region. The consumption-based emissions for Vietnam (Table 6) is considerably higher than its partner countries and also its own production emissions (Figure 7) which gives evidence of increased trade due to the implementation of CPTPP. Vietnam is the only country within the partnership whose consumption-based CO_2 emissions go up across all ten sectors. This trend in Vietnam's consumption emission pattern is consistent with the findings by Steinberger and colleagues (2012) that countries with lower socio-economic status import energy as well as other carbon-intensive goods and services from the global market. A report on the impact of CPTPP on the country's economy states that "textile and leather products, chemicals, plastic products, transport equipment and machinery are expected to get an export boost while imports would grow in almost all sectors" (VNS, 2018). This change could be an indication of the shifts in their socio-economic structure. The growth in domestic consumer market and local demand has developed greatly over the years and is expected to grow further with domestic consumption projected to increase at a rate of 20% per year (Mah, 2018).

Impact of CPTPP on SDG 13 and SDG 17

As published by SDSN and Bertelsmann Stiftung the SDG index and dashboards 2018 report shows that no country is on track to achieving all seventeen SDGs by 2030 and that high income countries produce substantial economic, environmental and security spillover effects obstructing efforts by other countries in attaining the SDGs (J. Sachs, Schmidt-Traub, Kroll, Lafortune, & Fuller, 2018).

The SDG scores and color codes of the SDG dashboard indicate a country's progress on a goal. The green band represents the maximum that can be achieved for any SDG and the color bands ranging from yellow, orange and red denote an increasing distance from SDG achievement (J. Sachs, Schmidt-Traub, Kroll, Durand-Delacre, et al., 2017). The red color indicates that the SDGs need top priority in order for the goals to be accomplished whereas yellow and orange denote major challenge but rooms for improvement are present in attaining those goals. The table below shows the SDG index and the color bands to denote the present progress of SDG 13 and 17 for the CPTPP parties:

Country	Global SDG Index	SDG 13 Score	SDG 13 Dashboard	SDG 17 Score	SDG 17 Dashboard
Australia	72.9	23.3	Red	59.0	Red
Canada	76.8	66.4	Red	63.4	Red
Chile	72.8	92.4	Red	73.8	Orange
Japan	78.5	85.2	Red	57.3	Red
Malaysia	70.0	84.6	Orange	56.6	Orange
Mexico	65.2	88.1	Orange	61.6	Red
New Zealand	77.9	87.6	Red	65.0	Red
Peru	68.4	87.4	Yellow	56.2	Orange
Singapore	71.3	60.0	Red	27.5	Orange
Vietnam	69.7	79.4	Orange	70.1	Yellow

Source: Sachs et al., 2017

Table 10: SDG Index and Dashboard for CPTPP Countries

Countries with high SDG 13 score and red color dashboard are far from reaching SDG 13 because of high environmental spillover effects embodied in exports (Sachs et al., 2017). No country within the partnership has a green color band for either SDG 13 or SDG 17 implying that none of these countries are close to achieving their goals. For most member states the color band for both goals is red denoting that they are farthest away from taking urgent actions to combat climate change, its impacts and building partnership for achieving the SDGs.

According to the report on Global Responsibilities by SDSN, countries significantly need to step up progress towards achieving SDG 13. For attaining the goal on building partnership for sustainable development, countries like Australia, Canada, Chile, Japan, Mexico and New Zealand face major challenges due to their insufficient contribution towards development investments and cooperation, trade rules and unfair tax competition. These countries also affect the ability of other countries, especially developing countries and emerging economies in achieving their SDGs through environmental spillovers like pollution embedded in international trade, trans-boundary effects of resource use, or the use of global commons along with other spillovers related to economy, finance and governance (Sachs et al., 2017).

The SDG trend data based on historic country performance of the SDGs shows that if the past pace of progression is sufficient enough to achieve the SDG by 2030 (J. Sachs et al., 2018). The SDG trend uses five types of indicators (Figure 8). The trend for SDG 13 and SDG 17 for the CPTPP member countries are shown in Table 11; the grey dots in the table indicate insufficient data (J. Sachs et al., 2018).

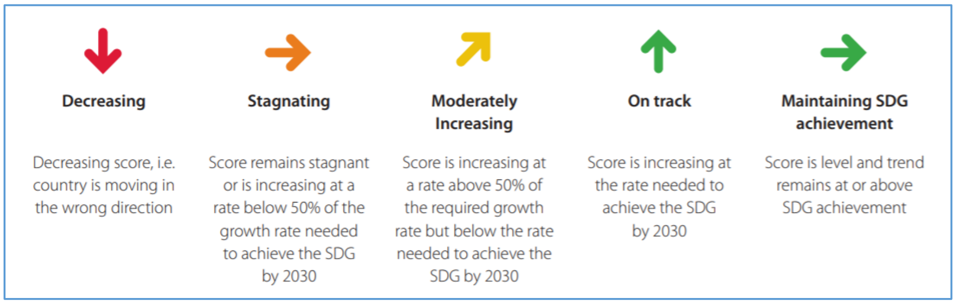


Figure 8: Five- arrow System for Denoting SDG Trends

Country	SDG Trend for Goal 13	SDG Trend for Goal 17
Australia	↗	↗
Canada	→	●●
Chile	↓	●●
Japan	↓	↗
Malaysia	↓	→
Mexico	↗	→
New Zealand	→	→
Peru	→	→
Singapore	↓	●●
Vietnam	→	↗

Table 11: SDG Trend for SDG 13 and SDG 17

It is seen from the table that for most CPTPP countries the trend for SDG 17 is either moderately increasing or stagnating while for goal 13, except for Peru and Vietnam, the SDG trend is mostly decreasing in the trans-pacific region.

The calculations performed earlier using MRIO analysis to estimate the changes in consumption-based CO_2 emissions, indices for SDG 13 and SDG 17, and their trends over the years for the CPTPP member states suggest that with the implementation of the agreement as trade liberalizes in the region the downward trend for SDG 13 will continue and partnership is likely to improve if not stagnate. This also indicates that the agreement is partially responsible for the member states' inability in attaining their Paris commitments.

Connections and Misalignments in SDGs and COP21 Commitments in Attaining Climate Objectives

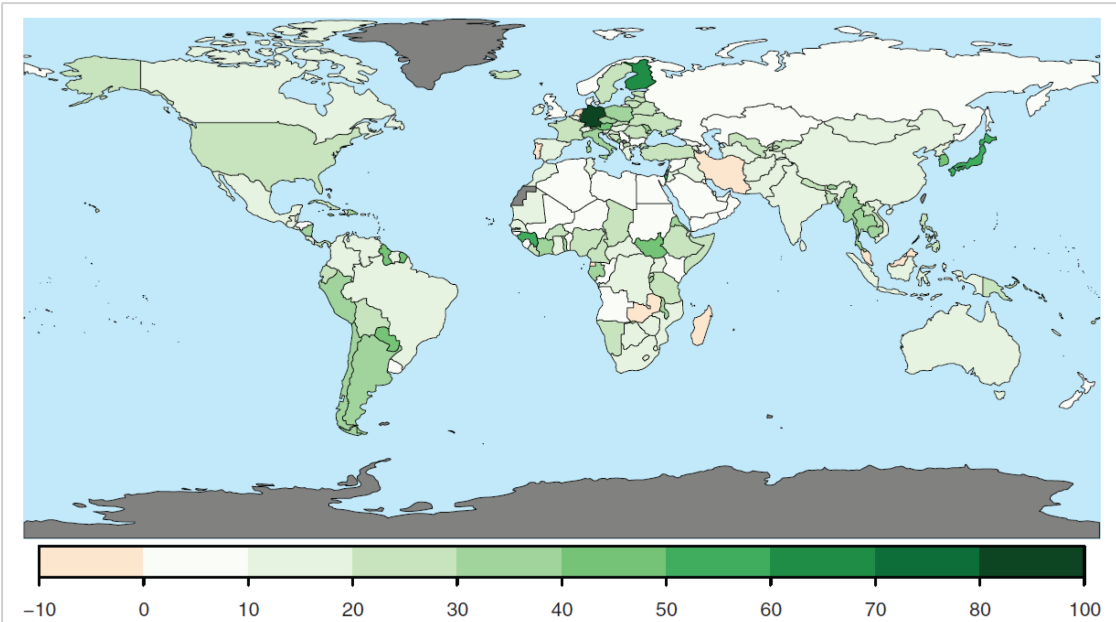
The SDGs encompass social, environmental and economic aspects whereas the Paris Agreement focuses on urgent climate action so alignment of these two agendas on national level provides ample scope for progress across both agreements by reducing duplication, increasing efficiency, maximizing and sharing resources, technical capacities, information and expertise. Both agendas need appropriate financial flows, new technology and capacity-building framework to support their respective ambitious goals (UNDP, 2017a).

The SDGs are designed to progress towards economic, social and environmental sustainability for the people and planet, for the present and into the future. The goals provide a blueprint for all countries-developed and developing- to form a global partnership for peace and prosperity (Martin, 2016d). Keeping that shared objective in mind, it is interesting to observe that SDG 17 encourages in promoting worldwide trade and facilitating developing countries in increasing their exports in order to achieve a universal rules-based and equitable trading system that is fair and open, and benefits all (Martin, 2016b). This is an example of the kind of potential misalignments that could be present within the goals themselves. Analyses find that there exists "a possible inconsistency in the SDGs, particularly between the socio-economic development and the environmental sustainability goals" (Swain, 2018). A report on the compatibility of the sustainable goals states that the inconsistencies of the SDGs is due to the fact that the concept focuses primarily on economic growth and consumption as a measure for understanding sustainable development as countries work for attaining higher economic growth and living standard while neglecting the natural world in the process (Spaiser et al., 2017).

A recent study on the SDGs titled "*A Critical Analysis of the SDGs*" by RB Swain find that GDP per capita has an overall positive impact on reducing poverty and increasing socio-economic conditions but has a negative relationship with CO_2 emissions. This means that incompatibility and inconsistencies between the goals is a result of increased economic growth and consumption given the business-as-usual scenario. However, factors like improved health, reduced child mortality, government investment in education and environment-friendly technologies positively affect the SDGs. The author suggests that policies and efforts should emphasize in investing for human well-being and clean technologies instead of consumption-based economic growth (2018).

A research undertaken by Pradhan and colleagues in 2017 quantifies the interactions among the goals show existence of both positive and negative relationship between the goals, but synergies offset trade-offs for most of the goals and for most countries. The study finds that negative correlation exists within all SDGs; for SDG 1 (No poverty) there exists both positive and negative relationship with other SDGs; and, SDGs 12 (Responsible consumption and production) and 15 (Life on land) have demonstrated trade-offs with most other SDGs. The study finds that SDG 1 (No poverty), 3 (Good health and wellbeing), 4 (Quality education), 10 (Reduced inequalities), 12 (Responsible consumption and production), and 13 (Climate action) show positive relationship in the sense that progress in one of the indicators of a goal positively affects the progress in fulfilling another indicator of the same goal. And, the opposite case happens for the goals of affordable and clean energy (SDG 7), decent work and economic growth (SDG 8), industry, innovation, and infrastructure (SDG 9), and life on land (SDG 14). Especially SDGs 8 and 9 have negative correlation to indicators of SDG 12 and other SDGs among which Climate Action (SDG13) is one; in 40% of the cases they also negatively affect the fulfilment of SDG17 (Pradhan et al., 2017). Responsible consumption and production also has a negative relationship to the indicators for partnership for goals. Literature shows that the trade-offs (significant negative correlation) of the goals can be typically linked to the rate of economic growth and human welfare at the expense of environmental degradation. Countries with high human development index (HDI) have improved health and lifestyle but with increased GHG emissions and waste (Pradhan et al., 2017).

The figure below shows the percentage of global distribution of the difference between the share of synergies and trade-offs among the SDGs by countries. The green color represents countries with higher share of synergies and the orange color denotes countries with higher share of trade-offs in their SDGs. The darker the color, the higher the difference. Among the CPTPP member states, Malaysia has more trade-offs than synergies in their SDGs.



Source: Pradhan et al., 2017

Figure 9: Synergy and Trade-offs in SDGs around the World

The research by Pradhan and colleagues (2017) finds that SDG 11(sustainable cities and communities) and SDG 13 to be one of the top ten synergy pairs with SDG 3 and 12 being the top trade-off pair. The study also locates the synergy and trade-off pairs for different countries based on their population. According to the paper, synergy between SDGs 3 and 6 is common among countries in the range of total population of 2.7 billion whereas, SDGs 3 and 12 have a negative correlation in countries with a population in the range of 3.4 billion people. The synergy and trade-off pairs for the CPTPP member states are show below:

Country	Synergy Pairs	Trade-off Pairs
Australia	SDG3 - SDG17	SDG3 - SDG12
Canada	SDG3 - SDG6	SDG3 - SDG15
Chile	SDG6 - SDG17	SDG3 - SDG15
Japan	SDG3 – SDG7	SDG3 – SDG 15
Malaysia	SDG3 – SDG6	SDG3 – SDG12
Mexico	SDG3 – SDG4	SDG1 – SDG12
New Zealand	SDG3 – SDG17	SDG3 – SDG15
Peru	SDG3 – SDG5	SDG3 – SDG12
Singapore	SDG1 – SDG4	SDG8 – SDG9
Vietnam	SDG4 – SDG6	SDG6 – SDG12

Source: Pradhan et al., 2017

Table 12: SDG Synergy and Trade-off Pairs for CPTPP Countries

It is seen from the table that most of the countries within the trans-pacific partnership have synergies as well as trade-offs with the goal of good health and well-being. SDG 17 plays a key role in converting the synergistic relationship into realities (Pradhan et al., 2017) but for only a few countries within the CPTPP there exists a positive correlation between SDG 17 and other goals. Except for Mexico, Singapore and Vietnam, trade-offs occur mostly with SDG 3-SDG 12 and, SDG 3-SDG 15.

The goal on urgent actions in combating climate change relevant to the commitments in the Paris agreement is absent in these pairs for all countries within the partnership. This goal is a part of the global top ten SDG synergy pairs (Pradhan et al., 2017) does not appear in the top synergy pair for the CPTPP countries. From table 10, it is apparent that three of the CPTPP member states are working towards good health and well-being, and clean water and sanitation through international partnerships. The cost-benefit analysis of SDG 17 targets (Table 2) related to technology are phenomenal or fair but those for capacity-building and systemic issues like policy and institutional coherence, and multi-stakeholder partnerships are uncertain as executing these targets depend on respective countries' priorities (Lomborg, 2014). It is outlined in CPTPP that all cooperation activities are dependent on funding, resources and regulations of the participating members. Also, as mentioned in target 17.19 developing measurements of progress to complement GDP is expensive with uncertain benefits (Lomborg, 2014).

The NDCs in the Paris Agreement are defined as achievable response to climate change carried out by each country that are "ambitious" as quoted in Article 3 of the agreement (Now This, 2016). Two major limitations of the Paris Agreement are the diverse national contributions and the possibility of carbon leakage. Countries that pledge smaller goals have the advantage of benefitting from countries that are committing to cut down emission by greater levels. Also, countries can keep their budgets in check by purchasing carbon intensive goods manufactured elsewhere, thereby allowing themselves to cause less emissions (Mehling, Asselt, Das, & Droege, 2018).

Countries have endorsed forestry as a key player in climate action in the Paris Agreement (UNCC, 2015). According to the results of the MRIO analysis, the decrease in consumption-based emission from the forestry sector might suggest that partner countries are focused on reforestation but no major step is taken to introduce or share new technology in the manufacturing sector (metal products, electrical and machineries, miscellaneous manufacturing and transport equipment). This might indicate a delayed action developing new clean technologies in this carbon-intensive infrastructure as scientists and researchers are skeptical on the reliance of future negative emissions technology and making the COP21 commitments and SDG targets harder to reach particularly due to increased emission reduction cost in the coming years (Clémençon, 2016). A study undertaken by ExxonMobil in 2006 forecasted that there would be a 60% upsurge in the use of energy by 2030 from 2000 but the increase in energy demand does not show any increase in the use of renewable energy from 2006 levels. According to the US Department of Energy, the cost of carbon sequestration using present technology is USD 100-300 for per ton of carbon emissions ("Low Emission Technology," 2018). The cost of carbon sequestration and its related technology, therefore, has to go down to make it accessible by all sectors and countries.

The national contributions specifically refer to the goal of climate change but they also cover other multiple SDGs and their targets as the thematic similarity between NDCs and SDGs share the same overall objective of sustainable development. The significance in understanding the synergies between NDC and SDG is essential in order to enhance policy coherence by maximizing co-benefits and reconciling trade-offs for better fulfilment of climate objectives (DIE-GDI, 2017). It has become crucial to link long term targets and strategies to concrete policy objectives (SDSN, 2018) as global warming due to increasing CO_2 emissions could potentially cause severe repercussions on future trade rules since the present growth and consumption centric trade agreement characteristics would leave perpetual negative impact on the environment (SDSN, 2018) and consequently the economy (environment being consistently exploited for economic gains). Trade agreements indirectly support climate goals through provisions like international market mechanisms, technology transfer, trade of environmental goods and services etc.; similarly climate treaties like the Paris Agreement require international trade elements to materialize the environmental objectives. Thus, even though the COP21 commitments are heavily structured around SDG 13, free trade would still be impacted by this agreement. . Even though trade-related elements are frequently mentioned in NDCs, the major emitters do not have a strong focus on trade or trade related measures to foster climate protection. It is important to recognize the interaction between trade policies like CPTPP and the Paris treaty commitments in order to ensure provisions supporting climate action in trade agreements are realized and that climate change mitigation are not exploited as a protectionist measure. Understanding the links between trade, SDGs and NDCs could also encourage better international collaboration and policy making that would have implications for both trade and climate change, and ultimately for sustainable development (Brandi, 2017)**.**

A look into the NDCs formulated by the CPTPP members show that for climate change mitigation all member states consider renewable energy and energy efficiency and focus on the sectors of agriculture and forestry in order to meet their COP21 commitments (Appendix 6). Except for Canada and Singapore, none of the parties consider carbon capture and storage in the nationally determined contributions which is essential for transforming to low emissions economy. All member states excluding Japan and Malaysia either express intention to use market mechanisms or intend to achieve partial reduction targets using such mechanisms. For climate change adaptation, Australia, Canada and Japan do not consider the rising global temperatures or assign agriculture or forestry as priority sectors. Chile and Malaysia do not mention the climate risk of increasing temperature but makes elaborate actions and strategies for the agricultural sector to adapt to the changes in climate (DIE, 2018). Mexico and Vietnam are the only countries that mention rising temperature as a climate risk in their NDCs and elaborate actions for their agriculture and forestry sectors. None of the parties mention SDGs in their NDCs; but Chile, Mexico, Singapore and Vietnam makes mention of sustainable development (Appendix 6).

Table 13 below examines potential alignment between the relevant climate targets, actions, policy measures or needs in the NDCs of the CPTPP partner countries to their SDGs of climate action and partnership. This connection is based on the contributions outlined in the Paris Agreement and not domestic policy of the respective countries. It is a representation of the starting point in understanding the extent to which the countries' climate and sustainable development objectives could be aligned (Climate Watch, 2017). It is evident that Vietnam and Chile have the most potential to connect their climate goals in the Paris Agreement to their SDG 13 and 17 whereas there is no possible alignment of Japan's NDCs to its SDG13.

Country	NDC and SDG13	NDC and SDG 17
Australia	2 targets (13.1, 13.3)	3 targets (17.1, 17.13, 17.14)
Canada	2 targets (13.1, 13.3)	None
Chile	3 targets (13.1,13.2,13.3)	6 targets (17.1,17.3, 17.6, 17.7, 17.16,17.19)
Japan	None	1 target (17.7)
Malaysia	3 targets (13.1,13.2,13.3)	None
Mexico	3 targets (13.1,13.3,13B)	3 targets (17.3, 17.7, 17.9)
New Zealand	No data Available	No Data Available
Peru	3 targets (13.1,13.2,13.3)	1 target (17.3)
Singapore	2 targets (13.1,13.3)	None
Vietnam	4 targets (13.1, 13.2,13.3,13A)	6 targets (17.1,17.3,17.6, 17.16,17.17)

Source: (Climate Watch, 2017)

Table 13: SDG-NDC Linkage for CPTPP Countries

From the NDC-SDG linkage of the CPTPP members it is seen that Chile, Malaysia, Peru and Vietnam have the potential to integrate climate change measures into their national policies and planning (target 13.2) into their NDCs. Based on the cost-benefit analysis of this target (Table 2) and their Paris Agreement commitments, as developing nations of the CPTPP these countries might be able to attract financing to accelerate development (Lomborg, 2014). According to the UN SDG indicator database, all CPTPP states have national provisions or legislations for disaster risk management (target 13.1.2) ("SDG Indicators," 2018). Even with these regulations Japan has no potential links of this target to its NDC.

Reconciling CPTPP, SDGs, & COP21 Commitments

The fundamental goal of free-trade agreements is to facilitate free trade between partners through the elimination of tariffs over a period of time with no binding environmental provisions for the participating countries. Though there is no explicit mention of climate change, GHG or CO_2 emissions in the CPTPP, the agreement has various articles in its Environment chapter that encourage parties in striving towards environmental protection and sustainable development. The objective of this chapter in CPTPP is to support trade between partners by promoting efficient enforcement of their respective domestic environmental policies and laws, and to enhance capacities of member states through cooperation to address trade-related environmental issues. It is binding for member states to ensure implementation of their own environmental laws and policies, and boost environmental protection. The articles of the chapter encourage the parties to adhere to the different multilateral environmental agreements (MEAs) that they are a part of and collectively achieve the goals outlined in such agreements. The binding provisions of the 'Environment' chapter requires countries to form or draw on already established consultative mechanisms in order to implement this chapter. It is also mandatory for parties to endeavor to settle on the interpretation and application of the chapter and work together in addressing any issue that might affect its operation. It has separate articles on the protection of ozone layer, emissions form ships, capture of marine fisheries, conservation and trade, biodiversity and wildlife trafficking and voluntary mechanisms to improve environmental performance but does not contain a separate article on climate change or global warming, the main global environmental issue at present.

According to the article on the protection of ozone layer (Article 20.5), *Each party shall take measures to control the production and consumption of, and trade in, such substances.*

The Montreal Protocol on Substances that Deplete the Ozone Layer and its subsequent amendments dealing with identifying and controlling ozone depleting substances are specifically referred to in this provision. The Montreal Protocol is the first successful binding agreement that was ratified by all countries in 1987. It particularly mentions phasing out the use of halogens, CFCs and HFCs. The article also pin-points the importance of cooperation and public consultation for developing and implementing measures in accordance with national and domestic environmental policies of individual member states in protecting the ozone layer. Countries are strongly encouraged to prevent pollution from emissions from ships by taking measures as indicated in the International Convention for the Prevention of Pollution from Ships, which sets limits on sulphur oxide and nitrogen oxide emissions, and emissions of ozone depleting substances.

The chapter also lays out procedural matters like promoting public awareness of environmental laws, policies and compliance procedures. It is legally binding for parties to ensure any request made by "an interested person residing or established in its territory" to appropriate authorities for probing into alleged violations of such policies or laws. According to Article 20.7.5, it is also binding on parties to offer sanctions or remedies for violations of its environmental laws. The provision also states that:

Those sanctions or remedies may include a right to bring an action directly against the violator to seek damages or injunctive relief, or a right to seek governmental action.

The voluntary mechanisms like voluntary auditing and reporting, market-based incentives, information and expertise sharing, public-private partnerships etc. and cooperation frameworks (dialogues, workshops, seminars, collaborative projects, technical assistance etc.) outlined in the chapter to enhance environmental benefits. Prevention of unnecessary barriers to trade through voluntary mechanisms are intended to encourage countries to adopt international standards, guidelines, recommendations and best practices and, improve and strengthen individual or joint capacities to support sustainable development through their trade and investment relations (Article 20.11 and 20.12). All cooperation activities summarized in this chapter are contingent to comparative capabilities and resources, and to the laws and regulations of the parties involved.

One of the objectives of the Environment chapter (20.2.3) is for parties to not enforce any environmental laws or other measures that hinders trade or investments between parties:

The Parties further recognize that it is inappropriate to establish or use their environmental laws or other measures in a manner which would constitute a disguised restriction on trade or investment between the Parties.

On the contrary, one of the environmental commitments (20.3.6) of CPTPP is to guarantee environmental protection as trade is liberalized in the region and also to prevent countries from impairing their environmental standards to promote trade or attract investment.

Transition to low emissions economy is recognized by the treaty and in case of cooperation for such transition parties are encouraged to consider domestic circumstances and capacities; it is binding on parties to collaborate on common interests and participate in capacity-building activities related to transitioning to such an economy (Article 20.15). Low emissions technology employs a variety of advanced technology to bring down the GHG emissions and uses sources like coal, gas and oil ("Low Emission Technology," 2018). The Agreement highlights on transitioning to a low emissions economy instead of taking actions to reduce the dependency on fossil fuels with past literature suggesting that response to technological innovations do not guarantee success (Clémençon, 2016). It is important to note that carbon pricing is an indispensable strategy in developing and transitioning to a low carbon economy (CPLC, 2016) and not all member countries of CPTPP have a carbon market mechanism in their economic structure. Also, mentionable that low carbon technologies like carbon capture and storage need carbon market mechanisms that are "too high to be politically acceptable or economically efficient" (CPLC, 2016).

The most recent update released by the IPCC in early October of 2018 states that at present, the world is heading towards a $3^{0}C$ rise and in order for countries to fulfil their Paris Agreement targets there needs to be a complete phase out of coal and a 50% increase in renewable energy (Cassella, 2018). To reach the global aim of keeping temperatures within $1.5^{o}C$ it is crucial to replace the fossil fuel industry entirely with renewable and clean energy. The trans-pacific treaty acknowledges the importance of trade in environmental goods and services in the region. It is binding for countries to address barriers to trade in these goods and services and the parties "may develop bilateral and multi-lateral cooperative projects on environmental goods and services to address current and future global trade related environmental challenges." (Article 20.18). From the calculations, it is seen that as the agreement is implemented exports and consumption-based emissions increase and decrease respectively on an average across the forestry and wood products sector. This is indicative of the fact that as per the Paris Agreement CPTPP states are relying on land use to bring down their CO_2 emissions and turn into a low emissions economy. According to Clémençon's paper on the failures and successes of the Paris Agreement, countries are heavily relying on 'negative emissions' to bring down their emissions by reforestation to absorb CO_2, carbon sequestration (a method of removing CO_2 from old and new coal and gas-fired power plants) and other high-tech solutions that capture carbon out of the atmosphere. But researchers are doubtful of the consequences of depending on such technologies to successfully reduce emissions and achieve the Paris targets since there is yet no hint of these negative-emission technologies and geo-solutions to be available at a large scale and low cost without any striking impacts on land use and other unforeseen consequences (2016). As indicated by the 2016 Executive Briefing of the Carbon Pricing Leadership Coalition, R&D and technology deployment policies relating to renewable energy support premiums "can play a major role in developing and lowering the cost of new and immature mitigation technologies and in testing their integration in existing systems" (CPLC, 2016).

Some contradictory provisions within the treaty might prove to be impediments in realizing environmental protection. The 'Development' chapter of CPTPP extensively acknowledges the importance of inclusive economic growth and the contribution of the treaty in establishing sustainable economic development in the region. The parties also recognize the influence joint development activities between countries can have on achieving the SDGs. The only binding element is the duties of the committee consisting of government representatives for the purpose of discussing trade and development. But, Article 23.8 states,

> *In the event of any inconsistency between this Chapter and another Chapter of this agreement, the other Chapter shall prevail to the extent of the inconsistency*.

That is, if this chapter comes in conflict with the rest of the treaty, the rest of the agreement takes precedence; even the dispute settlement chapter cannot be used to enforce it as stated in Article 23.9 "Non-Application of Dispute Settlement" (Matthews, 2015). This reveals the irrelevance of the agreement's development provision (Rimmer, 2015).

One of the most contested provisions of the previous version of this agreement (TPP) was the increased abilities of companies, especially oil and gas developments, to sue national governments. In the new version the scope for such claims have been reduced, for example any private company involved in investment contracts with the government cannot make investor-state dispute settlement claims (Corr, Rosenzweig, Moran, Scoles, & Solomon, 2019). Also, any party violating either environmental or labor commitments are apparently subject to trade retaliation. But environmental protection under this treaty remains subject to dispute settlement by panels "with a requirement that panelists possess specialized expertise, rather than being purely trade lawyers" (Schill & Vidigal, 2018). The controversial Investor-State Dispute Settlement (ISDS) provision retained in the 'Investment' chapter gives investors more protection than host countries by granting them the power to sue governments and not vice-versa (King, 2018). Thus, investors would be able to safeguard their own interests even though they might be detrimental to human lives and the environment. In Article 9.16 it is stated,

> *Nothing in this Chapter shall be construed to prevent a Party from adopting, maintaining or enforcing any measure otherwise consistent with this Chapter that it considers appropriate to ensure that investment activity in its territory is undertaken in a manner sensitive to environmental, health or other regulatory objectives*.

That is, the treaty claims to protect governments acting in the public interest but it actually does not do so since governments enforcing any environmental or health regulation might affect the value of the investors' assets (King, 2018). The primary objective of such a treaty thus remains to maintain business interests of the investors against health and environmental risks of the general population, even if there is a general willingness for change (Hailes, Jones, Menkes, Freeman, & Monasterio, 2018). Though such a clause has been in use over several years in many regional trade agreements, no convincing indication to this end has ever been documented (Prag, 2017).

Ways Forward

Trade relations especially free trade between developed and developing economies involve intensive transfer of environmental loads (use of land, water, energy etc.) depending on the comparative advantage of trade partners. So a combination of policies on technology, industrial structure and international trade could help create substantial changes for carbon embodied in trade (Wang et al., 2019). A study conducted on carbon emissions embodied in trade between Australia and China uses variables like GDP, share of R&D spending in GDP, share of services sectors in GDP etc. to determine carbon emissions embodied in exports. The R&D spending variable represents technological progress particularly progress in developing cleaner production technology. The study finds that, on average, one percent increase in the share of research and development spending in GDP would induce 0.84% and 1.18% reductions of total carbon intensities in Chinese and Australian sectors, respectively. This is clear indication of the crucial role research and development plays in initiating low-carbon innovation and solutions (Wang et al., 2019). Industrialized countries with the intention of switching and incentivizing green production process for their developing and emerging trade partners could significantly help in bringing down global emissions by using consumption-based policies (Lininger, 2013). According to Lininger (2013), this is possible if the developing countries have access to cleaner technology and an appropriate carbon (border) tax. CPTPP aims to transition towards a low emissions economy which requires carbon market mechanisms and the agreement provides an opportunity for the trade partners to establish domestic markets in the region. On top of that, CPTPP recognizes the importance of trade and investment in environmental goods and thus the member countries can take advantage of this provision, their intention to transition into a low emissions economy and the consumption-based emissions approach to introduce carbon prices at the borders. The prices on carbon will be different for developed and developing countries for creating a level playing field. Consumption-based carbon tax applicable in developed economies when introduced in developing countries impose an additional cost burden on them and this may act as an impediment in international climate negotiations or lead to retaliatory measures. Thus, the carbon taxes must be designed as such that the producers are charged only for the amount of carbon embodied in their exports and not any industry average or measures based on best available technology, as usually suggested. This kind of a carbon tax will thus act as an incentive for the developing countries to shift towards a cleaner production system (Lininger, 2013).

CPTPP provides ample scope for the member countries to move forward sustainably despite the absence of direct reference to climate change or GHG emissions, and the inconsistencies in the SDGs, Paris climate actions and the environmental provisions of the agreement. The agreement shows how tension between free trade and emissions could be addressed. It also presents the parties with opportunities to build on partnerships not only for trade but also for achieving their SDGs and other climate goals. As seen from the calculations and analysis, there is a possibility of carbon leakage as a result of the implementation of this treaty. This indicates the phenomenon of outsourcing of emissions and to address this issue it is necessary to strengthen cooperation between the developed and developing partners (Wang et al., 2019). As seen from the results of the MRIO analysis, the most significant increase in consumption-based emissions occur from the sector of agriculture (about 23.5%; Table 6). Thus, it opens up room for cooperation in reducing material footprint in the region to address unsustainable agricultural practices.

Economic outcome is the only indicator that assesses the quality of any trade agreement. As international trade causes a shift in production structure, it has the ability to greatly influence climate change (Choma, 2015) and its relevant policies. It is hence necessary to include new indicators like carbon emissions, knowledge sharing and capacity building to evaluate the significance of trade relationships for sustainable growth as an alternative to economic development.

The development provisions of CPTPP recognize the significant role of free trade, investment and inclusive growth in improving welfare and living standards, reducing poverty and creating new employment. These provisions also consider collaboration and cooperation in areas of female empowerment, technology sharing, access to finance, research and innovation, industry best practices etc. (Government of Canada, 2019). It also highlights mutual cooperation between parties through consultative mechanisms in realizing the commitments of the MEAs and the objectives of CPTPP itself. This opens avenues for the members of the partnership to integrate their SDGs and NDCs for the Paris Agreement while achieving the objectives of the Environment chapter. Moreover, the agreement binds the parties in working towards providing appropriate financial or in-kind resources for undertaking all kinds of cooperation and capacity building activities with each other. Capacity-building, existing technology sharing and cooperation are just as essential as trading goods and services to establish and accelerate economic growth and development. Thus, resource sharing and funding has to be a priority in free trade agreements, especially for agreements as large as the CPTPP, in order to support a growing and sustainable economy.

At the signing ceremony of CPTPP in 2018, Canada, Chile and New Zealand signed two joint declarations on fostering progressive and inclusive trade, and on ISDS. The joint declaration on ISDS restated the parties' right to regulate and intent to promote transparency in dispute settlement proceedings. New Zealand also signed side letters with five other countries: Australia, Brunei, Malaysia, Peru and Vietnam to exclude the mandatory ISDS provisions (IISD, 2018). The joint declaration on progressive and inclusive trade affirms the countries' commitment in positively influencing trade to support sustainable development, climate action (SDG 13), COP21 commitments, and domestic regional economic development and also reduce adverse impacts of climate change (Government of Canada, 2018). Other parties have the opportunity to follow the lead in using CPTPP for fostering a sustainable economy and trade relations. The signing of such joint declarations hints that some countries are ready to exploit trade for the advancement of economy and climate by enhancing regional cooperation and capacities. It also shows that it is essential for provisions directed towards achieving climate goals and sustainable development to be a part of the original text of the agreement instead of being side agreements for only a few members.

Limitations and Areas for Future Research

The most significant limitation of this research is data inadequacy. To address the lack of current and suitable data the thesis used two different databases and assumed the proportion of all ten sectors in the overall economy to be same for all CPTPP members. This assumption affected the accuracy of the results obtained.

To determine the changes in consumption-based emissions this study uses two datasets from two different databases: GTAP and Eora. In quantifying the impacts of CPTPP using GTAP Ciuriak and colleagues do not include Brunei in the region but consider it as part of 'Rest of Southeast Asia' as they model the GTAP framework for their estimations (Ciuriak et al., 2017). Thus, the estimated changes presented in their paper is not a precise reflection of the changes taking place as a result of CPTPP implementation. This thesis uses the export values obtained from that GTAP model to find out the emission multipliers using the IO tables from the Eora database. Although GTAP has data on the factors and multipliers needed to determine CO_2 emissions, this thesis uses the Eora database for this purpose as it provides with more recent IO tables (latest available year is 2015) compared to the GTAP database (reference year in latest version is 2011).

Another limitation of the study stems from the inherent shortcomings of input-output analysis. Assumptions of the model include constant input for any industry and constant returns to scale among others that do not reflect actual market scenarios. Even though all accounting methods suffer from some degree of uncertainty, the consumption-based approach entails the statistical uncertainties of production-based method as well as uncertainties due to their modelling assumptions (Andrew & Forgei, 2008). Therefore, some researchers argue that consumption-based emission accounting using input-output models might not be a practical approach to international environmental policy making (Afionis et al., 2017), though it can be effective in shaping fundamental environmental programs (Wiedmann & Lenzen, 2018).

These limitations provide opportunities for future research in the area. A study on the convergence between different MRIO databases (Moran & Wood, 2014) find that there exists discrepancies in each model for different countries and that MRIO-based consumption emission accounts need to be stable and replicable for policy making. Further work can be done using comparison statistics and confidence estimates to understand which model and database is better suited for creating consumption-based accounts and for environmental policy making (Moran & Wood, 2014; Owen, 2015), and how the results vary from the methods used in this research.

This research sets the scope to expand on issues like the impact of trade on consumption pattern and carbon footprint, especially for the agricultural sector where trade, technology and sustainable approach to lifestyle changes could lead to great reductions in emissions. Future research can also focus on the nature of the trade agreement and their impact on sustainable development to contribute to the discussion regarding the influence of trade agreements in improving environmental conditions. Research can be conducted to understand how power dynamics, geography and culture in the context of the members of a trade agreement influence trade flow and environmental performance. There is also a scope for expanding on how the CPTPP compares to EU trade agreements which have a more rigorous approach to environmental protection and sustainable development, and what that implies for the member countries.

Conclusion

Global warming from increased GHG emission is an emerging risk that has short, medium and long term implications on the patterns of lifestyle and trade. Trade liberalization has both positive and negative effects on sustainable development. Agenda 2030 for sustainable development recognize the role of international trade in promoting inclusive and sustainable economic growth and well-being. The focus of the research is on CPTPP, the current free trade agreement into force that combines the most number of developed and developing trade partners. It is the third largest free trade area after NAFTA and the European Single Market, has separate chapter on environment unlike NAFTA where environment is included in side agreements, and it also combines equal partners of developed and developing countries. The aim of the research is to understand the carbon implications of this agreement and how the emission resulting from trade affect sustainability and climate objectives of the member countries. The thesis also studies the effectiveness of the environmental provisions of the agreement and highlights the disparity between a free trade agreement like CPTPP and its climate objectives.

MRIO analysis was used to determine the change in consumption-based emission occurring in the trans-pacific region due to the implementation of the treaty. The present trend of SDG on climate change (SDG 13) and partnership (SDG 17) in the CPTPP countries was also studied to perceive the present state of those countries and how this trend is affected as the trade agreement is implemented. Calculations and analysis show that partnership improves because of implementation of CPTPP but emissions resulting from imports increase, particularly in the sectors of agriculture and energy. The changes in emissions when compared to the respective country's Paris Agreement targets it is observed that CPTPP member states are unable to achieve those by 2030. This implies that environmental pressure increases as a result of increased production, consumption and trade, and the effect of such an increase and the environmental provisions of the treaty have an opposing outcome on the SDG 13 and SDG 17 for the trade partners.

As is typical in trade agreements, obligatory commitments to open markets and foreign investments are subject to corporate-led dispute settlement, and governments act in opposite directions without even acknowledging the discrepancies in their trade and climate agendas (GRAIN, 2015). CPTPP also mirrors similar features as is found in this research. The pattern of contrasting nature and impacts of the SDGs of climate action and partnership as trade liberalization takes place is not unique to the CPTPP, as expected. As a trade agreement the partnership that the CPTPP helps to forge in the region provide influence in fostering sustainable development; the treaty has provisions of non-binding goals like transitioning to a low-emission economic region and other voluntary mechanisms for any party interested in engaging in such an endeavor. Although some of the members have linked their climate change mitigation and adaptation measures, and SDGs in order to reduce their territorial emissions, CPTPP implementation shows an increase in consumption-based CO_2 emissions; consequently an increase in overall emissions in the trans-pacific region.

The research finds that there are opportunities for the parties of the agreement to link their NDCs of the Paris Agreement to their SDGs and integrate climate change measures and sustainable development objectives. An important gap revealed in the study is that the market mechanisms necessary to promote transitioning to low a carbon economy essential for creating a sustainable economy is not supported by the partner countries. There is no policy coherence for such matters between the partners and though this is not a concern for a free trade deal, the intention of the treaty in building an environmental- friendly economic zone thus remains unfulfilled.

If environmental externalities are correctly priced then over the long term trade liberalization and comparative advantage could help flourish a more resource efficient economy. As emissions are not yet correctly priced its impact on international trade could exacerbate and could increase further where policy misalignments exist (Helble & Shepherd, 2017). When environmental costs are internalized using mechanisms like carbon tax, emission trading schemes etc. then free trade could be termed equivalent to sustainable development (Low, 1996). It is important for such pricing mechanisms to be fair and harmonized as in this age of globalized value chain the life cycle of goods leave environmental ramifications starting from extraction of raw materials, transportation, packaging, marketing, consumption and disposal (Low, 1996) irrespective of the location. Free trade agreements as well as climate policies do not take into account the emissions that occur off-shore rather focus on their territorial emissions and emphasize on “sustainable” economic development, not sustainable development encompassing economy, society and the environment.

Articles 20.2.3 of the Environment chapter of CPTPP talk about refraining from using environmental laws that would restrict trade and at the same time 20.3.6 refer to inappropriate derogation of environmental laws for expediting trade. Thus there is fine line between this objective and commitment of the agreement towards the environment and sustainable economic development. The development agenda of the agreement cannot materialize if it comes in conflict with other provisions of the agreement along with the ISDS that poses a great threat to overall sustainable development; giving trade and economic growth precedence over sustainable development. As mentioned by Spaiser and colleagues (2017) inconsistencies within the SDGs exist because sustainable development is defined based on pure economic growth and consumption hence the implementation of CPTPP would result in increased exports as well as consumption, and its environmental objectives and commitments would widen the gaps and inconsistencies deterring and misrepresenting actual sustainable development within the region.

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APPENDIX 1

The table shows in detail the sectors used for the MRIO analysis. It gives the CPTPP regional impacts across the sectors for 2035.

Sectors	Percentage change in Intra-CPTPP Exports	Change in Intra-CPTPP Exports (USD Million)
Rice	-0.12	-1
Wheat and cereals	0.63	32
Fruits and Vegetables	8.22	267
Oilseeds and vegetable oils	0.48	36
Sugar	0.11	0
Dairy	1.1	38
Beef	18	891
Pork and poultry	0.14	1
Other agriculture	0.97	9
Agriculture	**29.53**	**1273**
Mining	**5.06**	**158**
Forestry	0.19	195
Wood Products	1.72	414
Forestry and Wood	**1.91**	**609**
Chemical (Plastics: CRP)	**1.66**	**1070**
Metal Products	**0.99**	**624**
Electronic equipment	0.30	284
Machinery and equipment	1.81	1786
Electrical and Machinery	**2.11**	**2070**
Transport Equipment	**1.54**	**140**
Other Manufacturing	**3.20**	**160**
Energy (Fossil fuels)	**18.28**	**828**
Automotive	6.79	3608
Transportation services	0.69	139
Transport	**7.48**	**3747**
Total (across 10 sectors)		**10679**
Total (across 33 sectors)		**17334**

Source: Ciuriak et al., 2017

APPENDIX 2

The first two columns show the trade impacts of CPTPP obtained from the paper by Ciuriak and colleagues (2017) as the percentage change in exports for 2035 and their dollar values. The fourth column shows the calculated amounts of exports in 2017 and the last two columns indicate the total exports in 2017 and 2035 from only the ten sectors considered for study.

Exports to CPTPP from	Change in exports from 2017 (%)	Change in exports for 2035	Exports in 2017	Exports across ten sectors	
				2035	**2017**
AUS	0.15	115000000	114827758.4	70742219.43	70848332.76
CAN	4.88	2560000000	2440884821	1503761913	1577145494
CHL	-0.09	23000000	23020718.65	14182430.74	14169666.55
JPN	3.4	4323000000	4180851064	2575707195	2663281239
MLY	1.66	1985000000	1952587055	1202935108	1222903831
MEX	3.12	1548000000	1501163693	924825607.2	953680166.1
NZL	6.56	1638000000	1537162162	947003272.7	1009126687
PER	0.46	80000000	79633685.05	49060120.15	49285796.7
SGP	0.5	652000000	648756218.9	399680838.9	401679243.1
VNM	6.83	4507000000	4218852382	2599118760	2776638572

All export values are in USD.

APPENDIX 3

The following tables present the estimated changes across the ten carbon-intensive sectors from 2017-2035 for Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore and Vietnam.

CANADA:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0002009462	149165951.7	29.974	188005076.7	37.778	26.04%
Mining	0.0001682468	22826081.08	3.840	23334487.14	3.925	2.23%
Wood and Forestry	0.0001253912	90701016.89	11.373	89941156.11	11.277	-0.84%
Chemical	0.0012332981	159751644.5	197.021	158024691.4	194.891	-1.08%
Metal Products	0.0002211479	93781652.83	20.739	92156455.52	20.380	-1.73%
Electrical & Machinery	0.0001807285	307690249.8	55.608	305711318.8	55.250	-0.64%
Transport Equipment	0.0001705762	20926786.41	3.569	20676127.84	3.526	-1.20%
Other Manufacturing	0.0001201387	23531626.71	2.827	23629860.39	2.838	0.42%
Energy	0.0030212700	106250427.5	321.011	122284527.5	369.454	15.09%
Transport	0.0019107462	529136475.7	1011.045	553381793	1057.372	4.58%
Total		**1503761913**	**1657.01**	**1577145494**	**1756.697**	**6.02%**

CHILE:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0000861939	1406828.94	0.121	1689108.11	0.145	20.06%
Mining	0.0001845487	215279.63	0.039	209645.78	0.038	-2.62%
Wood and Forestry	0.0003032888	855428.56	0.259	808065.07	0.245	-5.54%
Chemical	0.0006213562	1506665.79	0.936	1419753.08	0.882	-5.77%
Metal Products	0.0003506002	884482.96	0.310	827968.15	0.290	-6.39%
Electrical & Machinery	0.0002155859	2901919.25	0.625	2746625.13	0.592	-5.35%
Transport Equipment	0.0002231778	197366.81	0.044	185762.08	0.041	-5.88%
Other Manufacturing	0.0001047662	221933.84	0.023	212299.52	0.022	-4.34%
Energy	0.0023528323	1002079.72	2.357	1098650.05	2.584	9.64%
Transport	0.0011587796	4990445.19	5.782	4971789.54	5.761	-0.37%
Total		**14182430.74**	**10.500**	**14169666.5**	**10.603**	**0.99%**

JAPAN:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0000803440	255497769.7	20.527	317478885.4	25.507	24.26%
Mining	0.0003464570	39097479.96	13.545	39404292.14	13.651	0.78%
Wood and Forestry	0.0003080282	155356549.3	47.854	151881100.7	46.783	-2.24%
Chemical	0.0003099147	273629393.3	84.801	266851851.9	82.701	-2.48%
Metal Products	0.0001227332	160633193.2	19.715	155622014.5	19.099	-3.12%
Electrical & Machinery	0.0000984531	527024912.1	51.887	516246105.9	50.826	-2.05%
Transport Equipment	0.0001221932	35844287.48	4.379	34915195.57	4.266	-2.59%
Other Manufacturing	0.0001630856	40305968.45	6.573	39903080.65	6.507	-1.00%
Energy	0.0029673563	181990239.3	540.029	206498442.4	612.754	13.47%
Transport	0.0011177193	906327401.7	1013.019	934480270	1044.486	3.11%
Total		**2575707195**	**1802.334**	**2663281239**	**1906.585**	**5.78%**

MALAYSIA:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0000644864	119325379	7.694	145777373.9	9.400	22.17%
Mining	0.0002285463	18259735.18	4.173	18093342.56	4.135	-0.91%
Wood and Forestry	0.0001707970	72556324.63	12.392	69739529.25	11.911	-3.88%
Chemical	0.0009097159	127793409.3	116.255	122530864.2	111.468	-4.12%
Metal Products	0.0001668144	75020680.92	12.514	71457251.64	11.920	-4.75%
Electrical & Machinery	0.0002492167	246136971.9	61.341	237045690.6	59.075	-3.69%
Transport Equipment	0.0001328935	16740393.44	2.224	16032075.69	2.130	-4.23%
Other Manufacturing	0.0002462961	18824136.77	4.636.	18322372.22	4.512	-2.67%
Energy	0.0069585061	84995083.55	591.438	94818276.22	659.793	11.56%
Transport	0.0026476717	423282993.1	1120.714	429087054.3	1136.081	1.37%
Total		**1202935108**	**1933.386**	**1222903831**	**2010.429**	**3.98%**

MEXICO:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0001057332	91738253.66	9.699	113684319.8	12.020	23.92%
Mining	0.0002260284	14038222.48	3.173	14110072.69	3.189	0.51%
Wood and Forestry	0.0001289391	55781851.03	7.192	54386292.83	7.012	-2.50%
Chemical	0.0011192793	98248539.42	109.967	95555555.56	106.953	-2.74%
Metal Products	0.0001736604	57676466.78	10.016	55725856.7	9.677	-3.38%
Electrical & Machinery	0.0003499411	189231965.3	66.220	184859813.1	64.690	-2.31%
Transport Equipment	0.0001947156	12870141.06	2.506	12502596.05	2.434	-2.86%
Other Manufacturing	0.0001763764	14472138.69	2.552	14288681.2	2.520	-1.27%
Energy	0.0053932082	65344862.94	352.418	73943925.23	398.794	13.16%
Transport	0.0016371016	325423165.9	532.750	334623053	547.811	2.83%
Total		**924825607.2**	**1096.496**	**953680166.1**	**1155.104**	**5.34%**

NEW ZEALAND:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0002197895	93938171.45	20.646	120293873.3	26.439	28.06%
Mining	0.0000827945	14374864.33	1.190	14930425.75	1.236	3.86%
Wood and Forestry	0.0000699979	57119520.77	3.998	57548286.6	4.028	0.75%
Chemical	0.0002541130	100604576.3	25.564	101111111.1	25.693	0.50%
Metal Products	0.0003062190	59059570.12	18.085	58965732.09	18.056	-0.16%
Electrical & Machinery	0.0000373228	193769818.9	7.232	195607476.6	7.300	0.95%
Transport Equipment	0.0000260958	13178771.88	0.343	13229491.17	0.345	0.38%
Other Manufacturing	0.0000324494	14819186.01	0.480	15119418.48	0.490	2.03%
Energy	0.0012311679	66911857.31	82.379	78242990.65	96.330	16.93%
Transport	0.0011467133	333226935.7	382.115	354077881.6	406.025	6.26%
Total		**947003272.7**	**542.037**	**1009126687**	**585.946**	**8.10%**

PERU:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0000765021	4866528.037	0.372	5875158.648	0.449	20.73%
Mining	0.0001450008	744699.1911	0.107	729202.723	0.105	-2.08%
Wood and Forestry	0.0002679984	2959113.904	0.793	2810661.128	0.753	-5.02%
Chemical	0.0007415658	5211885.474	3.864	4938271.605	3.662	-5.25%
Metal Products	0.0002690332	3059619.422	0.823	2879889.235	0.774	-5.87%
Electrical & Machinery	0.0002990972	10038371.43	3.002	9553478.712	2.857	-4.83%
Transport Equipment	0.0002029874	682734.8443	0.138	646128.995	0.131	-5.36%
Other Manufacturing	0.0002070439	767717.5647	0.158	738433.1372	0.152	-3.81%
Energy	0.0032240523	3466412.264	11.175	3821391.485	12.320	10.24%
Transport	0.0012647927	17263038.02	21.834	17293181.03	21.872	0.17%
Total		**49060120.15**	**42.271**	**49285796.7**	**43.079**	**1.91%**

SINGAPORE:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0002378624	39646417.55	9.430	47882542.98	113.89	20.77%
Mining	0.0011002292	6066882.766	6.674	5943002.192	6.538	-2.04%
Wood and Forestry	0.0000179871	24107179.6	0.433	22906888.2	0.412	-4.98%
Chemical	0.0004135342	42459960.4	17.558	40246913.58	16.643	-5.21%
Metal Products	0.0000237707	24925973.55	0.592	23471097.27	0.557	-5.84%
Electrical & Machinery	0.0000078568	81780164.86	0.642	77860851.51	0.611	-4.79%
Transport Equipment	0.0000219819	5562074.339	0.122	5265951.31	0.115	-5.32%
Other Manufacturing	0.0000921316	6254407.845	0.576	6018230.068	0.554	-3.78%
Energy	0.0013255694	28240015.67	37.434	31144340.6	41.283	10.28%
Transport	0.0002544542	140637762.3	35.785	140939425.4	35.862	0.21%
Total		**399680838.9**	**109.251**	**401679243.1**	**113.970**	**4.32%**

VIETNAM:

Sector	CO_2 Multiplier	2017		2035		Change in Emissions
		Exports (USD)	Emissions (Mt)	Exports (USD)	Emissions (Mt)	
Agriculture	0.0004974328	257820084.4	128.248	330991750.3	164.646	28.38%
Mining	0.0013099359	39452851.57	51.680	41081458.41	53.814	4.13%
Wood and Forestry	0.0009873100	156768643	154.779	158345621.3	156.336	1.01%
Chemical	0.0037076478	276116513.2	1023.742	278209876.5	1031.504	0.76%
Metal Products	0.0006848575	162093248.4	111.010	162245759.8	111.115	0.09%
Electrical & Machinery	0.0008999598	531815238.6	478.612	538219107	484.375	1.20%
Transport Equipment	0.0005775069	36170089.61	20.888	36401292.26	21.021	0.64%
Other Manufacturing	0.0008288863	40672324.47	33.712	41601476.87	34.482	2.28%
Energy	0.0152534149	183644416.7	2801.204	215287642.8	3283.871	17.23%
Transport	0.0081702774	914565350.4	7472.252	974254586.4	7959.930	6.53%
Total		**2599118760**	**12276.132**	**2776638572**	**13301.098**	**8.35%**

APPENDIX 4

The tables below show the consumption-based CO2 emissions for the CPTPP member countries during their base years of the Paris Agreement. The base year for Canada, Malaysia, New Zealand and Singapore is 2005; for Chile 2007; Japan and Mexico is 2013; and for, Peru and Vietnam is 2010.

Canada	CO_2 Multiplier	Exports (USD)	Consumption Emissions (Mt)
Agriculture	0.002915283	840277.788	2.449
Mining	0.000959135	5264589.55	5.049
Wood and Forestry	0.0042898	1335605.887	5.729
Chemical	0.004764669	1911004.588	9.105
Metal Products	0.002500527	1370665.722	3.427.
Electrical & Machinery	0.003255894	3156189.559	10.276
Transport Equipment	0.003267388	1709519.468	5.585
Other Manufacturing	0.00232605	171465.2372	0.398
Energy	0.005681563	1971.03569	0.011
Transport	0.006126756	1031357.066	6.318
Total			**48.352**
Chile			
Agriculture	0.0007118721	487059.7412	0.346
Mining	0.0012848049	1990311.477	2.557
Wood and Forestry	0.0014701601	897174.1762	1.318
Chemical	0.0016250445	4777605.542	7.763
Metal Products	0.0014675958	635769.3496	0.933
Electrical & Machinery	0.0010915022	280610.2503	0.3060
Transport Equipment	0.0020604209	302669.9423	0.623
Other Manufacturing	0.0016499605	53621.29763	0.088
Energy	0.0048439486	68183.38418	0.330
Transport	0.0020627990	2421362.068	4.994
Total			**19.263**
Japan			
Agriculture	0.0006118475	191157.3492	0.116
Mining	0.0010897399	5307499.199	5.783
Wood and Forestry	0.0012080670	3919179.603	4.734
Chemical	0.0013380638	37544059.41	50.236
Metal Products	0.0013548233	8972823.268	12.156
Electrical & Machinery	0.0009697938	33791390.78	32.770
Transport Equipment	0.0017190091	15896383.63	27.326
Other Manufacturing	0.0013400223	1808612.906	2.423
Energy	0.0038624956	8033507.851	31.029

Transport	0.0017213956	39294490.03	67.641
Total			**234.219**
Malaysia			
Agriculture	0.000893419	1783732.926	1.593
Mining	0.000917644	2602067.289	2.387
Wood and Forestry	0.003029692	1225226.258	3.712
Chemical	0.003253168	5928857.561	19.287
Metal Products	0.001740686	1429469.107	2.488
Electrical & Machinery	0.002706291	21502720.3	58.192
Transport Equipment	0.001409578	307146.1562	0.432
Other Manufacturing	0.003384073	1347915.315	4.561
Energy	0.011080593	6823.8898	0.075
Transport	0.006658884	3184487.346	21.205
Total			**113.937**
Mexico			
Agriculture	0.0004560112	552054.3925	0.251
Mining	0.0005235385	1148332.705	0.601
Wood and Forestry	0.0010316935	777547.2142	0.802
Chemical	0.0019006181	12831934.03	24.388
Metal Products	0.0011885666	1376348.459	1.635
Electrical & Machinery	0.0022648886	7534148.493	17.064
Transport Equipment	0.0010054805	9381893.508	9.433
Other Manufacturing	0.0010687239	266521.152	0.284
Energy	0.0069648032	4969892.598	34.614
Transport	0.0018823629	4465140.368	8.405
Total			**97.481**
New Zealand			
Agriculture	0.0028763692	503640.4664	1.448
Mining	0.0008798160	133461.9306	0.117
Wood and Forestry	0.0033029902	648567.6864	2.142
Chemical	0.0013896103	365043.2671	0.507
Metal Products	0.0021187037	622959.3442	1.319
Electrical & Machinery	0.0011341289	449540.0336	0.509
Transport Equipment	0.0007181056	119490.1729	0.085
Other Manufacturing	0.0016824358	77650.23357	0.130
Energy	0.0052495851	58602.05476	0.307
Transport	0.0033413324	664171.6832	2.219
Total			**8.788**
Peru			
Agriculture	0.0004352087	117344.6148	0.051
Mining	0.0008346621	922043.0396	0.769
Wood and Forestry	0.0013635198	50953.34389	0.069

Chemical	0.0020515427	161249.0927	0.330
Metal Products	0.0019951172	438677.2165	0.875
Electrical & Machinery	0.0014142712	30178.42127	0.042
Transport Equipment	0.0010723476	895.51751	0.00096
Other Manufacturing	0.0012862954	27385.70812	0.035
Energy	0.0038999558	110.187489	0.00042
Transport	0.0019985658	110685.3829	0.221
Total			**2.396**
Singapore			
Agriculture	0.004475719	43227.33674	0.193
Mining	0.003691547	34715.66842	0.128
Wood and Forestry	0.001405478	567599.4206	0.797
Chemical	0.002960735	9290526.664	27.506
Metal Products	0.001560119	1489183.078	2.323
Electrical & Machinery	0.001948637	15133882.35	29.490
Transport Equipment	0.001358866	271421.256	0.368
Other Manufacturing	0.001597637	91148.37386	0.145
Energy	0.005065099	4897.67899	0.024
Transport	0.001841502	2684162.724	4.942
Total			**65.922**
Vietnam			
Agriculture	0.0022429269	126251.5173	0.283
Mining	0.0042961645	1580232.385	6.788
Wood and Forestry	0.0063893430	34901.89924	0.223
Chemical	0.0107966659	109160.9408	1.178
Metal Products	0.0059651270	80383.83957	0.479
Electrical & Machinery	0.0057211580	306882.8618	1.755
Transport Equipment	0.0032630551	19570.73394	0.063
Other Manufacturing	0.0091244805	346246.2044	3.159
Energy	0.0234891069	1209.1439	0.028
Transport	0.0165211845	404660.4913	6.685
Total			**20.645**

APPENDIX 5

The table below shows the GHG emissions for 2017, projected 2030 emissions under current NDC policies and 2030 GHG targets for the CPTPP countries (except Brunei). For lack for 2017 GHG emission data for Malaysia and Vietnam their 2014 GHG emissions value have been used. The emission values are in megaton (Mt).

Country	2017 GHG	2030 GHG	GHG target
AUS	553	570	443
CAN	701	637	513
CHL	120	144	133
JPN	1290	1078	1078
MLY	316.9	741	140.04
MEX	693	810	755
NZL	78.7	75.9	53.9
PER	104	139	131
SGP	50.6	57.8	60
VNM	270.3	601	261.56

Source: CAT, EDGAR, Climate Watch, Low-Carbon Asia

Appendix 6

The following table shows the NDC-SDG connections along with the CPTPP countries' climate change mitigation and adaptation measures indicated in the Paris Agreement commitments. The table is made with the help of NDC Explorer developed by the German Development Institute (DIE) and Stockholm Environment Institute (SEI) to identify and determine synergies between the 2030 Agenda for Sustainable Development and the Paris Agreement, and entry points for coherent policies that promote just, sustainable and climate-smart development (DIE, 2018).

<table>
<tr><th>Countries/ NDC</th><th>Australia</th><th>Canada</th><th>Chile</th><th>Japan</th><th>Malaysia</th><th>Mexico</th><th>New Zealand</th><th>Peru</th><th>Singapore</th><th>Vietnam</th></tr>
<tr><td>Renewable Energy</td><td colspan="4">Considered</td><td>Focus Area</td><td colspan="4">Considered</td><td>Focus Area</td></tr>
<tr><td>Energy Efficiency</td><td>Considered</td><td rowspan="2">Focus Area</td><td>Not Indicated</td><td colspan="7">Considered</td></tr>
<tr><td>Transport</td><td>Not Indicated</td><td colspan="2">Considered</td><td colspan="5">Not Indicated</td><td>Considered</td></tr>
<tr><td>Carbon Capture and Storage</td><td colspan="8">Not Indicated</td><td>Considered</td><td>Not Indicated</td></tr>
<tr><td>Agriculture</td><td rowspan="2">Considered</td><td>Not Indicated</td><td>Considered</td><td colspan="7" rowspan="2">Considered</td></tr>
<tr><td>Forestry</td><td colspan="2">Focus Area</td></tr>
<tr><td>Priority: Agriculture</td><td colspan="2">Not mentioned</td><td>Elaborated</td><td>Not Mentioned</td><td colspan="2">Elaborated</td><td>Not Mentioned</td><td>Elabo rated</td><td>Not Mentioned</td><td>Elaborated</td></tr>
<tr><td>Priority: Forestry</td><td colspan="5">Not Mentioned</td><td colspan="3">Elaborated</td><td>Not Mentioned</td><td>Elaborated</td></tr>
<tr><td>International Trade</td><td colspan="3">Not mentioned</td><td colspan="2">Mentioned</td><td>To foster mitigation</td><td colspan="2">Not Mentioned</td><td>Mentioned</td><td>To foster mitigation</td></tr>
<tr><td>Market Mechanisms</td><td>To meet part of NDC target</td><td colspan="2">Use/intention to use</td><td>Not mentioned</td><td>Explicitly Excluded</td><td colspan="2">To meet part of NDC target</td><td colspan="2">Use/intention to use</td><td>To meet part of NDC target</td></tr>
<tr><td>Temperature increase</td><td colspan="3">Mentioned</td><td>Not Mentioned</td><td colspan="2">Mentioned</td><td colspan="2" rowspan="2">Not Mentioned</td><td colspan="2" rowspan="2">Mentioned</td></tr>
<tr><td>Sustainable Development</td><td colspan="2">Not Mentioned</td><td>Mentioned</td><td colspan="2">Not Mentioned</td><td>Mentioned</td></tr>
<tr><td>SDGs</td><td colspan="10">Not Mentioned</td></tr>
</table>

Source: DIE, 2018