ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF ARTS AND SOCIAL SCIENCES

TRANSNATIONAL MUNICIPAL NETWORKS AS BOUNDARY OBJECTS IN CLIMATE CHANGE SCIENCE AND POLICY: COVENANT OF MAYORS - TURKEY

M.Sc. THESIS

Ebru Gönül TÜRK

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ SOSYAL BİLİMLER ENSTİTÜSÜ

İKLİM DEĞİŞİKLİĞİ BİLİMİ VE POLİTİKASINDA SINIR NESNELERİ OLARAK ULUS ÖTESİ ŞEHİR AĞLARI: BAŞKANLAR SÖZLEŞMESİ AĞI - TÜRKİYE

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Ebru Gönül Türk, a M.Sc. student of ITU Graduate School of Arts and Social Sciences student ID 422171006, successfully defended the thesis entitled "TRANSNATIONAL MUNICIPAL NETWORKS AS BOUNDARY OBJECTS IN CLIMATE CHANGE SCIENCE AND POLICY: COVENANT OF MAYORS - TURKEY", which she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

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Dedicated to Gönül Türk and Mustafa Türk,

FOREWORD

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TABLE OF CONTENTS

Page

ABBREVIATIONS

BEI **:** Baseline Emission Inventory
CCP **:** Cities for Climate Protection
CoM **:** Covenant of Mayors
EC **:** European Commission
EPA **:** U.S. Environmental Protection Agency
GCoM **:** Global Covenant of Mayors for Climate and Energy
GHG **:** Greenhouse Gas
ICLEI **:** Local Governments for Sustainability
IPCC **:** Intergovernmental Panel on Climate Change
NASA **:** National Aeronautics and Space Administration
NOAA **:** National Oceanic and Atmospheric Administration
REC **:** Regional Environment Center
SEAP : Sustainable Energy Action Plan
SECAP : Sustainable Energy and Climate Action Plan
STS : Science, Technology and Society
TMNs : Transnational Municipal Networks
UNFCC : United Nations Framework Convention on Climate Change
WMO : World Meteorological Organization

SYMBOLS

CO_2 **:** Carbon dioxide

LIST OF TABLES

Page

TRANSNATIONAL MUNICIPAL NETWORKS AS BOUNDARY OBJECTS IN CLIMATE CHANGE SCIENCE AND POLICY: CONVENANT OF MAYORS - TURKEY

SUMMARY

This thesis is based on the science-policy gap on climate change. Climate change has become more visible and internationally debated with increasing scientific studies and rising of negative effects on especially human life. With the prominence of climate change science, taking measures depending on scientific evidences in the international arena has become mandatory. This situation urged scientists and politicians to cooperate and work together on the issue.

So far, many studies on climate change have been conducted, reports have been published, organizations have been established and international agreements have been executed to overcome the problems. Although these efforts lead to improvements bridging the climate change science and climate change policy, the problematic relationship between science and policy making on the climate change issue has not been prevailed over.

Since it is difficult to reach an agreement in the international arena, due to their scale and structure to be operational , cities and local governments appear as actors that can be more effective and take faster action in climate change policy making. Therefore, local governments have a significant influence in order to take action word-wide. Considering the potentials of cities, transnational municipal networks (TMNs) emerged as an interface in order to help cities to deal with climate change at the local level by strengthening the local capacity and the cooperation.

TMNs bring together over a thousand local governments in order to provide a collaborative solution on climate change. In this context, it was determined that some municipalities in Turkey benefited from TMNs' guidance in developing action plans and policy-making related to climate change. It was also examined that one of the TMNs Covenant of Mayors (CoM) was utilized primarily in preparing climate change action plans and preliminary reports that lay the groundwork for these reports.

While this is the situation, science, technology and society (STS) studies argue that responses to climate crisis should create bridges, connections, and most importantly a shared understanding between science and policy. In this respect, the concept of boundary object, developed in the STS literature emphasizes the opportunities that can be used in a shared space while maintaining identities among different elements.

Building upon this conceptual perspective, and considering that municipalities' climate change action plans and preparing practices processes in Turkey, in this thesis, it was analyzed whether as one of TMNs, Covenant of Mayors, acts as a boundary object for district municipalities in Turkey. In this context, three second-tier municipalities from Turkey, which have similar characteristics, were selected as the cases via Covenant of

Mayors' web site. These municipalities are Kadıköy, Tepebaşı and Maltepe Municipalities. The study used literature review and semi-structured interview for data collection. In order to examine the results and hypothesis testing, boundary object and boundary concept have been utilized as the conceptual framework.

In the study it has been revealed that Covenant of Mayors, with some limitations, generally acts as a boundary object for the three municipalities chosen as cases in the process of climate change policy development based on climate science.

İKLİM DEĞİŞİKLİĞİ BİLİMİ VE POLİTİKASINDA SINIR NESNELERİ OLARAK ULUS ÖTESİ ŞEHİR AĞLARI: COVENANT OF MAYORS - TÜRKİYE

ÖZET

Bu tez iklim bilimi ve iklim değişikliği politikası arasındaki boşluğu temel almaktadır. İklim değişikliği, bilimsel çalışmalar ve özellikle insan hayatı üzerindeki olumsuz etkilerin artmasıyla daha görünür ve hissedilebilir bir hale gelmiştir. Birçok uluslararası kurum ve kuruluş, insan faaliyetlerinin iklim üzerinde büyük bir etkisi olduğunu savunmaktadır. İklim biliminin gelişmesiyle birlikte uluslararası arenada, iklim bilime dayalı önlemler alınması ve politika geliştirilmesi gerektiği de kabul edilmiştir. Bu durum iklim bilimi insanlarının ve politikacıların birlikte çalışması gereken bir alan yaratmıştır.

Bilim, teknoloji ve toplum çalışmaları (BTT) ve siyaset bilimi gibi farklı disiplinleri içeren araştırmalarla iklim bilimi ile ortaya konan bilgilerin ve önerilerin iklim politikasına yeterli oranda yansıtılmadığı ve böylece iklim bilimi ve politikası arasında bir boşluk olduğu kabul edilegelmiştir. Bu açıdan bakıldığında, BTT çalışmalarında iklim değişikliği çerçevesinde bilim ve politika arasındaki boşluk tartışılmıştır. Bu kapsamda özellikle bilim, teknoloji ve toplum çalışmaları, bu sorunlara yönelik çözümlerin köprüler, bağlantılar ve en önemlisi bilim ve politika arasında paylaşılan bir anlayış yaratması gerektiğini savunmaktadır. Bu bağlamda, BTT literatüründe geliştirilen sınır nesnesi kavramı, farklı varlıklar arasındaki kimlikleri korurken ortak bir alanda kullanılabilecek esnekliği vurgulamaktadır. Sınır nesneleri kavramı, bilim ve politika gibi farklı dünyalarda/alanlarda yer alan aktörler arasındaki ilişkiyi anlamak için önemlidir. Sınır nesneleri, kaynakları birleştirme ve aktörler arasındaki rolleri yönetme sürecinin bir parçası olabilir, bu nedenle farklı aktörlerin etkileşim sağlamasında önemli nesneler olarak görülmektedirler.

Her ne kadar iklim bilimi ve politika konusunda hem akademik hem de politik çabalar iklim bilimi ve iklim değişikliği politikası arasında bir köprü kurulmasına yol açsa da, iklim bilimi ve politika oluşturma arasındaki sorunlu ilişki tam olarak çözümlenememiştir. Özellikle uluslarası mecrada son yıllarda bir takım çalışmalar yapılmaya başlanmıştır ancak uluslararası platformlarda harekete geçmek ve alınan kararların uygulanması her zaman kolay olmamakta, beklenen ve gereken sonuçlara ulaşılamamaktadır.

Söz konusu iklim değişikliği olduğunda şehirlerin enerji tüketimi ve sera gazı salınımı gibi atmosfere ve çevreye zarar veren etkenlerin bir parçası olduğu aynı zamanda bu soruna karşı mücadelede büyük potansiyelleri olduğu gözlemlenmiştir. Bu süreçte yapıları ve özellikleri nedeniyle şehirler ve yerel yönetimler iklim değişikliği ile ilgili politika hazırlamada daha etkili olabilecek ve daha hızlı harekete geçebilecek aktörler olarak ortaya çıkmaya başlamıştır. Durum bu iken iklim değişikliği konusunda eylem planlarının hazırlanması, politikaların ortaya konması ve yeni uygulamaların geliştirilebilmesi için şehirleri destekleyecek ve onlara rehberlik edecek ağlara ihtiyaç duyulduğu ortaya çıkmıştır. Bu kapsamda, ulus ötesi belediye ağları (UBA'lar), şehirlerin işbirliğini güçlendirerek iklim değişikliğiyle yerel düzeyde mücadele etmelerine yardımcı olmak için iklim bilimi ve politikası arasında bir ara yüz olarak ortaya çıkmıştır.

UBA'lar, iklim değişikliği konusunda işbirliğine dayalı bir çözüm sağlamak için dünyanın dört bir yanından yerel hükümetleri bir araya getiren platformlardır. UBA'lar yerel yönetimleri iklim değişikliği konusunda çalışmalar yapmak için motive ederken, bilgi, deneyim, somut projeler, finansal yardım ve iyi uygulamalar gibi birçok farklı unsur sunarak iklim değişikliği sorununa yerel ölçekte büyük katkıda bulunmaktadır. Sürdürülebilir Kalkınma için Yerel Yönetimler Birliği (ICLEI), Belediye Başkanları İklim Sözleşmesi (Compact of Mayors), İklim Koruma için Kentler (Cities for Climate Protection) ve Başkanlar Sözleşmesi (Covenant of Mayors) bu ağlara örnek olarak gösterilmektedir. Bu bağlamda, Türkiye'deki belediyelerin iklim değişikliğiyle ilgili eylem planları ve politika oluşturma konusunda UBA rehberliklerinden faydalandıkları gözlemlenmiştir. Buna ek olarak, Türkiye'deki belediyelerin iklim değişikliği eylem planları oluşturmada, politika hazırlamada ve bu raporların temelini oluşturan ön raporların hazırlanmasında öncelikli olarak Başkanlar Sözleşmesi Ağı'nı kullandıkları saptanmıştır.

Özellikle BTT literatüründe bilim ve politika oluşturma arasındaki boşluk üzerinde bu iki dünya arasında ortak bir anlayış oluşturulması gerektiği konusunda fikir birliği olduğu incelenmiştir. BTT literatüründe bilim ve politika gibi farklı aktörlerin birlikte çalışabilmesi için, tüm tarafların çıkarlarını korurken, çalışmalarını eş zamanlı olarak koordine edebilmeleri için mekanizmalara ihtiyaç vardır. Bu mekanizmalar sınır nesnesi olarak nitelendirilmektedir. UBA'lar tam da bu iki sosyal dünyanın kesiştiği alanda ortaya çıkan platformlardır. Sınır nesnesinin tanımı ve özellikleri göz önüne alındığında, UBA'ların, bilimsel bilgiye dayalı iklim değişikliğine işbirlikçi bir çözüm sağlamak için dünyanın dört bir yanından yerel yönetimleri bir araya getirmeleri dikkat çekicidir. UBA'ların iklim bilimi ve politikası arasındaki boşluktan etkilenmemeleri için yerel yönetimlere rehberlik ettikleri söylenebilir. Bu yüzden bu tezin odak noktası ve amacı UBA'larınTürkiye'deki ilçe belediyeleri kapsamında sınır nesnesi olup olmadıklarını keşfetmektir.

Bu kavramsal perspektife dayanarak, bu tezde, Türkiye'deki üç belediye ele alınarak Başkanlar Sözleşmesinin (UBA'lara örnek olarak) bir sınır nesnesi olarak hareket edip etmediği analiz edilmiştir. Çalışmada, nitel araştırma yönteminin yanı sıra vaka çalışması kullanılmıştır. Türkiye'de yerel yönetimlerin rehberliğinden en çok faydalandığı UBABaşkanlar Sözleşmesi (Covenant of Mayors) olduğu için bu çalışmada örnek olarak Başkanlar Sözleşmesi Ağı ele alınmıştır. Çalışmanın vakalarını seçebilmek için Başkanlar Sözleşmesi'nin web sitesinden Türkiye'den üye belediyelerin listesi çıkartılmıştır ve Türkiye'de ilk iklim eylem planı sürecini başlatan ilçe belediyelerinden biri olan İstanbul Kadıköy Belediyesi ilk örnek olarak seçilmiştir. Kadıköy Belediyesi ile benzer özellikler gösteren, ve Başkanlar Sözleşmesi rehberliğinde iklim değişikliği eylem planı geliştirme faaliyeti bulunan, Eskişehir Tepebaşı belediyesi ve İstanbul Maltepe belediyesi de diğer vakalar olarak çalışmaya dahil edilmiştir.

Çalışmanın veri toplama yöntemi olarak literatür taraması ve yarı yapılandırılmış mülakat olarak belirlenmiştir. Ayrıca, çalışmanın birincil veri toplama yöntemi yarı yapılandırılmış görüşme olarak belirlenmiştir. Bu kapsamda vaka olarak seçilen beledilerin iklim eylem planı hazırlama ve Başkanlar Sözleşmesi kapsamında yürütülen süreci deneyimleyen yetkilileriyle yarı yapılandırılmış mülakatlar gerçekleştirilmiştir.

Tezin kavramsal çerçevesi genel olarak sınır konsepti içinde şekillenirken, incelemeler sınır nesnesi konsepti bağlamında değerlendirilmiştir. UBA'ların bir sınır nesnesi olup olmadığını araştırmak için, ilk olarak sınır nesnelerinin tanımı, özellikleri, türleri ve örnekleri literatür taraması ile araştırılmıştır. UBA'ların tanımı ve amacı göz önüne alındığında, sınır nesnelerinin özellikleri çalışma için önemli hale gelmiştir. Bu nedenle bir nesnenin sınır nesnesi olabilmesi için sahip olması gereken özelliklerinin saptanması hedeflenmiştir. Sınır nesnelerinin özelliklerini belirlemek için, öncelikle sınır nesnelerinin farklı durumlarda nasıl ele alındığı ve bu durumlarda hangi özellikleri taşıdığı literatürde incelenmiştir ve sonrasında ön plana çıkan özellikler BTT yazınan dayanarak kategorize edilmiştir. Sonuç olarak, sınır nesnelerinin dört özelliği belirlenmiş ve bu özelliklerle birlikte yarı yapılandırılmış mülakatların sonucu üzerinde çalışmanın analizi yapılmıştır.

Tez çalışmasında ele alınan vakalar, literatürden derlenen sınır nesneleri özellikleri olan farklı aktörleri bir araya getirme, aktörler için kooperatif bir alan yaratma, iletişim sağlama ve paylaşılan bir sözdizimi sunma konuları çerçevesinde incelenmiş ve tartışılmıştır. Yapılan çalışmanın sonunda, bazı kısıtlar olsa da, Başkanlar Sözleşmesi Ulusötesi Belediye Ağının iklim bilime dayalı politika geliştirme sürecinde vaka olarak seçilen üç ilçe belediyesi için zaman zaman sınır nesnesi olarak hareket edebildiği saptanmıştır. Bu tez çalışması UBA'ların sınır nesnesi olarak ortaya çıkabildiğini böylece iklim bilim ve iklim politikası arasındaki boşluğun azaltılması veya köprü görevini üstlenmesi açısından UBA'ların olumlu bir etki getirilebileceğini işaret etmekte, , iklim bilimin ortaya koyduğu bilginin yerel yönetimler tarafından ortak bir şekilde kullanılabildiğini ve uygulamaya geçmese bile politik pratiklere yanstıldığını incelenen üç ilçe belediyesi deneyimi göstermektedir.

1. INTRODUCTION AND BACKGROUND FOR THE SUBJECT

In this thesis, a study has been carried out based on the science-policy gap on climate change issue, which is discussed in many ways in the literature. Increasing scientific knowledge and research on climate change reveals how important this problem is. Many international institutions and organizations have demonstrated that human activities have a major impact on climate. This scientific knowledge motivates international organizations to take action on climate change. Scientific information on climate change is at a sufficient level for policy making. The issue of climate change began to advance as a science, and its impacts and consequences began to come to light as science and technology progressed. Despite the scientific consensus that climate change is a serious problem requires government policy action based on climate science, as discussed by Wagner et al. (2019), an important science-policy gap remains (Eck, 2016; Hoppe et al. 2013; Jasanoff, 2010; Jordan, 2014; Miller, 2001; Mitchell et al. 2006). Science and policy came together to take measures on climate change and to carry them to the policy and practice? After many process and research from different disciplines such as science, technology and society studies (STS) and political science have acknowledged that there has been a problematic relationship between climate change science and policy. From this perspective, the gap between science and policy has recently been discussed in STS studies within the framework of climate change.

The problem between science and policy is cited as a series of gaps, obstacles, and friction in cooperation (Sundqvist et al, 2018). The idea that policy is seen as independent of science and that science is inadequate to influence policy has been at the forefront (Eisenack et al, 2014; Sundqvist et al, 2018). While this is the case, many international initiatives have been taken to strike a balance between climate change science and policy. For example United Nations Framework Convention on Climate Change (UNFCCC) was established by the United Nations to support the global fight against climate change (UNFCCC, n.d.). The UNFCCC assists in implementing the Kyoto Protocol and Paris Agreement mechanisms by analyzing and reviewing

reported climate change information (UNFCCC, n.d.). Although there are many organizations such as the UNFCCC trying filling the gap between climate science and policy, the pioneer organization on the issue is Intergovernmental Panel on Climate Change (IPCC) (Beck, 2015). In this respect, IPCC is known to provide scientific results to guide policy-makers on climate change. IPCC prepares assesment and technical reports explaining climate change science and related issues. The IPCC has both a scientific and a political structure. Basically, the IPCC is an organization that tries to balance between climate science and policy. In the literature, organizations created by scientific and political actors such as IPCC to coordinate their goals consistently are called boundary organizations (Guston, 2001). However it is important to mention that the IPCC does not consider the issue of climate change only as a political problem as it handled it initially as a scientific and technical problem. The IPCC creates a balance between science and policy within its own field, but it does not produce direct results for policy implementation and action in the real life, and it is needed speed and breadth required in the field.

When it comes to the relationship between science production and political outcomes, the STS literature draws attention in analyzing and understanding the relationship between these two worlds (Orsini et al, 2017). In fact, this issue has been evaluated within the framework of the boundary concept in the Science Technology and Society (STS) literature. Among boundary concepts (boundary work, boundary organization and boundary object), especially, the term of boundary objects is important to understand relationship between actors outside the boundary. While boundary object concept maintains a common identity across boundaries, it also emphasizes being plastic enough to be adapted and used in any discipline but also means the elements that form the basis of cooperation (Nunes et al, 2016). Boundary objects can be part of an ongoing process of connecting resources and managing roles between actors, thus it can be seen as the basis of interaction in more than business relationship (Harrison et al, 2018). Therefore, it can be argued that boundary objects are needed as well as boundary organizations to bridge two different worlds of work.

Despite the existence of an influential boundary organization like the IPCC, the issue of climate change is seen as a problem where global measures should be taken (Bulkeley, 2013). In a global area where international conventions are not concluded, such as the Paris Agreement, it is very important to take measures depending on

climate science at the local level. The importance of cities after COP15 negotiations in Copenhagen in 2009 has become a turning point in climate policy (Castán Broto, 2017). After Copenhagen, a new system was developed in the cities based on voluntary commitments. As claimed by Castán Broto (2017), Copenhagen was actually a success because it turned out that cities could take action locally, except for international climate change agreements (Castán Broto, 2017; Hoffmann, 2011; Jones, 2012). Although cities are proofed to be effective at local scale they have to be supported and integrated in many ways to become prime actors in climate change policy and action

Due to differences in government levels, most countries may be legally and financially inadequate to assess climate change risks and local security (Fünfgeld, 2010). A similar situation exists in climate change policy making (Rivas et al, 2015). While scientific knowledge and evidence on climate change have increased, at the same time, the need for innovative approaches for cities to deal with an urgent problem such as climate change has increased. On the other hand, the implementation of climate policies at the local level required new multi-level governance models (Betsill and Bulkeley, 2006; Melica et al, 2018). Multilevel governance provides the starting point for central governments to form and implement policies from the international framework at national and local level and most importantly, multilevel governance emphasis on adopting vertical and horizontal cooperation tools to reduce policy gaps (Corfee-Morlot et al, 2009). When examining the relationship between climate change and multi-level governance, Corfee-Morlot et al. (2009) emphasizes the importance of cities in international policy development. Accordingly, strengthening cities against climate change and developing international policies in line with the outcomes of experiments and various actions at city scale may be effective in closing the gap between climate change science and policy (Corfee-Morlot et al, 2009). In this context, transnational municipal networks (TMNs) began to form in order to support local governments on international platforms and to take measures on climate change.

TMNs have contributed greatly to the problem of climate change at local scale by providing local governments with many different elements such as inspiration, knowledge, experience, capacity, concrete projects, financial aid, and good practices (Barbi and De Macedo, 2019). Therefore, TMNs became an interface for policy-making at the local level and began to emerge to create implementable actions at the local level (Geldin, 2018).

According to literature, the involvement of local governments in TMNs has been a driving force for the development of effective policies and actions that can address the problem at the global level (Acuto and Rayner, 2016; Bai et al, 2010; Barbi and De Macedo, 2019; Bulkeley, 2010; Jordan et al, 2015). Thus, the emergence of these networks can be cited as an example of efforts to eliminate the gap between climate science and policy. The faster the science-based measures to be taken at the local level, the faster the science-based measures at the international level. Therefore, it can be argued in order to overcome the science - policy gap at the local level, TMNs have started to act as boundary object.

Since the emergence of the concept of boundary objects, there has been a large study of objects facilitating cooperation between scientists and policymakers (Carton and Thissen, 2009; Harvey, 2009; Nunes et al, 2016; Rajão & Georgiadou, 2014; Shackley and Wynne, 1996). Considering the TMNs purposes, they have become a platform for participants to share their experiences, learning each other best practices and take common actions based on climate science and requirements of international agreements. This cooperation is particularly important in the context of the ability of local governments to take action on climate change at the local level, especially in countries where central governments are timid, and where policies, plans, and activities of the central government are relatively slow and latecomer, as in Turkey.

Considering the general situation, there are one-thousand three-hundred ninety seven municipalities in Turkey (Türkiye Belediyeler Birliği, 2014). In this manner, municipalities in Turkey, independent from the central government, are benefiting from TMNs to make climate action plan or other activities related to climate change. According to Bütün (2020), Turkish cities have become members of city networks such as C40, Local Governments for Sustainability (ICLEI), Cities for Climate Protection (CCP), Energy Cities, Compact of Mayors, and Covenant of Mayors (CoM).

It seems that total of twenty-five municipalities have commitments to make climate change related plans in Turkey. Seven of these municipalities have been benefited from both ICLEI and CoM guidances. Seventeen municipalities are using only the CoM guiadance and three municipalities are using the only ICLEI guiadance. Apart from that, there is one municipality that using C40 guiadance. These data are given depending on the commitments of the municipalities. It is difficult to quantify the

number of municipalities that have implemented their commitments because not all TMNs provide this information.

It is seen that the TMNs ,especially CoM, have important role for municipalities in Turkey to make climate change plans. On the other hand, for the first time in Turkey, Kadıköy Municipality has completed a climate action plan as a second-tier municipality, and it has benefited from the CoM's guidance throughout this process. Additionally, İzmir and Bursa Metropolitan Municipalities, Tepebaşı Municipality, İzmir - Karşıyaka Municipality are some of the examples of the municipalities that completed their action plans by using CoM guidance. As of September 2020, there are twenty-two CoM member municipalities in Turkey and seven of these municipalities have completed their climate action plans.

While this is the case, whether the CoM act as a boundary object in Turkey has become the motivating question for this thesis. Basically, CoM's aim is to support local governments in climate change mitigation policies (Croci et al, 2017). A local authority is committed to reducing emissions in its territory by acting in policy zone while adhering to the CoM's (Melica et al, 2018) science-based guidance. This picture actually overlaps with the boundary object concept in the STS literature. Consequently, it can be argued, as one of the influential TMNs, CoM, acts as a boundary object in order to create meaningful integrity and provide scientific policy guidance to approach climate crisis for local governments in Turkey. Based on these discussions, the motivation and purpose of the study will be explained in the next section.

1.1 Motivation and Purpose

Since it is not easy to manage different climate effects in a wide range of areas, it has become important that local governments learn comprehensive studies on the field and practice (Geldin, 2018). Considering that GHG emissions in cities affect the climate and the cities are also affected by this change, it can be said that climate change and the cities are affected by each other (Rutherford and Jaglin, 2015). Therefore, cities are seen as the source of the problem, but they can actually be a part of the solution (Rutherford and Jaglin, 2015).

With the involvement of cities, climate governance has gained importance at local level. One of the critical situations to be considered here is that if cities are able to combat climate crisis quickly and systematically, it is very important to have a scientific and policy guide on issues such as how to reduce GHG emissions, what carbon neutrality is, how to apply and achieve it (C40 Cities, 2019). Considering the situation, there are a number of initiatives to fight against climate change that involve local governments in the world by implementing or combining mitigation or adaptation policies (Melica et al, 2018). In this context, local government networks began to emerge, which voluntarily gathered to improve climate governance (Busch et al, 2018; Kern and Bulkeley, 2009). Therefore, the number of TMNs increased, while memberships varied (Acuto, 2013a; Bulkeley and Broto, 2013; Croci et al, 2017). The global climate governance concept is combined with a network model involving multiple actors. Actors in climate governance across the network include national governments, cities, non-governmental organizations and more (Tosun and Schoenefeld, 2017). There are many local governments that have come together and made specific commitments on climate change through transnational networks. TMNs guide local governments on climate change by providing practices and examples on many issues (Barbi and De Macedo, 2019). Some of the examples of these networks are: Asian Cities Climate Change Resilience Network (ACCRN), The Cities Climate Leadership Group (C40), Climate Alliance, Covenant of Mayors (COM), The Global Cool Cities Alliance (GCCA), United Cities and Local Governments (UCLG), Urban Climate Change Research Network (UCCRN). Since TMNS's aim is to improve the relationship and communication between two worlds, what is important here is that learning more about the other side (Sundqvist et al, 2018). Therefore, accompanying these networks has become important for climate change policies at the local level.

It may be important to remember the role of the IPCC in this process in order to better illustrate the purpose of the study. The authority that comes to mind when it comes to climate change and policy is the IPCC, which is also a boundary organization, does not provide direct science-based policy developmentas far as local levels and cities are concerned. This situation increases the importance of TMNs. At this point, it will be useful to show the content of a report prepared by C40 Cities, one of the TMNs, as an example. A report was published in 2019 to explain the carbon neutrality and emission management to cities. According to this report, terms such as *carbon neutrality* or *net*

zero are not consistently explained (C40 Cities, 2019). However, any guide that cities may need on these issues has not been prepared. The C40 has been trying to fill this gap and help cities develop policies which provides carbon neutrality and net zero. Taking these arguments as evidence, investigating the status of TMNs as an object used by cities between climate science and climate policy is at the core of this study. Many municipalities around the world working with directly TMNs, not IPCC, for reports, plans and policy studies on climate change. For example, most of the municipalities prepared plans for climate change in Turkey are working with TMNs, especially with CoM.

In order to accelerate the process of local government in climate change it can be assumed that the boundary objects have seemed to take a role to bring together actors from different worlds and translate. As argued above TMNs are important for taking measures related to climate change at local scales in guiding them to embrace scientific approaches, proposals and tools. Thus, it can be argued that TMNs have been used as boundary objects at the local level which connects climate science driven knowledge, and local policy making and action through TMNs' guidance.

Boundary objects have been described as objects that live in different social worlds and meet information needs in any subject. They are also used for collaborative problem-solving (Orsini et al, 2017). I argue that it is important to define TMNs as boundary objects because, as claimed by Sismondo (2010, p.37), boundary objects provide serious coordination despite inter-disciplinary communication disruptions, in other words boundary objects can provide stability. On the other hand, boundary objects have an important role in providing cross-boundary change, and as claimed by Harrision et.al. (2018) this feature reveals the political aspect of boundary objects. In addition, boundary objects are objects that support cross-boundary cooperation and mediate change by enabling communication between different worlds such as science and policy (Harrison et al, 2018).

The purpose of this thesis is to examine whether TMNs are boundary objects within the scope of Turkey in district municipalities. As indicated previously, there is consensus on the gap between science and policy-making, especially in the STS literature, that a common understanding should be established between these two worlds. For different actors such as science and policy to work together, mechanisms are needed to coordinate their work simultaneously while protecting the interests of all

parties (Kirby, 2006). According to Turner (2017), one of the most common mechanisms for facilitating cross-boundary knowledge processing is boundary objects. Considering the definition and features of boundary object, it is noteworthy that TMNs, bring together over a thousand local governments in order to provide a collaborative solution to climate change based on scientific knowledge. In Turkey, CoM is one of the TMNs that is most actively used. Therefore, CoM was chosen as TMN to be examined within the scope of the study.

Based on all these explanations, approaches, and literature review on TMNs the hypotheses of the study is; *TMNs act as a boundary object in Turkey*. In order to test the hypothesis, answer to the question below will be investigated.

Whether TMNs act as boundary objects for district municipalities in Turkey?

For hypothesis testing, the method followed in the study will be discussed in the next section.

1.2 Methodology

In this section, the methodology of the study will be explained. Generally, information about the study's method, explanation of case selection process data collection techniques will be given. Finally, how to analyze the collected data will be explained.

Scientific research is based on finding solutions to a specific problem that an individual can identify. As it is known, there are two basic methods used in social sciences; quantitative method and qualitative method. These two methods are generally used for data collection and interpretation in research. Qualitative method is used to understand people's beliefs, controls, behaviors and interactions. One of the most important features of the qualitative method is that it produces non-numerical data (Pathak et al, 2013). Qualitative research provides a broad approach to the study of social phenomena (Rossman and Rallis, 2017). It is a method that tries to understand what is seen, heard and felt by collecting non-numerical data. It is also a method that focuses on how people perceive, observe and interpret different events and it covers methods such as interviews, observations, open-ended surveys and content analysis (Mohajan, 2018). In this study, the qualitative research method, which enables interpretation of the data obtained by various data collection techniques, was used.

Besides using qualitative research approach this study uses “Case Study” method in its investigation. Case studies usually examine many features of more than one case. Along with the qualitative method, case study aim to create representations of cases based on in-depth and detailed information (Neuman, 2003). The aim of the case studies is to examine a particular case closely and try to see the big picture, thus the case studies focus on specific things (Rossman and Rallis, 2017). In other words, one of the most important features of case studies is that it enables micro-level actions to be connected to macro-level or large scale structures and processes (Neuman, 2003). Case studies have many powerful aspects. According to Neuman (2013), it deals with abstract ideas in detail and helps relate them to concrete features, and makes the complex details of cause and effect relationships more visible.

On the other hand, it has been argued that the case studies have certain limitations. According to Rossman and Rallis (2017, p.42), case studies focus on the characteristics of a particular case and they are related to the context of the case, thus case studies cannot be generalized. Also, the results of a case study cannot be applied directly to another case (Rossman and Rallis, 2017).

To select the cases to be covered in the study, COM's website, which has the most membership and whose guidance most utilized during the climate change policy making process in Turkey, has been examined. Thus, which municipalities are CoM signatories and their current status in preparation of the action plan were observed. Kadıköy Municipality-İstanbul, one of the first municipalities that started the climate action plan process in Turkey, has been selected as the first case. Later, municipalities with the same qualities as Kadıköy Municipality, such as being a district municipality and starting climate change action plan studies, have listed. Then, the district municipalities that prepared action plans under CoM were contacted. These municipalities are; Nilüfer, Bornova, Karşıyaka, Tepebaşı, Maltepe and Kadıköy Municipalities. Kadıköy, Tepebaşı and Maltepe Municipalities, which replied and wanted to take a part in the study, have been chosen as cases of the study. All of these are district municipalities that have similar characteristics in preparing climate action plans. In this context, process of making of the action plans of these municipalities within the CoM has been analyzed. At this point, it should be highlighted that when contacting the municipalities, many institutions have made flexible study plans due to

the spread of the Covid-19 outbreak. This situation had a negative impact on the number of cases and interviewees.

To collect data, literature review and semi-structured interview were conducted. First, literature review was conducted in order to detail the conceptual framework of the study, and findings examined in the study under certain concepts and categories and to reveal the main themes. Since the conceptual framework of the study is based on the boundary concept, firstly, research has been made on the boundary concept in the literature review. Flowingly, the concept of boundary object is discussed and the boundary object properties are categorized in the light of the information obtained by literature review.

For the purpose of this study and to understand the TMNs' place between climate science and policy, the experiences of municipalities that have practical relationships with TMNs are important. Therefore, the primary data collection method of this study was determined as a semi-structured interview. In semi-structured interviews, the interviewer can obtain more detailed information by asking the same question in different formats each time (Gilbert and Stoneman, 2015). According to Adam (2015), the semi-structured interview usually uses a mixture of open and closed-ended questions created to track why and how questions (Adams, 2015). Semi-structured interview method was conducted with the municipal officials to better analyze how and for what purpose they use TMNs. In this context, questions to be asked to the interviewees were prepared. Interviews with an official from Kadıköy and Tepebaşı Municipality and two officials from Maltepe Municipality were interviewed. The interviewees are authorized in the environmental protection and control units of the municipalities. Besides the municipal officials, a semi-structured interview was held with Demir Energy, which provides consultancy services to the selected municipalities during the preparation of action plans under the guidance of TMNs, specifically under the guidance of CoM. Based on this method, three municipalities' process of making action plans were analyzed within the boundary objects properties. Together with the interviews, it has been attempted to reveal how TMNs are used by municipalities and their effects on the process of making science-based action plans.

While the conceptual framework of this study is generally shaped within the boundary concept, the examinations are evaluated in the context of the boundary objects concept. To investigate whether TMNs are a boundary object, first, it was explored the

definition, properties, types, and examples of boundary objects. Given the definition and purpose of TMNs, properties of the boundary objects become important for the study. Within this scope, what kind of different properties are necessary for a boundary object, tried to reveal through a literature review and presented in Table 1 (see chapter 2.3.3.3). In order to determine the properties of the boundary objects, firstly, how the boundary objects are handled in different cases and how the properties are addressed in these cases are examined in the literature. After that, the properties that differ in the literature are categorized. In this context, four properties of boundary objects were determined and the analysis of the study was carried out on these properties.

Boundary objects protect the identity of different parties, while allowing them to use different knowledge for a common purpose (Star and Griesemer, 1989). Therefore, the first property has been determined as "Being flexible and plastic for adaptation to local needs". While boundary objects allow different parties to work together, it has been also discussed in the literature that they provide communication and cooperation. Based on these facts, "Serving as a means of communication between actors" is the second property and "Enabling coordination, collaboration and mediating changes between boundaries" is the third property. In addition, to providing flexibility, communication and collaboration, there are also consensus that boundary objects are involved in translating the scientific knowledge into a shared language for political actions. Therefore property four is "Providing information, translation and shared language". Thus, whether CoM acts as a boundary object or not in Turkey, has been discovered through comparing the boundary object properties with the investigation of the selected cases.

2. CONCEPTUAL FRAMEWORK

Scientists have been working on climate change for a very long time. Many experts have done experiments on this subject, gathered evidence and discussed with each other. Extensive literature on this subject has been created by authority institutions and experts. With the advancement of science and technology, presence of climate change has become more consistent. While this is the case, people have started to worry about this issue, both by observing the changing abnormal climate movements in their environment and based on the scientific facts. As the effects of climate change began to be felt violently and concerns began to increase, policy makers also agreed that measures should be taken. Thus, climate change has begun to emerge as a field where science and policy intertwine.

Climate change is seen as a multi-dimensional and blended discipline. In this context, STS studies also addressed this issue from different aspects. When there is a relationship between science and policy in question, it has been observed that the boundary concept has been formed in the literature. In this chapter, the history of the climate change science and its emergence as a field, how it is included in the STS literature and the boundary concept will be discussed.

In order to better understand the climate science and climate policy interface, the following section will discuss how the climate change science has emerged and how it has developed as a field.

2.1 Climate Science

As discussed above, even the public's perception of climate change has evolved. The change from climate skeptics to the next generation of environmental activists can actually show that climate change is also going to a paradigm shift. Scientific knowledge is formed over time as it develops theories, makes new observations, and approves or refutes existing knowledge. At this point, it will not be wrong to say that climate change is still a developing science that is constantly subjected to new tests, hypotheses, and arguments. To understand problems and effects on climate change,

support from almost every field such as chemistry, biology, ethics, anthropology and policy studies is required. It is not enough to investigate the consequences or effects of climate change. Outputs should be evaluated and criticized. Therefore, it is important to mention history of climate science process and developments.

Climate science studies go back to the 19th century. Over time, many hypotheses have been developed for the changing factors in the atmosphere and environment and these ideas have been tested and discussed by the scientific community. Temperature records emerged in the middle of the nineteenth century when thermometers provided scientists with a meaningful global temperature calculation (Schneider and Mastrandrea, 2009). This interest in climate change ultimately led to studies revealing that CO_2 and other greenhouse gases (GHG) have a major impact on world temperature (National Research Council, 2011). The increase in the GHG that warm the world has accelerated with fossil fuel production and consumption, which causes the world to overheat. For the first time, Swedish scientist Svante Arrhenius has suggested that with the increase in CO_2 emissions as a result of the consumption of fossil fuels global warming can occur (Newig and Fritsch, 2009). Arrhenius did not fully explore global warming, but only proposed an interesting theoretical concept. This theoretical concept has evolved over the years and evolved into different dimensions.

It is known, science progresses cumulatively. As in almost all science fields, climate science is a process that progresses with data accumulation. According to a report which is published by U.S National Research Council in 2010; like all sciences, climate science is a process of collective learning progressing with data accumulation (National Research Council, 2011). In climate science case, for example, after Arrhenius, a few scientists began to explore in detail how CO_2 traps infrared radiation and they also made the first reliable assumptions about the proportion of CO_2 that did not dissolve in the ocean but remained in the atmosphere (Oppenheimer and Anttila-Hughes, 2016). On the other hand, National Aeronautics and Space Administration (NASA) science fellow James Hansen's testimony to the US Senate in 1988, he stated that "greenhouse effect, caused by human activity, was occurring with ninety-nine percent certainty" (Jasanoff, 2015). After Arrhenius, it was almost a century to make this statement. During this period, the findings obtained from many researchers and

different institutions began to be collected under the roof of climate science (Jasanoff, 2015).

Both historical and contemporary studies have contributed to the importance of climate science through scientific discussions and consensus (Jasanoff, 2015). According to Jasanoff (2015), historians began to record new theories, systematic climatic and ecological studies by observing changes at the local level. As can be seen, the introduction of GHG experiments with Arrhenius, and subsequent research and contributions by other scientists, had a major impact on the formation of climate and climate change science.

Studies and experiments conducted from past to present have identified the main factors that could cause the world to overheat. In recent years, it is well known that climate has turned into an act of alarming climate pattern changes. The environment is rapidly changing due to the dramatic increase in population and industrialization

Therefore, there has been a need for organizations that can carry out studies in the face of this worrying situation and present scientific information on the current situation. In this framework, The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 under WMO, in 1992 countries adopted the UNFCCC and The UNFCCC secretariat was established in the same year (UNFCCC, n.d.-a). In the forthcoming years, at the United Nations climate change conference in Paris (2015), governments have recognized that it is urgently necessary to mobilize a stronger and more ambitious climate action to attain the objectives of the Paris Agreement (UNFCCC, n.d.-b). The report, published by the IPCC in 2018, once again tried to draw attention to the seriousness of the situation. The report emphasizes that if we continue as usual, we can experience almost twice the temperature increase adopted by the Paris Agreement (IPCC, 2018). The Science Advisory Group to UN Climate has created the report "United in Science" to bring together the scientific outcomes of the work carried out by key institutions such as WMO, UN Environment, Global Carbon Project, the IPCC in the field of global climate change research (Science Advisory Group of the UN Climate Action Summit 2019, 2019). According to this report "the average global temperature for 2015-2019 is on track to be the warmest of any equivalent period on record" and also, the average global temperature is assumed to be 1.1°C higher than the pre-industrial period (Science Advisory Group of the UN Climate Action Summit 2019, 2019).

According to current reports and findings, the climate has changed dramatically compared to the past. Therefore, the question of what is climate change actually becomes important. Climate change has been documented by IPCC, National Oceanic and Atmospheric Administration (NOAA), NASA and many different authority organizations (Wong, 2016). According to UNFCCC, "climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods" (UNFCCC, 2011).

Moreover, IPCC defines climate change "refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (IPCC, 2007).

In general, climate change refers to a change in weather patterns and average temperatures over time due to human activities or natural changes.

While climate is affected by many natural factors, scientists note that human activity has become a dominant force. The human factor has a great effect on most of the warming seen in the last fifty years (Le Treut et al, 2007). As it mentioned by DiMento and Doughman (2014), the human factor is effective in the rapid change of climate change. According to them people prayed, danced and tried many different methods over the centuries for more rain, to reduce heat and change the weather. Thereby, human beings have inevitably tried to change the climate. In the end, human kind has greatly affected and changed the climate and today we are still changing it (DiMento and Doughman, 2014).

Human-induced climate change is also mentioned in several reports issued by the IPCC (IPCC, 2007, 2018). According to the literature, the IPCC seeks to create a "scientific consensus" about climate change, and in particular, the role of the human in climate change (Hulme and Mahony, 2010), hence much of the IPCC's current reports show human impact on climate (Fogel, 2005). Human-caused climate change can mainly be caused by changes in GHG emissions in the atmosphere, small particles (aerosols) in the atmosphere and diversified changes in land use (Le Treut et al, 2007).

Based on DiMento and Doughman (2014) it can be said that humans are tried to manipulate the climate or *forcing the climate*[1] in certain periods of history.

Increased emissions due to industrialization and urbanization have led to more warming of the world and caused human-based climate change. With the emergence of this science, the question of whether people affect the climate has gained importance and got the attention. A large number of climatologists argue that human activities have an impact on climate change, and many of the world's leading scientific organizations make statements to support this statement. The IPCC reports on the impact of people on climate change have answered this question. IPCC' Fifth Assessment Report (AR5) headline statement emphasizes that the climate system is affected by human activities and it is clear (IPCC, 2014). In other words, it is known by scientists that people have an active role on climate.

Humanity is affected by climate change as much as they affect it. Therefore, climate change is an increasing social concern for most of the people and countries around the world. For example, GHG emissions have started in the 1970s and increased between 2000 - 2010, despite climate change mitigation policies (IPCC, 2014). As the effects of climate change began to be felt more and scientific information was increasing, it was revealed that it was not possible to take measure with only science against this issue (Weart, 2008). In the period of increasing emissions, the issue of climate change emerged on the political agenda. When the climate change problem has come to the agenda of science and policy, there has been a rapid development in how the problem is handled and what kind of solutions are required (Gupta, 2010). The idea that political measures that require international negotiations should be taken has become important (Weart, 2008). As mentioned at the beginning of the chapter, although the climate change issue started to emerge in the 19th century, it has been discussed for the first time at "World Climate Conference" at international level, and different international events with many scientific and political elements started to be organized after this conference (Gupta, 2010). Establishment of the IPCC, international agreements and meetings such as the Paris Agreement can be cited as evidence. After this process, the literature on the collaboration of scientists and policymakers on climate change and

[1] Climate forcing can be defined as a deterioration imposed by the earth's energy balance (Committee on the Science of Climate Change and Research Council National, 2001).

the relationship between science and policy has occurred. In the subsequent process, a field emerged with different disciplines, where the relationship and boundaries between international climate science and policy were reorganized and social problems were handled (Beck and Mahony, 2018).

As climate science and policy are intertwined, it becomes important to address this relationship. Therefore, in the next section, the relationship between climate science and policy will be handled.

2.2 Climate Science and Policy Gap

In this section, the gap between climate science and policy, which is the main basis of the study, will be discussed. How and why this gap is formed, the history of the relationship between climate science and policy, and the current situation will be discussed.

Climate change makes difficult to use traditional methods for providing information and education (Reckien and Eisenack, 2013). According to Jordan (2014); the mitigation of climate change is largely a discourse in the technological field; it is also a problem for science and policy makers. The missing thing in here is human connection (Jordan, 2014). This argument actually supported by Jasanoff. According to Jasanoff (2010), climate change has a compelling global meaning and society's adoption of this idea is problematic.

It is already known that there was growing suspicion and rejection among the people against the studies carried out on climate change and its consequences. The supporters are generally referred to in the literature as climate change skeptics, contrarians, or deniers. This group attracted the attention of the media and made a significant impact on social issues such as social change and politics (Anderegg et al, 2010). According to national research conducted in 2008 and 2010, it was found that Americans had a decrease in their beliefs about climate change, their perceptions of risk and their confidence in scientists (Dunlap et al, 2011; Leiserowitz et al, 2010). Ninety-seven percent of researchers actively publishing on climate change acknowledge that human-induced climate change is happening. Nevertheless, this strong consensus is often rejected by the public in U.S (Somerville and Hassol, 2011).

In 2007 and 2008, climate change was a popular topic discussed by leaders (Leiserowitz et al, 2010). The 2007 Nobel Peace Prize was awarded to IPCC for their work on man-made climate change and scientific knowledge production (Hulme and Mahony, 2010). The discovery of a few mistakes in the IPCC Fourth Assessment Report in 2007 undermined the reputation of both the IPCC and climate scientists. After this, the IPCC worked to increase transparency, accountability and reduce the possibility of further mistakes (Somerville and Hassol, 2011). However, in November 2009, the computer server of one of the world's leading climate research centers was attacked by an unknown hacker and as a result hundreds of electronic messages and documents were stolen and published (Ramírez-i-Ollé, 2015). These e-mails consisted of correspondences about the different aspects of the work done by some climate scientists (Ramírez-i-Ollé, 2015). According to Leiserowitz et al. (2010) some of these emails have been cited by climate change critics as proof that British and American scientists have changed results to make their so-called climate change even worse (Leiserowitz et al, 2010). This scandal, called "Climategate" by climate skeptics and the media, has appeared in television, scientific journals and news (Leiserowitz et al, 2010). In the following process, environmental skepticism has reached a different level. All areas of climate science have been attacked as "junk science" and also peer-reviewed journals, which are considered the cornerstones of science have been attacked too (Dunlap et al, 2011; Jacques, 2006). As a result, the so-called fake climate change emerged as an opposing theory that hinders economic growth (Dunlap et al, 2011; McCright and Dunlap, 2000). As can be understood, the uncertainty about climate change fed the ongoing debates among climate skeptics. In this respect, according to Shackley and Wynne (1996), as long as scientific uncertainty persists, the scientific community cannot have full autonomy to decide how this uncertainty is presented. When both policy and scientific knowledge are the subject of disagreement, uncertainty can be seen as a strategy for negotiating and reaching a common idea (Campbell, 1985; Shackley and Wynne, 1996).

In the 2000s, systems began to be developed in order to predict what might happen in the future, that is to say, it can be argued uncertainty begins to disappear. Linden (2007) defines this change as a new paradigm in climate science. In the light of increasing scientific knowledge and studies on climate change, in the last two years, actions have started to raise awareness of climate change, especially among young

people. According to an article published in Nature, on 20-27 September 2019, climate activists around the world organized many strikes called "Global Week for the Future" to demand more action on climate change. According to reports, more than four-million people from one hundred- eighty-five countries participated in the strike on 20 September. The goals of the strikes included the abolition of fossil fuels by 2020 and the transition to renewable energy by 2030 (“Global climate strike,” 2019). According to Barret and Dunn (2019) 2019 was also a year in which central banks declared climate change as a financial risk, and many large companies talked about ambitious emission targets and the need for government intervention. Nestle, for example, committed to reducing its carbon emissions to "net zero" by 2050 (Barrett and Dunn, 2019). Also, COP25, which discussed the road maps of countries in the fight against the climate crisis, took place in Madrid 2-15 December 2019. However, it should be noted that the summit has not been agreed on by the official negotiations, and it has been described as a disappointment by UN Secretary-General and several non-governmental organizations. (Akgül, 2019). Moreover, according to the findings of the electricity sector research prepared by Agora Energiewende and Sandbag, one of the leading companies in Europe, the European Union's CO_2 emissions from electricity generation decreased by 12% in 2019 compared to the previous year (Agora Energiewende and Sandbag, 2020). In addition, according to the report, the share of renewable energy sources in electricity generation increased to 35% across the EU. Although this report is promising, according to the data of Mauna Loa Observatory in Hawaii, the CO_2 rate in the atmosphere reached a level of 416.08 ppm by breaking a new record on February 10, 2020 (NOAA, n.d.). Another interesting example of changing emission rates, and countries' attitudes on emissions is speech of Boris Johnson at COP26. Prime Minister of the United Kingdom Boris Johnson announced that plans to remove coal from energy systems in the UK are scheduled for an earlier date (October 1, 2024) (GOV.UK, n.d.). Johnson also urged other countries to keep their promises to reduce their greenhouse gas emissions to net-zero by 2050 in his speech (Adam & Dennis, 2020). Considering these situations, it is seen that the perception of climate change has changed and that the need to act together in the fight against climate crisis gains importance. In this case, perhaps the best proper interpretation is that the need to rely on climate science has been recognized by public and governments as to pave way to decrease policy and climate science gap.

In the last few years, it has been seen that experts have played important roles in global environmental policies. Increased concerns over environmental issues since the 1980s led to the creation of international conventions based on scientific knowledge and data (De Pryck and Wanneau, 2017; Miller, 2001). The idea that scientists and policymakers should work in a coordinated on the global environment issue has gained importance. The fight against climate change can be strengthened by political decisions, and governments can decide on what extent they can face climate change. This choice can be supported by research and scientific knowledge put forward by scientists. According to Shackley and Wynne (1996) many decision makers and advisory scientists argue that "policy ideally should rest on reliable, robust, and hence certain scientific knowledge" (Shackley and Wynne, 1996).

Reliable scientific knowledge reinforces consensus around a policy that fits a scientifically defined problem. However, scientific community has reached a consensus on a topic such as climate change does not mean that policymakers will accept the scientific results or recommendations (Wagner, Ylä-Anttila, Gronow, Ocelík, and Schmidt, 2019). It is important to find a solution and creating a bridge for problems between scientists and decision-makers and the gap between science and policy (Wagner et al, 2019). The bridging processes of the different actors and the objects and organizations discussed within the scope of the boundary concept in the study (see chapter 3).

Interestingly climate change science emerged at a time when STS studies focused on issues such as knowledge-making practices and these practices' social and political implications (Jasanoff, 2015). As an emerging field of knowledge and high political importance climate change immediately attracted the attention of STS scholars despite the difficulties in consensus and rational governance (Jasanoff, 2015).

2.3 STS Literature and Its Approach on Climate Change

In order to understand how science works both within itself and in society, the STS takes a different perspective on science processes and terminologies (Howe, 2011; O'Lear, 2016). In that case, climate science serves STS researchers both as a field and as a tool of theoretical research (Jasanoff, 2015). There are discussions about knowledge, results and unknowns about climate change in STS studies (Jasanoff, 2015). STS studies bring together scientific research, technological choice and social

discourse on climate change (Hadjilambrinos, 1999). On the other hand, STS studies are supported by many different disciplines and today it has a rich theoretical and methodological structure. Since climate science covers the phenomena that STS research defines, the emergence of climate science and its place in climate governance more like a playbook for STS (Jasanoff, 2015). Therefore, it is important to examine STS literature on climate change.

Sheila Jasanoff, a well-known STS scholar, examines the STS approaches on climate change in different ways. This STS framework determined by Jasanoff on climate change will be discussed initially. First, Jasanoff (2005) mentions the importance of characterizing climate change as a science. According to Jasanoff (2005), the science of climate change is a combination of different observations and reports with unique criteria. She also stressed that the IPCC is important for development of climate science since it provides collective thinking for the science of climate change (also see previous chapter). Secondly, Jasanoff (2015) argues that there was unhealed epistemic uncertainty, despite the controversy that has existed since the emergence of climate change. In this context within the chapter, it will be discussed how uncertainty in climate change is tried to be eliminated and what are necessary to be able to cooperate and communicate with policy makers. Finally, she pointed out that the science of climate change should not be separated from the policy dynamics and climate change for governance is part of the co-production process. Within this scope, the relationship between climate change science and policy will be investigate within the Jasanoff's framework.

Together with science, politicians have started to feel what is known about climate change as well as what is not known. In terms of STS, this is related to governance issues (Jasanoff, 2015). Science affects the social world and many other things, as well as policy. Many decision-makers and scientists believe that ideal policy should be based on reliable and specific scientific knowledge (Shackley and Wynne, 1996), and policies are now increasingly based on scientific evidence (Sismondo, 2010). It can be argued that scientific uncertainty damages the authority of scientific knowledge in policymaking. This issue is important given the history between climate science and policy gap. According to Shackley and Wynne (1996), the existence of uncertainty is important for scientific development. It is not always easy to measure uncertainty due to the complexity and uniqueness of the system in terms of climate change. Here the

scientific process comes into. The scientific nature of uncertainty may be misinterpreted because for many people it means that something is unknown or little is known. However, uncertainty is a way of defining how precise or hidden something is. This can be one of the reasons why STS literature dealing with climate change in the context of uncertainty. Because, to refuse or exaggerate scientific uncertainty will attract negative reactions as it can be seen in Climategate example. Therefore, it is important for scientists to accept the uncertainty that exists and to work on how to solve the problem. To eliminate such misunderstandings, scientists develop techniques to communicate a certainty or a specific theory to policymakers (Shackley and Wynne, 1996). Uncertainty regarding climate-related knowledge persist, the impact of the human factor on the processes causing climate change is clearly indicated by scholars and authority organizations (Schneider and Mastrandrea, 2009). Identifying and reducing the uncertainty associated with climate change has been the theme of many reports, including the IPCC's (Shackley and Wynne, 1996).

Jasanoff (2015) mentions that STS studies on uncertainty have developed many methods. For example, the numerical expression of the results makes the evidence understandable and reliable. In the context of climate change, this method is handled with climate models. Climate models are used as a tool to simulate future events by simplifying complex systems in environmental policies (Jasanoff, 2015). Therefore, they have an important role to play in representing the climate change in the uncertainty of estimations. While models help scientists by eliminating uncertainty in climate forecasts, scientists can communicate with policymakers using these tools. The point here is that climate models form an understanding between science and policy and are used as a useful object to make sense of the results. What matters here is not the existence of uncertainty. The important point Jasanoff wants to emphasize here is the emphasis on what kind of struggle is needed to minimize and eliminate such a problem. In this context, she defines climate models as tools that provide communication between scientists and policymakers, that is, they coordinate and collaborate across boundaries, and eventually mediate change by providing communication between the two worlds. That is, emphasized the there is a need for "things" in cross-boundaries communication.

One of the most important features of the STS studies is understanding how and when people do science and technology, and under what conditions (Felt et al, 2017). STS

tries to change the world in which people live and integrate them and the studies to their daily life. Since, climate change is an example of an unexpected result of natural factors, human factors and technological developments, it is a perfect subject for the STS. There is extensive literature on the consequences and future impacts of climate change. At this point, Jasanoff (2015) has a very interesting argument.

> never in the history of our species has a single story about the fate of the planet been told with so much conviction and expert authority; nor has any such story commanded attention from so many people positioned to understand and act upon its message (Jasanoff, 2015, p.36).

In this respect, the science of climate change carries the basis of its scientific knowledge to a global environment enough to cover and manage the climate change issue (Jasanoff, 2015). As a result, the issue of climate change draws attention from different disciplines in different ways. According to STS studies, in the construction of science and technology, people emphasize that they create or reconstruct themselves, their social identities, their societies and everything in their environment (Felt et al, 2017). The idea that orders such as epistemic, social and technological are co-produced has been emerged in the STS (Jasanoff, 2004b; Latour, 1993).

In general, science is used as a problem-solving tool in human life. With increasing awareness of climate crisis, science also has the same role in environmental protection. While the increasing CO_2 gives the impression that there is something wrong, the change of the actors involved in scientific production is also emerging. In this context, climate change is interdisciplinary, has strong links with policy and is also open to public inquiry (Jasanoff, 2015). Due to this character, climate change can be considered together with the co-product term of the STS context. Co-production draws attention to cognitive commitments and insights on social dimensions and besides that co-production interprets the knowledge and material relations of social entities (Jasanoff, 2004b, p. 3). In other words, there is a relationship between scientific knowledge and social order, and these two elements co-produce each other in various ways (Hajer and Versteeg, 2012). In this regard, climate change is closely linked to policy. This relationship requires the interoperability of science and policy disciplines. The complex processes between such relationships are also one of the topics of STS studies (Bowker and Star, 1999; Felt et al, 2017; Gieryn, 1995).

Knowledge in the modern world is essential to exercising policy (Baert and Rubio, 2012; Jasanoff, 2004a, 2015). Given its importance for worldwide policies, climate science has attracted the attention of policymakers. In the context of climate change, most of the attention was paid to the IPCC. The IPCC is, therefore, an important actor in addressing climate change. As is known the IPCC provides scientific information to decision-makers. According to Jasanoff (2015), the scientific assessment of climate change has not been kept away from political actors since the existence of IPCC because IPCC has been an important factor for global environmental and development policies. This evolution shows the phenomenon of co-production on climate change (Jasanoff, 2015). Knowledge co-production is a concept that encompasses collaborative knowledge generation processes that targets specific policies or issues to restructure and re-motivate interactions between science, policy, and practice (Wyborn, 2015). Because organizations like IPCC are located on the boundaries of policy and science and produce joint knowledge that should be perceived as reliable, legitimate and remarkable (Orsini et al, 2017).

Yet, after the Climategate scandal, it was discussed that scientific and politic functions within the IPCC should be met with a boundary (Jasanoff, 2015). According to Jasanoff (2015), STS studies focused on the resources and boundaries of the IPCC's epistemic authority; this also raises questions about how science affects the policy. According to Prycka and Wanneaub (2017), there should be no political intervention in the production of knowledge. Usually the traditional way is, after consensus among scientists, knowledge should be passed on to policymakers and should form the basis of international negotiations. This method is commonly used in different scientific disciplines (De Pryck and Wanneau, 2017). However, this model has been criticized with reference to the issue of climate change, which has broad social and political dimensions (De Pryck and Wanneau, 2017). New discourses that oppose these rigid divisions of scientific disciplines have begun to emerge (De Pryck and Wanneau, 2017). At this point, it is important to mention Sheila Jasanoff's (1990) statement, which is science - policy relation is a balancing act. This balancing act states that both sides (scientists and policy-makers) should keep their territory close but not too close (Gieryn, 1995; Jasanoff, 1990). Jasanoff (1990) also argues, to justify a science advice, it must be produced separately from policy. However, when successful examples are examined, it is seen that these practices create environments where scientific and

political conflicts can be negotiated successfully at the same time (Eisenack et al, 2014; Jasanoff, 1990). It is worth mentioning again that there should be boundaries for the two sides to successfully negotiate. Considering this paradox, the question of how science and policy can work together and achieve the common goal arises, despite the differences between the two elements, for example, tasks, devotions, goals and objectives. In a way, STS focused on how different worlds can work together. Due to the expansion of the fields of expertise, the boundaries have become more prominent. Therefore, experts have started to seek to prevent disintegration and to ensure integrity (Akkerman and Bakker, 2011). Managing these boundaries between science-policy and practice can help disseminate and make sense of scientific knowledge. The term of boundary is used emphasizing differences in science, policy, and practice and to describe the relationship between science and non-science (Wyborn, 2015).

Considering that policy and science are two separate worlds with their own dynamics, how to reach a common agreement is considered as another issue in the STS. As the classification of practices, for example, the distinction between science and non-science, boundary activities and the boundary concept have emerged as a need for these discussions. The boundary concept is important in mobilizing the transformations that take place in local and national policy practices. According to Orsini et al. (2017), STS has an optimistic attitude that the boundary concept will work as a solution to local and national policy problems. With this concept, STS argues that both science and policy should be built together, various organizational opportunities should be created, and one of the important things, this issue has been raised through climate change. Considering the issue of climate change and policy, it is important to examine it, as the boundary concept handles the interface between science and policy in a sophisticated way.

It is seen that there is an effort to examine the interactions between science and policy, to emphasize the need for a joint effort and to make scientific knowledge applicable in the field. Studies under the boundary concept emphasize the importance of joint efforts to promote the inequality between power and knowledge (Guston, 1999; Lovell, 2018; Wyborn, 2015) and interactions between science and policy. Moreover, the boundary concept literature shows the effort to turn knowledge into action within the scope of science-policy (Cash et al, 2003, 2006; Wyborn, 2015). In the next chapter of the study, the boundary concept is examined in order to understand the issue of gap

between climate change science and policy, and to understand how to deal with the issue and what kind of bridges are needed.

2.4 Boundary Concepts and Boundary Object

As discussed in the previous chapter; the traditional method of informing others by scientists was highly criticized. In general, this traditional model[2] has been criticized by emphasizing the complex, contextual and normative processes of knowledge transfer, and these failures have been called the gap or divide between science and policy practice (Wyborn, 2015). In contrast, boundary studies are used to conceptualize the complex interface between science, policy, and practice. This concept focuses on how social processes can be used to make better connections and understand relationships in science and policy practice (Wyborn, 2015). The boundary concept is important for bridging, not for separation or exclusion of boundaries, involving different actors in the process and supporting the production of knowledge (Fujimura, 1992).

In this concept, Star and Griesemer (1989) observed instead of a network that specifically focused on any group, they revealed a different situation in which many groups and actors operate independently. They discovered that instead of finding harmony between these actors, a self-sufficient harmony, each with its own working arrangements (Nunes et al, 2016). After these process, Star and Griesemer (1989) presented the concept of boundary objects. Later, Guston (1999) has demonstrated that not only objects but also any organization can meet the requirements between science and policy. Besides creating boundary objects, an ideal boundary organization should also include scientific and political actors equally and have equal accountability limits for each of these actors (Guston, 2001; Nunes et al, 2016). On the other hand, Gieryn (1999) defined the term of boundary work. Scientists are working on the boundaries to increase their competence and to be involved in the work process. Boundary work defines the limited amount of work done by professional interests to maintain both scientific integrity and relevance (Sundqvist et al, 2018). Additional, boundary work

[2] Traditional model is also called linear model in literature (eg. Wyborn, 2015).

is based on objects (Star and Griesemer, 1989) and organizations (Guston, 2001) to examine boundaries between science and policy (Wyborn, 2015) .

Since the boundary concept contributes to the reorganization of the definition between science and policy, as it has been argued in the literature, and the subject of this study is based on this concept and constitutes its hypothesis, the boundary concept and boundary objects will be examined in this chapter.

2.4.1 Boundary work

Some social problems have become dependent on more expert knowledge. This dependency has not only resulted in new policies or expertise, but also in new assessment systems and knowledge areas (Gustafsson and Lidskog, 2018). Therefore, the process of generating knowledge and policy-making became increasingly relevant (Gustafsson and Lidskog, 2018). While working in the relationship between science and policy, it may be difficult for scientific knowledge to be not affected by internal and external actors. As a background with these complicated relations and improvements, discussions have been made about the importance of better use of information as well as better integration and interaction between science, policy and stakeholders (Gustafsson and Lidskog, 2018). It has been argued that the boundaries are necessary in order to evaluate the produced knowledge within the framework of scientific approach (Gieryn, 1983). Many researchers have argued that it would be useful to confine scientists to challenge their own work and to limit their area of expertise as an autonomous region (Shackley and Wynne, 1996). This process is defined in the literature as boundary work (Gieryn, 1983). Boundary work helps to reduce the problems that may arise among actors who do not share the same knowledge (Orsini et al, 2017). In other words, the boundary work shows that mutual understanding can occur while preserving the boundaries to explain each role (Orsini et al, 2017). Therefore, it is crucial to understand the boundary work, the definition of the boundary object, and how boundary object is handled in terms of science and policy will be discussed in this section.

Boundary work has been defined by Thomas Gieryn as “boundary-work describes an ideological style found in scientists' attempts to create a public image for science by contrasting it favorably to non-scientific intellectual or technical activities” (Gieryn, 1983).

Boundary work helps manage all kinds of demarcation between different actors and groups and tries to present different motivations, perceptions, and actions in a harmonious framework to create a cognitive environment (Clark et al, 2016; Tisenkopfs et al, 2015). As it argued by Pryck and Wanneau (2017) "knowledge production should be untainted by political interference and evaluated through objective peer review". Pryck and Wanneau (2017) also claim that, in order to use knowledge in international negotiations, first scientists should reach a consensus, then the knowledge can be communicated to policy-makers and negotiations. Nevertheless, the idea that policy should not interfere with science has been questioned in the last decade with the fact that climate science is also popular. Boundary work acknowledged the idea that science cannot be considered an absolute authority and it cannot be independent of social activities (Jasanoff, 2004) and according to Jasanoff (2004) "boundary work, has amplified these ideas, underlining the role of mundane practices in stabilizing and delimiting the polities of science and in defining scientists' ultimate forms of life".

On the other hand, Clark et al. (2016) argues that boundary work is necessary to effectively create and manage interfaces between different stakeholders interested in "harnessing knowledge to promote action" (Clark et al, 2016).

As indicated by Orsini et al. (2017), there should be a balance between boundary work and decision-making, otherwise, it may run the risk of being irrelevant to policy, even if the boundary work is prepared in a very detailed and effective manner. Since climate change covers social and political issues, there are important processes in adopting the objectives of the Paris Agreement and the Sustainable Development Goals (De Pryck and Wanneau, 2017). Considered from this point of view boundary work has an important place in climate policy making?. Within the scope of science and policy boundary studies, boundary work is important for the legitimation of expertise and acceptance by policymakers. (De Pryck and Wanneau, 2017). With the development of these complex relationships, the importance of improving the use of knowledge as well as establishing a better relationship and interaction between emerges (Gustafsson and Lidskog, 2018). In this case, there is a need for organizations to support and facilitate knowledge production between partners (Franklin, Grossman, Le, and Shafer, 2019). According to Mauser et al. (2013) these organizations should have features to facilitate the actions of the stakeholders and to support the production and

use of knowledge outside the traditional knowledge production model in order to take relevant scientific knowledge into action. In other words, it is important that these organizations maintain the social boundary and create collaborative processes while helping both scientific knowledge and policy to achieve their goals (Gustafsson and Lidskog, 2018; Guston, 2001). Guston (1999) defines these organizations as boundary organizations.

2.4.2 Boundary organizations

With the emergence of science as a powerful social element during the twentieth century, various organizations began to emerge in society to establish a productive relationship with others (Miller, 2001). In that case, boundary organizations was discussed to define how the interface between science and policy should be regulated. In this part of the study, topics such as definition, properties and examples of boundary organization will be examined.

Boundary organizations produce the knowledge and translate them that should be perceived as legitimate and credible (Orsini et al, 2017). On the other hand, Gustafsson and Lidskog (2018) claim that boundary organization is frequently used in information transfer and science-policy relations studies. Boundary organizations covers both the science and the policy processes to achieve their own goals and stabilizing the boundaries between them (Gustafsson and Lidskog, 2018).

The concept of boundary organization was used by researchers to describe "how the boundary between science and politics is constantly negotiated in practice" (Beck and Mahony, 2018). In the literature, examples of boundary organizations has been discussed in many scales (from local to global) (Gustafsson and Lidskog, 2018). According to literature that introduced by Gustafsson and Lidskog (2018) some of these are the "Arizona State University's Decision Center for a Desert City, the Dutch Delta Committee, and the IPCC" (Gustafsson and Lidskog, 2018).

Some structural features, such as laws (Miller, 2001), policy, and cultural structures (Hoppe, 2010), are important for the formation of boundary organizations (Nunes et al, 2016). Moreover, in addition to these structural features, some studies emphasized the importance of boundary organizations for the continuation of certain boundary work (Cash et al, 2003; Jasanoff, 2004a). On the other hand, in the literature, the issues of balancing legitimacy, problem-solving within the boundary organization are

handled and highlighted (Nunes et al, 2016). According to Nunes et al. (2016), the focus of this literature on boundary organizations as a result of boundary work rather than fixed units has provided important information on the relationship between policy and science in climate change governance (Nunes et al, 2016). What these various studies have in common is to emphasize that there should be a legitimate balance between science and policy on issues such as environmental challenges (E. Lee et al, 2014) and climate change. In this concept, E. Lee et al. (2014) discussed how boundary organizations become tools for generating policy-related knowledge and overcoming barriers to climate change. Their case study has shown that boundary organizations are important for organizing multilateral cooperation, especially for less developed countries. Moreover, under the climate regime, less developed countries cannot make their voices heard sufficiently, and their work shows that less developed countries need boundary organizations to balance their positions. Although boundary organizations do not always achieve the intended results in cooperation, with this study, authors claim that it is possible to achieve climate change and policy objectives with boundary organizations (E. Lee et al, 2014).

Based on these arguments, as defined by Guston (2001), the success of a boundary organization in carrying out the tasks is based on the stability of the boundary and, in practice, to keep the boundaries to the lowest level. Thus, a successful boundary organization can satisfy both sides and eliminate instability and remain strong against external influences (Guston, 2001). As discussed in the literature, boundary organizations may exhibit various features. Not all of these features may occur in all boundary organizations, or these features may appear stronger or weaker in each organization (Hoppe et al, 2013). According to Guston (2001), an ideal boundary organization: (1) includes the elements on both sides of the boundary as well as the involvement of professionals for the role of mediation. This feature emphasizes that politicians may be struggling to cooperate due to limited information, in which case "boundary organizations with scientific expertise and political knowledge" can be useful (E. Lee et al, 2014). (2) They are located at the boundary of science and policy and have distinct accountability to both. This feature reflects the credibility of the knowledge flow for interactive production (Hoppe et al, 2013). In order to explain this feature Hoppe et al. (2013) are giving an example: "The European Environment Agency has a Management Board to deal with political issues like salience and

legitimacy, and a Scientific Board to attend to issues of scientific credibility." (3) They provide incentives for the creation and use of boundary objects and standard packages. In this process regarding the boundary objects, boundary organizations assist the actors to negotiate their different priorities (E. Lee et al, 2014). Thus the boundary organizations can support coordination by translating information into understandable terms.

At this point it is important to mention, in their study Gustafsson and Lidskog (2018) indicate that the boundary organization does not refer to any particular form of organization and does not provide any guidance on how to organize the science-policy interaction. Instead, boundary organization is often used as an empirical label when examining management of expertise and science-policy interfaces. Boundary organizations bring together the actors of the science and policy, allowing information to be produced together and this leads to the emergence of boundary objects. With this process, the results become reliable and legitimate for both policy and science (Gustafsson and Lidskog, 2018). For example, in their study, Dannevig and Aall (2015) mention that to legitimize knowledge for adaptation, the two boundary organizations create boundary objects such as online tools for avalanche risk mapping and guides for creating a map to track sea-level rise. On the other hand, Fogel (2005) argues that the dynamic processes of boundary organizations produce and use boundary objects in order to create science-based outputs and connect policy and science.

2.4.3 Boundary objects

Climate change has been the subject of controversy in many areas from past to present even climate change has been denied. However, over time, climate science has developed and new findings have emerged. Considering the history of climate change, the role of scientific knowledge in making environmental problems and climate change more visible and manageable is important. When this is the case, scientists and politicians desire to work together. However, there is also desire to establish a boundary between science activities and policy making. As discussed in this study, this demarcation is known as boundary work and on the other hand, boundary organizations host science and politics to carry out boundary work, such as climate change science. In this context, there is a need for objects that can work between

boundaries to form a common point and to translate different perspectives. Because, collaboration is at the core of science to create common understandings, to ensure credibility between different disciplines, and to ensure integrity between such elements. Considering the complexity of both actors meeting their demands, it should be noted that boundary objects should be created to ensure their consistency and support their actions (Lahn and Sundqvist, 2017).

The examination of boundary objects is important for this study's purpose. Considering the existing science-policy gap on climate change; there is a need for an area in which scientific and political practices can be productive interactions through a simplified or mixed language without having to be assimilated (Galison, 1997; Sismondo, 2010). From the boundary concept perspective, this gap is actually an area of negotiation and communication. In order to solve the problems between science and policy; bridges, connections and an environment where two sides can understand each other are needed. To produce these solutions, both sides need to know more about the other and learn about each other's practices. In this context, boundary objects should be seen as organizational work arrangements as a means of collaboration among people who want to achieve a goal, because boundary objects help actors act together in corporate settings and create a common space and purpose (Lahn and Sundqvist, 2017; Star, 2010). Moreover, for the gap between climate change science and policy, it has been previously discussed that a number of specific tools are needed to increase the process ability of scientific knowledge, by removing the uncertainty on the issue (Lahn and Sundqvist, 2017; van Pelt et al, 2015). For example, it was mentioned how climate models help communicating between scientists and policy-makers by removing the uncertainty in climate forecasts. These climate models are already described as a potential boundary object (Sundberg, 2007).

In this study, boundary objects will be considered as the objects used to facilitate interaction between climate science and policy practices and as objects that work as different work spaces between different social worlds where actors come together and share comments without need for consensus (van Pelt et al, 2015). Therefore, the definition of boundary objects and the examination of their properties are important for this study, and the following section will cover these issues.

2.4.3.1 The definition and context of boundary objects

Star and Griesemer (1989) observed the creation of Museum of Vertebrate Zoology at the University of California. Instead of a network that specifically focused on any group, they observed a different situation in which many groups and actors operate independently. They also observed that instead of finding harmony between these actors, a self-sufficient harmony, each with its own working arrangements (Nunes et al, 2016). After these observations, Star and Griesemer (1989) introduced the concept of boundary objects, which can support actors, who have different backgrounds and knowledge, to create a common understanding despite different perspectives (Hoogstra-Klein et al, 2017). Term of boundary objects has been defined by Star and Griesemer (1989, p.393) as: "boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites."

Considering that each of these groups belong to different worlds, it is quite clear that they have different visions and views. At this point, the museum director used boundary objects that united the different views of the actors, and which accorded the interests of each actor, while also maintaining the scientific goals of the museum (Turner, 2017). Based on their study, Star and Griesemer (1984) provided the typology for boundary objects as follows:

1. Repositories: They contain different resources, information, and applications that indexed according to certain rules and they provide people to access. According to Turner (2017), different actors add their data to a repository, allowing others to easily access it, and the important thing is that different experts can save data in the repository and use it to discuss the differences. An example of the repository is libraries.

2. Ideal type: It is more like a draft, it's not detailed, but it can be used for a purpose. According to Star and Griesemer (1984), this concept contains concrete and theoretical data and serves as a means of communication between both parties, and there are nothing any specific examples of the concept. As can be understood from its definition, they are quite vague objects (Star and Griesemer, 1989). However, becoming vague for this object allows such objects to be adapted to a local site and they are generally used as a means of communication and collaboration, and they are good enough road map for all parties (Star and Griesemer, 1989).

3. Coincident boundaries: Fox (2011) explaining as follows “an object whose boundaries are the same for different communities, although the content that is bounded differs (for example, a map that summarizes political or natural features of a landscape)”. These objects form a meeting point between different disciplines and specialties (Turner, 2017).

4. Standardized forms: Star and Griesemer (1989) defines these objects; “which can be transported over a long distance and convey unchanging information” (Star and Griesemer, 1989: p.411). These objects refer to the formats used to solve problems between groups. They are important boundary objects in facilitating collaboration by identifying differences between groups. Documents in a certain order such as forms and indexes can be examples of this kind of boundary object (Carlile, 2004; Turner, 2017).

Besides this typology, according to Turner (2017), the work of different scholars specify boundary objects as “physical/concrete” or “conceptual/abstract” (Turner, 2017). Physical / concrete boundary objects include concrete definitions such as instruments, forms, and technology (Turner, 2017). Conceptual / abstract boundary objects refer to metaphors of assets or processes. It is stated that these objects are especially used in speech interactions to facilitate the sharing of information between institutions (Turner, 2017).

With the advent of the boundary object concept, different definitions were made and the boundary objects were evaluated in different cases. As pointed by Hoogstra-Klein et.al. (2017); Bowker and Star define the characteristics of boundary objects as follows: Such objects have different meanings in the social worlds, but their structure makes them suitable for more than one world to be perceived as a means of translation. According to Harrison et.al. (2018) boundary objects “more specifically, they enable coordination, collaboration, and mediate change, across boundaries”. In addition, boundary objects play an important role in ensuring cross-border change. This feature reveals the political aspect of boundary objects (Harrison et al, 2018). Harrison et al. (2018) quoted Lee (2007) as saying: “boundary object can be used to push boundaries rather than merely sailing across them.” According to Orsini et al. (2017) boundary objects are objects that cross each other, live in different social worlds and meet the information needs of each. Boundary objects are also used to provide cooperative problem solving between boundaries. At this point, Orsini et al. (2017) mention two

specific features of boundary objects. First, they have a scale and structure, that is to say, the boundary objects have an architecture. The second is they can be interpreted by many different actors (Orsini et al, 2017). On the other hand, boundary objects can be part of an ongoing process of connecting resources and managing roles between actors, thus it can be seen as the basis of interaction in more than a business relationship (Harrison et al, 2018). Moreover, Carlile (2002) argues that the boundary objects will be effective in building the working relationship of individuals with different ideas on any subject. Therefore, boundary objects make it easy to analyze and adopt a new idea or product (Fox, 2011). According to Star (2010), boundary objects are a “kind of arrangement” that supports different groups to work together without consensus, however, the forms that boundary objects cannot be arbitrary. These are the infrastructures of the term "information requirement" defined by Star and Griesemer in 1989 (Star, 2010). At this point, Star (2010) mentions the term "information and work requirements" and this term represents groups that are local and want to collaborate. To be more specific, Star (2010) claims that, when different actors need to cooperate, boundary objects are created, which means they have a common information and work need. Furthermore, Koskinen and Mäkinen (2009) defines boundary objects as flexible enough to adapt to local needs and adapt to the constraints of different communities.

According to Star (1986), boundary objects are located in the middle of different actors. One of the important elements to be mentioned here is that the term object includes technology, other objects such as reports, policies or strategies and even human factors. Fleischmann (2006) indicates that , since its emergence, the boundary object concept has been extended to include other *things*, and examples how boundary objects can be things, ideas, processes, and even people (Fleischmann, 2006). Basically, these objects may not be concrete things. This approach and perspective has been employed in STS studies. The things that overlap in the social worlds, such as science and policy, have been considered non-passive objects, they are respected as they are actors with agency (Fleischmann, 2006). According to Latour (1996), these actors may not fixed entities, they could be concrete and abstract objects (Latour, 1996). Concisely, it is understood that boundary objects emerge from the intersection of diffrent social worlds. However, they may not passively located at these intersections. It can be said that these objects have roles in reshaping the interactions

and relationships between diffrent social worlds. Therefore, the boundary objects can be assumed as objects that might have agency features.

Since boundary objects exist in different systems at the same time they can be considered as a concrete objects, on the other hand, they are interpreted differently by different actors so they are also abstract objects. The point that should be considered here is not the subject itself but the understanding and interpretation of the actors (Ewenstein and Whyte, 2009; Hjalmarsson, 2015). At this point, Star (2010) states that the use of this concept has changed through the years. The complexity of interacting between different groups and coordinating different areas was perceived as a miraculous task and the concept gained a simple meaning because of "interpretive flexibility" that the object offers to a researcher (Lainer-Vos, 2013; Star, 2010). The problem is in a case, the object treated as the boundary object may not function the same for another case and may be useless (Carlile, 2002; Holzer, 2012; Lainer-Vos, 2013). This property of the boundary objects emphasizes that they can be subjected to many interpretations in the context of the knowledge in which they are used (Star and Griesemer, 1989; Turner, 2017). Therefore, this feature provides an opportunity for negotiation and interaction between groups (Carlile, 2004).

At this point Star (2010) focuses on the question “What is not a boundary object?" What is not a boundary object is related to the scale such as whether a word will be a boundary object or not (Star, 2010). For example, when actors in different disciplines collaborate to interpret certain words while working on a common subject, words can form a boundary object depending on the nature of the working relationships (Star, 2010). However, a word that anyone says definitely carries interpretive flexibility for the audience (Star, 2010). According to Star, as much as all concepts are useful at certain scales, according to her that the level at which the boundary object is most useful is at the organizational level.

Another issue that Star emphasizes the aspects of boundary objects is scope and again whether anything is a boundary object depends on the interpretive flexibility. However, according to Star (2010), the most useful level of coverage for the concept is much more specific. For example, a flag or a celebrity can have different meanings for different people and can be a boundary object. At this point, Star's (2010) assertion is a much more interesting way of working arrangements about these objects, examining the heterogeneity, than claiming that these objects have different

interpretations. Evaluating the networks of actors whose interests intersect as a result of interaction with the object can be assumed as the limit of the concept. Because how a flag is interpreted by different people remains analytically limited in understanding both material and infrastructure features. According to Star (2010, p.3) what is important here is that "boundary objects are not useful at just any level of scale or without full consideration of the entire model." To be more explanatory, for example, the boundary objects mentioned in the museum example have arisen due to the cooperation needs of different communities of practice bringing together for a common purpose. These objects have been evaluated and used differently by different communities for the same purpose. The scale and scope that Star (2010) mentions to limit the concept fits with this example.

These definitions for boundary objects actually reflect the properties of them. However, before specifying the properties of the boundary objects, it will be useful to examine case studies on the concept.

Different authors have different cases on boundary objects (Berker and Kvellheim, 2018). For example, Hsiao, Tsai, and Lee (2011) examined the use of many different objects, from mathematical terms to tanks and robotics, as a boundary object to facilitate inter-institutional learning and collaboration in a mathematical environment (Harrison et al, 2018; Hsiao et al, 2012). Miller (2005) suggests that different groups within industrial organizations work together to create maps that enable them to understand the whole production process. Lejano and Ingram (2009) found that boundary objects are inadequate to serve as interdisciplinary bridges in their work involving the legal and regulatory process around water problems in California Bay-Delta. To further understand what makes the new institution integrative, they explain the concept of "Ways of Knowing, which explains how new knowledge emerges from the new network of relationships" (Lejano and Ingram, 2009). Macpherson and Jones (2008) claim that boundary objects are important for organizational change. In their research, they found that inadequate mediators in the process of organizational change of a medical company, where different practice-based communities are involved in collective teaching (Berker and Kvellheim, 2018; Macpherson and Jones, 2008). These studies have been examined by Berker and Kvellheim (2018) and according to them "a closer look at these amendments reveals that they describe how a situation of

heterogeneity has been resolved into a working agreement facilitated by shared values, close and frequent social interaction or power" (Berker and Kvellheim, 2018).

Another example, a study conducted by Franklin et al, 2019, "Regional Integrated Sciences and Assessments workgroups" (RISAs) are boundary objects that provide research results and useful information for stakeholders and anyone interested in climate science. What makes RISAs a boundary object is that the research to prepare for climate change and inform decision-makers who support scientists and increase interaction (Franklin et al, 2019). When RISAs, which are boundary objects, are successful, practitioners, decision-makers can collaborate on relevant research regionally. In addition to these examples, Turner (2017) examines the impact of boundary objects on knowledge processes in the video game industry between publishers and developers. In Turner's study, it was emphasized that the parties use boundary objects and as a result, they establish and maintain a functional relationship.

Although different academics define boundary objects in different ways, all of these definitions show similar properties and highlights why boundary objects exist. This common texture can be seen in these case studies, and the next section discusses possible properties of boundary objects.

2.4.3.2 Properties of boundary objects

It has been well documented in both the STS literature and the literature of other disciplines that the boundary objects carrying some specific properties such as they can enable interaction, participation, and unity among actors from different social worlds, moreover, they can support developing common understanding and meeting local needs. These properties of boundary objects will assist in this study to understand the location of boundary objects in the gap between climate change science and policy within the scope of the study. Because boundary objects can play an important role in clarifying scientific information about climate change, supporting collaboration between different actors, and communicating with policymakers (Clark et al, 2016; van Pelt et al, 2015). On the other hand, it is foreseen that boundary objects can form a foundation for creating stable science policy assemblies (Lahn and Sundqvist, 2017). Hence, boundary objects embrace features.

Rather than the loose structure and fluidity caused by interpretive flexibility, some boundary objects may be more stable and strongly structured, and this is a feature that

helps groups protect their identity (Turner, 2017). In other words, groups from different disciplines do not have to change their own practices. According to Turner (2017), these dimensions of boundary objects include forms, contracts and protocols, because, these objects can clearly reflect the needs of different groups. These boundary objects are especially used to bring together different actors and reduce uncertainties and as a result, they create a common understanding and help reduce differences between boundaries (Turner, 2017).

As discussed above, not every boundary object shows the same feature or an object may not act as a boundary object at all in the context of knowledge they used. While this is the case, according to the typology put forward by Star and Griesemer (1984), the question of what is the difference between a good and a bad boundary object (Carlile, 2002) gains importance. Carlile (2002) has revealed three features that can make an object of a certain boundary useful in common problem-solving. According to Carlile (2002) "a successful boundary object must provide a shared language, allow concerns to be expressed, and enhance knowledge." With the first feature, Carlile emphasizes that; having a shared syntax or language, which represents the knowledge, for an boundary object, is a necessary feature to deal with any boundaries of knowledge (Carlile, 2002). The second feature emphasizes concrete tools for an effective boundary object to identify and learn the differences and dependencies of actors on given boundaries. These tools provide actors to communicate across boundaries about their concerns, questions, practice or idea (Carlile, 2002; Fox, 2011). Finally, with the third feature, Carlile (2002) argues that a boundary object should empower different communities to transform their knowledge into a new form of ideas (Fox, 2011).

Star (2010) claims the use of this concept has changed in recent years. The reason for this is that the use of the concept is focused on the interpretative flexibility aspect (Star, 2010). Looking at the studies and definitions in the literature, it is seen that the interpretive flexibility comes to the fore as a property. According to Star (2010, p.4) "boundary objects became almost synonymous with interpretive flexibility." However, Star and Griesemer have revealed two other main features in their study, which are rarely addressed in the literature (Star and Griesemer, 1989; Star, 2010). These aspects "the material/organizational structure of different types of boundary objects, and the question of scale/granularity" (Star, 2010). These features were also

pointed by Orsini et al. (2017). They mention two specific features of boundary objects. First, they have a scale and structure, that is to say, the boundary objects have an architecture.

These aspects of boundary objects help communities with different knowledge to work and build relationships around a particular subject. In other words, boundary objects can facilitate both the analysis and adoption of an idea or technique. It can be thought of as a means of communicating the opinions of individuals in different communities across boundaries between any application or an idea. On the other hand, Shackley and Wynne (1996) argue that a successful boundary object should be simple, understandable and transparent, and most importantly, they should be supportive in maintaining intersecting social relationships across boundaries. It can be seen that the explanations of boundary objects and the properties of boundary objects put forward by different academics are not very different from each other. Scholars are arguing that boundary objects facilitate the work done between boundaries by creating a focal point and manage information across the boundary by translating. The most common features of boundary objects are their ability to create a common space for interaction between different actors. Moreover, the literature shows that boundary objects act as a bridge between different worlds and facilitate collaborations.

Based on the definition of boundary objects in the literature, some properties of boundary objects are specified in order to be considered in this study. These properties, presented in Table 1, and they are prepared to help evaluate boundary objects within a certain scale and scope. The definition of boundary objects as useful tools for analyzing actions and practices among actors is subject to interpretive flexibility by the nature of the concept. In other words, the concept of boundary object does not require an essential definition (Lahn and Sundqvist, 2017). However, it is important to underline certain properties in this study to understand how boundary objects are bridging in the gap between climate change science and policy practices. Since the basis of the climate science-policy interface is based on the information exchange relationships between people producing and based on it (Wagner et al, 2019), the ability of boundary objects to cooperate in collaboration, to provide a common understanding among different stakeholders, may mean that they play a role in closing the gap between the science of climate science and policy practices.

The boundary objects will be evaluated within the scope of the specified properties. The properties in Table 1 are listed by examining the boundary object literature. Property - 1 is the most discussed main property of boundary objects in the literature. This property defines objects that different communities can work on together without consensus. Property - 2 is the ability of boundary objects to allow different actors to communicate. Creating a common space which these actors can work together is one of the boundary object properties as well as providing communication between different actors. This process describes the Property - 3. Lastly, Property - 4 emphasizes that boundary objects should provide common and shared language, and also they should provide translation between different social groups.

Table 1: Properties of boundary objects

Boundary Object Properties	**Reference**
Property 1- Being flexible and plastic for adaptation to local needs	Star and Griesemer (1989)- (flexible and adaptable) Kirby (2006)- (being a shared tools)
Property 2- Serving as a means of communication between actors	Star and Griesemer (1989)- (providing communication)
Property 3- Enabling coordination, collaboration and mediating changes between boundaries	Bowker and Star (2000) Carlile (2004)- (facilitating collaboration) Harrison et al, (2018)- (managing roles) Orsini et al, (2017)- (providing solutions) Star (2010)- (supporting on work) Carlile (2002)– (building the working relationship)
Property 4- Providing information, translation and shared language	Carlile (2002)– (providing information and knowledge) Fox (2011)- (translating) Franklin et al, (2019)- (providing information and knowledge) Orsini et al, (2017)- (meeting the information needs of each actors)

In addition, establishment of boundary organizations, as well as boundary work, to solve governance problems related to complex information such as climate change,

has been also seen as a solution (Dannevig and Aall, 2015). At this point the concept of boundary work contributes to the reorganization of the definition between science and policy and the re-definition of their relations (Wyborn, 2015). Moreover, the boundaries between policy and science need to be negotiated because scientific knowledge is not truly perceived without institutions and social facts that justify it (Dannevig and Aall, 2015; Jasanoff, 2004b). In this respect, boundary organizations are important for mediation, translation, and communication between science and policy to produce reliable information to solve policy problems.

It has been previously discussed that climate change is both an issue to work on for the scientific community and policymakers, and in this case, climate change science is a boundary work. More precisely, international boundary work has a significant impact on how climate change is structured and framed as a global and worldwide problem (Hoppe et al, 2013). Considering climate change as a global policy issue helped organized the boundaries between science and policy for co-production until the Climategate (Hoppe et al, 2013). Climate change, is often carried out by the IPCC to produce legitimate information and to bring together the actors of the science and policy world. In terms of the boundary concept, the IPCC has become the most widely discussed boundary organization in the literature on climate change. Therefore, IPCC was chosen as the boundary organization to be addressed in this study. Considering it as a boundary organization on climate change means that IPCC produces information about climate science for policymakers and may even producing boundary objects in this context. At this point, it is important how the IPCC positions itself according to science and policy on climate change and how it handles the boundary work it employs.

3. CLIMATE CHANGE POLICY ORGANIZATIONS AND THE LOCAL LEVEL

The role of scientific knowledge and expertise is crucial in the ongoing discussions on climate change policy. Problems such as climate skepticism that started in the past and the decision to withdraw of the US government from the Paris agreement in 2017 (U.S Department of State, 2019) were encountered. While all these difficulties arise, it is discussed that climate policies should be created and implemented all over the world and new ways should be considered. This is undoubtedly possible by providing scientific evidence and mobilizing political actions (Beck and Mahony, 2018). In this case, the establishment of institutions in the science-policy interface has become important for climate change governance (Hoppe et al, 2013; Pearce et al, 2018; Wesselink et al, 2013).

As globalization continues and the GHG emissions increase, it is inevitable to encounter intense climate change effects. Within this scope, it is expected to present a governance approach that disseminates information, builds capacity and includes more participants in the adaptation planning process from organizations such as IPCC (Graham and Mitchell, 2016). However, as discussed in the previous chapters of the study, it seems that despite IPCC there is a problematic relationship between the climate science and policy. This situation has not escaped the attention of various scholars and it has been argued that cities have a special place in fighting against climate change. Cities are turning to different practices in combating climate change. In this process, Transnational Municapal Networks (TMNs) emerged to share information, collaborate and offer different applications to cities (Keiner and Kim, 2007). Turkey has followed this tendency. When the effects of climate change began to rise, measures have been taken both at national and local level in Turkey.

In this chapter of the study, the IPCCs will be handled generally and TMNs that guide the policy making of cities on climate change will be discussed. Afterwards, Turkey's national and local actions on climate change will be examined.

The integration of science and policy is at the core of effective local climate governance (Graham and Mitchell, 2016). Therefore, IPCC is an important organization at the local level as well as globally. In the next section, general information about IPCC will be given.

3.1 Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) was established mainly to provide policy makers with adaptation and mitigation options by regularly providing scientific assessments on the effects and risks of climate change (IPCC, n.d.). Considering the history of IPCC, according to Pearce et.al (2018), a small and inadequate council was established by WMO in 1980, and this council did not have the infrastructure to discuss the political process. On the other hand, this has been described as an effort for a more comprehensive and international evaluation organization (Agrawala, 1998). After various negotiations between WMO and the US government, it was decided to establish IPCC. IPCC has been constituted by WMO and the United Nations Environment Program in 1988 (Eck, 2016; Pearce et al, 2018). Main objective of IPCC is "to provide governments at all levels with scientific information that they can use to develop climate policies. IPCC reports are also a key input into international climate change negotiations" (IPCC, n.d.).

There are many organizations on climate science research and policy making. For example, National Oceanic and Atmospheric Administration (NOAA), World Meteorological Organization (WMO), United Nations Framework Convention on Climate Change (UNFCCC) and United Nations Environment Programme (UNEP). However, IPCC is the pioneer organization in science-based global policy, and it has carried out the most comprehensive analysis and synthesis of scientific information on climate change to date, including experts from all over the world in its political advice (Beck, 2015). Scientists have succeeded in putting climate change on the global policy agenda through the work of IPCC (Jasanoff, 2015). In this context, IPCC prepares reports that synthesize and evaluate general scientific information about climate change. These reports consist of assessment reports, special reports, and methodology reports (IPCC, n.d.).

Thousands of people from around the world contribute to the work of the IPCC. In addition, scientists voluntarily support IPCC on causes, impacts, risks of climate

change, and also to the analysis of published reports and articles (IPCC, n.d.). IPCC is recognized as a successful example of scientific advice on climate change. There are thousands of volunteer scientists working in three working groups on extensive assessment reports on physics (WGI), social and economic impacts and adaptation of climate change (WGII), mitigation of climate change results (WGIII) (Pearce et al, 2018). The drafts and final versions of these reports are approved by government representatives and these reports provide the scientific basis for making the necessary policies. The emergence of IPCC has re-conceptualized the climate as a global system (Pearce et al, 2018). Later, decades of scientific studies were conducted on the data, modeling infrastructures and management of environmental problems through global collaboration (Miller, 2004). Also, IPCC addressed policy issues related to the dangers posed by climate change, highlighting current challenges such as extreme weather, renewable energy and the effects of 1.5 ° C warming (Pearce et al, 2018). Moreover, IPCC makes significant contributions to the policy as an intergovernmental organization to provide valuable input to the UNFCCC that includes Kyoto Protocol in 1997 and the Paris Agreement in 2015 (Sundqvist et al, 2018). In this framework, due to its functional role, Miller (2001) identified IPCC as international boundary organization (Fogel, 2005; C. Miller, 2001).

Although IPCC has done successful works since its establishment, it has also been criticized in many different ways in the literature. In this context, despite the organization like IPCC, the gap between climate science and policy may come to mind. The most striking finding of IPCC was that it claimed that the dramatic change in climate change addressed in the Fifth Assessment report was human-based. Today, this claim may seem normal, but it was not in the 1980s (Pearce et al, 2018). In the following process, publications that made very critical evaluations about IPCC had? emerged. Despite IPCC, international gains in the policy arena have not been impressive, for example, GHG emissions have continued to increase. In addition, it has been observed that transforming scientific research findings into politics is a complex process even with the support of an organization like IPCC (Sundqvist et al, 2018). All these discussions have led to controversy over whether IPCC is effective. Along with Climategate, IPCC has begun to be fully scrutinized in the literature. At the global policy level, IPCC has identified that climate change is a technical problem, and it has been argued that fundamental disputes and facts are made uncertain in this

case (Hoppe et al, 2013; Pearce et al, 2018; Wesselink et al, 2013). On the other hand, climate change has been addressed as a problem that global solutions should have found from the outset, but IPCC cannot respond to policy traditions (Demeritt, 2001; Hoppe et al, 2013). According to Wesselink et al, (2013) such situations are available to produce counter-information and create discussion areas. In addition, defining climate change as a global problem with global solutions has been a natural progression of both science and political trends, but the result has been geographically different and a very central source of scientific advice that neglected the need for multiple policy approaches (Hoppe et al, 2013; Pearce et al, 2018). Finally, Jasanoff (2015) argues, although IPCC has taken steps to put climate change on the global policy agenda, IPCC findings have caused uncertainty at many levels.

To sum up; it is a fact that the IPCC makes the issue of climate change more attractive and comprehensible at the global and political level. However, it cannot be ignored that there are some difficulties in producing solutions for the problem. For example, although the IPCC has addressed the importance of cities in dealing with climate change, it has not provided concrete blueprint and solutions about what should be done at city level, which also can be endorsed throughout the world. Thus, Betsill (2001) argues that effective climate governance should include local, national and international networks and partnerships. It has been widely accepted that adaptation related to climate change is a multi-level governance problem (Dannevig and Aall, 2015). Multi-level governance is addressed more extensively in the social, political and economic processes that shape global environmental governance (Betsill and Bulkeley, 2006). Therefore, research on adaptation governance has been tended to focus on local governance (Dannevig and Aall, 2015). Hence, local governments have been key actors in adaptation related to climate change and accordingly, the role of municipalities in this area has gained importance. However, due to the fact that IPCC does not provide direct solutions to cities, how cities translate scientific knowledge to local policy and practice have been a substantial issue. Many local governments have problems in accessing financial resources, special knowledge and capacities in the implementation of adaptation and mitgation activities (Sippel and Jenssen, 2009). While this is the case, TMNs can be considered as bridges that can carry out the IPCC's objectives at the local level and also help cities with such problems. Therefore, in the next part of the study, the importance of cities to fight against climate change and

TMNs that help cities in this context and their role to create bridge between climate science-policy gap will be discussed.

3.2 Transnational Municipal Networks

Managing climate change is an issue that requires policy coordination. This coordination can be achieved by collaborating with actors such as intersectoral, intergovernmental and non-governmental organizations. These measures are important to reduce GHG emissions and adapt to climate effects (Andonova et al, 2009; Corfee-Morlot et al, 2009). Actions related to climate change generally include both adaptation and mitigation (Corfee-Morlot et al, 2009). Mitigation includes reducing emissions and limiting GHGs in the atmosphere to slow or even stop human effects on the climate (NASA, n.d.). Adaptation, on the other hand, refers to the arrangements and adjustments against the experienced and expected negative effects of climate change (NASA, n.d.). Along with adaptation, it is aimed to increase the defense of societies against climate change.

Since cities take part in national and international climate change adaptation and mitigation targets based on their local actions, they are important for the program and other targets related to climate change (Heidrich and Tiwary, 2013; Reckien et al, 2018). In addition, as mentioned earlier, cities are one of the most affected structures by climate change, thus it can be assumed that mitigation and adaptation practices are felt most in cities. Although the continued increase in GHG emissions shows that there are difficulties with mitigation, cities have started to emerge as leading actors in responding to climate change, as they have authority over some of the key actors that produce GHG (Bulkeley, 2013). On the other hand, the ongoing uncertainty about climate change has not prevented various levels of governments from adopting adaptation plans and policies (Pelling, 2010). With cities being part of the climate change mitigation and adaptation process, it would not be wrong to say that more robust steps have been taken. In this case, according to Castán Broto (2017), cities play an important role in international climate governance in three aspects. First, cities support the learning and exchange processes between local and sub-national organizations. Second, they collect local resources and information to implement certain programs and practices. Third, the profiles of cities in the international arena are getting stronger, which attracts the attention of policy actors. Based on these, cities

need to take their place in the fight against climate change by making local climate change adaptation and mitigation plans (Castán Broto, 2017; Reckien et al, 2018).

As the importance of cities to fight against climate change increases, studies have begun on effective ways of developing governance and management structures for this issue. Gordon (2013) states that local innovations should be scaled and interconnected in order to achieve meaningful results. In this context, city networks have been seen as the most effective way to improve cities' governance methods related to climate change and many other issues (Keiner and Kim, 2007). Transnational Municipal Networks (TMNs) have emerged to help preparing local climate plans. The general objectives of TMNs are almost the same. It is stated that with the voluntary commitment goals of TMNs, they are responsible for helping the municipalities to fight against climate change, they support sharing knowledge and experience among members, and they are also responsible for the interests of their members at national and international level (Bütün Bayındır, 2020; Kern and Bulkeley, 2009). While this is the case, many TMNs are beginning to emerge to guide cities on climate change issue.

One of the most surprising responses to climate change in the past twenty years is that municipal governments and other urban actors have started to take GHG reduction and adaptation measures (Bulkeley, 2010). In this context, cities have started to participate in TMNs to determine climate strategies since the early 1990s, hence these municipalities around the world have become volunteer members of TMNs (Bulkeley, 2010). Gordon (2013) claims that cities began to be a part of the network interaction as a result of the interaction of three different powers. First, cities are influenced by the competitive environment brought by globalization, thus cities need some kind of agency to counter and minimize these competitiveness, and TMNs can help cities in this competitive environment. Secondly, joining cities to TMNs will increase local government capacity and help them integrate collectively. Finally, cities can increase their interactions with developed cities by joining TMNs.

Looking at the history of TMNs, it is seen that three different TMNs were established before the Rio United Nations Conference on Environment and Development. Plans were made in these years to reduce GHG emissions, such as the urban CO_2 reduction project (Bulkeley, 2010). Later, climate networks gained more importance and reached

many participants. TMNs began to diversify and create regional and country-based campaigns in the early 2000s, and TMNs also spread through wider geographies. Bulkeley (2010) defines these new generation municipal networks as "the second wave of municipal action on climate change". According to Bulkeley (2010) new generation TMNs have three important features different from others. Many of them are nationally organized. This situation shows the changing organizational structure of TMNs (Bulkeley, 2010). Moreover, these TMNs mobilize private actors along with the local government. Finally, they continue to emerge as clearer and more robust TMNs with their urban focus (Bulkeley, 2010).

TMNs are transnational networks established to allow local governments to exchange information and work together on climate change governance. There are several definitions on TMNs in the literature. Examples of these definitions are as follows. TMNs are institutions that provide local governments with space to exchange information on the governance of climate change (Busch et al, 2018). According to Barbi and De Macedo (2019) TMNs are institutions that address and guide the climate change problem of local governments around the world by offering inspiration, knowledge, experience, concrete projects and informal appreciation and reward structures to local governments. In addition, T. Lee and Jung (2018) maintains that the activities of TMNs include socialization, technological transfer, policy learning, business interaction, and the provision of financial standards. They give an example of using information and knowledge to make predictions that the policy learning function will be used to make decisions later (T. Lee and Jung, 2018). In addition to these, it is important to mention the main components of TMNs. They must have members from different countries and these participants can become official members. Since TMNs are more than city partnerships, they must have more than two members. Furthermore, TMNs are must work on the issue of climate change. Finally, each TMNs should have its own staff and address (Busch, 2015; Busch et al, 2018). Moreover, three defining features of TMNs have been addressed in the literature. TMNs give cities autonomy, freedom to join and leave. In addition, TMNs exist as part of the self-governing form of governance. As the last feature, it has been stated that all members directly implement the decisions taken within the network (Bütün Bayındır, 2020; Kern and Bulkeley, 2009).

While TMNs took their place in climate change and policy-making and became popular, researches about the effects of TMNs have gained importance in the literature. Zeppel (2013) found that Cities for Climate Protection (CCP), which is one of the TMNs, was an important actor in Australia in urban programs related to climate change. Hakelberg (2014) argues that TMNs support the spread of local climate change strategies, especially among European cities. According to Betsill and Bulkeley (2014), CCP attracts the attention of its members because it facilitates access to financial and political resources and it is an important actor in taking action on climate change. Another study found that TMNs have significant impacts on local climate governance in Germany by "enabling internal mobilization, formulating emission reduction goals, institutionalizing climate trajectories, enabling direct exchange and offering project support" (Busch et al, 2018).

In order to better understand the role of TMNs in the deal with climate change, it becomes crucial to mention what kind of services have provided by TMNs to local governments. When the C40 network is considered, it is seen that in addition to supporting the climate change adaptation and mitigation planning, cities are supported in many areas with different programs. For example, there is a "City Intelligence Team" under the C40 to expand the use of technology and analysis to effectively collect city data, improve access to information and improve the speed and scale of peer-to-peer connectivity (C40 Cities, n.d.). Another example is "C40 Cities Finance Facility" initiative that facilitates access to finance for climate change projects in cities, bridging the gap between cities and finance (C40 Cities Finance Facility, n.d.). In addition to its project, finance and guidance services, the C40 has explanatory and translated guides to make the reports published by the IPCC better understood by cities. For example, "Special Report on Global Warming of 1.5 ° C" prepared by the IPCC, a summary report was prepared to translate scientific findings and policy observations to authorities and policymakers. During the preparation of this report, C40 have worked with universities, scholars, research centers and even other TMNs' experts (C40 Cities, 2016).

As an another example, according to Frantzeskaki et al (2019), TMNs organize information flows and knowledge, resulting in advancing agendas for more effective information integration in cities (Frantzeskaki, Buchel, Spork, Ludwig, and Kok, 2019). In their study Frantzeskaki et al (2019), they selected the ICLEI as a case to

understand how TMNs function, and investigated how they function as agents of urban change, the practices they adopt and the effects of their operations, and how they fulfill their mediation function. This study revealed that ICLEI plays a major role in climate governance at the local level. According to the study, ICLEI undertook three main tasks; "knowledge roles (translator, educator and integrator), relational roles (connector and mediator) and game-changing roles (path breaker and co-creator)" (Frantzeskaki et al, 2019). As the final result of the study, it is argued that ICLEI and other TMNs provide more effective information and policy integration in cities. ICLEI organizes various webinars for member cities. ICLEI also conducts projects on various topics by explaining how local and national governments can work in coordination and prepare policies. For example, a project called "100% Renewables Cities and Regions Roadmap" has been prepared by ICLEI to draw attention to the issue of renewable energy. The main objective of the project is to develop a roadmap for renewable energy by working with the cities identified within the scope of the project and to effectively implement local climate and energy action plans (ICLEI, n.d.). TMNs, together with all these examples, are effective in the preparation of local climate change plans as well as factors such as population, development and city size (Reckien et al, 2018). In addition, it is stated that municipalities that do not have a national climate action plan benefit more from TMNs (Reckien et al, 2018). In other words, even if there is no national action plan, TMNs can influence municipalities and mobilize them to make their own climate action plans. In fact, it is conceivable that this process facilitates the formulation of a national climate chane plan.

Although most climate change scientists initially ignored local governments, the link between cities and climate change has been studied by many scientist (Rosenzweig, Solecki, Hammer, and Mehrotra, 2010). According to the literature, it is seen that municipalities and national governments are better positioned to deal with climate change through climate policy and cooperation at the local level. As the process of international climate policy ceased, cities began to position themselves as central participants and representatives of global climate governance, as well as emerging as actors implementing global climate governance efforts (Acuto, 2013b; Bulkeley, 2010; Gordon, 2013). The practices and studies of cities regarding climate change have gained an important place in global climate change governance. In this framework, TMNs have emerged as an important resource in providing information and expertise

for local governments. In addition, TMNs are more clearly visible, where actors work on climate change issue across organizational boundaries (Corfee-Morlot et al, 2009). Along with TMNs, learning, information transfer and collaboration are increasing among cities, regions and national governments (Bulkeley and Moser, 2007). As can be understood from here, since the cities have a great role in climate change mitigation and adaptation, some objects are needed to implement the climate science findings and suggested policies in the international arena, to make climate change plans at the local level. These objects should be guides for the cities on coordination, cooperation, information needs, and problem-solving in the case of climate change. As discussed in the previous chapter, these objects are generally covered by concept of boundary object. It seems that the use of these objects for urban climate change mitigation and adaptation planning could be a clear indication that boundary objects are needed in local climate governance. For example, IPCC is known to be an authority organization on climate change science. IPCC's goals, plans, findings, and many other elements that it contributes to climate change need to be transferred to sub-governmental actors, such as municipalities and local government units.

It has been argued in the literature that the IPCC's guidelines for policy makers, do not provide the necessary instructions (Fünfgeld and McEvoy, 2014). As discussed in the previous section, the IPCC does not provide direct solutions or guidance for cities. Consequently, the question how to achieve IPCC’s targets at the local level is gaining importance. Again, it was emphasized in the previous section that TMNs could be a bridge between the IPCC and local governments. Therefore, TMNs that trying to mobilize the boundary work that the IPCC handles as a boundary organization at the local level and moving between climate change science and policy, can be considered as boundary objects. At this point, it is important to remember that boundary objects can be *things* like technology, people, thoughts, terms. Therefore TMNs might be the boundary objects that can reshape interactions and relationships between social worlds as it argued in the STS studies.

Although climate change adaptation and mitigation process is generally understood, there are difficulties in effectively communicating this process to all levels of society. However, TMNs have a great place in the common use and application of scientific knowledge in governance processes designed for climate change. It seems possible to achieve the goals that cannot be implemented in the international arena with local

climate governance plans and strategies. Considering that local governments are more active and intended for fighting against climate change, it is important to consider the TMNs that guide them.

There are countless TMNs available for the local governments. For example, ICLEI - Local Governments for Sustainability is a global network operates in more than one-hundred countries, and it has more than one thousand seven hundred fifty local and regional government members that are committed to sustainable development (ICLEI, n.d.-a). Another example is the C40. Ninty-six cities from all over the world have adopted C40 Cities commitments to realize climate action plans and to implement the goals of the Paris Agreement at local level (C40, n.d.). In addition to these examples, there are TMNs such as Cities for Climate Protection Campaign (CCP), Energy Cities, Climate-ADAPT, EUROCITIES and Covenant of Mayors (CoM) that offer almost the same commitments and have many members from around the world. Although these TMNs have independent work, there are projects they work with. For example, ICLEI and C40 worked together in the establishment of Compact of Mayors, and they also have worked together on "Carbon Disclosure Project" (Heikkinen, Karimo, Klein, Juhola, and Ylä-Anttila, 2020).

Along with other countries in the world, TMNs membership in Turkey has increased (Bütün Bayındır, 2020). Many municipalities known to taking actions in fighting against climate change in Turkey are benefiting from TMNs. It has been observed that Municipalities are working with more than one TMNs. For example, Kadıköy, Tepebaşı and Maltepe Municipalities are working together with both ICLEI and CoM. However, it should be emphasized that these municipalities have prepared Sustainable Energy Action Plan (SEAP) or sustainable Climate Action Plan (SECAP) under the guidance of CoM. Therefore, in this study, CoM has been selected as the case and in the next section, it will be investigated.

3.3 Covenant of Mayors

CoM was established in 2008 by the European Commission (EC) to support local governments and contribute to the European Climate and Energy strategy's achievement of the 2020 European targets within the scope of the implementation of climate change mitigation policies (Croci et al, 2017). CoM is one of the initiative that enables local actors to voluntarily commit to reduce climate change by adopting

sustainable energy policies. CoM brings together more than nine-thousand local and regional authorities based on the support of a multi-stakeholder movement from around fifty -seven countries and the technical and methodological detail offered by private supporter (Covenant of Mayors for Climate and Energy, n.d.-a).

Signatories who joined CoM between 2008 and 2015 are included in the 2020 EU climate and energy package and the 2030 climate and energy package of the European Union. Signatories who joined after 2015 are included in the EU Climate Change Adaptation Strategy (Covenant of Mayors for Climate and Energy, n.d.-b).

The basic process of CoM signatories as follows:

1. Signatories should prepare Baseline Emission Inventory (BEI) that measures CO_2.

2. "Risk and Vulnerability Assessment (RVA)" should be conducted and sent to analyze potential hazards, assess vulnerabilities, and measure risk levels.

3. Preparation of "Sustainable Energy and Climate Action Plan (SECAP)."

4. After the presentation of the action plans, monitoring reports evaluating the action plans and the process should be sent regularly every two years.

In this framework, SECAP is the main document that signatories explain how to achieve the CO_2 reduction target and define the time frames and responsibilities as well as the activities and measures created to achieve the target (Croci et al, 2017). Since BEI is the document that will show whether signatories have reached their goals, it is the most important step towards the creation of SECAP (Christoforidis et al, 2013; Pablo-Romero et al, 2015).

In 2016, CoM joined forces with Compact of Mayors, which is one of the TMNs. Thus, "Global Covenant of Mayors for Climate and Energy" (GCoM) has become a major move for local governments to advance their climate change and energy goals (Covenant of Mayors for Climate and Energy, n.d.-c). GCoM aims to do works in line with UN Sustainable Development Goals and climate justice (Covenant of Mayors for Climate and Energy, n.d.-c). In this context, GCoM focuses on three main topics: climate change mitigation, adaptation, and "universal access to secure, clean and affordable energy" (Covenant of Mayors for Climate and Energy, n.d.-c). It can be seen, CoM is a versatile initiative involving multiple actors and processes. Since the

action plans of the municipalities selected in this study continue under the guidance of CoM, the study continued on CoM instead of GCoM.

CoM is an initiative that mobilizes local and regional governments around both multiple governance and locality actions to meet EU objectives. Since CoM has a different structure, different features of CoM are emphasized by different scholars. According to Heyvaert (2013), CoM is a leading project that unites public and private organizations operating at local, regional, national and transnational levels. It is claimed that CoM may be considered "a long-term EU energy policy instrument, as it does not have any conditions or deadlines for signatures" (Christoforidis et al, 2013).

To summarize, CoM signers are committed to following the standardized guidelines and methods for setting targets to reduce CO_2 emissions and implementing policies to achieve them (Croci et al, 2017). CoM provides opportunities to show cities with their actions to contribute to national emission reduction targets. Based on the literature, the point that draws attention here is that CoM not only provides scientific knowledge, but it also emerges as a structure that supports cities for the importance of climate change by using scientific information. It should be remembered that the IPCC's assessment reports have criticized in the literature for this reason. Moreover, the CoM process can facilitate capacity building and intercity information exchange and support policies on CO_2 emissions reduction (Croci et al, 2017). According to Croci et al. (2017), CoM can be considered as a "coordinated collection of experiments carried out by local governments" at the same time, based on common rules set by the EU.

As stated in the section 1.2, the aim of this study is to investigate whether TMNs act as boundary objects in Turkey. While the most frequently utilized TMN, CoM, was chosen for this investigation, three district municipality from Turkey were chosen to conduct the case study. In this context, for the case study, Kadıköy, Tepebaşı and Maltepe district municipalities have chosen. The municipalities have prepared their action plans on climate change and energy efficiency under the guidance of CoM, hence, one of the case studies to be conducted within the study will be carried out under CoM. Therefore, next chapter will focus on Turkey's and the municipalities' stance on climate change.

3.4 Climate Change, TMNs and Local Governments in Turkey

Climate is changing in Turkey. It can be said that recently in Turkey abnormal weather events has been observed. For example, when Turkey's difference between the actual temperatures with seasonal averages between 1961-2016 was examined; especially since the early 2000s, temperatures have been observed to exceed seasonal norms (Çelik, Bölük, Akbaş, and Deniz, 2017). The last ten years number of meteorological extreme weather events have occurred in Turkey, and this increase has broken the record with the thirteen thousand - thirteen weather events in 2016 (Coşkun et al, 2017). Since, Turkey is facing changes in rainfall and temperature caused by climate change to extreme weather events, the consequences can be fatal. This dangerous effect of climate change on people is included in the Center of Research on the Epidemiology of Disasters report. According to the report, nearly five thousand people have died so far in 2018, and nearly twenty-nine million people have needed help due to excessive weather (Levitt et al, 2018).

Since Turkey is an energy dependent country, the economic growth is mainly based on fossil fuels that lead to high energy demands increase (Timperley, 2018). In this case, it refers to the increase of GHG emissions in Turkey. UNFCCC' report highlights that "Turkey’s energy demand increases by six-seven percent every year" (UNFCCC, n.d.-c). According to the Turkey Statistical Institute’s data, total GHG emissions in 2016, 496.1 million tons of CO_2 equivalent (Mt), respectively (TUIK, 2018). While the largest share of CO_2 emissions in 2016 emissions was energy-related emissions with 72.8%, industrial processes and product use with 12.6%, agricultural activities with 11.4% and waste with 3.3%, respectively (TUIK, 2018). Moreover, the report shows that total GHG emissions in 2016 increased 135.4% compared to 1990, and also CO_2 equivalent emission per capita was calculated as 3.8 tons/person in 1990, while this value was calculated as 6.3 tons/person in 2016 (TUIK, 2018). When this is the case, Turkey has begun to take a number of measures to fight against climate change at national and local levels.

3.4.1 Turkey and international climate regime

It can be said that the effects of ecological modernization and sustainable development, which are the discourses of environmental policy since the 1990s, have begun to be observed. Sustainable development, especially in the period following the Rio Conference, is not initially binding, but over time, it became an important environmental policy, and it has begun to influence environmental policies in Turkey (Orhan, 2013). This period was a period when the discourse of sustainability and sustainable development came to the agenda (Orhan, 2013). Besides that Turkey's fragility in the face of climate change and contribution to emission, Turkey joins the international climate negotiations and engages some national policies. While Turkey has conducted studies on climate change since the early 1990s in conjunction with international developments together, becoming one of the most important developments in public policy of climate change it has been realized with the Eighth Development Plan (İklimin, n.d.). For the first time in the Eighth Development Plan, Turkey made a clear emphasis on climate change and prepared a report by establishing a specialization commission for climate change (İklimin, n.d.). In line with the objectives of the Development Plan, Turkey has been a party to the UNFCCC in 2004. In addition, with the Ninth Development Plan, a Climate Change Strategy and the Climate Change National Action Plan for 2011-2020 were prepared (İklimin, n.d.; T.C Çevre ve Şehircilik Bakanlığı, 2011).

UNFCCC is based on the idea that some countries should take more responsibility because they emit GHG that cause climate change after the industrial revolution more than other countries. The principle of "common but differentiated responsibilities and relative capabilities" envisages countries' contribution to this global effort within their socio-economic conditions. In this context, the Convention divided countries into three groups according to different obligations (T.C. Dışişleri Bakanlığı, n.d.-a). Turkey has a unique position under the UNFCCC negotiations. Special condition of Turkey have been adopted by the decision of the party, and Turkey is the only country under Annex-1 that does not have a transition economy (T.C. Dışişleri Bakanlığı, n.d.-a).

The special condition of Turkey can be explained as follows. In meetings before the Rio Summit, Turkey has located in both Annex-1 with developing countries and Annex-2 where developed countries placed. This situation has led to the evaluation of Turkey's climate policy together with developed countries. Therefore, in 1992, Turkey did not participate in the UNFCCC (Köse, 2018). Turkey, three years after removed

from Annex-2, joined UNFCCC in 2004. In this case, Turkey's special condition has reflected in position in the international climate negotiations agreements. For example, Turkey became a party to the Kyoto Protocol in 2009. However, on the date of acceptance of the Protocol; Turkey was not a part of UNFCCC, hence, Turkey was not included in the list of emission reduction commitments. Thereby, there is no obligation for the reduction or limitation of Kyoto Protocol's first and second commitment to Turkey (T.C. Çevre ve Şehircilik Bakanlığı, n.d.).

Moreover, Paris Agreement, which is the framework for the post-2020 climate change regime, was signed by Turkey (T.C. Dışişleri Bakanlığı, n.d.-b). Since the agreement is not approved by the parliament, Turkey has not yet been a party to the Paris Agreement. While Parliamentary approval of the Paris Agreement continues the US has been withdrawn and also Turkey has suspended the approval process. Therefore, the Paris Agreement has not been ratified by Turkey (Cerit Mazlum, 2019). Since the agreement was not approved in the Parliament and the legal process was not completed, the reduction obligations and commitments required by the Paris Agreement have not been put into effect in Turkey (Köse, 2018). Unlike the UNFCCC, the Paris Agreement brought a categorization into “developed” and “developing” countries by removing the classification of Annex-I, Annex-II, and Non-Annex-I countries (Köse, 2018). However, a list showing which countries are developed and which countries are developing has not been created. Since Turkey is one of the Annex-I countries therefore it considered a developed country within the Paris Agreement (Köse, 2018). In this case, Turkey will not benefit from the assistance fund will be given to developing countries (Çakmakt et al, 2018).

In 2008 “United Nations Joint Program on Enhancing the Capacity of Turkey to Adapt to Climate Change” was conducted (Balaban and Şenol Balaban, 2015; Gedikli and Balaban, 2018). Later, in 2009, “Directorate of Climate Change” was established on national level mitigation and adaptation policies. The Directorate has carried out a pilot project with Bursa Municipality and the British Embassy, and a guideline has been developed for the preparation of the climate change adaptation strategy after this project (Gedikli and Balaban, 2018). Also, according to the Official Gazette decision numbered 31093, it was decided on 8 April 2020 to establish a “Climate Change Department” in the metropolitan municipalities and a “Climate Change Department Directorate” in the provincial and district municipalities (T.C Çevre ve Şehircilik

Bakanlığı and T.C Aile, Çalışma ve Sosyal Hizmetler Bakanlığı, 2020). Within this framework it can be said that Turkey's position in the international climate regime around the special condition (Cerit Mazlum, 2009), Turkey's climate change process at the national level will shape accordingly. At this point, it is important to note that central government is not the only governance unit that develops and implements policies on climate change policies. Therefore, it is necessary to examine practices of local governments in Turkey.

3.4.2 The role of local governments in Turkey

Threats arising from climate change bring risks and new problems to be handled for municipalities. For this reason, it is important for municipalities to take action against these new risks and to establish emergency action plans. In short, it is necessary to harmonize the long-term effects of climate change with the plans of local governments (İklimin, n.d.). It was mentioned in the previous chapters that local governments around the world have developed climate change policies, many of them have made certain commitments to reduce greenhouse gases resulting from their activities within their borders, and thus local governments have overtaken international policy in implementing climate change policies. Local governments in Turkey also implement climate change policies. This section will examine the roles of local governments in Turkey within the concept.

The population of Turkey, compared to the previous year as of December 31, 2019, increased by 1 million 151 thousand 115 people and reached 83 million 154 thousand 997 people (TUIK, 2020). In addition, is also seen the population living in cities is increased. In Turkey, law numbered 6360 has entered into force in 2014. This law includes the establishment of metropolitan municipalities in fourteen provinces and the establishment of twenty-seven districts (Usta et al,2018). In 2011, while 76.8% of the population of Turkey lived in cities, with this law it increased to 92.1% in 2015 (TUIK, 2016). Since major part of the population of Turkey live in the cities, the local governance of climate change has become more important.

In 2009, ICLEI and the Regional Environmental Center (REC) -Turkey coordinated the "Climate Friendly Cities Campaign". Fourteen municipalities participated in this campaign and some municipalities participating in this campaign, for example, Kadıköy and Çankaya Municipalities, have taken important steps in combating climate

change (Demirci, 2015). Within this campaign, guidance has been provided for the preparation of the GHG inventory (Talu, 2019). For example, Kadıköy Municipality started to work on climate change in 2009 and Kadıköy Municipality is the first district municipality in Turkey is beginning to develop urban level climate change action plan (Bütün Bayındır, 2020). Gaziantep is the first metropolitan municipality prepared a climate change action plan in Turkey and this action covers planning, housing, industry, waste, and renewable energy targets (Gedikli and Balaban, 2018). Later, Bursa Municipality prepared a climate change plan in 2015. According to Gedikli and Balaban (2018), Gaziantep Municipality and Bursa Municipality are the municipalities that have developed a strong and concrete climate action plan.

The beginning of this process has helped cities to adopt TMNs. For example, in the project where Bursa Metropolitan Municipality was selected as a pilot region, cooperation with ICLEI was made (Talu, 2019). Experience in preparing climate change adaptation strategies in many cities of Europe in cooperation with ICLEI has been used in this project, and the project outputs have guided not only Bursa Metropolitan Municipality but also other municipalities (Talu, 2019). It can be said that the following process affected the relationship of Turkish cities with TMNs. Many municipalities in Turkey have joined different TMN's. For example, İstanbul Metropol Municipality is a member of C40 (İstanbul Büyükşehir Belediyesi Çevre Koruma Müdürlüğü, n.d.). İstanbul Kartal, Kadıköy, Tepebaşı, Seferihisar, İzmir Metropolitan, Seydikemer, Konya Metropolitan, Çankaya, Nicosia Turkish (Turkish Republic of Northern Cyprus), Gaziantep Metropolitan Municipalities are member of ICLEI (ICLEI, n.d.-b). Moreover, it is known that Bağcılar, Pendik, Şişli, Bayındır and Nilüfer Municipalities have studies on climate adaptation action plan under the guidance of Climate-ADAPT (Talu, 2019). On the other hand, according to Demirci (2015), some of the important developments occurring in Turkey in terms of climate change governance, was realized within the CoM. CoM has twenty-two members from Turkey. These are; Yenimahalle , Bolu, Çorlu, Pendik, Bayındır, Şişli, Bağcılar, Karşıyaka (Erdek-Balikesir), Çankaya, Maltepe, Nilüfer, Tepebaşı, Kadıköy, Seferihisar, Bornova, Karşıyaka – İzmir, Yenişehir district municipalities and, Sakarya, Gaziantep, Bursa, İzmir, Antalya metropolitan municipalities (Covenant of Mayors for Climate and Energy, n.d.-e).

When Turkey's urbanization rate and increasing GHG emissions are considered, it is extremely important to addressing climate change governance by local governments. However, municipalities are given more emphasis on mitigation rather than adaptation (Bütün Bayındır, 2020; Talu, 2019). Although Turkey's environmental policies shaped by the central government, local governments have important roles in the implementation of these policies. In this context, municipalities in Turkey have started to participate in TMNs especially in the last ten years (Bütün Bayındır, 2020).

Since Kadıköy, Tepebaşı and Maltepe Municipalities are the chosen municipalities, in the next chapter, the study will focus on these municipalities as a case study in order to better understand the action plans they have developed under the roof of CoM.

4. CASES: KADIKÖY MUNICIPALITY, TEPEBAŞI MUNICIPALITY AND MALTEPE MUNICIPALITY

In this chapter, general information will be given on practices, plans, and objectives of Kadıköy, Tepebaşı and Maltepe Municipalities. Then, process of making climate change and sustainable energy plans of municipalities will be explained. The three district municipalities selected as cases for this study; all of them and have prepared the Sustainable Energy Action Plan (SEAP) under the guidance of CoM. Semi-structured interviews were conducted with chosen municipalities to understand what actions are being taking on climate change and to understand how TMNs are used by the municipalities. The interviews were conducted with the officials involved in the preparation of the action plans. In the first section of the chapter general characteristics of the cases, the process of making climate change action plans and the interview result will be presented. In the second section, the interview results will be discussed along with the boundary objects properties.

4.1 Kadıköy Municipality

From past to present, Kadıköy has been one of the most important residential areas of Istanbul. The history of Kadıköy dates back to 675 BC (T.C Kadıköy Kaymakamlığı, n.d.). Today, Kadıköy is one of the most important districts of Istanbul in terms of

population size, economic activity and development (T.C Kadıköy Kaymakamlığı, n.d.). Kadıköy is on the Anatolian side of İstanbul. It is surrounded by Maltepe district, the Bosporus, Marmara Sea, Üsküdar and Ataşehir districts (Kadıköy Belediyesi, n.d.-a). As of the end of 2019, the population of Kadıköy is 482,713 (T.C Kadıköy Kaymakamlığı, 2020).

Kadıköy municipality is one of the municipalities in terms of the firsts in Turkey. For example, “Family Counseling Centers” in Turkey for the first time was established on November 8, 1994 by Kadıköy Municipality. In addition, the practice of paying taxes by credit card over the internet for the first time in Turkey was carried out by the Kadıköy Municipality (Kadıköy Belediyesi, n.d.-c). Besides all of these projects, Kadıköy Municipality has known as the most successful municipality in turkey in terms of sustainable energy, climate change, and environmental issues.

Kadıköy Municipality has been involved in many energy efficiency actions both in institutional and district-scale in order to achieve its environmental objectives since 2010. The Municipality signed the "Cities for Climate Protection Campaign" that coordinated by “International Council for Local Environmental Initiatives (ICLEI)” and Regional Environment Center (REC) on 21 June 2009 (Kadıköy Belediyesi, n.d.-d). Thus, Kadıköy Municipality has taken a step towards fighting against climate change, ensuring energy and water efficiency, supporting renewable energy sources, and sustainable urban planning. Later, the municipality has set targets in the corporate strategic plan covering 2010-2014 to fight against climate change and reduce GHG emissions (Kadıköy Belediyesi, n.d.-d). Kadıköy Municipality has carried out many works in line with the Cities for Climate Protection Campaign directives. For example, they announced that it would restrict the use of plastic bags on January 1, 2010, and the use of plastic bags was banned on March 1, 2010 (Kadıköy Belediyesi, n.d.-d). In addition, within the scope of energy efficiency targets, service vehicles belonging to Kadıköy Municipality were replaced by electric vehicles with lower emissions. Four electric vehicles started to be used in 2012 and the number of electric vehicles increased to fifteen in 2013 (Kadıköy Belediyesi, n.d.-d).

It can be said that Kadıköy Municipality accepts the reality of climate change and it is a concerned municipality in this regard. Kadıköy Belediyesi strives to minimize the effects of climate change and spread its negative effects in the long term. According to the Municipality’s Environmental Protection and Control Directorate, the natural

balance has been disturbed due to problems such as industrialization, rapid population growth and unconscious resource consumption. It was also stated that climate change is a situation that must be faced and, every step should be taken more effectively and carefully (personal communication, April 9, 2020).

It was previously discussed in the study that TMNs are important process for the transfer of information and resources and the spread of climate change policies at the local level. Since Kadıköy Municipality benefits from TMNs for action plans, analyzing the relationship between TMNs and Kadıköy Municipality is important.

4.1.1 Use of TMNs by Kadıköy municipality

In this section, general information about how Kadıköy Municipality has been benefited from TMNs will be given. Afterwards, the objectives of the municipalities and the use of TMNs will be detailed with semi-structured interview answers.

Kadıköy Municipality became a CoM signatory in 2012 to achieve its goals. The Climate Change and Energy Efficiency Platform, which includes academics and municipal employees, was established, thus studies for SEAP, which will be prepared within the scope of CoM, have been carried out in collaboration with universities and other institutions (Kadıköy Belediyesi, n.d.-d). As a signatory to CoM, Kadıköy Municipality has committed to reduce GHG emissions by 20% until 2020. Therefore, Kadıköy Municipality started to work to reach its goals by taking 2010 as a base. As mentioned before, CoM signatories should prepare Baseline Emission Inventory (BEI). In line with the objectives determined under the corporate strategic plan, Kadıköy Municipality together with REC Turkey prepared the Corporate Greenhouse Gas Emissions Calculation Project and prepared an inventory on institutional level GHG emissions (Kadıköy Belediyesi, n.d.-d). In this context, many methodologies have been developed to guide the municipalities. Kadıköy Municipality has chosen the International Local Governments Greenhouse Gas Emissions Analysis Protocol (IEAP) method prepared and shared by ICLEI. It should also be noted that, in Turkey, for the first time Kadıköy Municipality calculated corporate GHG emissions at the local level. (Kadıköy Belediyesi, n.d.-b).

With the Paris Agreement, it has been acknowledged that the 20% reduction target for GHG emissions by 2020 is not sufficient. Therefore, increasing the GHG reduction rate to 40% by 2030 has aimed (European Union, n.d.). After the Paris Agreement,

Kadıköy Municipality has updated its works and committed to reducing GHG emissions by 40% percent by 2030. This commitment was signed in 2018, and CoM commitment has been updated (Kadıköy Belediyesi, n.d.-e). Later, the municipality started preparations for a climate action plan. It was stated that the preparation process of SEAP and adaptation plans requested by Global Covenant of Mayors (GCoM), has become basis for the climate change action plan. In 2017, the Municipality was entitled to receive a grant with the "Kadıköy Municipality Integrated and Participatory Climate Action Project" under the "Capacity Building in the Field of Climate Change in Turkey Grant Program" created by the "Central Finance and Contracts Unit" (CFCU). As a result of the grant received, the climate action plan, which is a requirement for CoM; The Sustainable Energy Action Plan was prepared by updating and completing adaptation studies. Kadıköy Municipality is also a member of ICLEI. The reason why the municipality became a member of ICLEI in 2017 has been stated as the participation in European Union projects and the acceleration of the admissibility process (personal communication, April 9, 2020).

As can be seen, the municipality was able to implement climate action plans with TMNs guidance. At this point, it is important to clarify the TMNs process and how it helps the municipality. According to I-1[3] (Interviewee-1) both from Turkey and many different countries around the world are benefiting from TMNs guidance (personal communication, April 9, 2020). One of the features that make TMNs attractive is that they appeal to many local governments with different populations and scales (personal communication, April 9, 2020). This means that there can be many examples and practices on the TMNs. In this case, the CoM web page is often used by the municipality to monitor which cities and local governments are involved in the country (personal communication, April 9, 2020). Thus, while determining the climate change targets that suitable for the local, the studies conducted within the country were followed. In addition, local governments in Europe were followed and good practices were researched and evaluated (personal communication, April 9, 2020). In short, CoM's contribution to the process of preparing climate action plans has evolved to examine and investigate the practices of other actors. As a matter of fact, while preparing the climate action plans, Kadıköy Municipality examined different actions

[3] An official from Kadıköy Municipality.

and practices and included them in its own action plans (personal communication, April 9, 2020). In addition, CoM has been involved in this process as an encouraging and guiding actor (personal communication, April 9, 2020). It should be mentioned here that the municipality needed consultancy service from Demir Energy Consulting during the uploading of CoM data (personal communication, April 9, 2020).

As mentioned in the previous chapters of the study, TMNs contribute to the climate change problem on a local scale by offering many different elements such as inspiration, knowledge, experience, capacity, concrete projects, financial aid and good practices to local governments (Barbi and de Macedo, 2019). In the meantime, it is also known that TMNs emerged as mediators between the climate change science and policy making. From this perspective, it is important how TMNs present scientific outputs to local governments within the scope of policy making. According to I-1, scientific data was needed during the climate action plan preparation phase. It is important to investigate the past periods to prepare a plan for the future (personal communication, April 9, 2020). In this process, the municipality tried to access scientific data locally. It was stated that the local data is more accurate, practically applicable and much easier to access (personal communication, April 9, 2020). At that time, CoM has helped reflect the climate science to the municipality's action plans, by facilitating the implementation of new objectives set by the Paris Agreement (personal communication, April 9, 2020). In addition, it is stated that CoM has different guides on these issues. These guides contain descriptive information both in explaining the actions required in the preparation of climate action plans, such as preparing the GHG inventory, and on climate change science (personal communication, April 9, 2020).

In the interview with Kadıköy Municipality, it was highlighted that the guides prepared by TMNs (CoM) are both encouraging and guiding resources. In this process, TMNs offered the opportunity to see, follow and be informed about the municipalities that are working towards the same goal. According to I-1, TMNs are beneficial in terms of which way and method can be used in climate action plans with the sharing of up-to-date information through interactive meetings and examples of practices. For this reason, benefiting from TMNs is important for effective practices. In this way, municipalities can save time and determine proper goals (personal communication, April 9, 2020).

Overall, the examination of climate change related plan making history and the semi-structured interviews revealed that CoM's guides are used by Kadıköy Municipality effectively in the action plan preparation, and CoM was especially helpful in the investigation of the methods and actions taken by other local governments. Kadıköy Municipality is continuing to benefit from TMNs participating in conferences organized by CoM and ICLEI and following up-to-date information on their websites.

4.2 Tepebaşı Municipality

Tepebaşı, which is geographically located in Central Anatolia, is a district of Eskişehir City. Tepebaşı became a district in 2008 and located in the north of Eskişehir city center (T.C Tepebaşı Kaymakamlığı, n.d.). Tepebaşı Municipality has many artistic and social projects that appeal to children, young people and the elderly. In order to support children's various art skills, Özdilek Art Center was established in 2006 (Eskişehir Tepebaşı Belediyesi, n.d.-d). In July 2011, "19 Mayıs Youth Center" was established, which young people can interact, share knowledge and skills with each other (Eskişehir Tepebaşı Belediyesi, n.d.-a).

Besides all these social activities, Tepebaşı Municipality is known for its climate change and sustainable energy actions. The municipality's activities to deal with climate change include the use of electric and hybrid vehicles in transportation, the use of solar panels in local electricity generation, and the efficient use of energy in municipal service buildings (Eskişehir Tepebaşı Belediyesi, 2019).

Tepebaşı Municipality started energy efficiency practices with the determination of the current state of the service building (Eskişehir Tepebaşı Belediyesi, n.d.-b). In order to meet approximately 20% of the electricity need in the municipality's service building, a solar power plant was built. This project was launched in 2011 within the scope of the targets for low emissions (Eskişehir Tepebaşı Belediyesi, n.d.-b).

Another project carried out by Tepebaşı Municipality is the "REgeneration MOdel for accelerating the smart URBAN transformation project" (REMOURBAN). With the REMOURBAN Project, which started in 2015, it contributes to the goals of Tepebaşı Municipality with the improvement and energy activation of the buildings

reconstructed in Yaşam Köyü[4] with ecological sensitivity, and the transportation practices with low air pollution and carbon dioxide emissions (Eskişehir Tepebaşı Belediyesi, n.d.-b).

4.2.1 Use of TMNs by Tepebaşı municipality

This section will focus on semi-structured interview with the municipality to express its relationships with TMNs.

To take local measures against climate change, Tepebaşı Municipality became a CoM signatory in 2013 and committed to reduce carbon emissions by 23% until 2020 (Eskişehir Tepebaşı Belediyesi, 2019). In this context, Tepebaşı Municipality, prepared long-term targets covering all sectors in the region and determined a road map. Tepebaşı Municipality was one of the first three municipalities to prepare interim reports containing data between 2016 and 2018 (Eskişehir Tepebaşı Belediyesi, 2019).

In interviews with Tepebaşı Municipality, it is revealed that CoM is a starting point for these projects. It has been highlited the reason for becoming a member of CoM is to reduce the emissions in the city, raise the awareness of the citizens, and follow good examples (personal communication, April 10, 2020). As it stated by the municipality, becoming a CoM signatory is important to conduct an integrated sustainable energy action (personal communication, April 10, 2020). For example, the REMOURBAN project has emerged as a project that covers activities that will increase energy efficiency in the region in order to prepare the reports requested by CoM (personal communication, April 10, 2020). It is also stated that this project is a performance criterion for the effective and sustainable energy services of the municipality (personal communication, April 10, 2020).

Considering the relationship of the municipality with TMNs, the municipality benefited from both ICLEI and CoM in this process. With the decisions taken in the municipality in 2010, it was decided to increase energy efficiency. Therefore, Sustainability Center has been established that ensures the implementation of sustainable development goals following the institution's policies, and the municipality has been benefited from ICLEI within this process (Eskişehir Tepebaşı Belediyesi,

[4] Yaşam Köyü, which was implemented with the REMOURBAN project, is a community center that provides services such as guesthouses for Alzheimer patients, playgrounds, and nursery for children, and a physiotherapy center (Eskişehir Tepebaşı Belediyesi, 2020).s

n.d.-b, n.d.-e). In a sense, ICLEI membership has been a factor that supports the sustainability center.

On the other hand, CoM guided the municipality to prepare events on sustainable energy. According to the I-2[5] (Interviewee-2), the municipality voluntarily tries to complete this entire process. In addition, it was stressed that Tepebaşı Municipality is the first municipality that prepared these events in Turkey (personal communication, April 10, 2020). One of the important points is that these events are held especially to inform citizens. The municipality emphasized that they are trying to do these processes requested by CoM to deal with climate change as much as they can (personal communication, April 10, 2020). In this context, the best services provided by CoM to the municipalities is stated as helping to monitor performance and following the practices of other municipalities (personal communication, April 10, 2020).

In the interview with the municipality, it was stated that CoM did not provide any scientific information about climate change, but prepared reports to guide the municipalities based on the existing scientific information. In this context, it was also stated that CoM is a good starting point for preparing and implementing the plans of the municipalities (personal communication, April 10, 2020).

Based on the interview it can be said that, Tepebaşı Municipality prepared effective climate action plans and activities with the help of CoM. However, it was also stated that in the interview, there were difficulties in the process. I-2 emphasized that each municipality has its own structure. In this context, the standard form offered by CoM would not be appropriate for every local government (personal communication, April 10, 2020). As it stated by I-2, there was no guidance especially on collecting the requested data hence the process has been quite difficult.

Although municipal officials are competent to manage the entire process, consultation service was needed to ease the workload due to the different responsibilities of the officials (personal communication, April 10, 2020). According to I-2, outsourcing brings efficiency to the institutions. Therefore, consultancy support from Demir Energy Consultant was received for the completion of the scientific information about climate change and for the continuation of the process more effectively (personal

[5] An official from Tepebaşı Municipality.

communication, April 10, 2020). Apart from the consultancy service, the municipality has also worked with academicians and non-governmental organizations during the preparation of the climate action plan (personal communication, April 10, 2020).

Tepebaşı municipality continues its activities within the scope of dealing with climate change. As it presented in the interview results, TMNs helped the municipality on issues such as following different examples, meeting targets, monitoring performance, and organizing events for public awareness. In addition, it stated that SECAP studies will be started within the scope of CoM commitments, however the process has been delayed due to the Covid-19 outbreak (personal communication, April 10, 2020).

4.3 Maltepe Municipality

It is known that the Maltepe region is a very old settlement of İstanbul City. Maltepe became a district of Istanbul on 3 June 1992 (T.C Maltepe Kaymakamlığı, n.d.-b). The district is located in the southwest of Kocaeli Peninsula, on the shores of the Marmara Sea of Istanbul (T.C Maltepe Kaymakamlığı, n.d.-a). It is adjacent to Kartal, Ataşehir, Sancaktepe, and Kadıköy districts and has an area of 50 km² (T.C Maltepe Kaymakamlığı, n.d.-a). Maltepe municipality has a little more than 3% of İstanbul's population (Covenant of Mayors for Climate and Energy, n.d.-d). In addition, Istanbul meets most of its water need from Maltepe district (T.C Maltepe Kaymakamlığı, n.d.-a).

Like Kadıköy and Tepebaşı Municipalities, Maltepe Municipality provides many services. In order to create equal opportunities in education, the municipality provides free ring services to schools in eighteen neighborhoods. Moreover, eleven-thousand students received education in various courses offered by the municipality in three years (T.C. Maltepe Belediyesi, n.d.-a). A center was also established to support disabled citizens (T.C. Maltepe Belediyesi, n.d.-d). Maltepe Municipality provides nursery services to children of low income citizens with “Child Care Houses” (T.C. Maltepe Belediyesi, n.d.-b).

As in the other cases, Maltepe Municipality is working on the environmental issues and fighting against climate change. Maltepe Municipality became a CoM signatory on October 8, 2014 (Maltepe Belediyesi, n.d.). The two main sources of GHG emissions in Maltepe are emissions from buildings and transportation (Covenant of

Mayors for Climate and Energy, n.d.-d). In this context, the municipality made a voluntary commitment to reduce CO_2 emissions by 2020 and continues to work in this direction. The municipality especially carries out waste management actions. Maltepe municipality also cooperates with the Regional Environmental Center (REC) and ICLEI (T.C. Maltepe Belediyesi, n.d.-c).

4.3.1 Use of TMNs by Maltepe municipality

In this section, how and for what purpose Maltepe Municipality benefited from TMNs will be evaluated within the framework of the interview.

The municipality has started working with TMNs in order to comply with the planned targets. TMNs guidance has been a driving force and supporter to take action in combating climate change achieve goals and follow the process (personal communication, May 1, 2020). It was decided to prepare climate action plans and take measures to deal with climate change (personal communication, May 1, 2020). According to I-3 (Interviewee-3)[6], the presence of TMNs constitutes institutional responsibility for climate change. In this context, practices in Turkey have been examined, and inspired by Kadıköy Municipality, it was decided to work with CoM (personal communication, May 1, 2020). The Municipality has prepared a SEAP within the scope of CoM commitments (Maltepe Belediyesi, n.d.). GHG protocol has used during Baseline Emission Inventory (BEI) preparation (Maltepe Belediyesi, n.d.). This protocol has been prepared by the "World Resources Institute and the World Business Council for Sustainable Development" and is widely used (Greenhouse Gas Protocol, n.d.). The "2006 IPCC Guidelines for National Greenhouse Gas Inventories", which is developed by IPCC, were also used for the preparation of the urban-scale GHG release document (Maltepe Belediyesi, n.d.). The municipality also benefited from IEAP that is prepared by ICLEI (Maltepe Belediyesi, n.d.). With IEAP, GHG emission control of the Municipality has been facilitated. In addition, the outputs obtained from different communities' activities were brought together and a database was created. (Maltepe Belediyesi, n.d.). After becoming a CoM signatory in 2014,

[6] Interviews were made with two officials from Maltepe Municipality. I-3 is the first official interviewed.

Maltepe Municipality completed the SEAP in 2016 (personal communication, May 1, 2020).

Being a CoM signatory motivates the municipalities to work in order to achieve the goals and also helps to follow the process (personal communication, May 1, 2020). In this respect, according to I-3, CoM is a platform where actions and practices can be carried out in an organized manner. After preparing the BEI, good practices of CoM have examined to achieve mitigation. These good examples have inspired the projects to be carried out to achieve the GHG mitigation aims of Maltepe Municipality (Maltepe Belediyesi, n.d.). In addition, it was emphasized by I-4[7] (Interviewee-4), that the municipality participated in a project called CityFied. CoM has been used in participating and researching this project. In this way, Maltepe Municipality met with other CoM stakeholders and exchanged information (personal communication, May 6, 2020).

In the process of transferring scientific data to policy, the municipality needed consultancy service from Demir Enerji. However, compared to other municipalities, there is a different situation for Maltepe Municipality. According to both I-3 and I-4, climate change is a subject that requires a different specialization. Since there is no necessary experience in this regard, the municipality needed consultancy service from Demir Enerji. Nevertheless, according to I-4, within the process the officials gained experience and it was stated that they will be involved in the preparation of the next updated reports (personal communication, May 6, 2020). Although the municipality needed consultancy support, the process of preparing climate action plans was followed and experience was gained. In this process, it was stated that Demir Enerji have used a number of formulas and calculations prepared by IPCC to perform calculations and analysis of data (personal communication, May 6, 2020). The municipality also observed the points where CoM could be inadequate during the process. According to I-4, the practices of municipalities may not coincide with the reports that should be prepared within the scope of CoM. Therefore, many municipalities cannot fulfill their commitments. It was also emphasized that the main reason for the failure of many municipalities to fulfill their commitments is that the CoM's drafts are prepared based entirely on the activities of the IPCC, regardless of

[7] I-4 is the second official interviewed from Maltepe Municipality.

the district policies, and that the characteristics of local governments are ignored (personal communication, May 6, 2020). Also, according to I-4, CoM does not control whether municipalities' commitments are actually succeed. In other words, it is stated that CoM does not have a control mechanism (personal communication, May 6, 2020). I-4 stated that during the approval process of the SEAP, CoM did not contact the municipality in any way and SEAP was approved after a while.

It should be noted that, compared to other municipalities, Maltepe Municipality could not fulfill its commitments for 2020. Although the lack of experience, work intensity, and the points where CoM is inadequate are stated in the interview, the main reason for the municipality's failure to fulfill its commitments has been highlighted as changes in both in Turkey and the municipality during the SEAP process (personal communication, May 1, 2020). Despite some setbacks, in the case of Maltepe Municipality, it can be said that TMNs are used to follow up processes and different practices, motivation and communicate with other stakeholders besides prepare action plans.

Overall, the chapter, general information is given on how municipalities benefited from TMNs to deal with climate change. Municipalities have carried out various practices for climate action plan preparations and in this context they needed consultancy service from Demir Energy Consultancy. In this context, a semi-structured interview was held with the company on the role of TMNs on climate change, services, activities and how local governments used TMNs. In order to better understand TMNs, next section will primarily present the interview with Demir Energy Consultancy.

4.4 Consultancy on Climate Action Plans in Turkey

During the examination it was revealed that there is a certain consultancy (Demir Energy) company which involves climate action preparations in Turkey. In the study, it has been also revealed that the studied cases benefited from this company especially for technical knowledge requirement in the climate change action plans. In addition, it has been determined that municipalities needed consultancy service in order to save time, meet the personnel need and continue the process more effectively. All of the municipalities examined in this research utilized the consultancy company at some

point. Therefore, Demir Energy's experiences are important in order to understand the action of local governments and to understand it's relationship with TMNs.

Demir Enrgy Consulting, is a company consisting of team members who took part in pioneering and innovative projects in the industry, providing project management and consultancy services on issues such as climate change, carbon credit development, renewable energy (Demir Enerji, n.d.). One person in particular leads the company's work. Within this scope the company has worked and developed projects with many different municipalities in Turkey such as Kadıköy Municipality, Tepebaşı Municipality, Maltepe Municipality, Nilüfer Municipality, Bursa Metropolitan Municipality and İstanbul Metropolitan Municipality. In addition, the company has been involved in many international projects.

In the interview, what have been done in the deal with climate change and company's opinions about how TMNs are used in Turkey have been asked. It has been indicated that along with the problems caused by climate change, the interest in climate adaptation plans has increased. The process of fighting climate change in Turkey began with a pilot initiative of the Ministry of Environment and Urbanization (personal communication, March 26, 2020). According to the I-5[8] (Interviewee-5), although the cities' interest in climate and energy issues has increased in Turkey, it still takes the backseat and remains secondary. On the other hand, the existence of the climate change science and the availability of the data have made the situation much clearer. Also, it has been highlighted that climate change science has a parallel relationship with both the public and the political community (personal communication, March 26, 2020). In addition, business owners have become increasingly concerned about how climate change will affect the industry and the economy (personal communication, March 26, 2020). When this is the case, local governments need to take action. In this context, TMNs began to emerge to mobilize cities. According to I-5, the data and scenarios updated by IPCC are reflected as locally as possible with the help of TMNs thus the current data of climate change science can be directly reflected in the plans of the local governments. Accordingly, although different actors have an impact on the implementation of the decisions taken at the local level, it has been stated that TMNs

[8] An official from Demir Enerji.

have an important role in transferring the science of climate change to the policy agenda (personal communication, March 26, 2020).

Considering the role of TMNs between climate change science and policy making, the practical relationship between municipalities and TMNs should also be examined. According to I-5, TMNs facilitate the practices of municipalities by providing them a clear definition of climate action plans in dealing with climate change. In particular, CoM offers a very clear definition to local governments. Therefore, with definitions that put forward by CoM, all municipalities can understand the practices in the same way (personal communication, March 26, 2020). To better understand this claim, CoM commitments for climate action plans should be remembered. Within the scope of CoM, municipalities prepare two separate inventories and determine their sources. As known, at the beginning, municipalities have made commitment to reduce emissions by 20% until 2020. After the Paris Agreement, both mitigation and adaptation have included in the process. It was stated that CoM offers very clear and well-prepared documents and reports, thereby the whole process is defined very well by CoM (personal communication, March 26, 2020). In this context, it was determined that the consultancy company serves to municipalities for saving time, providing personnel and expert support (personal communication, March 26, 2020).

Apart from guiding municipalities' to climate action policies, I-5 highlighted that TMNs have different functional features. For example, TMNs create a competition environment and also TMNs are platforms that giving prestige especially to the mayors (personal communication, March 26, 2020). Furthermore, it was stated that TMNs are used in process monitoring, learning different practices of other local governments, developing cooperation and strengthening communication (personal communication, March 26, 2020).

As a result of the examination, it has been revealed that the municipalities are conscious about preparing climate actions plan and taking a part to deal with climate change. In this context, they have developed many different projects and actions with TMNs guidance. Documents prepared by TMNs have been described as encouraging and guiding resources for municipalities. It is also stated that they offer the opportunity to follow and be informed about the municipalities that are working for the same purpose. In addition to preparing climate action plans, they influence the actions of municipalities by sharing up-to-date information and presenting good practices. In this

way, being in such a platform for an effective process help saving time and determining municipalities' own goals. Morover, the promotion of local governments to the world on an international platform is emphasized as a separate feature.

On the other hand considering the details of the research, it is noticeable that this process is not very easy, consultancy service is needed at some point and TMNs' guidance might still be too technical (scientific) to use in the plan making and action organization. However, given the gap between climate change and policy, it cannot be ignored that TMNs have mobilized local governments and encouraged them to work on climate change. With all these arguments, it was tried to be revealed how TMNs used and what features they have.

In the next chapter, the data driven from the research related to municipalities will be analyzed in the boundary object concept to present the general discussion and test the hypothesis of the study. To make this analysis, the properties of TMNs will be analyzed with in the boundary object properties distilled from the literature.

5. DISCUSSION

In the previous chapter, general information is given on how municipalities benefited from TMNs to deal with climate change. Municipalities have carried out various practices for climate action plan preparations. All three municipalities have benefited from the consultancy company regarding the processes under TMNs. Within this process, Kadıköy Municipality has benefited from the consultancy company for more technical operations, while Tepebaşı and Maltepe Municipality have benefited more extensively to manage the entire process more efficiently in terms of time and context.

In this chapter, results of the study will be analyzed in the scope of hypothesis of the study to present. In order to make this analysis, the properties of TMNs will be analyzed with the boundary object properties according to the interview and literature review results.

5.1 Evaluation of TMNs in Boundary Object Concept in Kadıköy, Tepebaşı and Maltepe Municipalities

In the study, it has been discussed that TMNs have an important role in the gap between climate change science and policy, and in this section it will be examined that whether TMNs act as boundary objects. As expressed in the previous section, the three municipalities benefit mostly from the CoM and additionally receive support from ICLEI. Therefore, in this section, TMNs will be evaluated primarily in relation to CoM and time to time ICLEI's guidance will be also indicated.

To analyze whether TMNs act as boundary object, properties of boundary object were determined based on the literature. In order to provide detailed information as well as interviews, a literature review was conducted on the web pages of the municipalities and the documents that prepared by the municipalities for TMNs commitments. Based on this literature review and semi-structured interviews with municipalities and Demir Energy in this part of the study, it will be discussed whether TMNs reflect these properties. It should be highlighted again, the consultancy company has been involved in the TMNs process within the climate action plans of all three municipalities and has more practical experience with TMNs. In order to analyze, each boundary object properties will be evaluated by the findings from interviews and literature review.

To conduct the study cases were selected as three municipalities from Turkey. As stated in the methodology section, result of these case studies cannot be generalized without further studies or triangulation. Therefore, the results revealed in this section valid for three municipalities chosen for the case study.

The properties that were previously distilled from literature and which will be used in the analysis of the interview results are as follows:

Property 1 - Provide flexible and plastic guidance for adaptation to local needs

Property 2- Serving as a means of communication between actors

Property 3 - Enabling coordination, collaboration and mediating changes between boundaries

Property 4- Providing information, shared language and translation

In the following chapter first, meanings of properties and how they are located in the cases will be presented. After that, it will be discussed whether TMNs encompass these properties in the studied cases.

Property 1: Provide flexible and plastic guidance for adaptation to local needs

While the boundary objects by bringing different actors maintain the autonomy of the actors, they adapt the different perspectives of these actors for a common purpose. In other words, boundary objects are flexible and plastic objects located at the interface between communities and capable of bridging the differences of these communities (Lynch, Lee, and Rebecca, 2008). This fluidity of boundary objects means that they can be subjected to multiple interpretations for the purpose (Star and Griesemer, 1989; Turner, 2017). For example Star and Griesemer (1989), in their study, where they introduced the boundary objects, discovered that boundary objects were used, which can combine different views of different actors working in the museum and provide the interests of these actors while protecting the scientific goals of the museum. As it is known, TMNs guide cities in dealing with climate change, that is, the common purpose of the cities that are members of these networks is to develop set of practice against climate change. In this context, Property – 1 (P-1) defines the process of bringing together different actors for the same purpose and reflecting different meanings for these actors. It is important to explain what "different meaning" is. TMNs commitments are clear and have no different meaning for actors. For example, at first, CoM commitments were to reduce GHG emissions by 20% until 2020. After the Paris Agreement scientific authorities acknowledged that this rate would be insufficient and it was emphasized that emissions should be reduced by 40% until 2030. CoM has updated its commitments and documents, taking into account these scientific outputs, and has started to provide guidance to its members with its updated objectives. In this case, reducing the emission rate does not mean different things for actors, goals and objectives are clearly stated. What is different for the actors here is that the actions and practices to be carried out for the purpose. For instance, CoM member city of Križevci has developed a project to install a solar panel plant on the roof of the municipality's Development Center and Technology Park administrative building to reduce the emission rates to the specified level (Covenant of Mayors for Climate and Energy, 2020b). On the other hand, the city of Barcelona has started to

develop a methodology to use insurance data in its mitigation and adaptation policies (Covenant of Mayors for Climate and Energy, 2020a).

Every local government have its own scale, structure and practices. Therefore, it is not possible for them to act in exactly the same way for a common purpose. For example, there are more than ten thousand local governments with different features that members of CoM. Boundary objects come into play here. Given the importance of local governments ability of reduce the gap between climate change science and policy, TMNs need to provide flexibility to cities to realize their commitments. Therefore, with P-1 whether TMNs provides flexibility as part of their commitments will be discovered.

It is known that there are documents that need to be prepared for CoM commitments. While guiding how to prepare these reports, CoM also allows municipalities to use their own preferences. The point to be considered here is that municipalities act for a common purpose regardless of what methods they use. It was revealed with the research that Kadıköy, Tepebaşı and Maltepe Municipalities prepared climate action plans by examining different practices within the CoM as a method. This point has also indicated by the consultancy company. For example, Kadıköy Municipality was able to reflect the measures to be taken for CoM's 2020 commitments to its services, and started working for 2030 commitments. The municipality has been planning to reduce GHG emissions with the "Integrated and Participatory Climate Action Project" in order to fulfill the 2030 commitments of CoM (Kadıköy Belediyesi, n.d.-d). Furthermore, I-1 emphasized that the updates made with GCoM after the CoM commitments constitute a basis for the climate change action plan and facilitate the process (personal communication, April 9, 2020).

I-1: With the emergence that adaptation is also necessary in combating climate change, CoM and GCoM updates have become a basis for our Climate Change Action Plan preparations, which are among our activities (personal communication, April 9, 2020).

It can be argued, in order to update existing commitments and prepare members for a new process, CoM and GCoM provided the flexibility and plasticity.

Another example, it was stated that after the decision taken in 2010 within the Tepebaşı Municipality to increase the energy efficiency studies, decrease the emission rate in

the city, raise the awareness of the citizens and to follow good examples, CoM guidance was used.

In the interview with Tepebaşı municipality, there are points experienced and highlighted within the scope of P-1. As stated by I-2, w*ith the decisions taken within the municipality in 2010, it was decided to increase the energy efficiency activities. We preffered CoM to reduce the emission rate in the city, to raise awareness of the citizens and to follow good practices. Thus, CoM has been a guide for us to carry out an integrated energy activities* (personal communication, April 10, 2020).

In this context, municipality started energy efficiency studies and started REMOURBAN project in order to fulfill CoM commitments. Additionally, SEAP and other reports requested by CoM were completed within two years with this project.

I-2 explained the details of the project as follows: *We started to work to increase energy efficiency in the region in order to prepare the documents requested by CoM. In this context, we prepared the REMOURBAN project in 2015. With this project, urban transformation was made and Yaşam Köyü was established. Solar panels were placed on the buildings and parking lots, and also heat systems have been updated and made efficient. This project has become a performance benchmark for our energy efficient services* (personal communication, April 10, 2020).

Furthermore, a sustainability center has been established to make policies within the municipality, inspired by ICLEI for the implementation and localization of sustainable development goals. In other words, the municipality aimed to provide a service by organizing its local applications within the scope of ICLEI. In this context it can be assumed that both CoM and ICLEI have provided the municipality with the flexibility to create its own project in order to fulfill its commitments.For the Kadıköy and Tepebaşı cases, TMNs are a tool that is flexible enough to adapt to local needs and used to common purpose. It can also be said that these TMNs are plastic for both municipalities. As in the example of the museum mentioned at the beginning of the section, TMNs seem to be the objects that bring together different actors and considering interests of the actors while protecting their own goals. At this point the interview with consultancy company reflects the same opinion. According to the result of the research carried out in the study, local governments can act for a common purpose by selecting the most suitable types of plans for them provided by CoM. To

be more precise, consultancy company stated that the policy commitments put forward by CoM provide the flexibility to be evaluated by the municipalities in terms of their own resources, budget and potential (personal communication, March 26, 2020).

Maltepe Municipality has planned to establish a service building with green building features, develop services on solar panels and gray water use and to benefit from solar energy in parks lighting for CoM's commitments (personal communication, May 1, 2020). Because of the changes that occur in Turkey and the Maltepe Municipality, the municipality couldn't implement these plans. Although the municipality's plans have not been implemented, it can be said that CoM has provided the municipality with the flexibility to make its own plans. However, it is important to note that officials in Maltepe municipality differ in their evaluation of CoM in terms of the *being pastic enough*. For example, I-3 expresses that

> w*e made a promise as an institution. As an institution, we started to work with TMNs in order to comply with the planned limits. As the municipality, we wanted to carry out a study on combating climate change and we used TMNs guidance to fulfill these requirements. In order to achieve these goals, you can start working and follow the next process. It can be said that TMNs are an organized working platform. You start to work in accordance with the purpose and they also offers you a service where you can follow international activities closely* (personal communication, May 1, 2020).

On the other hand, , I-4 stated that

> *CoM does not provide a guide on how to prepare the requested documents. In addition, the reports prepared within the scope of CoM and the practices of municipalities may not match. This is a problem even if your policy and plans are ready. One of the main reasons why municipalities can not fulfill their commitments because planned activities are based on IPCC and they are independent of district policies, hence the characteristics of local governments are ignored. We are the district municipality and there are policies determined for us on the basis of provinces and also the district has its own policy. While this is the case, when it is anticipated that emissions from transportation can be prevented by electric vehicles, the question arises such as whether we have a budget or not. We could not fulfill our 2020 commitments. Good practices are available on CoM's web page, but not every municipality's situation has been taken into account. Thus, CoM's guides are very general. There is no specific guide for the characteristics of a city or district. You promise to lower your emission rate, but CoM doesn't control how you do it or whether you actually do it* (personal communication, May 6, 2020).

In this case, it should be taken into consideration that the three municipalities receive consultancy services and this company involved in the whole process in the case of Maltepe Municipality. According to I-5,

> *in particular, CoM offers a very clear definition of climate change and what should be done. Therefore, with this definition all municipalities can understand the same thing. Within the scope of CoM, the municipalities prepare two separate inventories for themselves and the city. They determine their sources, energy consumption and emissions. After the Paris Agreement, both mitigation and adaptation were included in the process and they were all very well defined by CoM. The document presented by CoM is very clear and well prepared. That is why we use these CoM templates in our work with municipalities* (personal communication, March 26, 2020).

As seen in the example of Maltepe, although CoM has presented a purpose to the municipality in combating climate change and directed the municipality to the preparation of targets and plans, it is seen that there were difficulties in practice and CoM could not help in this manner. On the other hand, although the municipality is not involved in the whole process, it is seen that there are opposing views on the perception of whether CoM was being plastic enough.

Property 2: Serving as a means of communication between actors

Serving as a means of communication between actors means that boundary objects provide a common space for actors to communicate. According to Star and Griesemer (1989), boundary objects can be used as common communication methods between dispersed workgroups (Star and Griesemer, 1989). For example, the authors state that in their work a form was created for a group of actors to fill in line with the information they obtained. Through the use of form, the information was standardized and it has been used by the other actors, hence communication was provided between different actors (Star and Griesemer, 1989). For instance, it is known that different municipalities can develop different practices with the guides provided by CoM. Therefore, it will be examined with P-2, whether the municipalities that need different knowledge and experience practices can establish this type of communication through TMNs.

To give an example of this type of communication, CoM conducted an event named *"Small Talk with the Mayor - Get to know the Covenant Community in Eastern Europe and South Caucasus!"* in 2020. Thousands of participants from Eastern countries

gathered on different online platforms to give speeches and share ideas diffrent topics such as clean energy, green spaces and participate in virtual competitions. During these events, insights, practices and measures were shared (Covenant of Mayors for Climate and Energy, 2020d).

As another example, CoM's website included a seminar announcement named *"Greening our cities with district energy"* on how to work together with policy makers and other actors to make the heating and cooling sector carbon neutral.

As can be seen, CoM provides direct or indirect communication between different actors about different policy examples and how they work with policy makers to deal with climate change. The outputs of this webinar are stated as learning new pilot cases, generating solutions for successful projects, meeting and sharing experiences with like-minded people (Covenant of Mayors, 2020d). In addition to this event and webinar, CoM also provides an indirect communication environment by sharing projects and programs offered by itself or by different platforms through its website. One of the striking points here is that more than one boundary object is involved in the process. Star (2010) mentions that diffrent *outsiders* involved in the process have the potential to initiate other boundary objects. In other words, when different social worlds intersect, more than one boundary object can be formed and these objects can initiate a nested cycle (Star, 2010).

It is important to mention that this is one of the most emphasized property of TMNs in interviews with municipalities. Kadıköy Municipality has been indicated that TMNs offer the opportunity to see, follow and be informed about the municipalities that carry out different studies for the same goal (personal communication, April 9, 2020). Thus, municipalities can save time and determine suitable targets. In this context, the municipality has been researching up-to-date information and evaluating different practices by following local governments in Europe via the CoM's and ICLEI's web pages (personal communication, April 9, 2020). At this point I-1 stated that *we participate to online conferences organized by TMNs and try to follow up-to-date information on their websites. Thus, we have the chance to investigate the methods and activities implemented by other local governments and add them to our plans* (personal communication, April 9, 2020).

Furthermore, Tepebaşı Municipality emphasized that good examples can be analyzed with TMNs, and thus the municipality can update its climate actions. In addition, it was stated by I-2 that as a tool CoM helps develop applications by allowing monitoring different performances.

On the other hand, Maltepe Municipality directly emphasized that TMNs can be used to communicate with other municipalities and that they are informed about what kind of measures are taken politically on climate change at the local level. I-3 explained this process as follows: *It helps you get in touch with other municipalities. It allows you to see the applications. You will be informed as soon as possible about what has been done regarding climate change locally* (personal communication, May 1, 2020).

Within this scope, Tepebaşı and Maltepe Municipalities have prepared their own action plans by following different practices and plans through this communication provided by CoM. The consultancy company indicated that TMNs provides communication between the actors and allows municipalities to be aware of each other. According to given example by consultancy company, sometimes the use of green spaces can be misunderstood by the municipalities, however, they can learn the correct use of green space practices by communicating through CoM.

Considering the results, it can be said that TMNs play the role of "the form" in the example of Star and Griesemer (1989). Moreover, as can be seen in the example of green space use, TMNs can be effective in the climate change science and political actions of actors while providing communication. In other words, TMNs can be evaluated as objects that can providing communication on scientific knowledge and political practices between actors mostly indirectly at the international level.

Property 3: Enabling coordination, collaboration and mediating changes between boundaries

This property means the "things" that enables cooperation between the actors who want to accomplish something, that is, the objects that contribute to actors to act together and make a shared space together (Lahn and Sundqvist, 2017). To share meanings across boundaries ,as mentioned with P-1, actors should establish a common area of practices (Levina and Vaast, 2005). Actors need to transform their practices in local environments to establish this area. In this process, boundary objects are used to achieve cooperation by adapting to the interests of multiple parties (Hsiao et al, 2012).

For example, City of Uppsala, one of the CoM's members, established the “Climate Protocol” organization. In this organization, local governments, scholars, universities, private companies and non-governmental organizations have worked together for the 2020 commitments and the partnership is currently working for 2030 goals (Covenant of Mayors for Climate and Energy, 2020c). As can be seen in this example, CoM commitments have been moved to the local scale and a cooperation area has been established.

In addition, ensuring cooperation and between actors reflects the role of mediation between different social worlds such as science and policy. Whether TMNs have a mediator role between climate change science and climate change policy by bringing together different actors and let them cooperate will be analyzed under this property.

As a result of the research, different practices are seen on cooperation and coordination in the cases. The municipalities have been developed local, national and international collaborations within the TMNs process. For example, Kadıköy Municipality have held meetings with experts on issues such as revising carbon emission targets and preparing SEAP template. I-1 gave the following example in this context: *Within the scope of CoM, we carried out our efforts for the preparation of SEAP in cooperation with the Boğaziçi University - Sustainable Development and Cleaner Production Center* (personal communication, April 9, 2020). In addition, the municipality has set up working groups to announce and disseminate plans to the public. On the other hand Tepebaşı Municipality has organized “Energy Days” recommended by CoM besides preparing climate action plans. In these events, topics such as "Energy Efficiency", "Energy Saving" and "Renewable Energy Sources" are discussed. Also, varios institutions, organizations, scholars and private companies made presentations within the scope of the event. For example, II. Sustainable Energy Days event has included seminars on Municipal Development Goals and Tepebaşı, Tepebaşı Municipality Energy Efficiency, EU and Turkey (Eskişehir Tepebaşı Belediyesi, n.d.-c). Thus, CoM encourage the municipality on bringing together different actors to raise awareness about the activities and objectives of the municipality, ensuring that these actors have information about the process and climate change. *According to I-2, most important property of CoM; it offers the opportunity to follow the work of many municipalities and to collaborate therefore you can see good examples and move forward* (personal communication, April 10, 2020). In addition, Kadıköy Municipality stated that the

studies under TMNs were introduced to the world on international platforms, and with these studies, the chance of being involved in local projects and developing cooperation increased.

Although Maltepe municipality does not give an example of a local study like the other two municipalities, it should be noted that the municipality is involved in a project called CityField. It was stated that the municipality informed by consultancy company about this event, and details about the event were provided through CoM in the following process (personal communication, May 6, 2020). However, in the following period, the municipality started to do research on CoM for the project. In addition, I-4 explained the effect of CoM on this process with the phrase *"CoM had an impact on our orientation towards this project"* (personal communication, May 6, 2020).

As consultancy company play an active role in organizing and notifying such events to many municipalities, through their experiences they emphasized that TMNs are supporting local governments on developing cooperation as in the case of Tepebaşı and Maltepe municipalities.

With the research it has been also revealed that TMNs have an encouraging and guiding role in preparing effective action plans. In this context, TMNs are involved as mediators at the boundaries between actors. Furthermore, TMNs are platforms that brings together different municipalities, and they have helped the municipalities in preparing climate action plans and more. For example, Tepebaşı Municipality has established the sustainability center inspired by ICLEI to prepare policies for its sustainable goals. Based on this example, it can be seen that TMNs mediate between climate change science and policy. The mediation role of TMNs is seen in every case. Together with TMNs, municipalities are developing new practices for climate change policy purpose, participating in projects or renewing their goals. In doing so, municipalities are developing a cooperation by trying to address their practices at a local level, and they are trying to continue the process by participating in international projects. All these tasks are the responsibilities of becoming TMNs member. Also, as seen it he cases, TMNs help municipalities by mediating policy making at the local level. CoM is a collaborative platform as discussed already. Energy Cities , one of the founders and supporters of CoM, defines the CoM as follows: "a community of thousands of cities driving the Paris Agreement and the 2030 Agenda for sustainable development" (Energy Cities, 2020). Along with CoM, signatories benefit not only

from the experiences of other cities, but also from stakeholders where they can find support in creating and implementing energy and climate actions. For example, it was mentioned earlier that TMNs provide financial support to cities. CoM helps municipalities to develop and implement projects together by keeping them aware of various funding programs. One of these funding programs HORIZON supports municipalities seeking partners with a platform called *CORDIS Partners Service* (Covenant of Mayors, 2020e.). With this example, it can be emphasized that CoM both provides a communication within the scope of P-2 and has a collaborative and mediator role. In fact, Kadıköy Municipality has participated to Making City project in 2018 that financed by HORIZON - 2020. According to I-1's statement; *project is bringing together thirty-four partners from nine countries, which will continue for sixty months between December 2018 and November 2023, aims to address and demonstrate the urban energy system transformation for low-carbon cities following the Positive Energy District concept*. Once again it can be seen with these examples that more than one boundary object can be involved in the process and create a cycle together.

The fact that TMNs bring together different actors and allow them to collaborate has been revealed in the research results as well as discussed in the literature. The important point here is how the cooperation under the guidance of TMNs has an impact on climate change science and climate change policy. In three cases, it has been revealed that municipalities have benefited from the cooperation offered by TMNs. In other words, TMNs act as a bridge between the climate change science and policy making.

Property 4: Providing information, shared language and translation

Climate change science is a subject that requires a different specialization. IPCC is known to lead in climate change science and provide scientific ground for political actions. In this case, in order to prepare the climate action plans at the local level, the scientific data produced by the IPCC should have a common language feature, that is, it should be translated. This translation should be science and policy specific. It has been argued that with the P-3, TMNs are mediating and bringing together different actors between climate change science and climate change policy. This mediation does not only mean bringing together different actors from these different worlds of works (science and policy). At this point, providing the necessary information, translating or

providing a common language to the fore. Developing a common language and providing information is essential for actors to work together effectively. According to Carlile (2002), creating a shared and stable syntax means that fluid communication can be established at a boundary between the sender (climate change scientist) and the receiver (policy makers), and many challenging communications can be resolved. For example, it is useful to remember that how climate models help developing common language between policy makers and climate change scientist (Jasanoff, 2015). This feature will be scrutinized to discover if TMNs provide information about climate change science to take political actions at the local level and whether that information is translated into a common language that actors can understand.

Kadıköy Municipality emphasized that CoM has different guides and that these guides explain the necessary actions in the preparation of climate action plans and contain descriptive information about the science of climate. It has also been discovered that CoM has helped reflect the climate science to the municipality's action plans by facilitating the implementation of new targets determined by the Paris Agreement. With the new objectives that came with the Paris Agreement, in addition to SEAP, which was previously requested, adaptation practices has been included to CoM commitments (personal communication, April 9, 2020). In this process CoM provided all scientific information to Kadıköy Municipality and prepared a basis for the municipality's SECAP studies in this regard (personal communication, April 9, 2020). CoM has provided current outputs and information about climate change science to Kadıköy Municipality in an understandable way and made this scientific translation. In a way, CoM has provided a shared language. In this context, the consultancy company acknowledged that both the mitigation and adaptation were included in the process after the Paris Agreement, and all of them well defined by CoM (personal communication, March 26, 2020).

When it comes to whether TMNs have P-4, it seems that this feature is reflected in the example of Kadıköy Municipality, while there is a controversial situation for the other two cases. It was observed that there was a situation to be examined in the Tepebaşı case. It was emphasized in the interview with the municipality that TMNs do not provide any scientific information, but they have supportive and guiding features in policy making for climate change. I-2 explained this situation according to their experience as follows:

> *I can say that CoM is the driving force. However, CoM does not tell you in detail everything you need to do. It requests many data, but it does not help how to collect it. On the other hand, it does not provide any scientific information but it has been a driving force for us to access scientific information* (personal communication, April 10, 2020).

According to this statement, although CoM does not provide scientific information directly, it can be argued that CoM is trying to guide the municipality by using scientific knowledge and providing scientific information indirectly.

Additionally, it was stated that in the interview with Maltepe and Tepebaşı Municipalities, especially process of using the scientific knowledge was managed by Demir Energy. According to I-4, *there is information and science about climate change, but there are difficulties in implementation* (personal communication, May 6, 2020). In Maltepe case, assistance was received from the consultant company since the officials of the municipality did not have experience in the process of combining the necessary data and preparing the reports. However, it was also emphasized that the municipal officials gained the necessary experience during the preparation of the SEAP and that the next action plan preparations were planned to be carried out by the municipal authorities.

Withind the scope of Tepebaşı and Maltape cases, it was emphasized above that CoM may have provided and translate scientific information indirectly. The opinions of the consultancy company that helped these two municipalities in this process support this idea.

During the Demir Energy interview, where the municipality received consultancy services, it was highlighted that TMNs directly reflected the steps on how to use IPCC and Paris Agreement's objectives. To support this claim, it is necessary to include the experiences I-5 shared in the interview. Accordingly, *the data and scenarios updated by the IPCC are reflected and scaled locally as much as possible. For example, you are doing a project about Izmir, and the IPCC is used to determine how the temperature and precipitation regime will change in Izmir. That is, the current data of climate science is directly reflected in the plans of the local government* (personal communication, March 26, 2020).

Based on this, it can be said that TMNs make scientific data provided by the IPCC usable for policy making. When examining what CoM offers within the scope of P-4, the presence of the *Urban Adaptation Support Tool* draws attention. It explains all the

steps necessary to develop and implement an adaptation strategy for the covenant community and guides them to materials and tools (Covenant of Mayors for Climate and Energy, n.d.-f). In addition, the activities, formations and examples discussed within the scope of P-2 and P-3 are the events where the climate change adaptation, mitigation plans and other issues about climate change are explained by the authorities and the relevant units are informed. From this point of view, property of providing information discussed with P-4 stands out. Additionally, it can be said that in addition to providing guides and templates for the plans to be prepared for climate change, the CoM translates the scientific outputs with the help of different boundary objects in order to deal with certain natural phenomenons that occur due to climate change. For example, there are brochures on the CoM website on how to be prepared for heat waves and other climate change impacts. Moreover, CoM offers its members tools in many formats that they can use. For example, it suggests the use of a map viewer that brings together predictions of high temperatures, floods, and other natural disasters, or a database that brings together the knowledge about ecosystem services and nature-based solutions and addresses different needs and interests in science, policy and practice. In fact, it can be argued that CoM, like a library, contains boundary object properties that are described as *Repositories* by Star and Griesemer (1989), storing piles and offering them for use by different actors in different ways.

To summarize, in the cases of Kadıköy Municipality and Demir Energy, which are directly involved in the SEAP process, TMNs, specifically CoM, provide general and up-to-date information on climate change and reflect them directly in the action plans of local governments. However, the situation is not the same for Tepebaşı and Maltepe Municipalities cases, which are not directly involved in the process since they receive consultancy.

After discussing the properties of boundary objects one by one, this section will continue by explaining how these properties are embodied in the three municipalities. First of all, as platforms where three municipalities can make their own arrangements and can work together for the same purpose without being strict bindings, both CoM and ICLEI provided flexibility to municipalities and act as a boundary objects. Secondly, it has been discovered CoM create a working environment for actors, activties and municipalities communicate to be aware of other actors and to follow different examples via CoM. That is, CoM serves as a communication tool between

actors. This communication can be provided directly or indirectly. In addition, it was discussed that CoM is involved in the process of communication with different boundary objects within the scope of P-2. Therefore, the CoM can be considered as a boundary object for three municipalities in terms of P-2. While this is the case, establishing an environment where municipalities can work together is one of the features of CoM. Outcomes of the examination inticates that, CoM is supporting the municipalities for developing cooperation. Municipalities can organize the practices they learned to cooperate at the local level and develop both international and local collaborations. In doing so, it has also revealed that CoM is also a mediator between climate change science and climate change policy. With the flexibility that comes with Property-1, it was revealed that the municipalities have developed various cooperation with different actors to fulfill their commitments and develop different actions to deal with climate change. Details were discussed under Property-3 also present that in this cooperation process, CoM reflects a mediator role between climate change science and policy by bringing different actors. In this framework, it is seen that CoM is a boundary object for three municipalities.

Since CoM has emerged as a mediator in climate change science and political practices, one of the important factors is whether CoM makes scientific knowledge suitable for practical use. According to examination, CoM guide local governments to deal with climate change by trying to cease the needs of municipalities with standard formulas prepared according to specific calculations method and international norms thus all local governments can understand the same thing. Although three municipalities received consultancy services for action plan studies, it was concluded that in the Kadıköy Municipality case, scientific information was presented by CoM and this information could be understood by local governments. On the other hand, this situation differs in Tepebaşı and Maltepe Municipalities. It is seen that the consultancy company assisted two municipalities in this process. As claimed by Star (2010), boundary objects exist in a certain scale and scope. Considering this argument, it can be said that CoM reflects this feature in certain scope and scale for these two municipalities. Because, both municipalities have prepared SEAP by using CoM guidance. Although there is no direct impact for the two municipalities within the scope of this property, it has been revealed that CoM has offered a shared language for consultancy company and make the outputs of climate change science understandable.

When all these findings were interpreted, it was revealed at the end of the study that TMNs reflect boundary object properties. While TMNs, specifically CoM, brings together different actors, it helps these actors learn new things about climate change science and transfer this knowledge to their policies. Considering all the properties, CoM is a bridge between climate change science and policy by providing municipalities with flexibility and plasticity in line with their local needs, creating a cooperative space, providing communication between actors and offering a shared syntax.

While the outcomes of the examination of three cases within the boundary objects concept was presented in this chapter, the results of the overall study will be discussed in the next chapter.

6. CONCLUSION

Climate change has been one of the issues on the world's agenda with different dimensions from past to present. Considering the data and outputs provided by the science of climate change, this issue has become an issue that can no longer be ignored and taken into the background. With the development of climate science, the importance of political elements has increased gradually, and climate change science and policy making have started to be considered as a whole. Today, although positive developments have started about this issue, it has been observed that there are ongoing difficulties in integrating climate change science into policy in practice. Therefore, this study focused mainly on the gap between climate change science and climate change policy. Since the issue of climate change is handled as a scientific subject and has a high political significance, especially STS literature has been analyzed to build the framework of the study. This analysis has led the study to boundary concept literature. As a result of the researches carried out within the scope of this relationship, the boundary concept discussed in the STS literature has been examined and it has been revealed that boundary objects can form assemblies between the climate change science and policy. At this point, the importance of cities to deal with climate change has become prominent and accordingly presence of TMNs that guide local

governments in the preparation of climate change policies has become remarkable. The idea of need for unifying things between climate change science and policy, and the presence of TMNs have gathered in this study. Therefore, this study examined whether TMNs can be a boundary object between climate change science and policy in Turkey. The study covers the three district municipalities selected from Turkey and benefiting from CoM. That is, the outputs of this study are based on three municipalities' CoM experiences.

In the evaluations made within the scope of selected examples and cases in this study, it has been revealed that, as in the example of CoM, TMNs can directly or indirectly and time to time act as a boundary object between climate science and climate change policies. These outputs can be evaluated under four properties of boundary objects. First, TMNs provide a variety of guidelines to municipalities to help them prepare appropriate policies. In this regard, CoM in particular provides the municipalities with the necessary plasticity and flexibility. However, taking advantage of this plasticity and flexibility may depend on factors such as structure of the district, budget or central management. For example, while Kadıköy and Tepebaşı can directly benefit from the flexibility and plasticity provided by CoM, this situation differs for Maltepe municipality. It can be seen that the CoM can reflect P-1 directly or indirectly. According to Star (1988), boundary objects can be *ill-structured*, that is they can be inconsistent or ambiguous, but they are still functional and provide unity between different social worlds.

Secondly, when P-2, which is serving as a means of communication between actors is analyzed, it has been revealed that CoM provides direct and indirect communication for all cases within the study. Additionally, with P-2, it has been discovered that CoM uses different boundary objects to provide indicated communication.

Third, it has been observed that CoM provides cooperations and has a mediator role between climate science and policy. It has been ascertained that the CoM provides local, national or international cooperation environments where different scientific and political actors can come together for all cases within the study. With this property, it has been revelaed once again that CoM uses different boundary objects. The existence of different boundary objects should not be viewed as suspicios, because, as it stated by Star (1988), boundary objects tend to create and work with different boundary

objects in order to meet the dynamic needs of the social worlds and to manage different processes of the same relationship (Star, 1988).

Finally, with the P-4 it has been discovered that CoM is insufficent to provide scientific information and translation directly for the three selected municipalities. At this process municipalities were depending on a different mediator. Among the four properties, P-4 may be the most indirect one. Because none of the municipalities have directly stated that CoM provides scientific information, translates scientific information into an understandable language, or directly provides such a service. Although the situation is slightly different for Kadıköy Municipality, it can be seen that they receive additional services for this process.

With P-4 it has been also determined that the municipalities need the consultancy company the most in the process of converting scientific knowledge into practice and in the scientific translation process. Because, all three municipalities stated that they are working with a consultancy company especially in this process and consultancy companya agreed with that. According to the study, this need may arise from time and personnel limitations, workload and insufficient experience.

As well as the examination of whether TMNs act as boundary objects in Turkey, with this study additional results have been revealed on how TMNs are been used in Turkey by district municipalities in bridging climate science and policy. One of the results is as a boundary object CoM guidance is not used by second-tier municipalities alone but took part as an effective tool between climate science and policy making with the involvement of a different mediator such as the consultancy company. Additionally, when examining the properties, it was seen that CoM uses different boundary objects itself as well, such as “Urban Adaptation Support Tool”.

Another interesting result is that the CoM mobilizes municipalities in Turkey to prepare climate change policies, action plans, events and projects, but it is insufficient when it comes to implementation. Furthermore, some benefits of TMNs, specially CoM, were also indicated by interviewees. For example, TMNs are stated to be tools that raise awareness about climate change and inspire municipalities to work on the issue. In addition, it has been noted that TMNs create a competitive environment, provide prestige to mayors and increase visibility in the global community.

This study has tried to show concretely what kind of interactions are needed for eliminating and decreasing the gap between climate science and policy in local goverments by utilizing the concept of the boundary object in the STS literature. In this respect, the study provides a different perspective for solutions and discussions in the STS literature, especially for the gap between climate science and policy. From the policy perspective, it has been argued that as a key issue, TMNs may act as a boundary object in the gap between climate science and policy if they are used deliberately. In other words, there are possibilities for bridging the gap between climate change science and policymaking through the use of TMNs. Starting from the local level, it is possible to integrate climate change science and climate change policy practices in the international arena more rapidly and easily through TMNs if some support outside of the municipalities could be attained.

Based on the results of this study, one of the issues that can be discussed in further studies could be why the municipalities need a second mediator for TMNs' guidance in Turkey, and how is the situation in different countries. Since this study was conducted within the case study method, its findings cannot be generalized. Therefore, further studies can be conducted with more cases regarding the generalization of the findings of this study. In addition, studies can be done by diversifying and differentiating the cases. For example, examining the metropolitan municipalities in this context may lead to the discovery of different results. Finally, this study was based on the STS literature and its perspective, thus it can be a guide for further studies that will use the boundary concept, especially the boundary object concept, as a framework.

In conclusion, it should be considered that there are numerous studies in the literature on the gap between climate science and policy, however, exploring what kind of actions, tools and objects will be needed in practice to overcome this gap may soon help to eliminate this gap to reach more effective climate policies both at the international and local level.

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