Research Article

Developing and Evaluating the Long Range Transportation Plan Using the Climate Change Protocol

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Abstract

Transportation sector is held responsible as the major contributor to climate change due to increased Green House Gas emissions resulting from excessive travel. Travel demand theory suggests that most travel is a result of the existing land uses. The regional planning council is responsible to develop the Long Range Transportation Plan (LRTP) that plans the development for existing and future 'transportation-land use' projects. However, no protocol has been developed to evaluate the LRTP, even when transportation sector is responsible for the CO_2 and NO_2 emission, two of the major GHGs. This study conducts a thorough review of existing protocols developed to evaluate the local, state, coastal, and climate action plans to develop a protocol that can help evaluate the awareness, analysis and action of the LRTPs for climate change for six metropolitan planning organizations (MPOs) in Texas, US. This can help [1] provide important insight to develop policies and strategic approaches to deal with CO_2 emission from transportation sector, [2] compare the actions and process of communities proactive about climate change issues with communities that aren't to provide policy recommendation and [3] standardize the plans to match the protocol thus helping the decision making stakeholders with policy formulation and inter and intra-governmental decision making.

Keywords: Protocol; Climate change; Plan evaluation; Transportation

Introduction

Analysis of the climate change action plans using the greenhouse gas (GHG) emissions inventory is becoming a standard practice to determine if the communities want to address the problem of climate change. For a global problem that mainly remains ahead of us, the challenge of local planning for climate change is great indeed. Researchers suggest that planners will have to assume a greater leadership role in formulating local mitigation and adaptation responses than in the past [1] and therefore appropriate and effective local mitigation initiatives should be undertaken regardless of national and international initiatives

The three major GHGs driving climate change are carbon dioxide (CO_2), methane (CH_4) and nitrous Oxide (NO_2). Increasing CO_2 and NO_2 emissions are all consistent with increased fossil fuel use for generating electricity and transportation. Rising methane emissions are mostly driven by increased livestock farming and urban landfills. The burning of fossil fuels (coal, oil, and natural gas) for power, surface transportation, and heating and cooling buildings accounts for 91% of anthropogenic CO_2 emissions [2]. One of the most obvious ways to mitigate climate change would be to reduce the volume of CO_2 emission into the atmosphere. One of the strategies that offer great opportunity for CO_2 emission is reduced automobile travel and increased reliance on walking and mass transit. However stakeholders at the regional levels vary from each other and have substantially different worldviews and different frames for understanding the problem (Table 1).

Although the obvious link of transportation sector to air pollution has been in discussion for some time now, the investigation of transportation plans to deal with the CO_2 emission, especially with respect climate change and sustainable and healthy communities has not been the focus for reasons unknown. Although several recent studies have evaluated climate action plans [3], local plans [4,5], and coastal plan [6] to investigate the process and policies related to climate change, no study has investigated the process and policies of the Long Range Transportation Plans (LRTP) in relation to climate change. This is especially important because the interaction of transportation and land use has significant impact of travel choices and travel distances and eventually the CO_2 emission from the transportation sector. However, before LRTPs can be investigated for their adherence to air quality standards and climate change standards, a protocol to evaluate these plans remains to be developed. Such protocol can help evaluate action, awareness, process and policies of LRTP across various metropolitan regions in the nation. Such an assessment can

Table 1: Protocol with components and elements (items) for LRTP evaluation.

Sub-Components	Specific Planning Elements Assessed
Awareness	
Background	In the background, does the plan provide a brief description of issues of climate change
	Does the plan explicitly identify the potential impacts of climate change on the region
	Does the plan provide brief description about the region's unique risks
	Does the plan provide brief description of the climate change issues in the entire state
Vision & Mission	Is there a statement about the issues of climate change
Public participation	Formal public hearings
	Open meetings
	Workshops or forums
	Call-in hotlines
	Citizen advisory committees
	Household survey
	Interviews with key stakeholders
	Internet (website, social media, email)
Coordination	Inter-agency
	Intergovernmental
Consistency	with NEPA (National Environmental Policy Act of 1969)
	with TEA-21 (Transportation Equity Act for the 21st Century)
	with SAFETEA-LU (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users)
	with Energy Efficiency Act of 2007
	with Energy Independence and Security Act of 2007
Social consideration	Assistance to special needs population
	Assistance to minority groups
	Assistance to low-income groups
Analysis	
Data	Projected impacts of climate change with business-as-usual and alternative approaches
	Base year emissions
	Projected growth in population
	Total emissions trend forecast
	Projected growth in total emissions from energy consumption (business-as-usual and alternative approaches)
	Projected growth in total emissions from transportation (business-as-usual and alternative approaches)
Modeling	Modeling tools used to evaluate scenarios

Action	
Emission Reduction	Reduction in use of fossil fuels (in specific amount/percentage in specific time)
	Reduction in GHG emission (in specific amount/percentage in specific time)
	Reduction in Vehicle Miles Traveled (VMT) (in specific amount/percentage in specific time)
	Evaluate parking policies
	Promote use of efficient vehicles
	Adopt/enforce idling regulations
	Examine incentives to reduce emissions in aviation sector
	Examine incentives to reduce emissions in freight sector
	Conduct GHG analysis in comprehensive planning and new capital projects
	Consult with other regions/COGs to determine options for GHG reduction
Environment	Preserve (urban) parks and open spaces
	Conserve forest area
	Preserve agricultural land
	Sustain street tree system
Alternative Travel Mode	Promote use of public transportation
	Promote use of non-motorized mode of travel (walking and biking)
	Promote use of other non-auto mode of travel (ferry, etc.)
Land Use	Encourage transit-oriented development
	Encourage mixed use development

A. Provide important insight to develop policies and strategic approaches to deal with CO_2 emission from transportation sector,

B. Compare the actions and process of communities proactive about climate change issues with communities that are not to provide policy recommendation and

C. Standardize the plans to match the protocol thus helping the decision making stakeholders with policy formulation and inter and intra-governmental decision making.

This study, therefore, develops an evaluation protocol to measure the LRTPs across major urban areas related to climate change. A protocol is in effect a guide or template that identifies the key topics, sometimes referred to as components or parts that should be covered or addressed in a quality plan. Once it is developed a protocol can then be used as a guide or metric to assess or determine if a plan includes key component that should be found in a quality plan and how completely or well a given plan addresses critical planning elements associated with these components. It should also be noted that once a protocol is developed it can also provide an important guideline for planners, decision makers, and concerned citizens to develop high quality long range transportation plan in the future. To tests its validity and reliability, this protocol will be used to analyze the six LRTPs for the state of Texas.

In following section review literature that guides the development of the protocol. This includes review of methodologies used by scholars to evaluate plans and the component of the climate change plan by the ICCC. The methodology used to develop the protocol and the evaluation criteria to assess the LRTPs in Texas is discussed in the next section. Finally we report the protocol with its components, sub-components and the specific items for the assessment followed by the outcome of the assessment of the LRTPs. Finally we discuss the implications of this study and its limitations along with future research opportunities (Table 2).

Table 2: Total and average scores of the six LRTPs in Texas.

Components		El Paso	Lubbock	San Antonio	NCTCOG	CAMPO	HGAC
Awareness	Average sub-score	0.609	0.565	0.609	0.826	0.696	0.739
	Total sub-score	14	13	14	19	16	17
Analysis	Average sub-score	0.571	0.286	0.571	0.571	0.714	0.714
	Total sub-score	4	2	4	4	5	5
Action	Average sub-score	0.382	0.441	0.5	0.647	0.662	0.544
	Total sub-score	26	30	34	44	45	37

Literature Review

The objective of this study is two folds:

A. To develop a protocol and the criterion to evaluate the LRTPs and

B. A sample study of six LRTPs in the state of Texas. Therefore the literature discusses the process to develop the protocol and the criteria of evaluation along with evaluations done by scholars that guided our assessment of the LRTPs.

Although there has been a great deal of research on climate change and on transportation planning [7-9], there is currently a gap in the body of knowledge concerning the relationship between GHG emissions and the transportation sector. Meyer [3] reviewed the existing knowledge to identify research that was still needed to better inform transportation planning for climate change, determining that future research is still needed in the following areas:

a) Appropriate scale of GHG analysis;

b) Appropriate assumptions to be used in GHG analysis;

c) Appropriate methodologies, models, and data sources;

d) How to evaluate different GHG reduction strategies;

e) Determining which variables have the strongest impact on GHG emissions and the variables' range of values that should be tested;

f) Whether to include lifecycle GHG emissions in planning;

g) How to consider GHG emission in prioritizing projects; and

h) How to convey GHG analysis results to decision makers, other agencies, stakeholders, and the public.

The recent development in evaluation of plans related to climate change has been conducted at different levels of governance. For eg. Wheeler [10] evaluated the state and municipal climate action plans, while Boswell et al. [11] evaluated the city climate action plans. Wheeler analyzed the plans of three types of governments: all states with planning documents on climate change; cities with populations of over 500,000 that are members of the CCP campaign; and selected smaller cities that are CCP members. He conducted this research by analyzing planning documents as well as interviewing state and local officials by telephone. Meanwhile Boswell [11] identified 70 factors on which they evaluated the city climate action plans. A recent study by Bassett & Shandas [12] used a mixed method to evaluate the climate action plans. They evaluated the content of 20 CAPs from municipalities of a range of sizes and locations using a scoring matrix, reconciling coding differences.

Because there is no federal climate action plan (CAP), a diverse body of plans has developed at the regional, state, and local levels. It is therefore less straightforward to determine whether climate action taken across the United States has in fact reduced GHG emissions. Although state-level CAPs can reduce emissions, the reductions are too small to sufficiently address the problem of climate change; therefore, the next generation of CAPs must go beyond the first generation in policy action in order to make a greater impact [13]. The obvious level to investigate, thus, is the regional scale policies that influence climate change actions. With transportation being one of the most important regional services, policies that relate to transportation and CO_2 can guide planners and decision-makers better about the effective approaches to deal with climate change.

Peacock [6] designed a protocol to assess mitigation action plans based on FEMA guidelines and recommendations. A protocol did not yet exist so they followed FEMA's guidelines under the major planning components to develop such an assessment tool that could be used to evaluate individual mitigation plans at various subnational levels. The protocol divides the main areas covered in the FEMA guidelines into sub-components and then into a total of 164 specific planning elements. Each mitigation plan assessed using the protocol were analyzed to determine if it addresses each planning element and the extent to which that element is addressed. The primary goal of the protocol is to highlight opportunities for improvement and to encourage the consideration of including more elements in a plan, rather than making comparisons among existing plans. Results revealed that the mitigation plans assessed obtained scores ranging from 28.7 to 53.3 on a 100-point scale.

Therefore to address the concerns discussed above, the evaluation tool will be developed based on the criteria of the climate action plans and the current literature that evaluates the climate change plans, comprehensive plans, and the coastal development

plan. There are undoubtedly many approaches that could be taken in the development of a protocol to be used in this research. A logical starting point would, of course, be EPA's guidelines for establishing or developing a climate action plan (CAP). In addition, approaches that have significantly improved on techniques of plan evaluation and assessment, in particular, the work of Brody [14-17] and Berke et al. [18] will be used to develop the protocol.

Analysis and Results

The study develops a protocol that uses the mixed method to analyze the climate change content in the six LRTPs across Texas. The U.S. Environmental Protection Agency (EPA) provides guidelines for developing a climate change action plan (CCAP). A CCAP is a policy and planning document used to develop and implement a strategy to mitigate climate change (US Environmental Protection Agency [EPA], 2012). It usually addresses risks and vulnerabilities in a given region, baseline and target emission levels, analysis of mitigation options and projected results, recommendations for action, and an implementation strategy (EPA, 2012). The EPA encourages local governments to develop a CCAP, as so many local government activities could be altered slightly to yield significant decreases in GHG emissions while concurrently benefiting local residents. The agency's recommendations for developing and implementing a CCAP include the following:

a. Collaborate with all stakeholders, including the public and local agencies, businesses, and industry entities,

b. Identify the scope of GHG emissions to analyze trends and to locate and target sources of increases in emissions,

c. Identify the region's vulnerabilities to the effects of climate change for consideration in planning, particularly in large infrastructure initiatives,

d. Establish quantitative goals with a specific timeframe,

e. Establish evaluation criteria for mitigation of climate change,

f. Identify policy options based on regional goals and priorities,

g. Evaluate and select policy options based on potential quantitative impacts on the region,

h. Establish the administrative process required for implementation and evaluation of the plan, including funding mechanisms, progress reports, and time frames.

i. Implement the planned initiatives, adjusting as necessary, and

j. Communicate with stakeholders about the processes and benefits to maintain continued support of the plan's policies and programs (EPA, 2012).

The National Capital Region Climate Change Report (NCRCCR) addresses all of the areas covered in the EPA guidelines for a CCAP (Climate Change Steering Committee [CCSC], 2008). It approximates a "model" long-range transportation plan for our purposes, as it incorporates issues of and contributors to climate change, in addition to comprehensive planning for energy consumption, transportation, and land use within the region. The NCRCCR was developed by the Climate Change Steering Committee of the Metropolitan Washington Council of Governments to analyze the years 2005-2030. It begins with a regional GHG inventory and then thoroughly follows the recommendations set by the EPA by listing several action items for each area. The report sets reduction targets, estimates costs of action and of inaction, and establishes a plan of action. More specifically, the report includes

a. Mitigating emissions from energy consumption, transportation, and land use;

b. Anticipating economic development;

c. Preparing for climate change impacts;

d. Instituting financing mechanisms for plan implementation;

e. Developing a campaign for outreach and education in the region;

f. Encouraging local government members within the council to lead by example through local initiatives;

g. Adopting advocacy positions to push for state and federal action in reducing GHG emissions;

h. Creating a permanent climate change climate change initiative within the council's organizational structure; and

i. Setting priorities to reach both short- and long-term GHG emission reduction goals (CCSC, 2008).

From the NCRCCR and the EPA guidelines, we developed a protocol instrument that covers all of the recommended planning areas categorized under subcomponents comprising three main areas: Awareness, Analysis, and Action. Awareness includes the plan background section; vision and mission; public participation in developing the plan; coordination with other agencies and/or governments; plan consistency with major national environmental acts; and consideration of underrepresented and underprivileged social groups. The Analysis section of the protocol addresses projected impacts of climate change on the region; projected emissions and population trends; use of modeling tools in evaluation; and comparison of business-as-usual (BAU) and alternative scenarios. Finally, Action includes emissions reduction activities; environmental preservation; promotion of alternative travel modes; land use recommendations; needs assessments; existing funding, cost estimates, and financing mechanisms; implementation plans; education and outreach; energy efficiency and energy demand reduction; and "green" economic development.

Each of the specific planning elements under the subcomponents can take on a value of 0 or 1, where 1 indicates that a LRTP addresses or meets that element while 0 indicates that it does not. Twenty-three elements comprise Awareness, 7 elements comprise Analysis, and 68 elements comprise Action, for an overall total of 98. When a LRTP is evaluated using the protocol, the plan's degree of action taken against climate change can be assessed using the average and

total sub-scores from the Awareness, Analysis, and Action areas, as well as the average and total scores overall.

Assessment of LRTPS

To test the validity and reliability of the protocol, we analyzed the LRTPs in six of the most populous regions in Texas. Each of these plans was developed by a council of governments (COG), metropolitan planning organization (MPO), or similar regional organization. These organizations tend to be voluntary associations of local governments in a region, in which representatives of the local governments meet frequently to plan and coordinate regional transportation and development. The LRTPs used in this analysis were developed by the following six organizations: El Paso MPO, North Central Texas COG, Capital Area MPO, Houston-Galveston Area Council, Lubbock MPO, and San Antonio-Bexar County MPO. Four of the plans focus on the 25-year period from 2010 to 2035 (El Paso, North Central Texas, Capital Area, and Houston-Galveston). The Lubbock MPO also focuses on a 25-year period, but it spans from 2007 to 2032. The San Antonio-Bexar County MPO plan is the only plan in this analysis that focuses on 30 years, from 2000 to 2030.

The analysis indicates that although the MPOs vary little across the components, the MPOs with major cities such as Dallas-Ft. Worth, Austin, Houston-Galveston and Capital Area report better adherence to the protocol. Also, this protocol if tested across major MPOs across the nation may report higher variance. Using this protocol may thus guide planners and decision-makers to develop transportation policies that can adhere to climate sensitive issues.

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