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Please cite this paper as:

Clapp, C. *et al.* (2010), “Cities and Carbon Market Finance: Taking Stock of Cities’ Experience With Clean Development Mechanism (CDM) and Joint Implementation (JI)”, *OECD Environment Working Papers*, No. 29, OECD Publishing.
doi: 10.1787/5km4hv5p1vr7-en

OECD Environment Working Papers
No. 29

Cities and Carbon Market Finance

TAKING STOCK OF CITIES’ EXPERIENCE WITH CLEAN DEVELOPMENT MECHANISM (CDM) AND JOINT IMPLEMENTATION (JI)

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JEL Classification: F30, F53, G15, H87

OECD

*OECD, France

Unclassified **ENV/WKP(2010)15**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **19-Nov-2010**

English - Or. English

ENVIRONMENT DIRECTORATE

ENV/WKP(2010)15
Unclassified

ENVIRONMENT WORKING PAPER NO. 29

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English - Or. English

JT03292800

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ABSTRACT

The importance of cities in climate policy stems from the simple reality that they house the majority of the world's population, two-thirds of world energy use and over 70% of global energy use emissions. At the international level, global carbon markets have become an important new source of financing for mitigation projects and programmes. Yet to date, the participation of urban authorities and of urban mitigation projects in the global carbon market remains extremely limited. The under-representation of urban carbon projects can be linked both to the difficulties to implement urban mitigation projects and to the difficulties for cities to access the carbon market. This paper reviews 10 in–depth case studies of urban projects proposed and operating within the realm of Joint Implementation (JI) and the Clean Development Mechanism (CDM) of the Kyoto Protocol. It explores the drivers of success for projects, examining in particular: types of projects that have been successful and their profitability; leadership and other roles of various actors in project initiation development and operation (i.e. local, regional and national governments as well as international, private sector or other non-governmental organisations); the role of local co-benefits; and project financial structure and risk management approaches. This paper also considers how these lessons learned may inform decisions in the future about how to best tap the potential for carbon markets to offer increased levels of financial support for urban mitigation projects or programmes.

JEL classifications: F30, F53, G15, H87

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RESUME

La place accordée aux villes dans la politique climatique découle d'un constat simple : elles abritent la majorité de la population mondiale, consomment les deux tiers de l'énergie mondiale et produisent plus de 70 % des émissions mondiales liées à cette consommation. Au niveau international, les marchés mondiaux du carbone sont devenus une nouvelle source importante de financement pour les projets et les programmes d'atténuation. Pourtant, à ce jour, la participation des autorités urbaines et des projets urbains d'atténuation au marché mondial du carbone reste encore extrêmement limitée. La sous-représentation des projets urbains dans le domaine du carbone est à mettre en rapport avec les difficultés inhérentes à la mise en œuvre de projets urbains d'atténuation et avec les obstacles rencontrés par les villes pour accéder au marché du carbone. Ce rapport examine dix études de cas approfondies portant sur des projets urbains, envisagés ou existants, dans le domaine de la mise en œuvre conjointe (MOC) ou du mécanisme pour un développement propre (MDP) du Protocole de Kyoto. Il explore les facteurs de succès des projets, en examinant plus particulièrement les types de projets qui ont réussi et leur rentabilité ; le rôle moteur des autorités et celui des différents acteurs dans le lancement des projets, leur développement et leur fonctionnement (autorités locales, régionales et nationales, et organisations internationales, non gouvernementales et du secteur privé) ; les avantages connexes locaux ; et les approches en matière de structure financière des projets et de gestion des risques. Cette étude envisage aussi comment les enseignements tirés de ces expériences pourront à l'avenir éclairer les décisions futures sur les moyens de mobiliser au mieux le potentiel des marchés du carbone au service de l'accroissement du soutien financier aux projets ou programmes urbains d'atténuation.

Classifications JEL : F30, F53, G15, H87

Mots clés : changement climatique, finance carbone, Protocole de Kyoto, villes, atténuation des émissions de gaz à effet de serre

FOREWORD

The report was based on collaborative work in 2009-2010, managed by Christa Clapp, from OECD, and Alexia Leseur, from CDC Climat Recherche (www.cdcclimat.com). The OECD research team managed all CDM case studies, whereas CDC Climat Recherche managed all JI ones. Research and interviews were conducted by Gregory Briner on Bogotá, São Paulo, Ho Chi Minh City and Durban projects, by Christa Clapp on the Luz Verde project, by Oliver Sartor on Christchurch City, Palmerston City and Timisoara projects, and by Alexia Leseur on North Rhine Westphalia and Lille metropolitan area projects. Leading contributions have been written by Oliver Sartor for Section 2, Christa Clapp for Section 4 and Jan Corfee Morlot for Section 5.

The authors are grateful to their CDC Climat Recherche colleague Ian Cochran for his useful contribution, and to their former OECD colleague Nicholas Davidson who initiated research on several CDM projects. Useful input was also provided by colleagues Benoit Leguet and Dorothée Teichmann from CDC Climat Recherche; and Helen Mountford, Jane Ellis, Christopher Kaminker, Olaf Merk, and Andrew Prag from OECD. Useful feedback was also received from Rutu Dave (World Bank Institute), Benoit Lefevre (IDDRI), Dennis Tirkpak (World Resources Institute), and Dimitri Zenghelis (LSE Grantham Research Institute). The authors would also like to sincerely thank all interviewees involved, and the following reviewers for their helpful comments on the case studies: Yves André (CDC), Klaus Benkau (KfW), Jürg Grütter (Grütter Consulting), Gabrielle Henry (Cool NRG), Akiko Ishii (Mitsubishi UFJ Morgan Stanley Securities), Leonid Itskovich (Christchurch City Council), Emma Jenkin (Cool NRG), Karsten Karschunke (German Federal Environment Agency), Miriam Kramp (Town of Kamp Lintfort), Gildas Lesaux (Lille Métropole Communauté Urbaine), Dougal McInnes (Cool NRG), Kenneth Möllersten (Swedish Energy Agency), Michael Muller (EnergieAgentur.NRW), John Parkin (Durban Solid Waste), David Rusnok (KfW), Rafael Seixas (São Paulo City Hall), and Reinhard Six (Rhonalpenergie-Environnement).

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EXECUTIVE SUMMARY

In the search for solutions to address climate change, carbon markets and cities are increasingly part of international and national policy frameworks. Yet the rise of carbon markets as a policy instrument to put a price on and limit greenhouse gas (GHG) emissions and the increased role of urban governance in climate policy frameworks are two quite separate trends. To date the actual or potential interaction between carbon markets and city or urban scale mitigation has received little attention from analysts and policymakers. This paper offers an in-depth analysis of experience with urban projects in compliance carbon markets. It addresses two key questions of relevance to international and national policymakers: *How have cities accessed carbon markets to date? What lessons might we draw from this experience for the reform of future market mechanisms?*

Cities and climate change mitigation

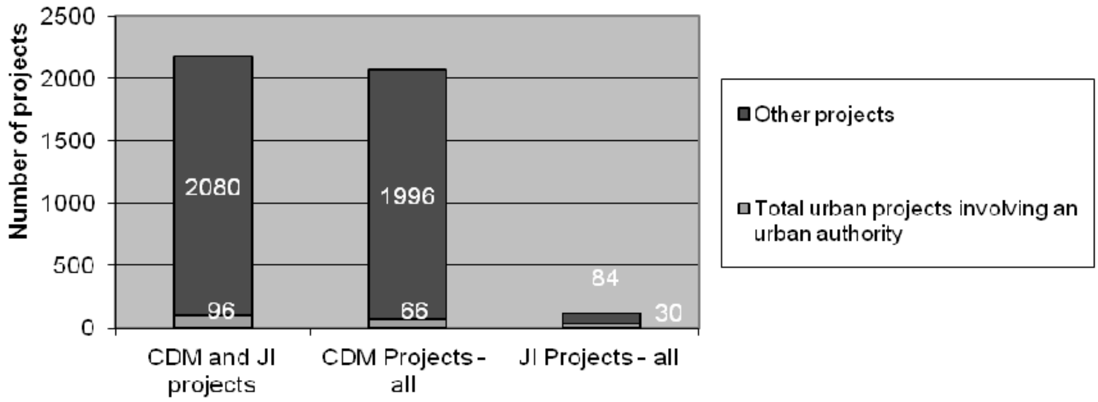
The importance of cities in climate policy stems from the simple reality that they house the majority of the world's population, two-thirds of world energy use and over 70% of global energy use emissions. Approximately 50% of the global population is urban dwelling and this share is expected to increase significantly in the coming decades, with much of this growth due to rapid urbanisation in developing countries. Cities are expected to house 76% of world energy use emissions by 2030.

Urban development policymakers - either at the municipal, regional or national level - have the potential to alter urban emission pathways. For example, buildings and land-use zoning, transport, local distribution networks, waste management, and urban forestry and land use are urban activities that typically have large and cost-effective abatement potential in principle. For various reasons, urban authorities are increasingly active in setting local mitigation policy goals and developing local plans. Local policymakers have good access to relevant stakeholders and are well-placed to develop a context-specific vision of a low-emission future. Importantly, they have the ability to identify urban mitigation projects with high local co-benefits (e.g. in areas other than reduced GHGs such as clean air and streets, or increased safety and health). However, the extent to which cities can actively engage in changing emission pathways depends, in part, on how cities fit within national and other layers of governance.

At the international level, global carbon markets have become an important new source of financing for mitigation projects and programmes. In particular, the two offset mechanism, currently operating under the Kyoto Protocol -- Joint Implementation (JI) and the Clean Development Mechanism (CDM) -- play a key role in financing mitigation projects. The value of primary transactions in the carbon offset market (i.e. CDM, JI or voluntary project-based transactions) was approximately 5.2 billion € in 2008, while the mitigation projects behind them represented approximately 463 million tonnes worth of emissions reductions respectively. Although the carbon market has suffered from uncertainties about the post-2012 period, and from the global economic downturn, it has become an important mechanism for financing low-carbon technology choices and offers the potential to fill some of the gaps in technological, financial or institutional capacity for projects in both developing and developed countries. Carbon markets could offer potentially significant support to viable urban mitigation projects, working alongside other financial and policy instruments (e.g. taxes, bonds, subsidies, norms, etc). Yet, limited market activity in urban areas to date suggests that this potential is not being realised.

To date, the participation of urban authorities and of urban mitigation projects in the global carbon market remains extremely limited. Almost all of the experience has occurred through the compliance offset market, which accounts for around 90% of the primary transactions. However, urban mitigation projects represent less than 10% of all projects in the compliance market today and are concentrated in few sectors (waste management, energy efficiency, and energy distribution networks) (see Figure ES-1).

Figure ES-1. Overview of CDM and JI registered projects initiated by city or involving city authorities



Source: CDC Climat Research – from JI pipeline overview (UNEP Risoe) as at 1/3/2010 & project design documents

The under-representation of urban carbon projects can be linked both to the difficulties to implement urban mitigation projects and to the difficulties for cities to access the carbon market. Among factors that explain implementation difficulties are the limited autonomy that urban authorities often have to directly regulate GHG emissions, as it is often seen as a national priority and not a sub-national one, the limited budgets and access to start-up capital, as well as limited institutional capacity (e.g. human resources and technical expertise) of many urban authorities. Further, some of the likely types of mitigation projects that can be city-led do not easily lend themselves to accurate measurement, at least using existing current methodologies (e.g. transportation, energy efficiency in buildings).

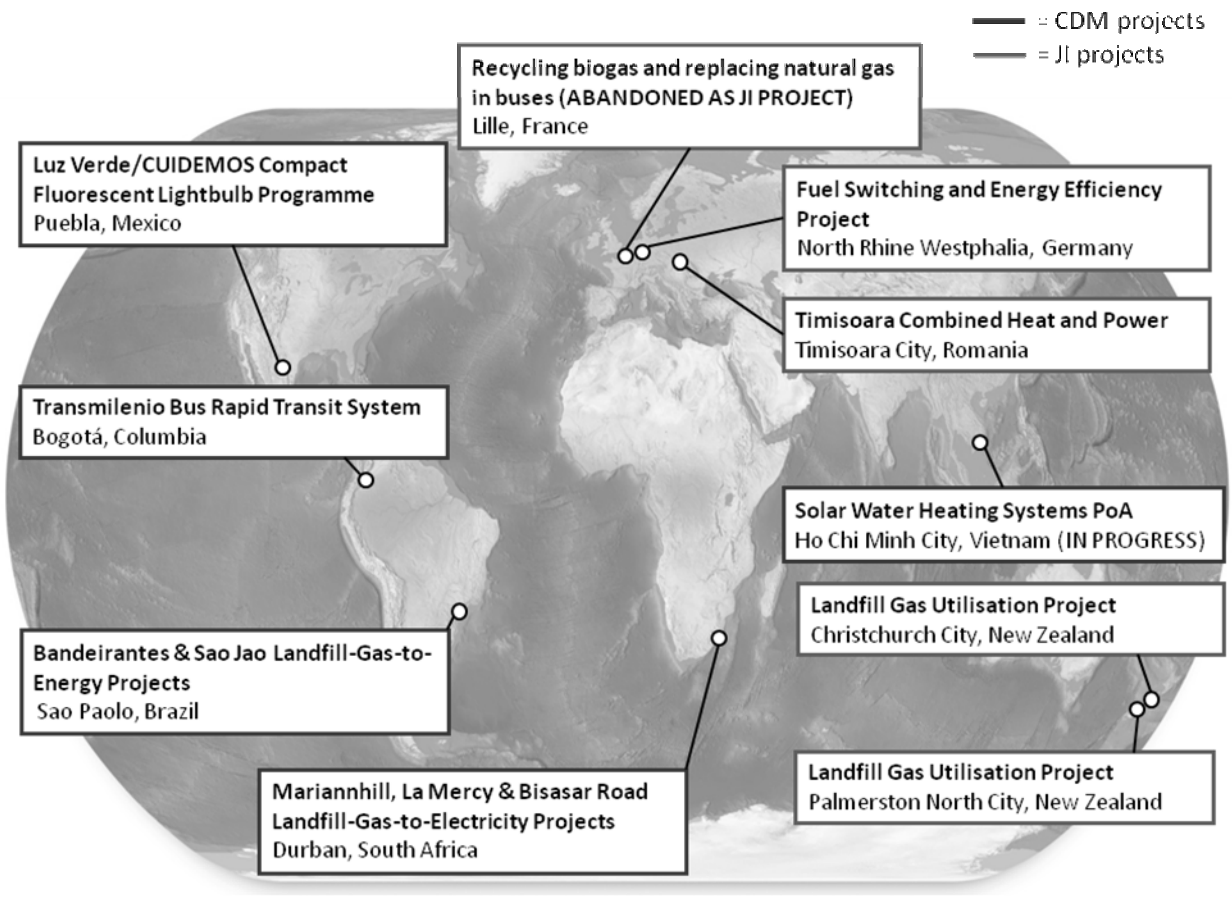
The analysis presented in this paper thus centres around the question of how urban-scale actors might be better able to exploit the potential of carbon markets to contribute to urban mitigation than what is currently suggested by the relatively low levels of urban project activity.

Aim of the paper

The aim of the paper is to develop a better understanding of the factors that currently drive success in the access of urban mitigation projects to carbon offset markets. The paper explores why there are limited volumes of urban-led project offsets and also takes a brief look at how lessons from the past may inform decisions in future about how to reform offset mechanisms in the compliance carbon market. It identifies and reviews a number of urban projects proposed and operating within the realm of Joint Implementation (JI) and the Clean Development Mechanism (CDM) of the Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC). It examines the drivers of success for projects, examining in particular: types of projects that have been successful and their profitability; leadership and other roles of various actors in project initiation development and operation (i.e. local, regional and national governments as well as international, private sector or other non-governmental organisations); the role of local co-benefits; and project financial structure and risk management approaches. Drawing lessons for the future from this experience, the paper seeks to identify institutional models and actions that can help cities to successfully access carbon markets.

The analysis is based on an in-depth review of empirical evidence, examining 10 offset projects (5 CDM and 5 JI) as case studies from around the world where local authorities are benefiting from carbon market financing to support investment in urban greenhouse gas abatement projects (see Figure ES-2). The case studies were selected to represent the geographic and project type diversity that exists across urban projects, and to provide interesting examples of the role of urban authorities in project development and implementation. The selected projects directly involved local authorities (city or regional) as project instigators or hosts. The analysis draws on qualitative research methods and information gathered through semi-structured interviews carried out with approximately 30 people (from project developers and operators including city governments, national governments, firms, and consultants), from primary source documents and from other literature on cities and markets.

Figure ES-2. Project case studies by region



Source: Image Natural Earth II from Tom Patterson, US National Park Service, derived from Natural Earth (www.shadedrelief.com)

Lessons from case studies

Comparative analysis of the case studies suggests there are a number of common barriers and features of project risk that tend to limit the access to carbon markets by urban projects. Since the rules and legislative frameworks that create and regulate carbon markets have not been designed with urban mitigation projects in mind, various legal, technical and financial barriers to offset markets often appear to be insurmountable for urban projects. Challenges include potential overlapping jurisdiction of GHG-emitting sources, the lack of knowledge about carbon market possibilities among urban governments or local stakeholders to identify viable project options (and assess the costs and benefits); the lack of specific capacity to develop, monitor and bring projects to approval (i.e. particularly given quantification difficulties of typical urban projects such as transportation); high transaction costs due to long time frames, administratively complex procedures, and the typically smaller scale of urban projects; financial barriers in the context of city budget constraints due in part to high start up costs and risk of project failure; the risk of projects underperforming in terms of carbon reductions verified and credits ultimately delivered; and a political context that can discourage carbon market projects. While many of these same challenges are faced by non-urban projects, they are often exacerbated for cities, particularly given the limited financial resources and working knowledge of carbon markets within city authorities.

Table ES-1 highlights key features of the cases examined, demonstrating that there is no dominant institutional model. While political leadership is common from a key actor to champion an urban project throughout the development and approval phases, the source of that leadership varies. Although local authorities were typically instrumental in the initial decision to exploit carbon market financing, the ongoing leadership for these projects has only occasionally come from individuals or organisations within the urban government itself. Rather, this often comes from other governmental partners, international institutions or the private sector, which in turn have been instrumental to overcome financial or technical barriers in early phases of the project development.

The case studies examined highlighted that while carbon credits can be a genuinely important source of finance for urban projects, they are not necessarily a magic bullet solution to project finance. In other words, the existence of carbon credits may not change the principle design of a pre-existing urban project, but can provide a supplementary revenue stream. Contrary to what is sometimes understood, the Kyoto carbon markets are not designed to pay for the entire cost of a new investment project that reduces emissions. Rather, they operate on the principle that carbon credits can be used by project developers to cover the surplus cost of opting for a more carbon-friendly technology as part of an existing installation or a planned investment. Over the 10 case studies, this expected carbon revenue stream varied widely from 50% to less than 15% of overall project costs. Given the supplementary nature of carbon credit revenue, additional funding is typically needed in the form of revenues from new services, or additional public or private investment.

The case studies also revealed large differences between the amount of expected carbon credits and the amount of issued credits: some projects received less than half of expected credits. Although this may be quite technology specific, this trend highlights the ongoing risks involved in relying on carbon financing. Such risks are particularly important for local authorities who may struggle to manage them through a diversification of revenue streams. Moreover, since carbon revenues arrive after the project is operational and has begun reducing emissions, other means must be found to meet the start up costs of a project. However, even if relatively small within a project finance package, carbon finance can leverage additional private financing. Finally, our case studies highlight that there is no unique financing model for projects: the levels of private financing vary significantly, and the carbon finance aspect can be managed in a variety of ways, from easier to more complex approaches involving credit prepayments, auctions, or other options.

Table ES-1. Project overview

Project type, name, & location	Role of urban authority	Role of national or regional government	Private sector role or credit purchasing role	Other international partner role	Co-benefits	Carbon Finance [a]
Waste – Methane Capture to Energy						
Landfill Gas to Energy, Bandeirantes and São Joao; CDM; São Paulo, Brazil	Pro-active in project development; have rights to ½ of credits generated and sold them by auctioning	Limited role, acted as DNA	Joint venture -- “Biogas” -- created between 3 private companies with concession contract with city government for the methane.	KFW, Germany is purchaser of ½ of credits sold by Biogas	Job creation, odour reduction, improved safety, revenue raising for local amenities (e.g. green space)	High actual carbon revenues = ~ 100% of capital costs[b]
Landfill Gas to Electricity Projects, Mariannhill, La Mercy and Bisasar Road; CDM; Durban, South Africa	Municipality signed MoU with WB PCF; Provided technical oversight and operation of projects	Provided funding for upfront costs	Credits from Bisasar Road bought by Trading Emissions Plc	WB PCF – initiated PDD in return for credit purchase, developed methodology; AFD French development bank provided loan for upfront costs	Landfill odour management, displaces coal-fired electricity thereby improving air quality, job creation	Medium - high projected carbon revenues = ~50% of total costs[c]
Landfill Gas Utilisation Project; JI ; Christchurch City, New Zealand	Proactive in project identification and development.	Sponsored national programme to identify and develop projects (Track I)	A variety of private consultancies, provided important expertise, local broker helped with transactions. Buyer was hands-off investor for EU ETS obligations. No upfront purchase of credits by buyer.	*(no significant role)*	Energy savings, odour reduction, additional revenues used to achieve additional reductions	High projected carbon revenues = ~70% of capital costs[d]
Landfill Gas Utilisation Project; JI; Palmerston North City, New Zealand	Proactive in project identification and development.	Sponsored national programme to identify and develop projects (Track I)	A variety of private consultancies, provided important expertise, local broker helped find buyer, an institutional investor on behalf of Austrian Gov’t. Some upfront purchase of credits by buyer.	Buyer was Austrian national government for Kyoto compliance.	Energy savings, additional revenues used to achieve additional reductions	Medium - high projected carbon revenues = >50% of capital costs[e]
Building Energy Production & Use, Including Energy Efficiency						
Solar Water Heating Systems Programme of Activities; CDM; Ho Chi Minh City, Vietnam	Established Energy Conservation Centre and provided funding	Vietnam Ministry of Industry and Trade provided funding for Energy Conservation Centre	MUMSS (Japanese investment bank) conducted feasibility study and collected data	Japan Ministry of Environment provided grant to MUMSS to collect data for PDD	Energy security	Medium projected carbon revenues = ~18-30% of capital costs[c]
Luz Verde/CUIDEMOS Mexico Programme of Activities for compact fluorescent lightbulbs; CDM; Puebla, Mexico	Project host	Co-sponsored project development through a grant	Private sector partner initiated project – partnered with national gov’t; Local distribution facilities and awareness campaign sponsored by private sector	Eneco in Netherlands is credit purchaser; ING provided debt financing; Philips provided a grant for the light bulb supply	Poverty alleviation, reduced electricity subsidy payments by national government	High projected carbon revenues = ~100% of operating costs[f]

Project type, name, & location	Role of urban authority	Role of national or regional government	Private sector role or credit purchasing role	Other international partner role	Co-benefits	Carbon Finance [a]
NRW Programme of Activities for fuel switching and energy efficiency of boilers and heat productions; JI ; North Rhine Westphalia, Germany	Project host	Regional agency managed the entire project, including carbon aspect. Regional Gov't supported and financed project development phase. National Gov't verified methodology, as JI track 1	Private consultant developed methodology, Private and public sectors purchase credits	Rhonalpenergie-environnement as foreign partner, helps to obtain the LoA	Energy savings, reduced regional subsidy	Low - medium projected carbon revenues = ~5-20% of total costs
Combined Heat and Power Project; JI ; Timisoara, Romania	Guaranteed debt issuance of subsidiary to finance upfront project costs.	National government verified methodology, as JI track 1. Formed part of a Gov't scheme to launch domestic JI projects.	Some private expertise provided by domestic carbon market consultancy. But limited private sector involvement aside from some indirect debt financing	Swedish Energy Agency was the credit buyer. Found project through a call for tender process in the Baltic and Eastern European region as part of an existing Government policy to invest in region's energy sector.		Medium projected carbon revenues = ~15-20% of total costs[d]
Transport						
Transmilenio, Bus Rapid Transit; CDM; Bogota, Colombia	Mayors championed project, , provided funding for infrastructure	Financed project construction; promoted BRT systems elsewhere	Public private partnership -- Transmilenio S.A. -- formed between City Hall and private actors; also CAF – regional bank and credit buyer intermediary - financed project development	Netherlands VROM, ultimate credit purchaser	Public transport reliability and access; reduced air pollution; improved traffic congestion	Low projected carbon revenues = ~1-2% of operating costs[c]
Bus network fuel switching project from waste management; JI ; Lille metropolitan area, France	Local government championed the entire project, defined methodology	Help in methodology, and definition of additionality, as JI Track 1	Caisse des Depôts (French bank) forsees to purchase carbon credits, and acts as administrative and financial intermediary	Foreign partner for LoA	Reduced air pollution, fuel savings	Low projected carbon revenues = ~13% of capital costs

[a] Depending on data availability, carbon revenues are indicated as part of the total cost or the capital cost (and rarely the operating cost). This refers to projected carbon revenue (with the exception of São Paolo); however, issued credits are often less than projected (See Annex 2).
[b] Received CER auction proceeds for two years (2007-2008) for both landfills.
[c] Projected 7 year CER stream valued at 10€/tonne.
[d] Projected 5 year ERU stream valued at 5€/tonne.
[e] Own estimates, calculated based on the conservative assumption that ERUs were sold for at least 10 NZDs each. We also use the reported figures of 5-15% simple return on capital, and assuming that this return is shared between energy sold to grid (190 000 €) and energy savings (370 000 €) and carbon credits sales (680 000 €). The latter two figures are reported on the council's website: http://www.palmerstonnorth.com/YourCouncil/NewsAndViews/MediaReleases/Detail.aspx?id=13254
f Projected 1 year CER stream valued at 10€/tonne.

In most cases, project “co-benefits” played a pivotal role in the motivation to pursue and in the design of projects. This is a key difference between projects involving an urban authority and purely private sector projects, where often the co-benefits get no more than lip service. Cases showed that the motivations for engagement by city authorities are not purely related to climate policy but stem from the multiple co-benefits in other non-climate areas of policymaking. For instance, in New Zealand, Christchurch’s Landfill Gas Utilisation project began with local resident complaints about escaping odours and the desire to reduce energy costs. In one case (São Paolo) the financial benefits of the project are high, covering 100% of capital costs, and the city is also using a share of project revenues to invest in local amenities, notably green spaces in the area to improve local living conditions. Co-benefits can make carbon market projects more attractive at the city level. The way carbon market projects and finance are integrated with, and assist to achieve, existing policy priorities (e.g. energy poverty reduction, energy security) is key to the success of the project.

The analysis shows that successful projects demonstrate a pattern of institutional features or drivers that go beyond project profitability. These include: the demonstration of political will and strong multilevel governance; private sector engagement to bear risk and provide financial and technical support; and presence of tangible local co-benefits (waste management, odour reduction, energy reduction consumption, etc.) (see Table ES-2). These inter-related drivers have combined in unique ways for every project, however in all cases each of these clusters of drivers were present and contributed to the success of the project, and they sometimes highlight key differences between the way public and private actors weigh investment decisions.

Table ES-2. Motivating Factors - Drivers of Urban Project Success

Project Element	Conditions for Carbon Market Access & for Project Success
Project profitability and type/suitability	✓ Suitable project types for city authorities ✓ Use of existing or simple methodologies/technologies ✓ Projected profitability
Co-benefits	✓ Existence of high local co-benefits
Private sector engagement	✓ Risk management through private sector engagement e.g. for technical expertise and financial risk management
Political will and strong multi-level governance	✓ Local political support ✓ Alignment with national climate strategy ✓ Support from national or regional government for methodology and project development ✓ Engagement of international partners

Looking forward: supporting low carbon urban development through carbon markets

The review shows that the carbon market in its present form is cumbersome and infrequently used as a means to support low-carbon urban development. Carbon markets are not currently an important source of finance for urban projects when looking across the pool of offset projects to date. In almost all cases, urban projects have overcome numerous barriers to market access through recourse to higher levels of government, international institutions and private sector partners who can offer both the technical know-how and the financial support that they lack themselves.

Looking forward the challenge is how to best tap the potential for carbon markets to offer increased levels of financial support for urban mitigation projects or programmes. What kind of targeted market reforms could address the two-fold problem of low volume (and size) of urban projects and the slow pace of project development and approval? Suggestions for possible solutions include: developing methodologies for urban programmatic or sectoral projects to boost the volume of urban emissions, and simplifying the project development phase to accelerate the pace of project development and approval and reduce transaction costs. A decision by the representatives of the Parties to the Kyoto Protocol could help to guide the Executive Board of the CDM to develop methodologies and guidelines applicable for urban level projects, and the Joint Implementation Supervisory Committee to develop criteria of eligibility for "Track 2"urban projects. For "Track 1" countries (which have the right to oversee the monitoring, verification and issuance of credits for projects in their country), possibilities are theoretically greater as each national government is responsible for its own JI rules although it is not used in practise – mainly because of a lack of knowledge – and typically Track 1 projects tend to follow Track 2 like procedures. However, as pointed out in earlier analysis, the CDM market tends to support larger, low-cost, low-risk projects, which is not in favour of urban projects.

Beyond existing market mechanisms, other avenues that could be explored for urban mitigation projects are domestic offset mechanisms and possibly participation in national cap and trade systems. These are already viable options in the case where national governments have taken on a national cap as they do not require changes in international market rules. Examples of existing or proposed systems include: in New Zealand, Germany, France and most new EU Member States, where the domestic offset option is technically already in place using the JI architecture; and in the US, where the idea of regional or federal domestic offset projects has been proposed. Domestic offset projects are interesting mechanisms as they offer the possibility of scale on a national level, whereas city-wide trading schemes, such as the Tokyo cap-and-trade programme, are more limited in scale by definition and context specific.

Over the longer term, it will be important to consider how to mainstream urban low carbon development and move towards large scale private investment in these options. Experience from CDM and JI urban offset projects provides valuable information and opportunities for learning about the costs, technical and financial aspects of mitigation and should help to limit future project risk associated with mitigation technologies and practices. Carbon market rules should be designed to encourage such projects to be taken up in the market on their own.

National governments and international organisations will need to act to create urban-friendly carbon markets. First steps could include: subsidising the development of relevant urban methodologies for key sectors at urban scale; working through national governments to simplify and reduce costs of the project approval and verification procedures for urban projects; and advancing internationally harmonised accounting methods and reporting guidelines for urban emissions to help cities identify potential target areas for mitigation projects and provide a consistent accounting framework to integrate with national policy frameworks. National governments are also well placed to support capacity building of urban actors and institutions and to align policies and incentives to support action at the urban scale.

1. INTRODUCTION

Tackling climate change requires a global effort. Including urban areas in greenhouse gas mitigation strategies is critical to the fight against climate change. As centres of population, economic activity and energy use, cities are increasingly important sources of greenhouse gas emissions. Cities currently account for approximately 50% of the global population and this is expected to increase to 60% by 2030, with this trend driven by rapid urbanisation in developing countries (UN, 2009). The major consequences of this urbanization trend include not only a continued rise in the proportion of global energy consumption by cities, but also profound impacts on the nature of energy use itself.[1] Urban areas currently account for around 67% of world energy use and 71% of world greenhouse gas emissions from energy (IEA, 2008). Based on recent policy settings, these figures are projected to increase to around 73% and 76% respectively by 2030 (IEA, 2008). Approximately 80% of the growth in energy use and 89% of the growth in emissions by cities is expected to come from developing countries.[2]

Consequently, investment choices made today about urban infrastructure and capital will have a major impact on both national and global emissions pathways into the coming decades (World Bank, 2005; World Bank, 2010b). Governments with responsibility for key areas of urban policy can play an important role in how these choices are made. Urban policymakers, either at the municipal or regional level, can have authority over some policy areas with the potential to materially affect urban emissions, particularly through changing patterns of energy use (refer to Table 3). For example, buildings and land-use zoning, transport, local distribution networks, waste management, and urban forestry and land use are often cited as policy areas representing high abatement potential (e.g. Betsill & Bulkeley, 2007; Corfee-Morlot et al., 2009; Lefèvre & Wemaere, 2009; OECD, 2010 forthcoming; World Bank, 2010).

Table 3. Examples of Local-Level Mitigation Policy Areas across Sectors

Source	Sector	Mitigation Policy Areas
Energy	Building	Energy efficiency measures
Energy	Electricity Generation/Distribution	Fuel mix; use of renewable; transmission loss
Energy	Heating/Cooling	Energy demand management; heating and cooling
Waste	Waste Disposal	Shipping of waste; Methane emissions mitigation (capture/co-gen)
Energy	Transportation	Modal mix; Vehicle efficiency; Infrastructures;
Energy	Land-use planning	Land-use regulation (increased density, increased proximity); Energy efficient development;
Energy	Water Provision	Emissions related to pumping

Source: Corfee-Morlot at al., 2009; OECD, 2010 forthcoming

[1] Energy consumers are expected to continue current trends to shift from CO_2-neutral energy sources (biomass and waste) to traditionally CO_2-intensive energy sources (fossil fuels), leading to an increasing greenhouse emissions in cities (IEA 2008).

[2] This figures are based on the IEA's 2008 Reference Scenario, which is based on trends and policies in place as of mid-2008.

Furthermore, urban authorities are often in a position to both improve the climate change policymaking process through effective communication and engagement with key actors and decision-makers on a local level (Corfee-Morlot *et al.*, 2009, OECD, 2010 forthcoming). In this capacity, local and urban authorities may work most effectively by functioning as 'conveners' who bring together a full range of actors, thus improving information exchange and reducing practical barriers to cost-effective mitigation. Urban policymakers therefore have a range of potential ways of providing a complement to national mitigation policies.

But while urban policymakers may have a high potential to cost-effectively reduce emissions, many of the potential reductions in emissions require significant new sources of finance to be viable. Urban and even regional governments are often not in a position to finance large scale projects from their balance sheet, and may have limited access to capital markets (Kamal-Chaoui et al, 2009; OECD, 2010 forthcoming). Cities may have a wide array of financial and policy instruments at their disposal (e.g. taxes, bonds, etc.), but can face challenges in effectively implementing such policies for a variety of reasons. As a consequence, there has been significant interest in new and innovative sources of financing, for example opportunities provided to cities by carbon markets.

Carbon markets offer urban actors a new source of financing because they typically allow covered market participants to meet a part of their compliance obligations by investing in offset projects that reduce emissions. Carbon market participants will therefore have an economic incentive to find investments that reduce emissions at a relatively low cost compared to paying for emissions permits or abatement within the firm, region, country, etc. To date, the international carbon market created under the Kyoto Protocol includes two "flexibility mechanisms", which have been a means of mobilizing relatively large sums of capital for projects to reduce emissions, with the CDM and JI markets worth over 12 billion € over the period 2007-2009 (World Bank, 2010a).

A key question for international and national policymakers is: how have cities accessed carbon markets to date and what might we draw from this experience for the reform of future market mechanisms? This paper examines this question by drawing on empirical evidence from 10 in depth case studies where urban actors have attempted to make use of carbon market financing to invest in urban greenhouse gas abatement. In particular, we focus exclusively on projects conducted through the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation (JI)[3]. Figure 3 illustrates the scope of this paper, which focuses on the CDM and JI aspect of the carbon markets as one of an array of tools available to cities.

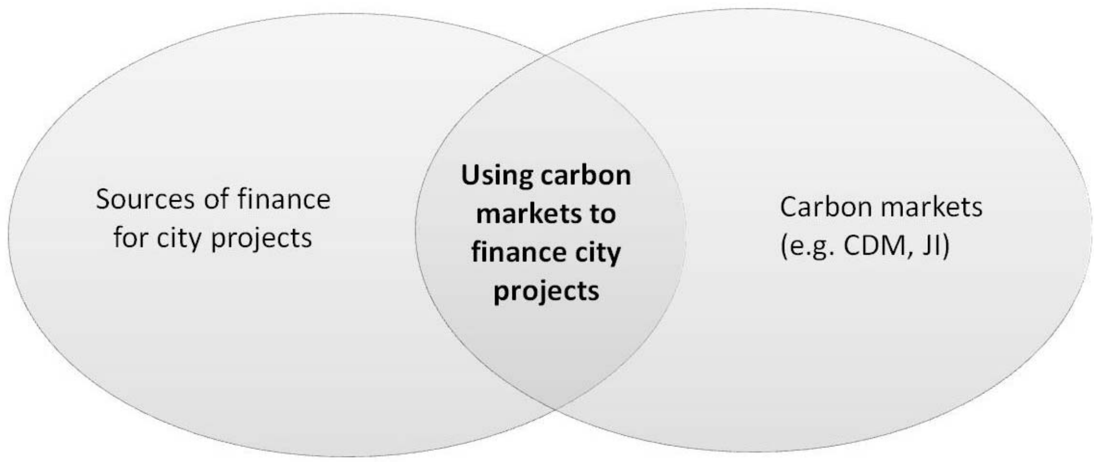
The paper aims to develop a better understanding of the factors that drive success in the access of urban mitigation projects to the world's largest carbon offset markets and to draw lessons for the future from experience to date. Through these case studies, this paper seeks to identify institutional models that can help cities to successfully access carbon markets. This includes an examination of the role of both local and national governments as well as private sector actors.

For the purposes of this paper we define "cities" as urbanised areas and "city-" or "urban projects" as projects in which city governments are directly involved in efforts to materially reduce greenhouse emissions by systematically modifying, or investing in, less emissions intensive technologies, capital and infrastructure.

[3] The scope of this paper therefore does not include cities' engagement in other carbon markets such as the European Union Emissions Trading Scheme (EU ETS), the New Zealand Emissions Trading Scheme, the Regional Greenhouse Gas Initiative (RGGI) and the various voluntary markets.

The structure of this paper is as follows. Section 2 provides an overview of the Kyoto carbon markets, data on cities' use of the carbon markets to date and summarises the relevant literature. Section 3 assesses ten case studies of city projects that provide a cross-section of project types, geographical regions for both the CDM and JI market instruments. Section 4 analyses the results and draws broader lessons in terms of risk management and important factors that affect city projects when accessing carbon market finance. Section 5 elaborates on how to move beyond existing carbon market mechanisms to more broadly address emission reductions in cities and concludes.

Figure 3. The context of this work



2. CARBON MARKETS: A SOURCE OF FINANCING FOR URBAN MITIGATION PROJECTS

2.2 Carbon market mechanisms in cities

From the point of view of urban authorities, well functioning carbon markets can offer a means of enlarging the pool of available financial resources that can be directed towards urban GHG abatement projects. The existing carbon market that is perhaps most suitable for doing so is the so-called "compliance offset" market, which operates through the "flexibility mechanisms" of the Kyoto Protocol, and which accounts for around 90% of the primary transactions (voluntary markets cover the rest). This includes two relevant project-based mechanisms: the Clean Development Mechanism (CDM), which targets projects in non-Annex I (developing) countries to the Protocol; and Joint Implementation (JI), which concerns projects in Annex I (developed) countries. Text Box 1 explains how these mechanisms work (see Annex 1 for detail on the administrative process).

The value of primary CER transactions from CDM projects, assessed from existing contracts (i.e. ERPAs, for "Emissions Reduction Purchase Agreement"), is estimated to be approximately 5.3 and 4.7 billion € in 2007 and 2008 respectively (World Bank, 2009a). In 2009, the global financial crisis along with other factors impacted this market and the value fell to 1.9 billion € (World Bank, 2010a). On the other hand, the international JI market is estimated to be much smaller, worth 360 and 264 million € in 2007 and 2008 respectively (World Bank, 2009a)[4]. In 2009, it was around 255 million € (World Bank, 2010a). These two mechanisms are both a significant new source of project financing targeted towards emissions reductions, with potential for access by cities.

Continuation of these mechanisms after 2012 is subject to current negotiations under the United Nations Framework Convention on Climate Change (UNFCCC, 2010h). However, it is likely that international compliance carbon markets will continue to play a significant role in financing both public and private efforts worldwide to reduce emissions in the near and longer term.[5]

[4] The 2008 results for all three credit markets would likely have been significantly higher if not for the global financial crisis, competition from 'greened hot air' AAUs, and ongoing uncertainty about future demand for credits after 2012.

[5] Demand for carbon offset credits is expected to continue through markets, such as the European Union's Emissions Trading Scheme, that is supposed to continue at least to 2020, according to the EU climate and energy package. The CDM, which has been a major supplier of carbon credits to the EU ETS participants, is therefore expected to continue beyond 2012 in one form or another, regardless of the nature of the post-Kyoto international architecture agreed through negotiations. The JI mechanism is however quite different, in that it requires Annex I countries to have AAUs to convert to ERUs to be able to create credits, However, new AAUs won't exist after 2012 unless a post-2012 agreement foresees it (UNFCCC, 2010h). In essence, any international mechanism that does not allow for a suitably robust accounting framework, and which prevents double counting for inter-Annex I exchanges of credits would therefore render JI a more difficult mechanism to maintain in the absence of a Kyoto-type framework.

Box 1. The CDM and JI Mechanisms

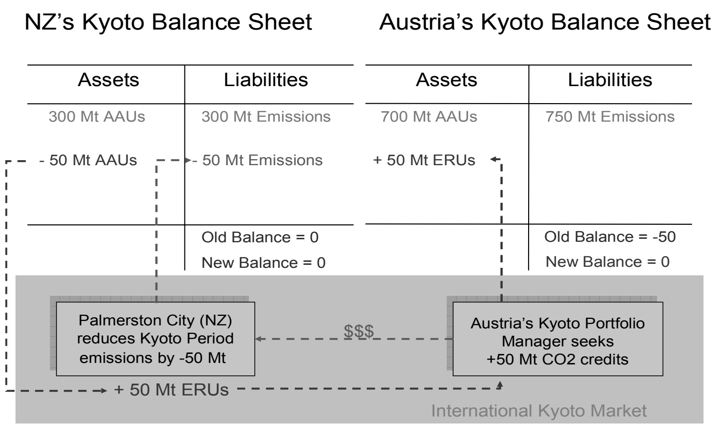
The Clean Development Mechanism (CDM) allows Annex I countries to support low cost options globally to reduce emissions, while supporting low-carbon development in non-Annex I countries. The CDM functions by allowing Annex I countries to purchase emission reduction credits from projects in non-Annex I countries. Where CDM projects can be reliably demonstrated to reduce emissions relative to a projection of emissions without that project – a concept known as "additionality"[6] – and compliant with an accepted methodology, the CDM Executive Board will approve the project, verify the emissions reductions and issue Certified Emissions Reduction units (CERs) to the project investor. CERs can then be added to the Kyoto compliance account of the country sponsoring the CDM project, or sold to an entity (country, firm, etc.) wishing to purchase them to offset its emissions.

Joint Implementation (JI) works in a similar but slightly different manner. JI allows an Annex I (developed) country to generate Emissions Reduction Units (ERUs) by sponsoring emissions reduction projects in another Annex I country. Like the CDM, JI can thus provide benefits to the investor country by providing relatively low cost sources of Kyoto compliance. JI projects will be neutral to the host country if it generates as many ERUs as emission reductions; but JI projects can be beneficial to the host country wherever they reduce emissions by more than the credited amount, either during the Kyoto commitment period, or in the longer term, once future international emissions commitments are taken into account.[7]

The diagram below presents the mechanism at the country level for JI. A project can reduce emissions by 50 Mt, so when it is approved, the host country (New Zealand in this example) will convert 50 Mt of its carbon credits (AAU – Allowance Amount Units) into ERU and give them to the foreign investor (Austria in this example). Emissions in New Zealand will be reduced by 50 Mt so the mechanism is neutral in terms of CO_2 assets and liabilities for the host country, but, via its investments, Austria will gain 50 Mt of carbon assets that are useful for its compliance.

For New Zealand, on the other hand, the gain is three-fold. Firstly, it has reduced its emissions at low cost – because rational investors will typically identify projects which generate the highest amount of emissions reduction credits for a given investment cost. Secondly, by welcoming investment in technologies that reduce emissions, the country may improve its technical and institutional capacity to reproduce such projects. Thirdly, under the Kyoto Protocol projects that reduce emissions will only be credited for emissions reduced during the period 2008 – 2012. However, for investments in long life capital and other infrastructure, the emissions reductions will often continue beyond that period. Hence, to return to the example, New Zealand would typically reduce its emissions for meeting targets under future international agreements as well.

Example of a hypothetical JI project



[6] Additionality can be either financial (i.e. the project would not have occurred without the financial stream from emission credits) or technological/institutional (i.e. some barriers – technical, institutional, social, etc.- prevent the project implementation, and this mechanism overcomes them).

[7] In contrast to CDM, JI projects can follow either of two processes to be registered, depending on the status of the host country, known as "Track 1" and "Track 2". If an Annex I country meets certain criteria defined in paragraph 21 of the guidelines for the implementation of Article 6 of the Kyoto Protocol (UNFCCC, 2006c) – mainly a reliable and updated inventory, and possession of its Assigned Amount Units in accordance with the Kyoto Protocol – it can choose the process it prefers. If no, it has to follow track 2, and to submit the project to the Joint Implementation Supervisory Committee.

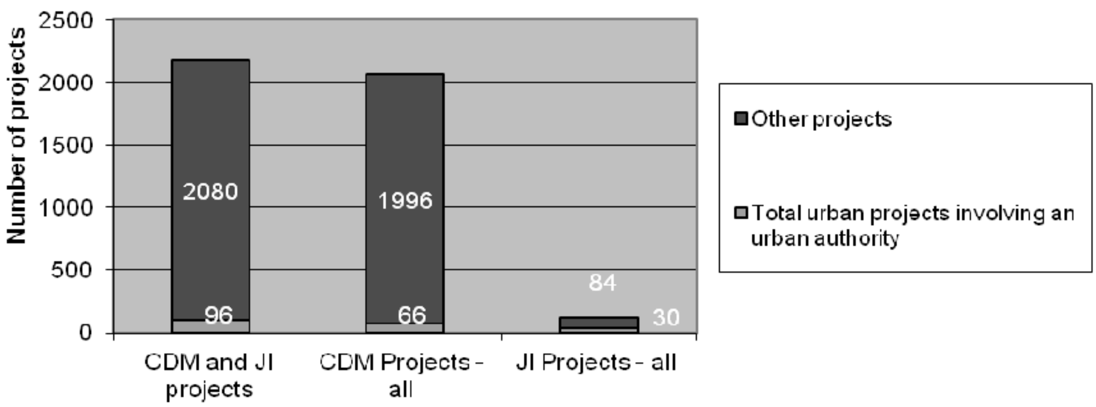
Carbon market finance could be useful for many cities as they face budgetary constraints. Often, cities and urban authorities either have limited or no capacity to raise capital on private markets (OECD, 2010 forthcoming). Where they can, that access can be limited by a number of factors unrelated to the value of the project itself; such as a city authority's size and ability to bear transaction costs (OECD, 2010 forthcoming; ICLEI, 2010)[8]. The absence of a sufficient lending track record for the urban authority or project type, the unpredictability of project returns, or the city's incapacity to generate economies of scale, can all impact the accessibility of private sector financing. Moreover, limited financing resources as well as the longer time frame of larger scale investments compared to the political and budgetary cycles can also reduce the attractiveness of financing mitigation projects.

In well-functioning carbon markets, finance should in theory be flowing to cities or urban scale projects when they offer least cost mitigation and whenever those emissions reductions can be verified with a reasonable level of reliability. Moreover, a successful JI or CDM project can generate revenues and potentially a positive return from the sale of the carbon credits. Some of this return on the project can be directed back to the city government's budget if the institutional arrangement of the project is set up to do so. A priori, these features of the carbon market appear attractive for urban policymakers as they can expand the available resources at their disposal to achieve climate policy goals and to deliver local co-benefits simultaneously.

However, despite the advantages that CDM and JI promise for urban projects on paper, the evidence so far suggests that the access of city governments to these mechanisms has been limited. In particular, it has been constrained to a small subset of potential project types. Less than 1% of projects registered with the CDM are credited to urban collectives (World Bank, 2010b). If a broader definition of "urban projects" is applied, as in ICLEI (2010), less than 9% of projects in the CDM meet the definition.

While the CDM and JI project pipeline databases do not always allow project originators to be clearly identified, an analysis of the types of projects registered[9] confirms that cities' use of the mechanisms is marginal (see Figure 4). According to our calculation, as of March 2010, 4% of CDM and JI projects come from urban collectives and concentrated in landfill gas and waste to energy projects.

Figure 4. Overview of CDM and JI registered projects initiated by city or involving city authorities



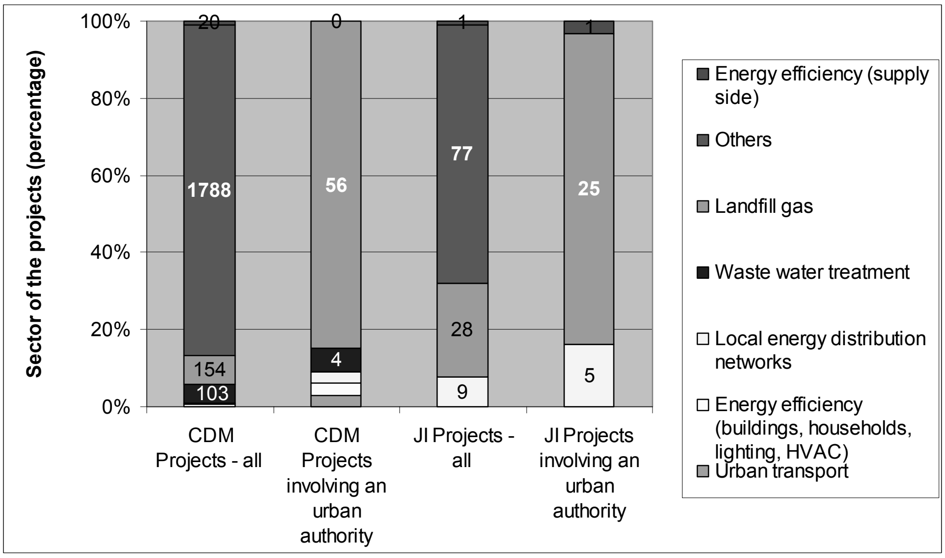
Source: CDC Climat Research – from UNEP Risoe CDM and JI Pipeline Overview as of 1/3/2010 & project design documents

Note: 'Involving an urban authority' was taken to mean that the urban government or its direct service provider was an important actor in the project according to the PDD (e.g. project developer, manager, etc).

8 For example, transaction costs include the costs of developing the methodology, obtaining credit rating approvals required for accessing international capital markets, or the search costs of finding a suitable lender.

9 Registered projects are those which have been validated and then accepted by the CDM Executive Board, the Joint Implementation Supervision Committee, or the host country (depending of the case).

Figure 5. Urban CDM and JI registered projects initiated by city or involving city authorities, by sectors



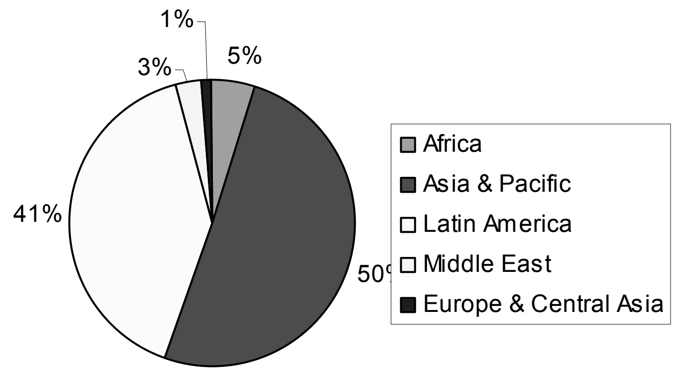
Source: CDC Climat Research – from UNEP Risoe CDM and JI Pipeline Overview as of 1/3/2010 & project design documents

Note: 'Involving an urban authority' was taken to mean that the urban government or its direct service provider was an important actor in the project according to the PDD (either project developer; manager; etc)

As of March 2010, of the 2,062 CDM projects that had been registered, 56 referred to urban landfill gas, only 2 were urban transport projects and 4 were projects associated with energy efficiency in buildings and lighting and energy distribution (see Figure 5). Only 4 of the 103 registered waste water projects in the CDM are urban authority-led projects. For the JI mechanism, project statistics paint a similar picture, with a relative high proportion of local energy distribution networks projects (see figure 5). The proportion of urban projects appears to be higher for JI than for CDM (26% of total JI projects). This can be explained in part by several factors: the EU ETS has already covered several sectors; there is a high level of urban population in Annex I countries; and there are very few hydropower and wind JI projects.

CDM projects involving urban sectors are distributed worldwide, but with a high preference for Asia and Pacific, and Europe and Central Asia (cf. Figure 6), whatever the kind of projects (cf. Figure7).

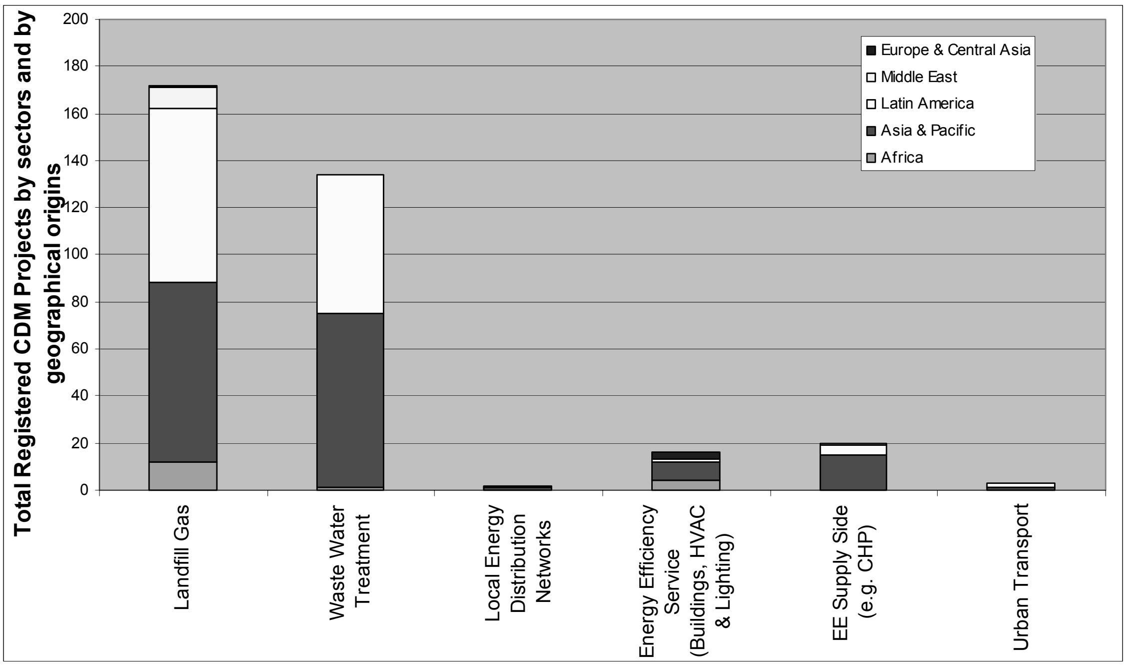
Figure 6. Breakdown of registered CDM projects involving urban sectors by geographical origins



Source: CDC Climat Research – from UNEP Risoe CDM and JI Pipeline Overview as of 1/9/2010

Note: here "urban sectors" are defined as projects of the following types: landfill gas, waste water management, local energy distribution networks, energy efficiency (both "demand side" and "supply side"), and urban transport.

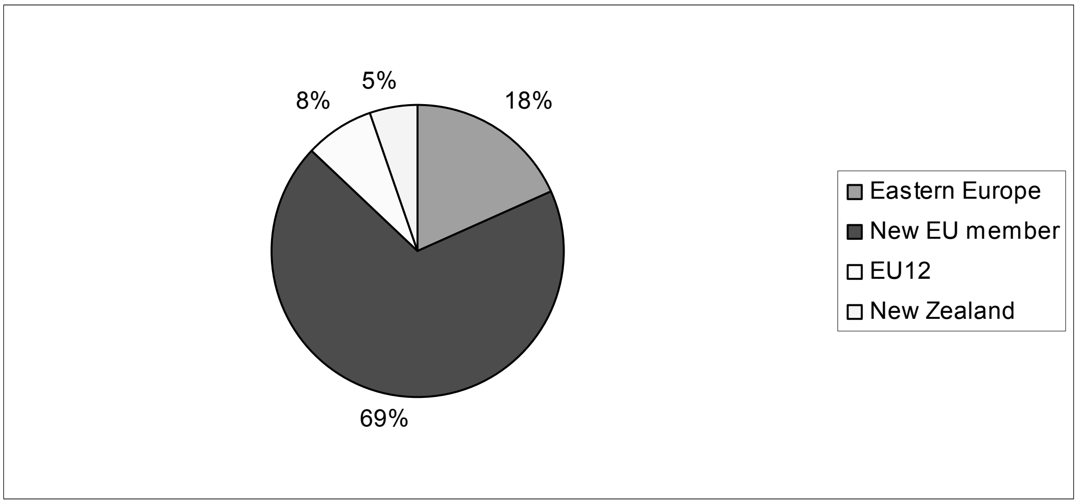
Figure 7. Total Registered CDM Projects by sectors and by geographical origins



Source: CDC Climat Research – from UNEP Risoe CDM and JI Pipeline Overview as of 1/9/2010

JI projects involving urban sectors are distributed worldwide, but with a high preference in new EU members (mainly Czech Republic), and Eastern Europe (Ukraine) (cf. Figure 8), whatever the kind of projects (cf. Figure 9), with the exception of energy efficiency projects that are developed in EU 12 (i.e. Germany).

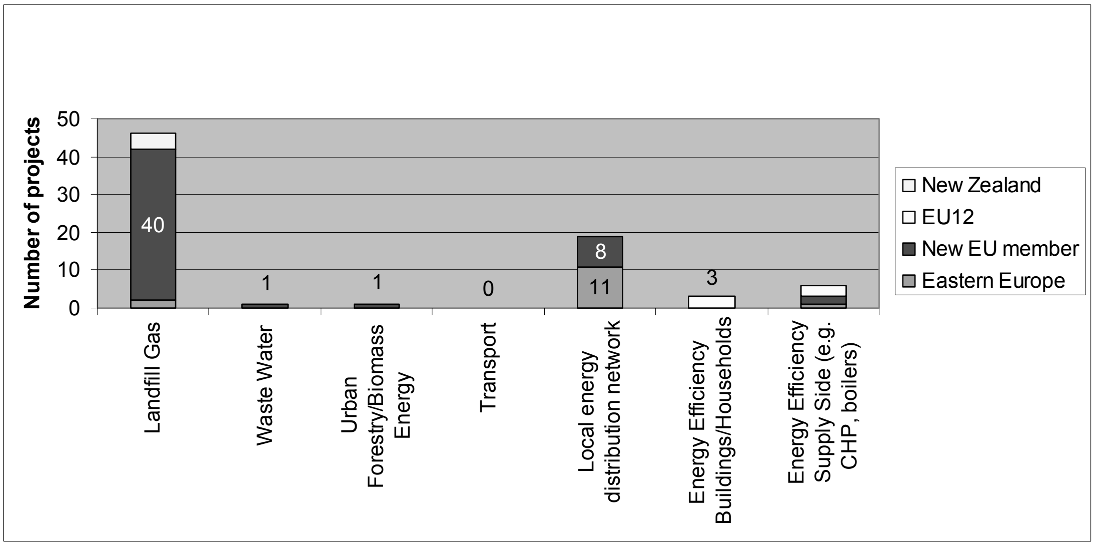
Figure 8. Breakdown of registered JI projects involving urban sectors by geographical origins



Source: CDC Climat Research – from UNEP Risoe CDM and JI Pipeline Overview as of 1/9/2010

Note: New EU members include Bulgaria, Czech Republic, Hungary, Lithuania, Poland, and Romania.

Figure 9. Total Registered JI Projects by sectors and by geographical origins



Source: CDC Climat Research – from UNEP Risoe CDM and JI Pipeline Overview as of 1/9/2010

2.2 Challenges in accessing market mechanisms

There are several underlying reasons why city governments have not taken further advantage of carbon market mechanisms. Several studies have suggested that their limited use of the JI and CDM mechanisms can be explained by high transaction costs associated with project development and approval by authorities (e.g. Ellis and Kamel, 2007). For instance, NEFCO (2010) points out that there is a common misconception that carbon market finance pays for the entirety of the development of the underlying project, whereas in reality carbon credit revenue is usually a marginal supplementary revenue stream on top of underlying project finance and since projects do not start earning credits until after at least one year of operation and monitoring, alternative financing is anyway required to cover start up costs. Ritter (2009) and NEFCO (2010) suggest that the relative complexity and uncertainty of the approval and verification mechanisms for CDM and JI may discourage urban authorities with limited institutional capacity to manage the project development and approval process. The World Bank (2010b) also cites this problem underscoring that city-level GHG emission reduction activities or programmes, such as efficiency improvement in street-lighting, are often not large enough to warrant the transaction costs associated with obtaining carbon finance, although the programme of activities (PoA) approach to CDM helps to alleviate some of the challenges of smaller point-source projects.

In addition, numerous studies argue that many of the likely types of mitigation measures capable of being led by cities do not easily lend themselves to accurate measurement, at least with current methodologies, e.g. ICLEI (2010). As described in Ellis and Kamel (2007), buyers (and suppliers) on the CDM market support larger, low-cost, low-risk projects, which is not in favour of urban projects. Since emissions from urban activities, such as transport, are often diffuse they can be difficult to measure with accuracy, and may require programme-wide or systemic changes to be reduced. For example, in the case of transport, difficulties can arise in the context of CDM approval when determining the project boundary, establishing a reliable emissions baseline, and monitoring project performance (e.g. Lefevre et al., 2009). Indeed, to date the majority of proposed or accepted transport-related projects in the CDM claim their benefits through fuel switching or engine improvements in captive fleets, rather than modal or structural shift in the way city inhabitants use transport.

For urban building projects, UNEP (2009) points to similar challenges for the CDM. In this recent study, UNEP notes that enhanced architectural design to improve energy efficiency is not easily quantifiable in terms of emissions reductions. Moreover, Sippel *et al* (2009) and NEFCO (2010) point out that municipal energy efficiency and distribution projects are often too small in terms of crediting potential to justify transaction costs. Finally, ex-ante evaluation is important but may often prove difficult, because actual emissions depend on how buildings are actually constructed as well as the way inhabitants use the buildings and apply the new technology.

World Bank (2010b) argues that the low use of the CDM and JI by cities can be explained by high transaction costs relative to small size of urban projects and two other factors. They point to broader mitigation policy frameworks and priorities that are typically set at the national level, meaning that local scale actors may not be sufficiently engaged in the larger policy debate, so as to obtain needed support to better exploit these markets. Also cities often have limited financial resources and improving access to basic urban services is often a greater priority than improving the energy and emission performance of those services. The World Bank (2010b) noted, for example, that "most city-level agencies in developing countries have severely limited financial resources and find the scrapping of equipment that functions, even those with lower-efficiency, difficult to justify."

On the other hand, ICLEI (2009) notes that a lack of awareness, a lack of expertise and technical know-how, as well as institutional inertia, have all limited the exploitation of carbon finance by city authorities. The same report also notes complaints by some city decision makers that the payback periods of CDM projects remain unattractive, due to its non-conformity with their city's budgetary or political cycle – meaning that projects run into competition with other policy goals even despite the revenue stream offered by carbon financing. The use of carbon finance also faces enhanced political, cultural and institutional challenges, as international carbon finance is not primarily designed for cities and can therefore require strong coordination with either the national level government or the private sector.

To address some of these challenges, some authors have argued that the Kyoto flexibility mechanisms should be made more friendly to those urban sectors where they have the greatest potential to achieve rapid and low economic cost reductions, i.e. buildings, energy distribution, transport, water and wastewater management, and urban forestry (see, for instance, World Bank (2010b); Lefevre & Wemaere (2009); NEFCO (2010)). A possible approach that is addressed in the case study analysis of this paper is that of so-called 'programmatic' CDM and JI projects, which seek to provide marketable methodologies for projects that involve diffuse and small emissions sources in particular. To further enhance the use of grouped projects under a city umbrella, the World Bank (2010b) is developing a city-based methodological approach, consisting of a program which covers all or some sectors within a perimeter. This approach is being developed using Amman, Jordan as the pilot city.

Coherent accounting methodologies and consistent city-scale GHG inventories could also help lay the foundation for assessment of mitigation options (Cochran, 2010; Kennedy, 2010; OECD, 2010 forthcoming). These accounting tools are critical for integrating urban-scale mitigation into national frameworks and carbon markets.

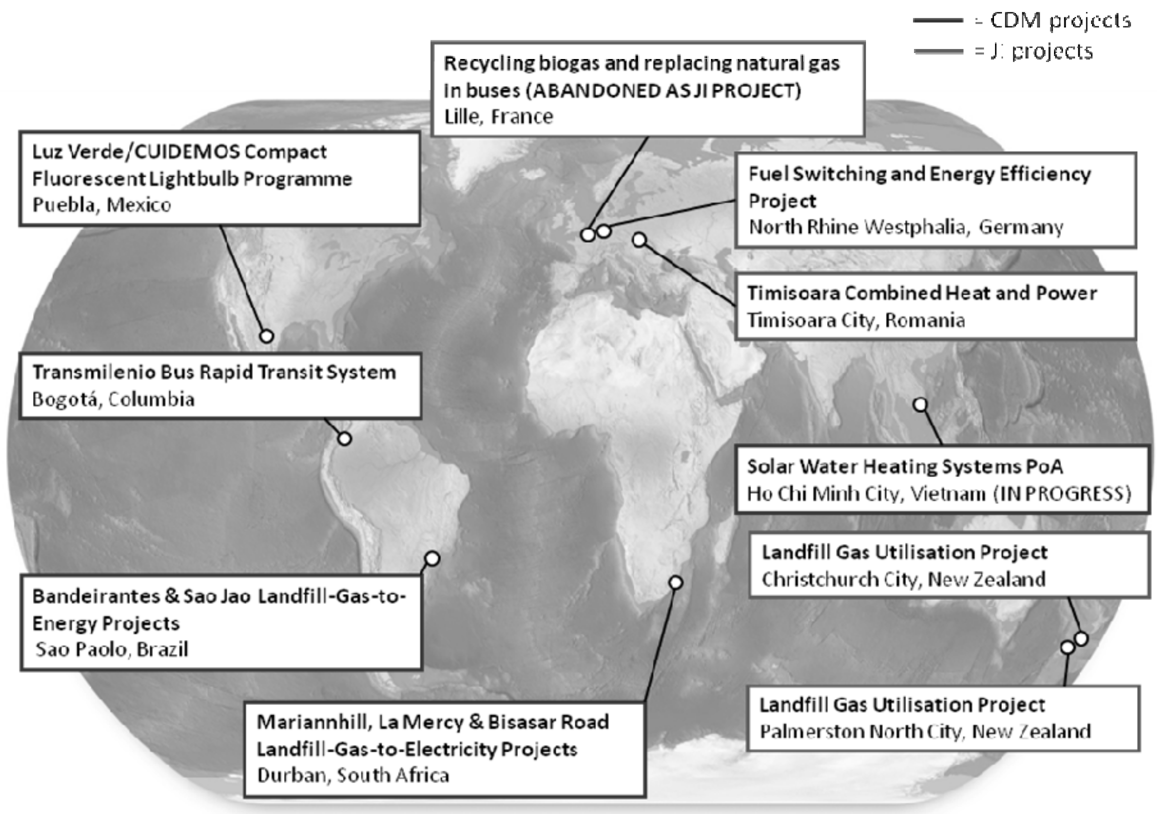
In summary, this section highlights a large gap that exists between the theoretical potential and the actual use of carbon markets to help contribute to the financing requirements for urban mitigation projects and/or programmes. The following section takes up the question of how cities have accessed carbon markets to date empirically, providing a detailed discussion and analysis of 10 case studies of urban projects which obtained (or about to obtain) carbon financing through Joint Implementation and the Clean Development Mechanism.

3. CASE STUDIES

This study examines 10 existing CDM or JI projects involving cities across a range of geographical locations, institutional environments and project types, as indicated in Figure 10. The range of cases was chosen to represent the diversity of geographic location and projects types in which city authorities have to date engaged with the Kyoto carbon markets to finance GHG mitigation projects. These case studies represent a range of continents (with 3 projects in Europe, 1 in Africa, 3 in Asia & Pacific, and 3 in Latin America), and cover a range of sectors (including waste management, energy efficiency, and transport).[10] While not representative of all possible urban projects in the CDM or JI, the cases do illustrate interesting examples of the role of urban authorities and their interactions between urban and national governments, and the private sector.

The information presented in the following case studies is based on a semi-structured interview process with approximately 30 people from city governments, national governments, firms, and consultants. The case studies focus on the story of how the project came to fruition, including the motivation, the financial risk management, and the actors involved across national and local governments as well as the private sector.

Figure 10. Project case studies by region



Source: Image Natural Earth II from Tom Patterson, US National Park Service, derived from Natural Earth (www.shadedrelief.com)

[10] The availability of data was also a factor in selecting the projects.

3.1 CDM Case Studies

3.1.1 Transmilenio Bus Rapid Transit System, Bogota, Colombia

Transmilenio is an innovative mass urban transportation project in Bogota, Colombia. Bogota is the largest city in Colombia with a population of over 7 million. The project was registered as a CDM project in December 2006. The project was initiated by Enrique Peñalosa, who served as Mayor of Bogota in 1998-2000. At this time transportation was high on the political agenda, as the old public transit system was chaotic, average journey times were long and the quality of service was generally poor (Lleras, 2003; Echeverry *et al*., 2004). The objective of Transmilenio was to establish an "efficient, safe, rapid, convenient, comfortable and effective modern mass transit system ensuring high ridership levels" (UNFCCC, 2006a).

The project is based on a Bus Rapid Transit (BRT) system. The key features of this transit system include dedicated bus lanes, large capacity buses, bus stations for fast boarding, a pre-board ticketing system, centralised coordinated fleet control and feeder bus services to main stations. The construction plan for the Transmilenio project consists of 25 trunk routes with a total length of 387 km (Gilbert, 2008). It is intended to roll-out the project incrementally over the period 1999-2031 in eight phases (UNFCCC, 2006a) so that Transmilenio will eventually cover 80% of the urban transport needs of the city (Gilbert, 2008). The first bus service operations began in December 2000 (UNFCCC, 2006a). However, the political priority of the project may have become lower in recent years (Hidalgo *pers. comm.*, 2010) and the present administration has promised to implement a metro system (Americas Quarterly, 2009).

The GHG emissions reduction potential of the Transmilenio project comes from the use of new and larger buses with greater fuel efficiency per passenger than existing buses, combined with a modal shift towards greater use of public transportation. Projections in the PDD estimate that the project will reduce GHG emissions by 1,725,940 tCO_2-eq in the period 2006-2012, relative to the baseline scenario (UNFCCC, 2006a). At the time the project was being developed there were no previous approved CDM methodologies for mass urban transit projects, so a new methodology was required. Developing a methodology for this project was particularly challenging due to the lack of previous methodology formats for this sector and because it was complicated to measure leakage and to determine the baseline (Scordellis *pers. comm.*, 2010; Hidalgo *pers. comm.*, 2010). The first attempt to develop a methodology for the project was unsuccessful. A second methodology, developed by Swiss consultancy Grütter Consulting, was approved in July 2006 and became the first approved large-scale methodology for reducing GHG emissions from the transport sector. The name of this methodology is "AM0031: Baseline Methodology for Bus Rapid Transit Projects – Version 1".

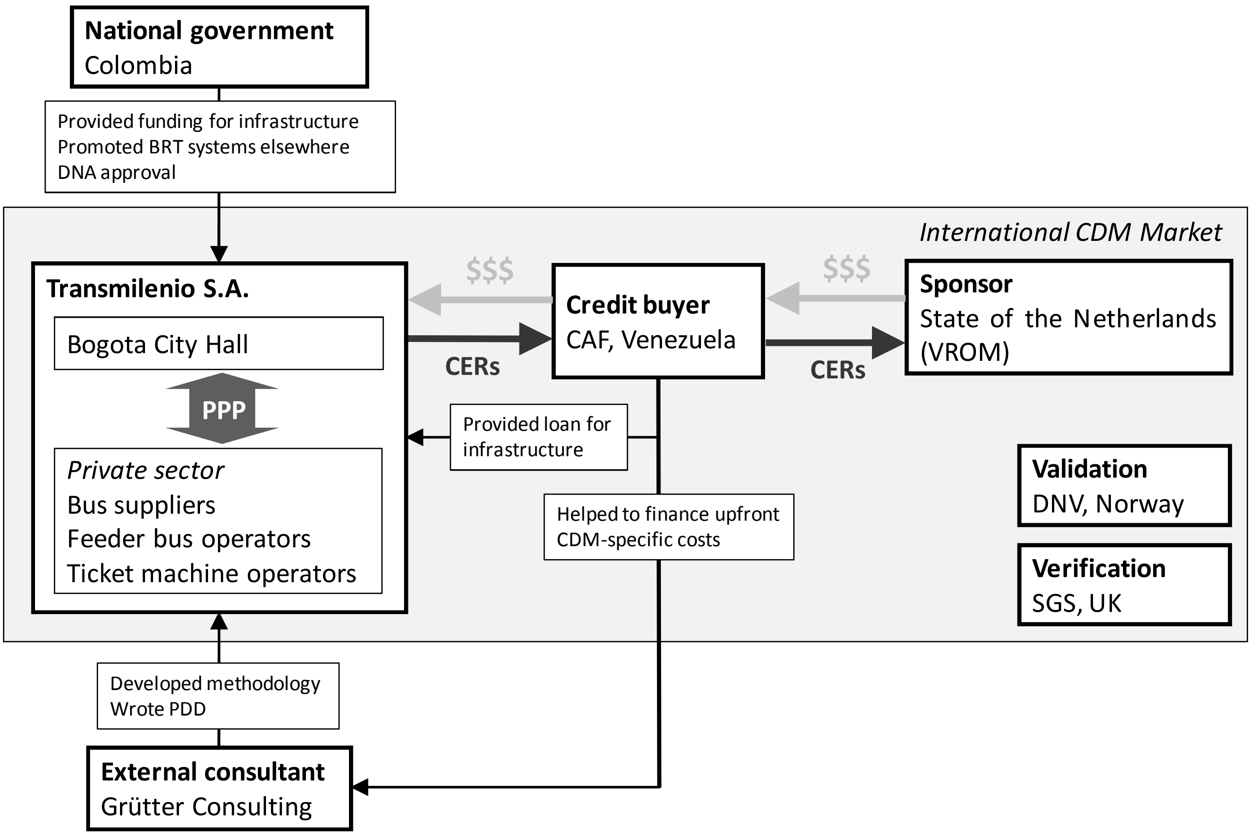
Prior to Transmilenio, the average commute time in Bogota was over one hour, accidents were frequent, and traffic was a major contributor to air pollution (Echeverry *et al,* 2004). The Transmilenio project provides multiple co-benefits, including reduced traffic, accidents and commuting times, and improved air quality.

In order to implement the project a private-public partnership named Transmilenio S.A. was formed, in which Bogota City Hall was responsible for investment in the project infrastructure (dedicated bus lanes, bus stations, bus terminals, access ways to stations, bus depots and operations control centre) and private companies were responsible for investment in the bus fleet, ticket machines and the operation of the trunk and feeder bus services. The CDM aspect of the project was a joint initiative between Transmilenio S.A. and Corporación Andina de Fomento (CAF), the Andean multilateral development bank. CAF acted as both project developer and an intermediary credit buyer on behalf of the State of the Netherlands. It helped to finance the upfront CDM-specific costs for the project. CAF contracted SASA, a Bolivian consultancy, to develop the first methodology, which cost around 100,000 € (Scordellis *pers. comm.*, 2010). They subsequently contracted Grütter Consulting to develop the second methodology. The contract form was a success fee based on a percentage of CERs, and Grütter Consulting developed on own cost the methodology and the Project Design

Document (PDD). The development of the second methodology took around two years (Grütter, *pers. comm.*, 2009). Figure 11 shows the key actors involved in this project and the interactions between them.

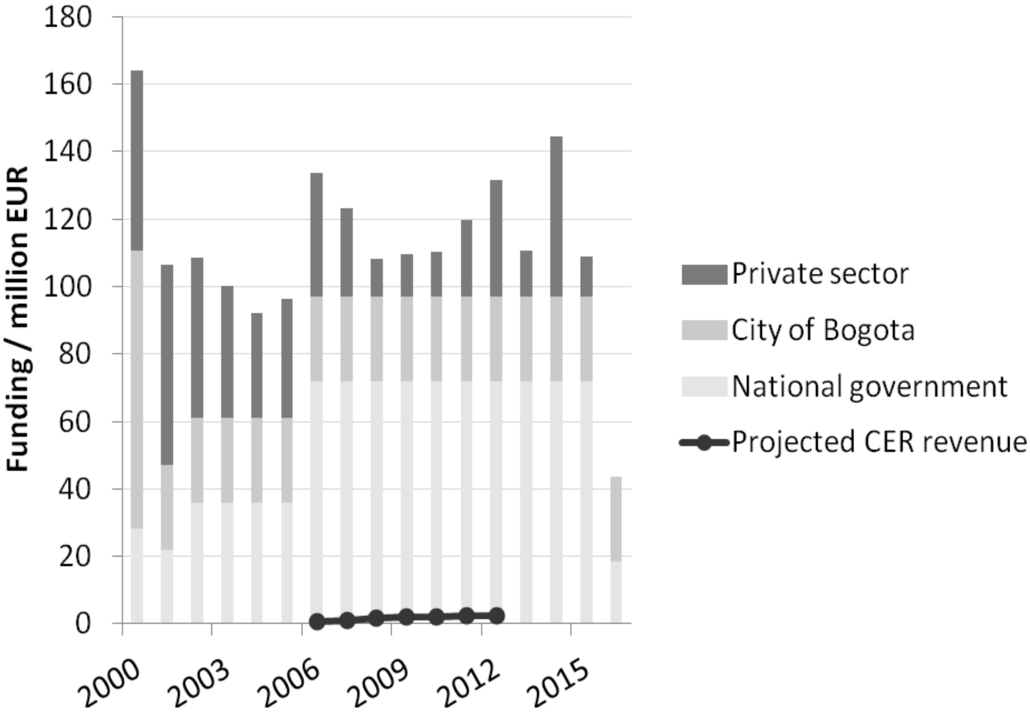
Early projections by the National Planning Department (2000) estimated the cost of the project infrastructure at 1,750 million € for the period 2000-2016. Under an agreement made in 2000, 66% of the infrastructure costs are covered by national government public funds and 34% are provided by Bogota City Hall (National Planning Department, 2000). These costs are not repaid. The projected cost of the buses and fare collection equipment for the same period is 859 million € (National Planning Department, 2000). This cost is financed by private investment. The revenue from ticket sales covers operational costs only.

Figure 11. Key actors and interactions in the Transmilenio CDM project



The City Hall's funding for the Phase I infrastructure came from multiple sources. These included a fuel surcharge and privatisation of part of a public power company (UNFCCC, 2006a). However, the extent to which revenues from these sources could be further increased was limited. This, coupled with greater-than-expected investment costs for Phase II, left the project in a difficult financial situation. The City Hall was therefore keen to explore alternative sources of funding for the project, such as the CDM. The Emissions Reduction Purchase Agreement (ERPA) between Transmilenio S.A. and CAF, combined with media coverage of the project including a feature in the New York Times (2009), also enabled the City Hall to leverage a significant amount of further funding for the project from various sources (Hidalgo *pers. comm.*, 2010). Figure 12 shows how the expected revenues from CER sales were modest in comparison to the total levels of funding required for the project, and demonstrates how additional sources of funding in addition to the CDM are often required to finance CDM projects. The projected revenue from CERs is approximately 1-2% of the annual total funding, for a cumulative total of around 120 million € over the period 2006-2027 (assuming 13 €/tonne) (Grütter *pers. comm.*, 2010).

Figure 12. Comparison of projected levels of public & private funding for infrastructure and expected revenues from CER sales for the Transmilenio CDM project in the period 2000-2016*



*Projected CER revenues calculated assuming a CER price of 8.9 €/tCO_2-eq

Sources: National Planning Department, 2000; UNFCCC, 2006a

However, the actual amount of CERs received has been 30-60% less than the amount projected in each year (see Annex 2). This has been largely due to a lower than expected ridership on Transmilenio, potentially due to a combination of optimistic projections, a lower than expected shift in transportation modes, and construction and operational difficulties. The actual ridership in 2006 was 94 million people, versus a projected 147 million (Millard-Ball, 2008).

3.1.2 Bandeirantes and São Joao Landfill-Gas-to-Energy Projects, São Paulo, Brazil

Bandeirantes and São Joao are the names of two landfill sites serving São Paulo, the largest city in Brazil with a population of over 10 million. Two CDM projects were set up to capture the landfill gas from these sites and use it to generate electricity. Both projects were registered with the Executive Board in 2006.

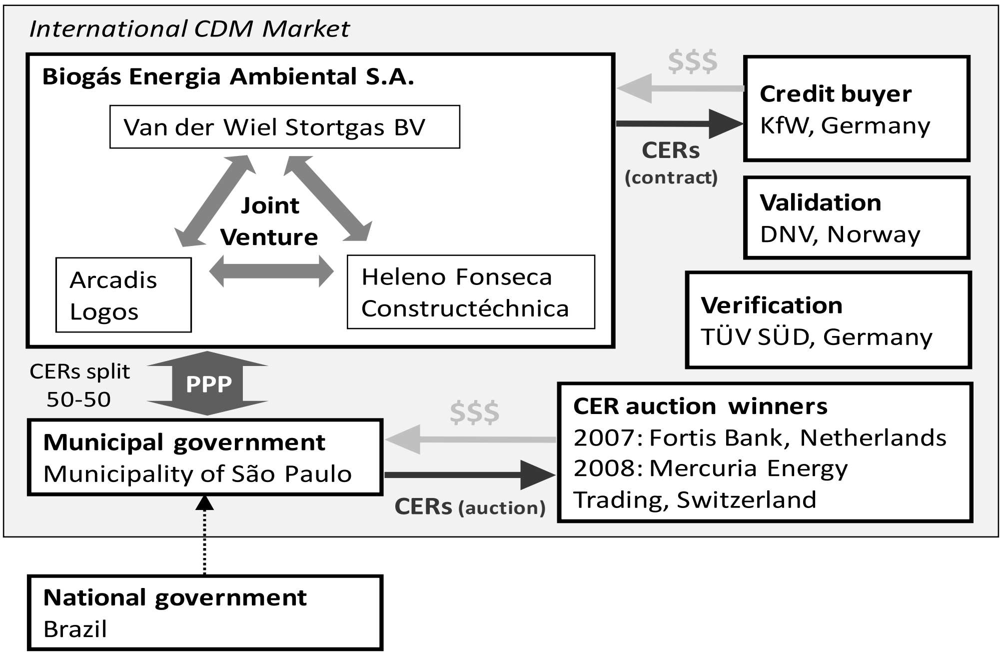
Bandeirantes is a landfill site located to the north-west of São Paulo covering an area of 1.5 million m^2 (Delbin, 2007). It began operation in 1979 and closed in 2007. During this time it received around 7,000 tonnes of waste per day (UNFCCC, 2005a). In order to capture the landfill gas a network of tube wells and gas collection pipes was installed in the landfill in 2003 (Delbin, 2003). The landfill gas is first pumped to a treatment plant where it is dried and cleaned, and the quantity and quality of gas is monitored. The methane-rich gas stream is then pumped to the power plant. The power plant consists of 24 Caterpillar gas engines with a combined installed capacity of 22 MW (Caterpillar, 2004). Surplus methane is burnt off by flares. The electricity is fed into the local power grid. São Joao is a slightly smaller landfill site located to the east of the city. It also received around 7,000 tonnes of waste per day until it was closed in 2009 (UNFCCC, 2005b). The technology employed at São Joao was very similar to that at Bandeirantes, including a gas treatment plant and a power plant with an installed capacity of 20 MW (UNFCCC, 2005b).

It was projected that the Bandeirantes and São Joao projects would save 1,070,000 tCO_2-eq and 820,000 tCO_2-eq on average each year, respectively (UNFCCC, 2005a; UNFCCC, 2005b). Most of the emissions reductions come from the avoided emissions of methane gas directly into the atmosphere, which it is assumed would have occurred in the absence of the projects due to the current lack of environmental regulations on landfill gas capture in Brazil. Instead the methane is burnt, either by flares or in the gas engines, and converted to CO_2, which has a lower Global Warming Potential (GWP) than methane. The remaining emissions reductions come from the electrical output of the power plants, which is assumed to displace fossil-fuel plant at the margin of the local electricity system. The title of the methodology used for these projects was “ACM0001: Consolidated methodology for landfill gas project activities, version 2”.

The co-benefits of the projects include a reduction of explosion risk at the landfill sites, reduction of odour in the vicinity of the landfill sites, the creation of new jobs during both project implementation and operation, demonstration of the viability of landfill gas capture technology in the region (Bandeirantes was the first landfill gas capture project in Brazil, for example), and the generation of new revenue for the Municipality of São Paulo to spend on local waste recovery facilities, waste awareness programmes and the creation of parks and playgrounds for communities in the vicinity of the landfill sites.

Both landfill sites are owned by the Municipality of São Paulo. For each site, the Municipality held a municipal bid for a 15-year concession contract to develop the landfill gas capture project (Delbin, 2007). Both bids were won by Biogás Energia Ambiental S.A. (hereafter Biogás), which is a joint venture between three private firms: Arcadis Logos, a Dutch firm responsible for the business structure and project management, Van der Wiel Stortgas BV, another Dutch firm who designed and built the gas collection and treatment plants, and Heleno Fonseca Constructéchnica, a Brazilian construction firm. The gas collection and treatment plants are owned and operated by Biogás. The Bandeirantes power plant is owned by Biogeracao, a Brazilian investment fund, but operated by Sotreq, the local representative of Caterpillar. A 10-year Power Purchase Agreement (PPA) was made between Biogeracao and Unibanco, the third largest private bank in Brazil, which uses the electricity to power its branches in the region (BNamericas, 2004). The electricity generated by the power plants is exempt from transmission rates from ANEEL, the local power regulator (BNamericas, 2004). Biogás paid for the development of the PDDs. While the national government provided support as the Designated National Authority (DNA), Biogás carried out most of the procedures for this project independently. Figure 13 shows the key actors involved in this project and the interactions between them.

Figure 13. Key actors and interactions in the Bandeirantes and São Joao landfill-gas-to-energy CDM projects, São Paulo



Note: The municipal government of São Paolo and Biogás formed a public-private partnership (PPP).

The cost of the landfill gas collection equipment at Bandeirantes was around 1.6 million € (BNamericas, 2004). The cost of the power plant was 12 million € (Caterpillar, 2004). These capital costs were financed by Biogás. The CERs generated by the projects were split equally between Biogás and the Municipality of São Paulo. Biogás traded a large proportion of their credits via an ERPA with the German banking group KfW, which has a dedicated Carbon Fund for procurement of emissions reduction certificates (KfW, 2008).

The cumulative amount of CERs issued to date for both landfill sites have been significantly less than the amount projected (see Annex 2). For Bandeirantes, the cumulative CERs issued are approximately 50% of those projected. This was due in part to settling of the landfill, which caused some concrete wells to break, and poor landfill cover, which allowed some of the landfill gas to escape to the atmosphere (Terraza *et al*, 2007).

The Municipality of São Paulo sold their credits via CER auctions. The auctions served to increase general public awareness and transparency regarding the project and the CERs collected. The first auction – the first of its kind in the world - was held at the Brazilian Mercantile and Futures Exchange (BM&F) in September 2007. Bids were submitted electronically for 808,450 CERs from the Bandeirantes project, with a minimum price of 12.70 €/tonne (C40 Cities, 2009). The winning enterprise was Fortis Bank of the Netherlands, with a bid of 16.20 €/tonne (C40 Cities, 2009). A second auction was held in September 2008 for 713,000 CERs from both Bandeirantes and São Joao (C40 Cities, 2009). This time the winning enterprise was Mercuria Energy Trading of Switzerland, with a bid of 19.20 €/CER (C40 Cities, 2009)[11]. These auctions of CERs issued for both landfills generated total revenue of 26.8 million € for the Municipality of São Paulo (C40 Cities, 2009). Part of this revenue was used to create two new leisure areas with playgrounds, benches, walking paths and gym stations in the borough of Perus, which surrounds Bandeirantes landfill.

[11] In comparison, in September 2008 the price of the EUA on the market was around 23,73 €, and the CER price 19,64 € (CDC Climate research). Thus this deal was marginally beneficial for Mercuria Energy Trading (if the transaction costs linked to this deal are assumed to be negligible).

3.1.3 Solar Water Heating Systems Programme of Activities, Ho Chi Minh City, Vietnam

"Installing solar water heating systems in the South of Vietnam" is the name of a Programme of Activities (PoA) CDM project currently awaiting validation in Vietnam. The aim of the project is to install solar water heating (SWH) systems in households, kindergartens, small hotels and other buildings by subsidising the costs of these systems. The PoA will be coordinated by the Energy Conservation Centre of Ho Chi Minh City (ECC-HCMC), an organisation set up by the People's Committee of Ho Chi Minh City in 2002 to promote and implement energy conservation activities. The geographic boundary of the PoA is the 22 provinces of South East Vietnam and the Mekong River Delta, including Ho Chi Minh City. Ho Chi Minh City is the largest city in Vietnam, with a population of over 7 million.

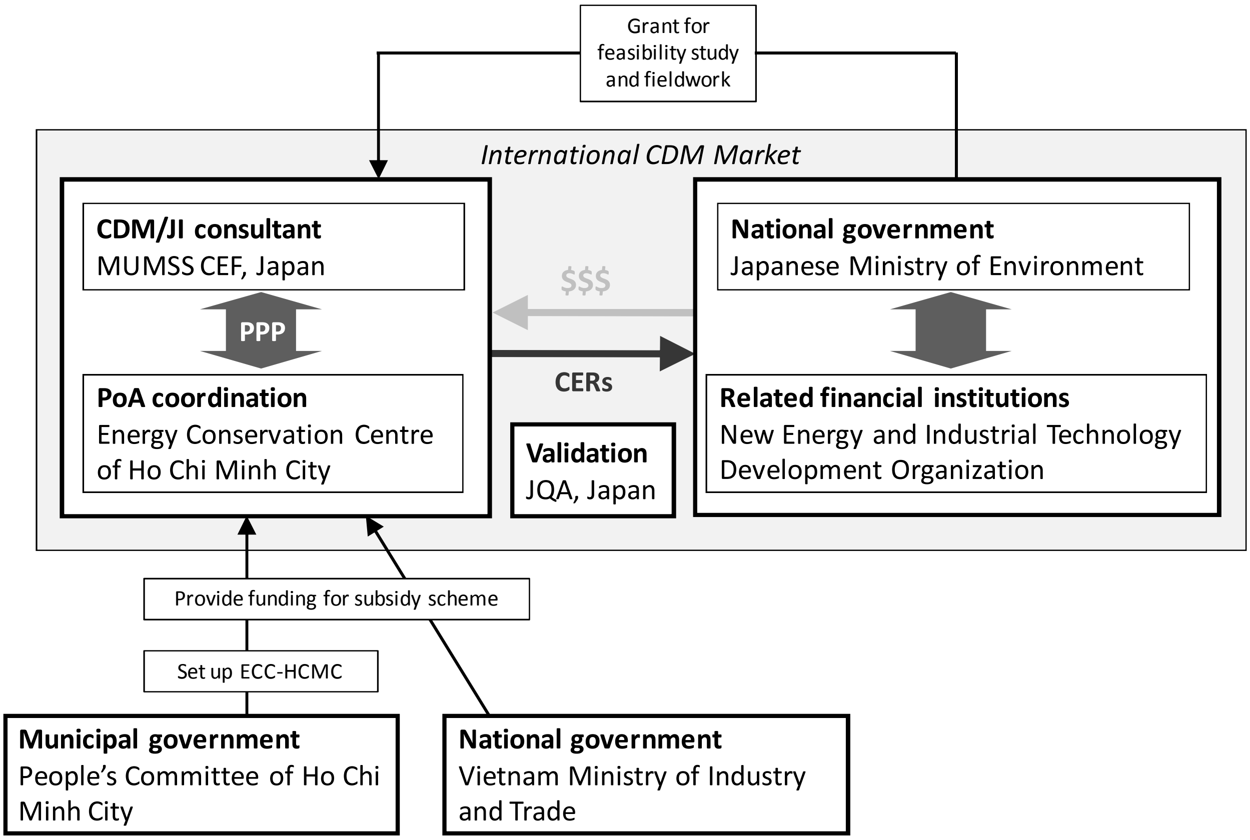
Two SWH technology types are eligible for subsidy under the scheme: flat plate collectors and evacuated tube collectors. The principle of both is similar: a dark-coloured absorber material is used to absorb solar radiation and heat tubes containing a heat-transport fluid (normally water), which in turn is used to heat water in a hot water storage tank. The difference is that a flat plate system has a single flat sheet of absorber material, while an evacuated tubes system has a series of tubes of absorber material with a vacuum inside each tube in order to reduce convection and conduction heat losses. The SWH systems installed during this scheme will typically have an area of around 2.2 m^2 and a hot water tank capacity of around 180 L (UNFCCC, 2009a). Passive circulation systems are used so that the systems require no external electrical energy input for pumping the heat-transport fluid.

It is currently common practice to use electric heaters for space and water heating in Ho Chi Minh City. By replacing electric heaters with SWH systems the project therefore reduces GHG emissions by displacing fossil-based electricity generation at the margin of the local electricity grid. The first CDM Programme Activity (CPA) will consist of the installation of 2,000 SWH systems in the Ho Chi Minh City region (UNFCCC, 2009a). It is estimated that these will displace around 4,900 MWh of electricity and in doing so save around 2,500 tCO_2-eq per year for seven years (UNFCCC, 2009a). The methodology used for this PoA is "AMS-I.C. Thermal energy production with or without electricity, version 14".

An important co-benefit of the project is that it will improve energy security in the region by helping to curb electricity demand. Ho Chi Minh City is a rapidly growing economy and it is estimated that the annual growth rate of the electricity demand of the city is over 11% (UNFCCC, 2009a). This is putting pressure on the local electricity grid and there are frequent black-outs. Consequently there is an urgent need to reduce electricity consumption on the demand side, as well as to install new generating capacity on the supply side. Further co-benefits of the project include improved safety as electric heaters can cause electric shocks, the creation of new local jobs in the solar sector and demonstration of the benefits of renewable energy technologies and energy conservation in Vietnam.

A significant proportion of the funding for the ECC-HCMC comes from the Vietnam Ministry of Industry and Trade. The idea for the subsidy scheme for SWH systems came from the ECC-HCMC (Ishii, *pers. comm.*, 2010). However, they did not have sufficient financial resources to maintain the scheme after the first year and so began to consider alternative sources of funding such as the CDM. They developed the scheme as a CDM project in partnership with the Clean Energy Finance Committee of Mitsubishi UFJ Morgan Stanley Securities (MUMSS), a large Japanese investment bank and brokerage that provides consultancy services for CDM and JI projects. In 2008 MUMSS received a grant from the Japanese Ministry of the Environment to conduct a feasibility study and to conduct fieldwork to collect the data needed to prepare the PDD (Ishii, *pers. comm.*, 2010). In return the New Energy and Industrial Technology Development Organization (NEDO), a publicly funded independent administrative agency, has been commissioned by the Japanese government to acquire the credits (Ishii, *pers. comm.*, 2010). Figure 14 shows a summary of the key actors involved in the project and their interactions.

Figure 14. Key actors and interactions in the SWH systems in South Vietnam PoA CDM project



In order to qualify for the subsidy scheme, a SWH system must be purchased from a SWH system distributor registered under the ECC-HCMC's program. Around 50 distributors are currently participating in the scheme, most of which are Vietnamese companies (Ishii, *pers. comm.*, 2010). It is estimated that the cost of purchasing and installing one 2.2 m^2 SWH system is 300-500€ (UNFCCC, 2009a). The ECC-HCMC's subsidy scheme will subsidise 43€ of this cost (UNFCCC, 2009a). Therefore the cost of the first CPA, which aims to subsidise the installation of 2,000 SWH systems, will be around 86,000 €. These upfront costs may potentially be financed by loans from financial institutions such as the World Bank and the Asian Development Bank (Duc Huy, *pers. comm.*, 2010).

3.1.4 Luz Verde/CUIDEMOS Mexico Programme of Activities, State of Puebla, Mexico

The Luz Verde programme, or Campaña De Uso Inteligente De Energía México (CUIDEMOS Mexico), was the first Programme of Activities (PoA) to be approved by the CDM Executive Board. The project plans to distribute 30 - 50 million Compact Fluorescent Lightbulbs (CFLs) to low- and middle-income households in urban areas across 23 states in Mexico by the end of 2012 to support demand-side energy efficiency (Cool NRG). In November 2009, the first 1 million CFLs were distributed in the state of Puebla (Eneco, 2009). The programme encourages individual households to bring their functioning incandescent light bulbs to their local retailer, where they are exchanged for an equivalent number of new CFLs free of charge (up to four per household). The exchange aspect of the programme helps to ensure that the new CFLs will be used. The awareness campaigns and distribution points aim to provide the majority of CFLs to low-income households based on geographic boundaries. CFLs use up to 80% less electricity than incandescent bulbs, and can last up to 10 times longer (UNFCCC, 2009c).

Cool NRG, an Australian company with CDM expertise, plays a central role in this project as developer, focal point, project entity and implementer. They also invested in developing the methodology for this project, in order to diversify their CDM portfolio. Through the replacement of incandescent light bulbs with higher-efficiency CFLs, CUIDEMOS Mexico is expected to reduce emissions by 7.5 million tCO_2-eq over ten years (Cool NRG), with a 243 thousand tCO_2-eq reduction occurring in Puebla, the first state to take on a CDM Programme of Activity (UNFCCC, 2009c).

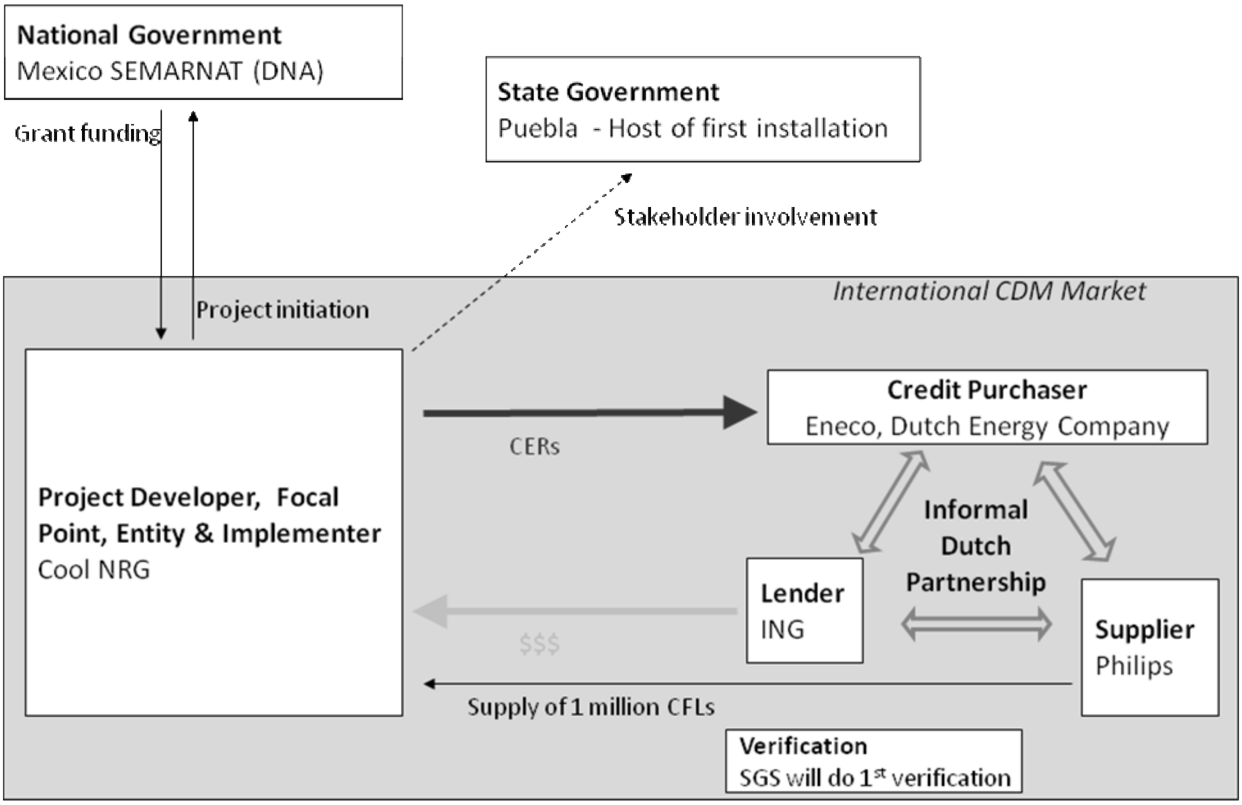
Cool NRG initially approached the Mexican national government through their networks in the private sector to instigate the project. The national government was interested in supporting the project in part because they ultimately save on avoided electricity subsidy payments, and provided a grant to fund part of the up-front costs of the project. The first period of installation involving 1 million CFLs will save approximately 8.8 million € per year in electricity consumption costs. Low and middle income families are expected to see combined utility bills reduced by 4 million € per year, while governments will avoid electricity subsidies of close to 4.7 million € per year (UNFCCC, 2009c). The full programme of CFL distribution is expected to save households a total of 120 million € per year on their energy bills, and save the Mexican government 145 million € per year on electricity subsidies (Cool NRG).

Through stakeholder workshops, the state and local governments became involved. The state of Puebla was chosen for the initial phase of the project because 1) the demographics were appropriate for the project (low-income urban population), and 2) the mayor of Puebla supports the project (McInnes, 2010). While the support of the local government helped the project, it was not instrumental to the design or deployment of the project, since the project does not involve city-owned public space or equipment. Because the State of Puebla is the host of the first phase of the programme, this case offers an interesting example of state and national level interaction on a project. However, it is expected that there will be increased engagement with mayors as the roll-out continues (McInnes, 2010).

The support mechanism at the local level for the project is primarily in the private sector: Coppel and Comex are the retail distribution points, and Televisa is the media company involved. These private sector partners support the awareness campaign and light bulb exchange through in-kind support. Coppel and Comex have over 3,500 retail stores across Mexico, with over 90 stores participating in the lead project in Puebla (McInnes, 2010). The retailers both have high foot traffic in Mexico, enabling the awareness campaign, and are supportive of the project. Televisa has promoted the CFL exchange and increased awareness about energy efficiency and climate change more generally. These partners have interest in the publicity and government interaction gained from the project.

The private sector is also engaged in this project through a series of partnerships with Royal Philips Electronics, Eneco Energy Trade and ING Wholesale Banking based in the Netherlands (Eneco, 2009). Philips provided the supply of light bulbs for the project and received the associated publicity. Eneco, a Dutch energy company has guaranteed the purchase of the CERs for the lead project, with access to CERs over the whole PoA. ING provided the debt finance. Figure 15 outlines how the actors in the project are organised.

Figure 15. Key actors and interactions in the Luz Verde/CUIDEMOS Mexico CDM project



Up-front costs were provided through a combination of Cool NRG equity, ING debt financing, attractive pricing and terms from Philips for the supply of 1 million CFLs, and commercial support through a grant from the Mexican government. . The project operation costs are wholly financed through CER revenue. The awareness campaign and exchange facilities are provided by the Mexican private sector partners (Televisa, Coppel, Comex).

This programme uses the small-scale baseline and monitoring methodology "AMS-II.C. Demand-side energy efficiency programmes for specific technologies (version 9)". This project has Gold Standard (GS) certification for CERs, resulting in a price premium over other CERs. This GS certification was obtained after it was requested by the CER purchaser Eneco (McInnes, 2010).

3.1.5 Mariannhill, La Mercy & Bisasar Road Landfill-Gas-to-Electricity Projects, Durban, South Africa

Mariannhill, La Mercy and Bisasar Road are three landfill-gas-to-electricity projects situated in Durban, which is part of the eThekwini Municipality in South Africa. Durban is the second largest city in South Africa with a population of around 3.5 million. Marianhill and La Mercy were registered together as a single CDM project in 2006. Bisasar Road was registered as a separate CDM project in 2009.

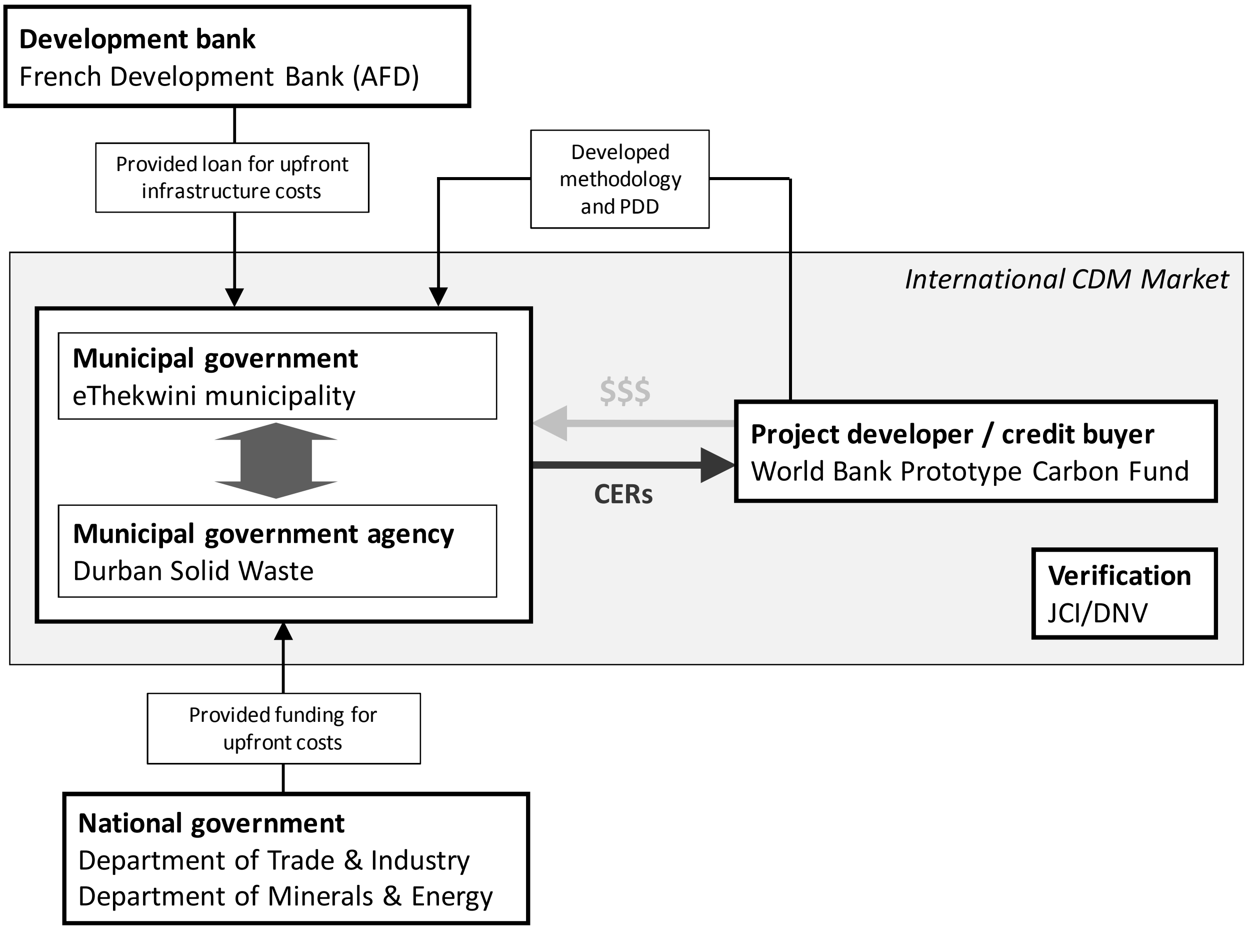
Mariannhill is an active landfill site which contained around 850,000 tonnes of waste in 2005 and receives around 550-700 tonnes of waste per day (UNFCCC, 2006b). La Mercy is an older landfill site which was closed in 2006. In 2005 it contained around 1 million tonnes of waste and received around 350 tonnes of waste per day (UNFCCC, 2006b). Bisasar Road is a large landfill site that collects up to 5,000 tonnes of waste per day and is expected to continue to receive waste until 2014 (Parkin *pers. comm.*, 2010). The technology used for the projects was similar to that of the São Paulo landfill-gas-to-energy projects described in Section 3.1.2, consisting of a landfill gas collection system, flare units, and power plant at each site. The power plants at Mariannhill and La Mercy each have an installed capacity of 1 MW and 0.5 MW respectively, while the Bisasar Road power plant initially had an installed capacity of 4 MW (this was subsequently increased to 6.5 MW in July 2009) (UNFCCC, 2006b; UNFCCC, 2009b; Parkin *pers. comm.*, 2010). The majority of the power plant equipment is imported, while the gas collection equipment is available locally (UNFCCC, 2006b).

A new methodology was developed specifically for these projects in 2003 by the World Bank Prototype Carbon Fund (PCF). The title of the approved methodology was "AM0010: Landfill gas capture and electricity generation projects where landfill gas capture is not mandated by law, version 1". The GHG emissions reductions come from two sources: the destruction of methane in the engines at the flaring units, and the displacement of fossil-based electricity generation at the margin of the local electricity grid by the output from the power plants. It is estimated that the Marianhill and La Mercy projects together will save 69,000 tCO_2-eq per year, and the Bisasar Road project will save 340,000 tCO_2-eq per year (UNFCCC, 2006b; UNFCCC, 2009b).

Co-benefits of the projects include improved air and groundwater quality in the local area. By displacing electricity from coal-fired power plants they indirectly reduce emissions of sulfur dioxide, nitrogen oxides and particulates, as well as reducing the adverse impacts of coal mining and transportation. They improve the quality of life for people living in the vicinity of the landfill sites by reducing emissions of landfill gases and odours. The projects also created a small number of skilled jobs for operation and maintenance of the equipment. For example, the Bisasar Road project created 109 jobs during installation and 11 permanent jobs (Times Live, 2010; Parkin *pers. comm.*, 2010). While the co-benefits are numerous, it should be noted that there has been some controversy surrounding the Bisasar Road project. The local community had previously voiced health concerns about the landfill, as the site is adjacent to residential areas. There is a widely-held perception in the local community that this CDM project only serves to extend the lifetime of the landfill (Erion, 2005).

The landfill sites are owned by the eThekwini Municipality. A Memorandum of Understanding (MoU) regarding the development of three landfill gas projects was signed between the eThekwini Municipality and the World Bank PCF in 2003 (UNFCCC, 2006b). The Department of Cleansing and Solid Waste of the eThekwini Municipality, also known as Durban Solid Waste (DSW), was responsible for technical oversight and operation of the projects. The World Bank PCF developed the methodology and the PDD. Figure 16 shows the key actors and interactions involved.

Figure 16. Key actors and interactions in the Mariannhill, La Mercy and Bisasar Road Landfill-Gas-to-Electricity projects



The total cost of the three projects combined was estimated at 9.6 million € (UNFCCC, 2006b). This figure includes the cost of the gas collection equipment, power plants and preparation of the Environment Impact Assessment (EIA). A significant proportion of the upfront costs of the landfill gas collection equipment and power plants were financed by loans from the French Development Bank (AFD). The projects were also subsidised by the Department of Trade and Industry through their Capital Infrastructure Program and received seed funding from the Department for Minerals and Energy (Parkins, *pers. comm.*, 2010). An ERPA for the CERs generated was agreed between DSW and the World Bank PCF for Marianhill and Trading Emissions Plc for Bisasar Road (Parkin, *pers. comm.*, 2010)[12].However, the issuance of CERs for these projects has been delayed, in part due to concerns raised by the verification DOE regarding flare efficiency (Couth *et al.*, 2010).

[12] The World Bank PCF decided to withdraw from the Bisasar Road project.

3.2 JI Case Studies

The following JI case studies illustrate examples of projects across project types from landfill gas utilisation, combined heat and power and fuel switching for buses. While CDM and JI operate in very similar ways, there are differences in the oversight of the validation of the project (see Box 2).

Box 2. 'Track 1' and 'Track 2' Joint Implementation Projects

One important difference between the CDM and JI is that JI uses two different paths for the validation of a project and issuance of credits, depending on the characteristics of the country (see footnote 7): "Track 1" countries have the right to oversee the monitoring, verification and issuance of ERUs for projects on their own soil independently of the oversight of another international body, such as the Executive Board in the case of CDM. Alternatively, "Track 2" countries do not have that right and the crediting of projects which they host is administered by the JI Supervisory Committee (JISC). This implies that there is no specific methodology for JI: under Track 1 the country has its own criteria to accept the project; under Track 2, the Joint Implementation Supervision Committee defines some essential criteria based mainly on additionality, baseline scenario, correct calculations of emission reductions, and clear, transparent, auditable explanations and figures. The significance of the two-track mechanism is discussed in more detail in Section 4 of this paper.

3.2.1 Christchurch City Landfill Gas Utilisation Project, New Zealand

The Burwood landfill gas utilisation project is a "Track 1" (see Box 2) JI project in Christchurch City, New Zealand. Prior to the project, the city's landfill gas mostly escaped into the atmosphere as methane emissions with only a small portion of methane emissions were flared off. Around 2002, this began to lead to a series of complaints from residents about odours from the 40-year old site, prompting the Council to respond. At the time, the Council also owned and run a nearby swimming pool, called "QEII", which was open all year round and had roughly 1 million patrons a year. An Energy Advisor working at the Council linked the landfill waste problem with the idea of capturing the waste to power a nearby pool.

The project sought to use the gas from the landfill to generate electricity and heat for the QEII. Since the project was commissioned in 2007, the landfill gas has been collected in gas wells, treated, and then piped via a new 3.7km pipeline to the pool's boilers, where it has displaced electricity purchased from the national grid. This saves the Christchurch City Council money and, once the destruction of the methane gas through this process is taken into account, the project is estimated to avoid approximately 40 000tCO_2-eq emissions per annum. The methodology used is ACM1+AMS.III.B.

The decision to make use of the carbon markets to finance the project came about largely because it was viewed as an attractive way to pay for a project with a relatively long payback period (and therefore otherwise less attractive compared to other investments). However, the decision also came about because in 2003 the New Zealand government launched a new national offsets program called the "Projects to Reduce Emissions (PRE) Scheme" (see Box 3). The PRE made use of New Zealand's status as an eligible "Track 1" country under the Kyoto Protocol, which gave it the right to approve, validate and issue credits to domestic offset projects. Thus, in 2003 Christchurch City Council was a successful bidder in first round of bids submitted to the New Zealand Government, winning the right to earn 200 000 ERUs for its project, known as the "Burwood Landfill Gas Utilisation Project", over the five years of the Kyoto Protocol first commitment period (2008-2012).

Box 3. The Projects to Reduce Emissions Scheme in New Zealand

In 2003, upon ratifying the Kyoto Protocol the previous year, the New Zealand government launched the Projects to Reduce Emissions Scheme (PRE) in order to achieve a suite of domestic environmental policy goals. One of the main goals was to help prepare domestic entities for the eventual entry into force of the Protocol, by encouraging and helping local entities to learn about the international carbon market. It was foreseen that a learning-by-doing process utilizing the Track 1 JI mechanism could be of benefit to local entities and the national government in a number of ways. In particular, it would help teach local actors how carbon markets work through a learning-by-doing process and it would help to start to shift the New Zealand government's emissions trajectory or baseline, which would be likely have benefits in terms of reduced carbon liabilities extending beyond the first Kyoto commitment period (ECOFYS, 2007).

In 2003 and 2004 the national Government held two rounds of competitive tendering for domestic projects that reduced emissions. Bidding entities were wide ranging, and came from both the private and public sectors. Bidders competed on the basis of the number of credits they requested be awarded per ton of emissions reductions, and were also required to reliably demonstrate project additionality (both financially and in terms of "qualitative factors affecting decision to build", feasibility, and show that the projects resulted in reductions in Kyoto accounted emissions. Winning bidders then entered into contracts of agreement with the national government requiring them to carry out domestic offset projects in return for a promise to be awarded a given quantity of ERUs created under New Zealand's Track 1 facility.

In its first two years, the PRE scheme quickly attracted and approved 41 domestic JI projects, of which 34 were ongoing as of 2010, representing approximately 9 735 000 ERUs being pledged over the 2008-2012 period (New Zealand Ministry of Environment and Forestry Website, March 2010). The PRE Scheme attracted significant interest from domestic entities and, despite the absence of further tender rounds since 2004, has been broadly viewed amongst stakeholders, including unsuccessful bidders, as having successfully contributed to the learning-by-doing and engagement in international carbon markets that was one of its initial policy aims (ECOFYS, 2007).

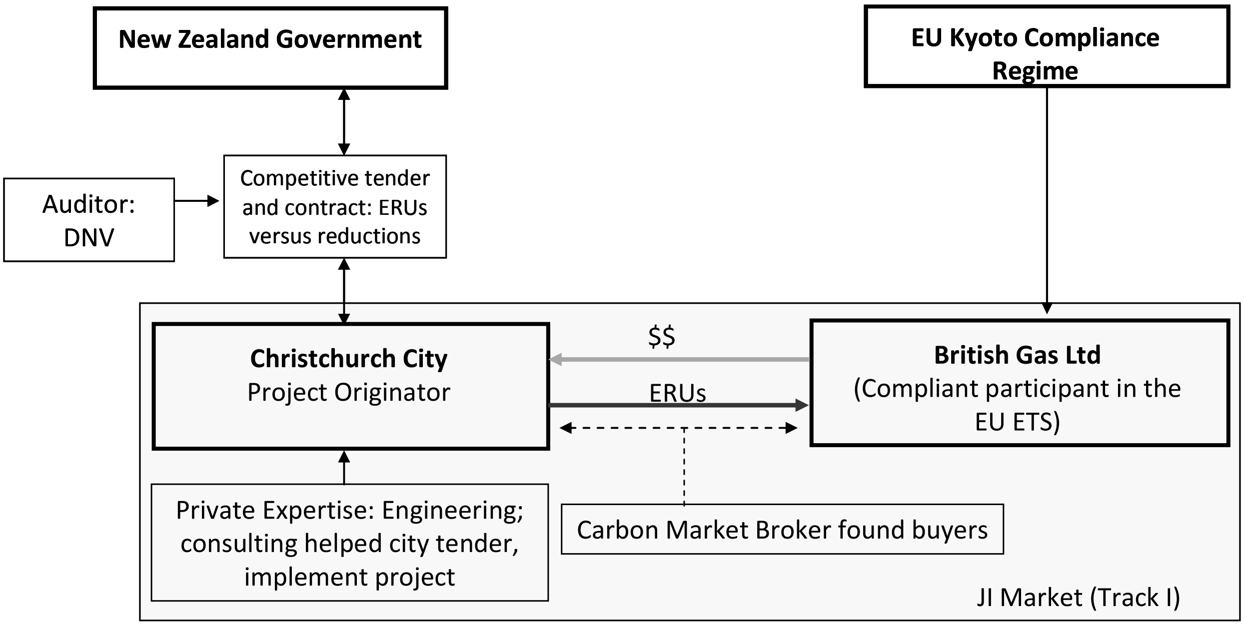
One council official described carbon market finance as "critically important" to reducing the payback period and for reducing the perceived financial risk to policymakers at the council. Typically, the council was interested in projects with a 4 to 6 year (simple) payback period. However, without the credits, Burwood LFG was estimated to have a 10-year simple payback period (*pers. comm.* Itskovich, 2009).

Initially, the simple payback period was estimated at 7.5 years with the carbon credits, making it suitably attractive to the government decision-makers (given that environment was a priority policy area already). However, based on realised gas and electricity prices since the early feasibility studies of the project, the expected payback has shortened considerably to approximately 4.7 years. The sale of the 200 000 carbon credits is conservatively expected to generate over 1.4 million € in revenue over five years (2008–2012) in addition to energy savings approach 0.5 million € per year. The initial capital cost of the project was 1.9 million € (www.ccc.govt.nz, 2009).

During the implementation of the project, a number of European buyers contacted the council and made offers to the council for its carbon credits. A New Zealand-based carbon market financial services company, Carbon Market Solutions, helped the council manage the transaction of its carbon credits. Figure 17 illustrates the key actors in this project. The credits were eventually sold to a buyer in the UK called British Gas Trading Ltd, which used them for compliance in the EU ETS. The council must send the project audit report to the company each year for its own reporting purposes. To date, the project has been issued more ERUs than initially projected (see Annex 2).

Revenues from the sale of carbon credits are being set aside by the city to fund other projects through Christchurch Council's Sustainable Energy Strategy (2008-2018) (pers. comm. Itskovich, 2009). Since not all of the methane was collected for the pool complex to use, it has been additionally used to provide further energy at a bio-solids drying facility for the Christchurch Wastewater Treatment Plant and the power and heating facilities at the Council Civic offices. It was also decided to flare the remaining landfill gas not otherwise combusted.

Figure 17. Key Actors and Interactions in the Burwood Landfill Gas Utilisation Project



The Burwood landfill gas project also generated considerable interest among other councils in New Zealand and is believed by many interviewees to have helped encourage other technically similar projects in other New Zealand cities. The project received a significant amount of positive publicity in the media and won the 2008 New Zealand Engineering Excellence Award. The project lifespan is conservatively estimated at 15-20 years, although uncertainty is introduced by the practical difficulty of knowing the lifespan of the landfill in terms of both the quantity and quality of gas.

3.2.2 Palmerston North City Landfill Gas Utilisation Project, New Zealand

Beginning in 2004, Palmerston North City Council developed the Awapuni Landfill Gas Project to utilise methane emitted from its over 50-year old landfill to generate power for a local water treatment and recycling plant. The idea for the project originated among the council's energy and planning department experts, who saw an opportunity to make use of the National Government's Projects to Reduce Emissions (PRE) Scheme (so following JI Track 1) to save on energy costs for a local waste water treatment plant and help implement an existing sustainability strategy implemented by the council.

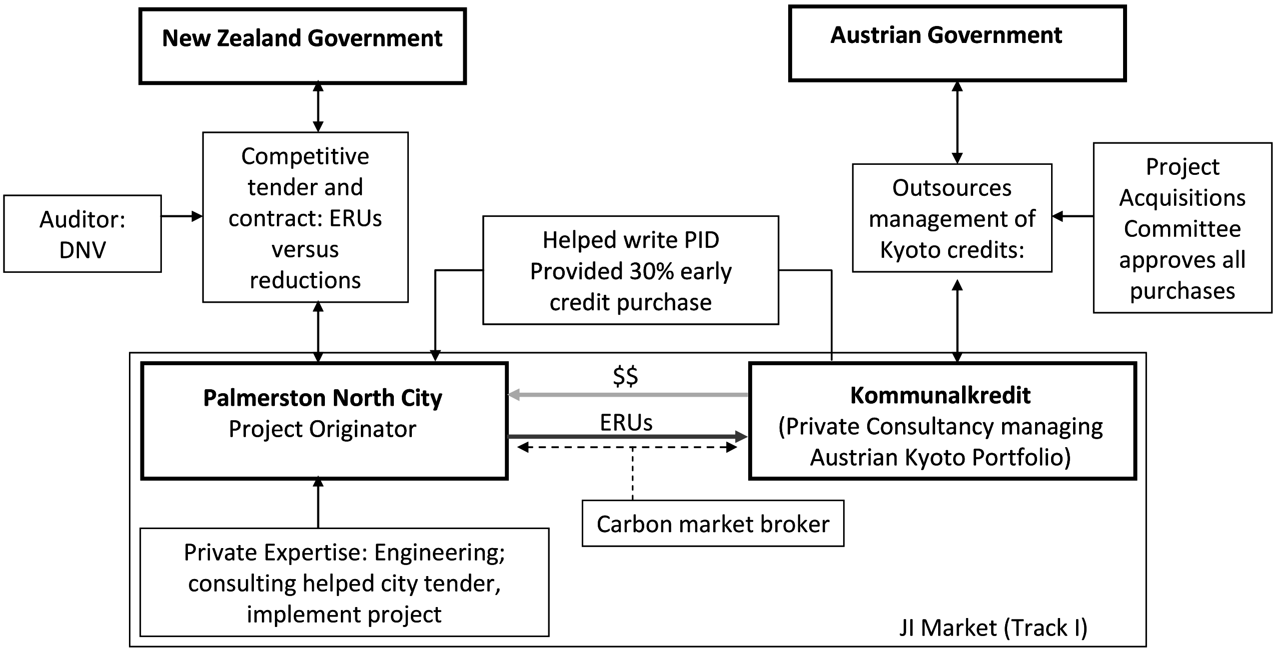
The council now manages to generate around 3 GWh of power per year which is used on-site to offset local loads, and the balance is exported for sale to the national electricity grid. The 149 000 ERUs earned helped to give the project a positive return (estimated by the council's private consultancies (PWC) to be between 5-15% depending on the price of electricity). In addition, 11,000 "grey credits" originating outside the Kyoto commitment period (in 2006) were sold on the Chicago Climate Exchange. Carbon revenues represent more than 50 % of the capital costs of the project.

Like the Burwood LFG project in Christchurch city, Awapuni LFG was an existing idea before New Zealand ratified the Kyoto Protocol. However, project managers at the council insisted the project would not have been possible to approve without the promise of carbon credits. They pointed out that New Zealand's track record at the time for extracting gas from landfill for energy was not impressive and, along with inherent financial risks in LFG projects, obtaining private financing would have been difficult.

Co-benefits to the City from the project included saving money on energy costs for the local waste water treatment plant, raising revenues by both selling power to the national grid and earning carbon credits. The revenues raised from the project also helped it to pursue its sustainability strategy, and the project has since been expanded to provide power to other city buildings.

Once the project had been accepted by the Government to become a Track 1 JI project, the Council was approached by three or four entities which came to look at the site and expressed interest in purchasing credits. The national Government apparently assisted the council by facilitating contact between potential buyers and the council, although it was a local carbon broker which found the eventual buyer. The buyer, Kommunalkredit, is an Austrian financial institution specialising in public infrastructure financing and is also a consulting firm, which managed the Austrian Government's Kyoto portfolio (see Figure 18). As part of the deal to purchase the credits, it offered considerable financial and logistical assistance to the council, especially in terms of managing its engagement in the carbon markets and the JI mechanism. It offered to pay for the development of the Project Idea Note (PIN, the first document required during the project development cycle), thus saving the council considerable expense.

Figure 18. Key Actors and Interactions on the Awapuni Landfill Project



To mitigate credit delivery risk, the council organised for the future auditing company, DNV, to give feedback on the project's progress from a compliance perspective. The council also organised a trial audit 1 year before the crediting period. Various conservative measurement assumptions were also included by the national government in the deed of agreement, such as the fact the reimbursement of the carbon credits would be issued at relatively conservative ratio of 18 ERUs to each tonne of methane destroyed.

The project's current status is ongoing. The project is likely to provide power for up to 20 years. The council won additional recognition by winning some national local engineering awards.

3.2.3 Timisoara Combined Heat and Power Project, Timisoara Romania

The Timisoara combined Heat and Power Project was a Track 1 JI project in the eastern European city of Timisoara, Romania. Indeed, the project was one of the very first registered Romanian Track 1 projects. The goal of the project was to use an upgrade of the Municipality of CET Timisoara's Sud's existing district water heating capacity to produce heat more efficiently, to provide own electricity generation, and to create additional electricity which could be sold back into the national grid. Doing so was estimated to reduce the city's GHG emissions by 34 671 tCO_2-eq/year over 2008-2012, by displacing the consumption of brown coal-fired electricity in both the heating system and in other places.

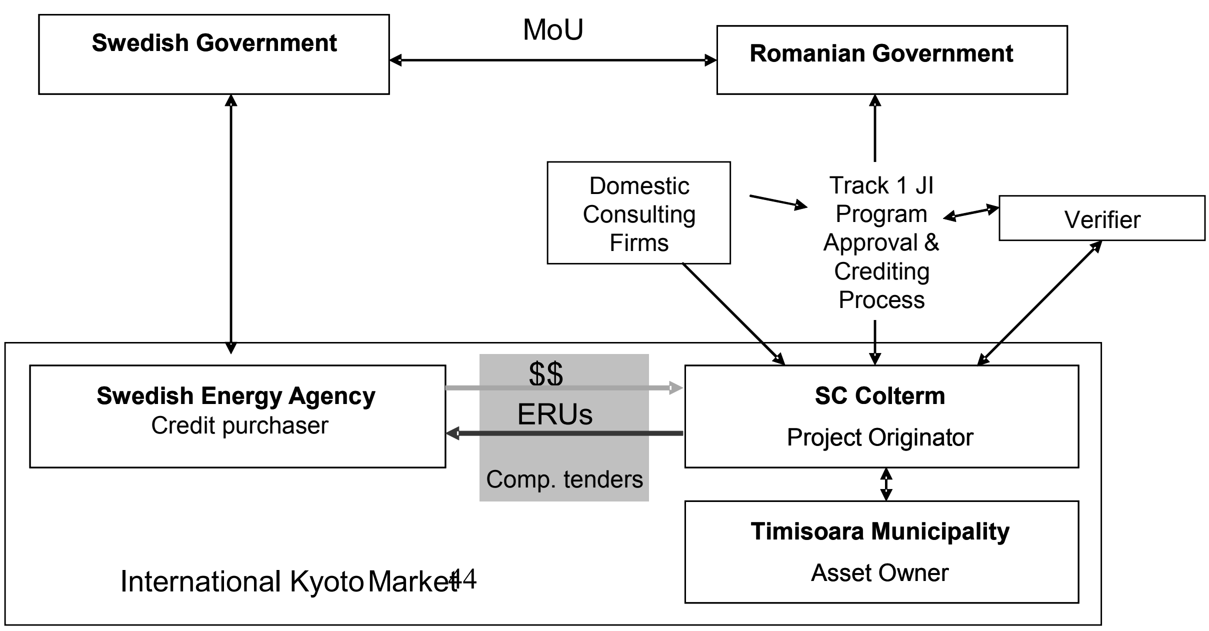
The city was motivated to pursue the project because it had an existing interest in improving the quality and efficiency of the district heating plant. It also wanted to develop the district heating system in Timisoara City and own-generation of the plant would avoid purchasing increasingly expensive electricity from the national grid.

Figure 19 shows the relation between the different actors in the project. Romania was the host country, with the project taking place in Timisoara, the country's second largest city with 310,000 inhabitants and situated in the country's west. The municipality of Timisoara was the owner of the project site (i.e. the heating facility), which it manages through its fully owned domestic subsidiary, SC Colterm SA, which is the operator of the entire district heating system (DHS) chain in Timisoara. The PDD noted that "excess electricity will be sold to the grid, used by SC Colterm SA in other locations, or sold to the Municipality, the owner of SC Colterm SA" (p.12). It therefore designated the subsidiary as the project developer, while giving it financial and political support.

Sweden was the financing country, which purchased the carbon credits through the Swedish Energy Agency (STEM) (see Figure 19). The project formed part of the Swedish International Climate Investment Program, which invests in a number of JI and CDM projects around the world, though vehicles such as the NEFCO Baltic Sea Testing Ground Facility fund (TGF). The Swedish interest in energy efficiency and environmental projects in Romania dates to an international agreement for cooperation in the field of power and environment, signed in November 2001. This agreement aimed to increase the participation of Sweden in the Romanian power and environment sector. A Memorandum of Understanding between the Government of Romania and the Government of the Kingdom of Sweden concerning Climate Change was signed at Bucharest, on 9th of April 2003, and ratified by Romanian law thereafter. It became the project sponsor by offering a call for tenders for JI projects, for which the Timisoara project was a successful competitor.

Although the Swedish Energy Agency was not the official project advisor, its relative experience as an investor in project-based mechanisms have seen it engage frequently during the development of the project, approval process, PDD development, etc. This seems to be seen as important from the point of view of providing a project champion who can apply pressure to force the project through various stages of approval, development, verification and crediting. In addition, the PDD lists the official project advisor as a Romanian company located in Bucharest called Eninvest SA. It apparently has helped develop the project methodology, baselines and PDD.

Figure 19. Key Actors and Interactions in the Timisoara Project



The project was commissioned in 2006. According to the PDD, the project cost was approximately 5.433 million € (see Table 4). It was financed by a combination of debt, equity and the sale of emission reduction units (ERUs) under the JI program. The equity came out of owners' equity from SC Colterm SA and accounted for around 60% of costs. Debt was issued by SC Colterm and secured against cash flow and company assets. Effectively, since SC Colterm was not able to earn profit from its operations due to tight regulations from the Romanian Electricity and Heat Regulatory Authority (ANRE), and rising operating costs, the company therefore depended on significant subsidies from the Municipality. The municipality therefore effectively underwrote much of the debt that was issued to finance the project.

Table 4. Project financial structure (amounts in 1000s of €)

	Pre-sale of ERU	Upfront ERU	Debt/Equity with ERUs	Amount
Debt	32.3%		30.6%	1664
Equity	67.7%		64.2%	3490
Grant		5.1%	5.1%	279
Total project costs			100.0%	5434

Source: Project PDD, http://ji.unfccc.int/, actual financing composition may differ.

The possibility of carbon credits through JI also proved to be an important factor for obtaining finance from the bank lender, by helping to ensure company debt service payments to the bank in case of uncertainty. For example, in this project, changes in the natural gas price impacted operating costs for SC Colterm and thus its ability to generate cash flows from the project to repay debt. However, the possibility of carbon credit sales helped assure the bank that the project was better covered against revenue risks. Participants also commented that the risk of implementing the project was low due to strong support from the municipal government.

From January 2008 until 2012 GHG emission reductions of the Project were initially estimated to reach 34 671 tCO_2-eq/year. Assuming 5€ per ERU, these reductions are estimated to have accounted for around 1 million €. With ERU sales, the project was initially estimated to have a return on investment for ten years of about 13.4% with ERU sales. This is normally not an acceptable return on investment but was acceptable for a municipality owned project.

The funds that were supposed to be generated were intended for re-use in the operation for both an early repayment of the debt and for further investment in efficiency improvements, such as the rehabilitation of the network of pipes. However, at the time of writing, the project had yet to be successfully verified and thus no credits had yet been issued. We understand the reason for this to be a combination of the effects of the global financial crisis on fiscal budgets in Romania and technical complications affecting the ability of the project developer to pay the verifier up front cash for an amount superior to 20 000€ in order to move to the next step of having the credits issued. The project is expected to last for 20 years, therefore generating emissions reductions beyond the scope of the first commitment period of the Kyoto Protocol (2008-2012).

Since the project began before Romania entered the EU ETS in 2007, the problem of double counting emissions reductions[13] did not pose a barrier to project development in this instance. However, this does pose a barrier to future similar projects being developed (Möllersten, *pers. comm.*) as does a general lack of sources of debt and equity financing after the 2009 economic down-turn

[13] The question of double counting emission reductions arises when emission reductions involve a plant that is under the EU ETS (European Emission Trading Scheme). In this case, emission reductions are already rewarded towards the EU ETS mechanism and can not be double counted in a JI process.

(Grindeanu, *pers. comm*). Moreover, a lack of institutional capacity and clarity, a weakly developed 'commercial' culture, and uncertainty about the future of Joint Implementation after the Kyoto Protocol expires in 2012, are also seen as reasons to turn away from repeating similar projects in eastern European countries (Möllersten, *pers. Comm.*).

3.2.4 NRW Programme of Activities, Germany

This Track 1 Programme of Activities consists of fuel switching (making use of natural gas or biomass) and increasing the energy efficiency of steam and/or hot water production through replacement and modernisation of low efficiency heating boilers by highly efficient new ones. This activity was conducted for a set of small installations (with a minimum size of 50 kW) in the state of North Rhine Westphalia (NRW). At the time of writing, 8 urban centres (City of Düsseldorf, City of Cologne, Town of Kreuztal, Town of Hamm, Town of Kamp-Lintfort, Town of Guetersloh, District of Raesfeld and District of Aachen) and 24 installations are involved, but those installations covered under the EU ETS or already receiving subsidies were excluded. The total expected emission reductions is estimated at 240 000tCO_2-eq over 2008-2012, with annual reductions of 48 000tCO_2-eq.

The main co-benefit of the PoA is to reduce energy consumption of boiler and heat plants, which is a policy priority in NRW.

The first steps in project development date back to the beginning of 2006 when EnergieAgentur.NRW and FutureCamp (the latter being an external private consultant that already had expertise in carbon markets) started the conceptual design and prepared a Project Idea Note (PIN). This work cost about 40 000€, and was financed by the Ministry of Economic Affairs and Energy of the state North Rhine Westphalia. The work on the methodology lasted a few months, and discussions took more than one year until the designated German focal point (DFP) gave the green light to the project and issued a letter of endorsement in October 2007 (Muehlpointner and Hoelscher, 2009, *pers. comm*.). After conclusion of the determination process with the independent entity, the official approval from the German authorities was issued in January 2008 and the approval of the French authorities, France being the investor country, was issued in April 2008.

One of the main motivations for the project at all institutional levels was to demonstrate that JI can work on a regional level and to demonstrate the feasibility of implementing a "programmatic" approach to projects. This aim was strongly supported by the state of NRW. It was also perceived by cities and other actors to be valuable to learn about the carbon market as a new funding instrument (Muller, *pers. comm.*, 2009; Kramp, *pers. comm,* 2009). Carbon markets are now one part of NRW's energy and climate strategy.

One of the most interesting characteristics of the methodology used (known as "JIM NRW") is that it is a programme of activities ("PoA") as opposed to a stand-alone project. It combines various, diffuse participants and emissions sources, and two main activities, i.e. energy efficiency and fuel switching. In comparison with the typical single project single site approach, the programme did not prove particularly complicated to define and manage because the two relevant activities are for the same kind of installations (boilers) and the monitoring of the two activities is based on the same approach. Verification is done by an external consultant (SGS) and costs around 15 000 € per year. EnergieAgentur.NRW, the federal energy agency of the state, designed the general framework and does the reporting and monitoring, which reduces greatly all administrative costs. EnergieAgentur.NRW commented that it worked hard to engage potential participants at the beginning of the project, but it should be easier now. All participants have to comply with a pre-defined framework, and can join the programme whenever they want.

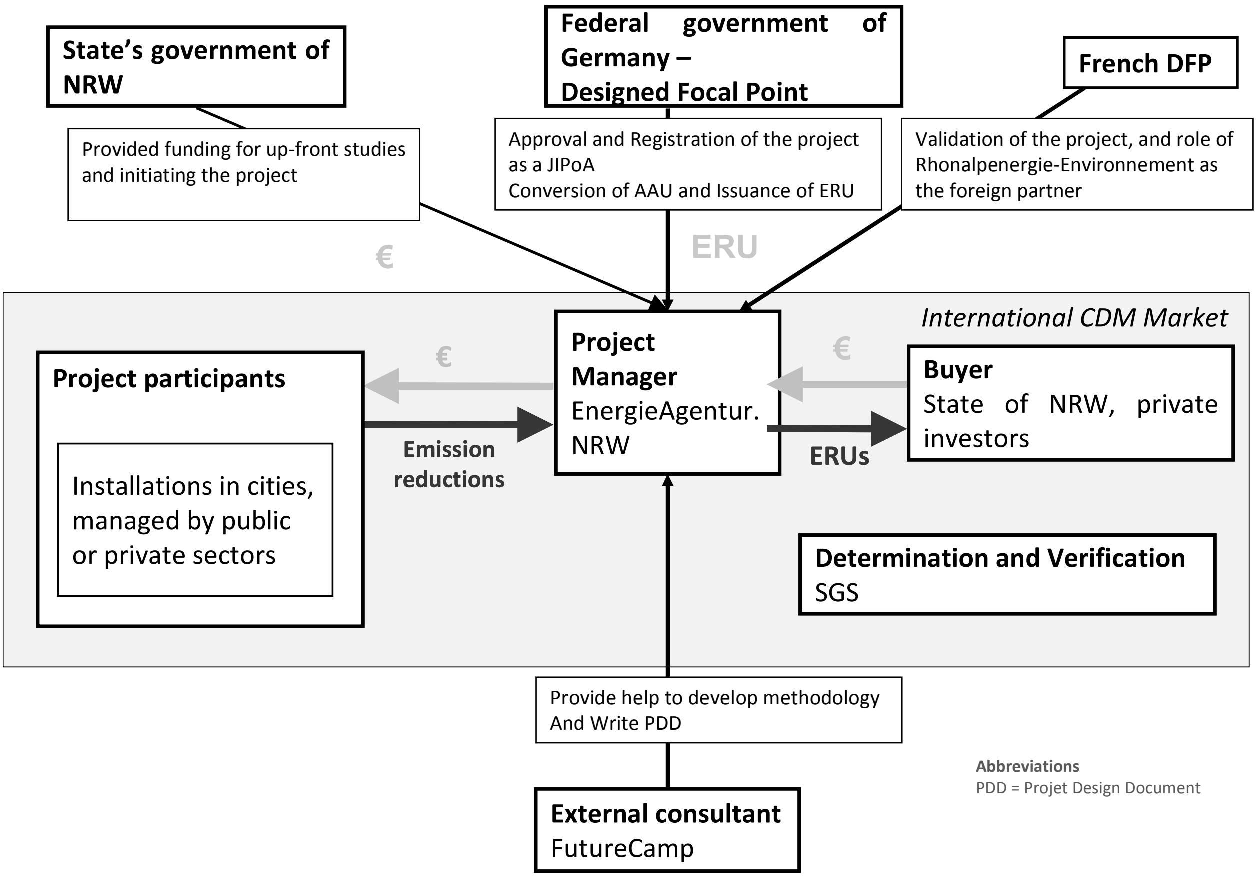
The programme utilised some elements of existing CDM small scale methodologies for energy efficiency and fuel switching, but added some specific elements. Indeed, the German Government expressed some methodological requirements within the content of the Letter of Endorsement. Like for the CDM, a key element was the demonstration of additionality: it has been demonstrated following the rules of the CDM additionality tool by showing relevant barriers for the implementation of boiler replacements (step 3 of additionality tool), and also was based on economic criteria.

Another interesting feature of the project is that participants at the city level receive cash instead of ERUs. The payment is annual and based on individual generated emission reductions. EnergieAgentur.NRW manages all the financial aspects of the project, including those related to the carbon market: it developed the business plan, it contacted potential buyers at an early stage of the project, it bore the risk of price volatility, etc. Participants appear to prefer cash payments as this avoids the need to commit resources to a deep understanding of the specificities of carbon markets. Rough estimates by the project manager suggest that these cash payments based on carbon emission reductions represented between 5-20 % of the investment costs. Finally, the state of North Rhine Westphalia buys a portion of the ERUs for offsetting the travelling emissions at 16€ by their staff. The rest of the ERUs, if any remain, will be sold to a private investor. The initial ERUs received by the project are approximately 10% of the projected level of ERUs (see Appendix B), as the number of boilers and heat production were less than initially expected.

The project is not restricted to any cities and participation is possible for installations in the whole state of North Rhine Westphalia (with a minimum size of 50 kW). The use of an external consultant – in this case FutureCamp – was essential to develop the methodology. All costs (40 000 €) were supported by the Ministry of Economic Affairs and Energy of the state North Rhine Westphalia. This was a Track 1 JI project, with France as the partner country (see Figure 20). Indeed a letter of Approval from another Annex I country is necessary for JI, but it is not necessary to have a foreign partner that invests in the project. Rhonalpenergie-Environnement, a regional energy and environment agency in France, was the foreign partner in this project, and obtained the crucial French letter of approval, but did not finally invest in the project. The major motivation for the participation of Rhonalpenergie-Environnement was to learn about the project design and functioning, and analysing the possibility of implementing such mechanism in Rhone-Alpes[14].

[14] Partly because of multiplicity of subsidies or other financial mechanisms in France (white certificates, "fond chaleur" – or heat fund), and therefore the difficulty to define additionality, the idea of setting up a similar project in France was given up in 2008.

Figure 20. Key actors and interactions in the NRW JI project



Following the success of this program, other new JI PoAs, quite similar to the NRW one, are developing in Germany: for instance, the state of Hessen is replacing or modernizing existing boilers, and the same consultant – FutureCamp- developed the PDD but also acts as the project manager on behalf of the federal energy agency, Hessen EnergieAgentur GmbH.

3.2.5 Lille bus network fuel switching project, Lille metropolitan area, France

The Lille Métropole Communauté Urbaine or LMCU (Lille metropolitan area) had sought to develop a JI track 1 project in the framework of the French domestic offset project set up by the French Government in 2005. The Lille bus network fuel switching project sought to recycle local biogas produced from household organic waste for use as fuel in the urban bus fleet, replacing around a quarter of the natural gas buses, which are more emissions intensive. Estimated emission reductions were projected between 33 and 50 ktCO_2-eq over five years (2008-2012). The intention was to power approximately 100 gas-fuelled buses based at the bus depot built close to the biomethane production plant, the so-called Organic Recovery Centre. It was envisaged that the waste collection trucks would be powered the same way.

This project is a part of a wider approach taken by the metropolitan authority focused on waste management. Since 1992, LMCU has set up a biodigestion unit for household organic waste, called Organic Recovery Centre, and under the LMCU authority's supervision. Until then, this produced biogas was intended to generate electrical power. But this would have reduced emissions by 85 g CO_2/kWh, instead of 205 g CO_2/kWh in the case where the fuel is used for buses. However the electricity solution would have been more profitable as electricity sales would have yielded 1.5 million €, instead of only 1.1 million € received for the sale of biomethane as fuel. The main objective of the project was emissions reductions at an acceptable cost. This project of biomethane as fuel for buses was strongly supported at the outset by the LMCU, who were very keen to develop the use of waste for energy because of its environmental benefit. However, because the national legal framework didn't allow the use of a necessary canalisation to carry biogas, the project has been delayed for two years.

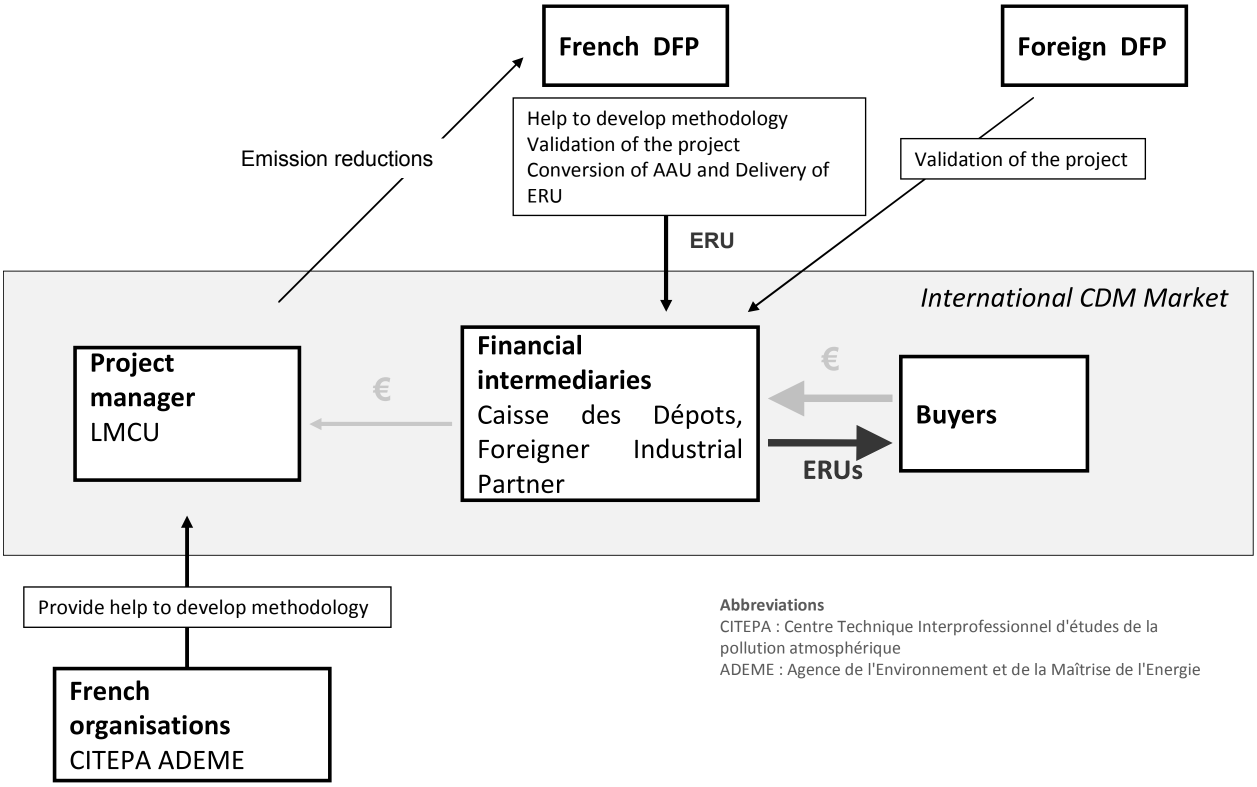
Technically, the project extracted methane from the bio-waste collected door-to-door from the residents of the urban community in the Organic Recovery Centre, which entered in operation in September 2007. The raw biogas produced (approximately 1300 Nm3/h as a maximum capacity) would then be cleaned and upgraded in a pressurised water scrub column (Flotech system) in order to increase the methane content and eliminate any pollutants (including H_2S). Once the resulting biomethane is dried and odorised, it is identical to natural gas and can therefore be substituted wherever natural gas is used, e.g. as a fuel in vehicles. The project consisted of using the existing plant, and adding a new purification unit and a place to store the gas. The entire project would have been managed by the city authority.

In France the domestic offset program uses Track 1, so the project didn't require approval through the UN JISC process. However the use of a methodology approved *ex ante* by the French government is required, as is the demonstration of additionality. The methodology was developed mainly at the city level, with the help of the French organisation in charge of the national inventory (CITEPA), and the designated focal point authority in France (DFP). It was surprisingly completed within only one month, by a civil servant from the city who was a specialist on biodigestion, with the aid calculations done by a French technical agency specialised in environmental measurement issues (ADEME) and the CVO. Additionality was defined using economic criteria.

One important innovation in this project is its financial functioning: the LMCU wouldn't receive carbon credits but cash, and this amount was guaranteed by contract: a French financial institution (Caisse des Dépôts) would act as an intermediary to remunerate the project developer with cash instead of carbon credits. The relationships between the different actors were intended to function as follows (see Figure 21). First, the project was submitted to the French DFP. Second, once the project wasoperating, the project manager (in this case the metropolitan authority) would have the GHG emission reductions certified after verification. The DFP converts AAU into ERU and gives them to the financial institution and the foreign partner that has made the project approved by its own DFP. Finally, the financial institution and the foreign partner pay the project manager at a previously agreed-upon price. Other financial sources were necessary, as carbon sales represented only 13% of the total cost of the project evaluated at 3 million €. The carbon part appears to be small but enough to compensate the difference of revenue (around 400 000 €) if the electricity power generation project had been set up.

The use of the carbon mechanism appeared to be a beneficial solution given the profitability of the project, as at this time there were no other financial options available for the local authorities to implement the project. However, some new legal developments (the so-called "Grenelle II" law) in 2010 leads to the local authority favouring another solution, which consists of feeding the produced biogas directly into the natural gas network, benefiting from a newly created feed-in tariff, and using the gas from the network as fuel for buses: this appears easier to achieve (no need to store biomethane), with satisfactory profitability (i.e. beneficial tariffs, lower transaction costs than for JI as there is no lack of time, no auditing costs, no volatility on the sale price, etc.), and also very beneficial for the environment. However, this change in policy should induce an extra cost for natural gas consumers, as the feed-in tariff might be financed by gas consumers as a whole.

Figure 21. Key actors and interactions in the LMCU JI project



4. ANALYSIS AND DISCUSSION

At the time of writing, the ten case studies just outlined were representative of the family of projects in which urban and city municipal authorities were seeking access to international carbon markets for financing. Obviously, given the range of diversity among those CDM and JI projects, the insights which these case studies can provide into the heterogeneous types of urban projects is not without its limitations. The limitations of our approach are described in more detail towards the end of this section. However, the goal of the analysis provided in this section is not to provide an exhaustive explanation of all the requirements for the success of all possible types. Rather, it is to highlight key issues and general themes that emerged as factors affecting cities' access to carbon markets and the success or otherwise of using the mechanism. This section thus provides an analysis that identifies common issues across the various types of CDM and JI project studies and which can serve as a basis for thinking about cities' roles in the carbon markets. This analysis is divided into several themes, beginning with a discussion of projects risks and risk management issues for cities, followed by a discussion of important drivers of success for city projects using carbon markets, and an overview of the case studies.

4.1 Managing risks and the financing of carbon mitigation projects

From conception to completion, a JI or CDM project involves a long and complex preparation process, often characterised by setbacks that threaten project viability or affect profitability. Such setbacks may stem from competing or shifting policy priorities for the local government, changes in political leadership or the budget position, or technical difficulties. Thus city authorities face several types of risk when engaging in GHG mitigation, including technical, financial, legal, and political elements. Some of these risks may be addressed in part through effectively managing carbon market finance. Although many risks are not unique to projects that involve city authorities, they do take on a different dimension when it is a city authority that has to tackle them. Typically cities face greater budgetary and capacity constraints, and often lack carbon market expertise, compared to other possible project partners, such as those in the private sector. Moreover, as public rather than private actors, cities may seek to maximise the certainty of project outcomes for their policy dollar and thus may avoid risky or innovative projects, especially where their budgets are constrained.

4.1.1 Managing financial risks of the project

While risks of carbon-finance projects can result from many different aspects, they can all ultimately have an impact on the project financials. Table 5 outlines the sources of risk that may be encountered throughout the lifetime of a carbon-finance project. Carbon-finance projects can be more sensitive to risks than others because they require the combination of both technical and institutional aspects. These factors listed in Table 5 can have important financial implications, for example, underestimates of the time it takes to approve methodologies or over-runs of capital costs due to technical issues can lead to higher project costs. These risks are not specific to cities, except the political ones linked to city functioning (the mayor election cycle, the political support at the city level and changes in priorities), but can be exaggerated for cities with limited resources.

In every project, there is some degree of technical and operational risk. But for carbon projects, the consequence of the under-production of project outputs is important not only for the project operation, but also for the revenue stream linked to the sale of carbon credits that will be reduced. On the contrary, an over production may be very beneficial. Symptomatic of this risk, some of the case studies examined here (Transmilenio in Bogota, and the two landfill gas projects in São Paolo) predicted a significantly higher level of CERs than were actually realised (see Annex 2 for further detail). While the specific reasons for this over-estimation of emission reduction credits are case- and technology-specific and related to a wide variety of different risk factors including technical and operational difficulties, this can be viewed as a general illustration of the degree of risk of these projects.

Table 5. Sources of risks encountered with carbon-finance projects

Risk Source	Planning phase	Construction phase	Operation phase
Technical & Operational	• Implementation feasibility	• Unforeseen difficulties to implement • Interest rate and currency fluctuations	• Project-specific technology operation • Supply of necessary inputs (e.g. biomass, waste gas) • Demand and use of the installation (e.g. buildings)
Carbon market mechanism (CDM/JI) regulatory risk	• Methodology development and approval • DNA/DFP approval • DOE validation* • CDM EB and JISC (if track 2) registration and issuance • Links with foreign partner	• Investor country approval • Contract performance renegotiation risk (esp. JI)	• Post-Kyoto CDM & JI continuation • Verification of emission reductions • Crediting risk: quantity of issued credits • Crediting risk: timing of credit issuance • Sales of carbon credits and carbon price volatility • Regulatory risk: e.g. quality/quantity controls on offset credits • International Transaction Log (ITL) risk**
Other legal	• Permit/licence approval • Conflict with national laws or rules • Regulatory change • Counterparty failure to meet contractual obligations		
Political	• Mayoral election cycle • Political support from higher levels of government • Change in priorities at the city or other important level • Government budget and carbon positions • Departure of one key participant		

Source: Authors, Ellis and Kamel (2007), IETA (2007), UNEP and EcoSecurities (2007)

* There is an additional risk that the DOE involved at the validation or verification stage could be temporarily or indefinitely suspended by the Executive Board, as occurred in the São Paulo case study.

**At the beginning of CDM, delays in CER transactions occurred as the ITL was not functioning.

There are also inherent regulatory risks associated with the CDM and JI mechanisms themselves. An over-arching uncertainty is in the continuation and form of the mechanisms in the post-Kyoto period beginning in 2013. Some interviewees pointed to this limit as a key problem. These issues will largely be decided at the international level, but cities can work with their national governments to make sure their issues are on the table and their interests are considered in the negotiating positions ultimately taken by the national government.

In addition, there are risks and challenges associated with project methodology approval, validation and registration. Long time frames for approval (and non-approval) may lead to sunk costs that are difficult to project and to recover from public budgets. During the lengthy approval process, there is also the possibility of evolving rules that must be adapted to along the way. Moreover, as explained by many interviewees, the required precision for submitting a project can involve risks in terms of delays and transaction costs to gather all needed information. In this respect, the crediting authority could better take into account the relative scale of project monitoring, reporting and verification (MRV) costs to project size and profitability for the developer[15]. These risks can be addressed through using or adapting existing project methodologies, or by using a simple approach to a new methodology. Cities can partner with experts from the private sector in developing or adapting methodologies and walking through the approval process. Also, cities can work with their national governments to push for reform to provide financial and technical support to develop relevant methodologies and to streamline the project approval process at national level.

The legal framework under which the project is pursued is important. Permits or licenses needed to implement a project may encounter difficulties during the approval process: delays can occur during each step of the process (validation, registration and verification). In addition, if the policy framework changes during the planning phase of a project, it could have implications on the additionality of the emission reductions. For example, if a regulation is implemented to require certain emission standards, projected emission reductions from a mitigation project may no longer be considered additional to the baseline according to the responsible entity (CDM EB, JISC, or DFP if JI track 1). In the case of Lille, when the legislation changed, another solution was chosen. In this case the change in regulation was favourable to the city and provided an easier and less financially risky way to operationalise than would use of the JI mechanism. However the change could have also swung in the other direction, making approval of the project more difficult. Some of the legal risk is at the national level (e.g. for some permits, national policy changes). To ameliorate national level legal risks, national and city level authorities could work more closely on aligning climate goals and mitigation strategies.

Pursuing a JI or CDM project through to completion is a long and involved process, over the course of which political leadership, policy priorities and budget position can change for a city government. Where a project does not have buy in and support from local government and stakeholders it may be difficult to advance. A particular risk can hinge on the role of one key political personality, where departure of this person can compromise the project.

Another type of political risk is the potential for different interests and agendas of city authorities as compared to national authorities, for example in the case of Joint Implementation. As issued ERUs are directly linked to Kyoto target accounting of the country, the government can be very cautious about their approval of JI projects, depending on the time frame. National authorities may be much more conservative or even sceptical about the usefulness of an urban project to a national climate change strategy or policy, as any project, especially if there are questions about its ability to deliver emission reductions at predicted levels. This issue of additionality is crucial: the project manager has to prove that the project would not have occurred if there were no carbon credits. Depending on its Kyoto position, a country can be more or less cautious about the agreement. This could lead to a refusal to approve the project, in order to ensure more control over mitigation performance, or a limitation of the project. For example, in France the national government adopted an approach to discount a project's ERUs (as the rule is to reward only 90 % of the actual emission reductions) so as to limit the risk of project underperformance to the government's ability to achieve its national target.

4.1.2 The role of carbon financing

All of the above are important sources of financial risk in the current JI and CDM offset market. A common characteristic of city mitigation projects is that usually the city government is unable to assume a significant amount of financial risk. Interviewees frequently commented that carbon market financing provided critical cash flow needed to pursue their respective projects. The extent and the manner in which carbon financing was important to the successful completion of the projects differed

[15] For example, unforeseen transaction costs can occur when the project manager develops a new methodology (e.g. Lille, Bogota), implements the MRV system and bears the auditing costs, or is obliged to find partners and buyers, etc. Using existing methodologies can help reduce transaction costs. Moreover, when an urban project CDM methodology is already developed, it may be easier to adapt it in another context (e.g. in other cities, or as a JI project such as NRW, etc).

across the cases investigated. However in our ten case studies, there is no unique model of carbon financing. In this context, the private sector is likely to continue to propose new ways to innovatively combine with city governments on mitigation projects.

In some cases, the carbon financing appeared to be instrumental to the pursuit of the project from the outset. Interviews of city authorities revealed that while their projects may have been economically rational in the long run even without carbon finance (for example for waste to power projects), the start-up capital required from a limited budget and the length of the payback period made them uncompetitive with a range of competing public interest projects. In most cases, financing for projects was diversified across public, private and carbon market streams, but the exact proportion depends on the project. The role of private sector partners is discussed further in Section 4.2.3.

The ability to intelligently structure project cash flows to tailor them to the project developers needs was also important. In one JI case (Palmerston City in New Zealand) a project was capable of going ahead because a credit buyer was discovered early and agreed to pay for 30% of the prospective credits in advance. The local authority managing the project commented that this was extremely helpful, since, as a small authority, start-up costs were a significant barrier. Managing the cost of the project was also done by conducting "trial audits" during the project implementation stage, in order to foresee any costly pitfalls that might prevent verification and credit issuance.

In the case of the New Zealand landfill projects, for example, project developers noted that despite the long run financial profitability of the projects, the country's poor track record with the technology type meant that private debt would have been difficult to raise. Moreover, the project's share of the operating budget in the short run was a key source of concern to decision makers at the city level, who face a variety of competing claims on funds for public infrastructure projects and services. Thus when considering project types and profitability, transactions costs and technological risk must also be considered.

In other cases, the projects had already commenced without having applied for carbon finance, had subsequently become financially unviable, but were able to be rejuvenated by the promise of carbon credits. For example, carbon finance was considered as a means to refinance an existing project in the cases of Transmilenio, Bogota and Solar Hot Water Heaters, Ho Chi Minh City.

An analysis of the financing of the urban projects suggests that the contribution of carbon credits to the overall finance base was sometimes relatively small depending on the project type (see Table 7 in Section 5.1 for an overview of carbon finance contributions across the case studies). In the case of Transmilenio, Bogotá, the CER revenue stream only accounted for approximately 1-2% of total project costs, but the promise of carbon credits helped attract larger levels of additional private sector financing (see Figure 12 in Section 3.1.1). In most of the case studies, the stream of finance coming from the sale of carbon credits is a supplement to finance coming from more traditional public and private sources (e.g. Bogotá, Timisoara) and, despite advanced credit payment (start-up capital) for some projects (e.g. Palmerston City, Timisoara) other sources of up front financing are always necessary for such projects. It must be also noted that the aim of the carbon finance is not to cover all costs of a project but to pay the extra-cost due to the choice of a more carbon–friendly and more expensive solution.

In addition, the amount of revenue from carbon credits sales that is directly returned to the city authority varies depending on the arrangement of city, national and private sector actors. An innovative approach to directing a stream of finance back to city hall can be seen in the São Paolo case study, which held the first city auction of its kind. Half of the CERs are received by the city government, which are then auctioned off for proceeds. This approach may increase the risk of price volatility, but can also increase the potential revenue for the city. This approach was interesting in so far as it appeared to prolong the uncertainty over the price at which credits would ultimately be sold, but also offered a potentially higher pay off for the city (although a lower pay off is also a risk, depending on the timing of the sale). Some cities are more risk-adverse about carbon price volatility and prefer to have a guarantee on the price (either a fixed price, or a range of prices, or a minimum price): this has been seen for the projects in NRW, Lille and Palmerston (which succeeded in selling credits in advance). For these first two projects, cities don't have to deal with carbon credits, as, when ERUs are issued, they are converted into cash by intermediaries who have assumed the carbon market price risk.

Overall access to the carbon market has offered an advantage to these projects as an added margin of profitability, compensating in part for the risk of project failure. Indeed, in the case of the Christchurch landfill project a local authority official commented that "*the project was profitable already, however council would probably not have approved it without the additional return promised by the carbon credits. It would have still been viewed as too risky*" (Itskovitch, *pers. comm.*). The motivation for using carbon markets therefore varied, while a common theme was that the carbon market was seen as providing critical financing for decision makers both public and private to lower the risk of investing in the project.

While it may be tempting to view cities as acting like private enterprises in seeking to maximize return relative to risk, cities were observed to operate under unique sets of constraints and motivating factors in selecting projects. The decision making process for urban authorities is informed by considerations that extend beyond an assessment of project return relative to a benchmark market interest rate. This is also linked with the calculus of "additionality" for these projects. These findings agree with those of NEFCO (2010) which noted undue focus on financial cost benefit analysis under the flexibility mechanisms that does not take account of financing and other constraints. A failure to give due consideration to the unique constraints of urban authorities to advance mitigation projects, may inhibit genuinely additional projects from obtaining the needed political and technical support to advance their access to finance provided by carbon markets. In CDM, this can be addressed by proving additionality through analysis of barriers, rather than pure investment analysis. However, barrier analysis has often been viewed by Designated Operating Entities and the Executive Board as a weaker proof of additionality. It would be beneficial if, in the case of city projects, this analysis would be taken as a serious justification of additionality.

4.2 Drivers of success for urban carbon market projects

Despite the challenges and risks associated with accessing carbon markets, the case studies examined here demonstrate several motivating factors or drivers of success for urban carbon finance projects. These include: suitability of project type and profitability; co-benefits and spill-over benefits; private sector engagement to manage risk; political will at the local level as well as strong multilevel governance. Each of these is discussed briefly below.

4.2.1 Project types and profitability

City authorities tend to have responsibility for specific emitting sources, some of which provide more technically straightforward and immediately profitable mitigation project types than others. However they can only implement projects under their jurisdiction. For example, landfill gas projects are the most numerous project types involving an urban authority currently in the CDM and JI (see Figure 5 in Section 2). Landfill gas projects in particular offer not only an opportunity to exercise city authority, but are also generally profitable as the landfill gas can be used or sold as a commodity[16]. The relative ease with which the landfill gas utilisation projects (e.g. see São Paulo, Durban, Christchurch and Palmerston case studies) were adopted, the methodology validated, and buyers found on the carbon market appears to be due to their relatively high increase of the financial rate of return compared to the baseline scenario without carbon credits and the low technical and financial

[16] Landfill gas is largely composed of methane, which has a higher global warming potential than carbon dioxide (IPCC, 2007).

risk of these project types[17], in comparison with others. Whereas the average size of CDM or JI projects is around 160 000 tCO_2-eq/yr (UNEP Risoe database, 2010), our ten projects have a lower size (around 30 000 tCO_2-eq/yr) except landfill projects which provide a more significant amount of emission reductions (between 0.35 to 1 M tCO_2-eq/yr). These project types are not just favoured by cities because they are potentially profitable and the technology is well known, but also because they represent a relatively sure bet for policy makers keen to see a concrete outcome for public expenditure.

Several of the projects also demonstrate the low-cost mitigation opportunities embedded in city operations themselves, particularly where cities own and operate energy using infrastructure in close proximity. Additionally, the ability for the cities to achieve significant energy cost savings for other owned assets, such as a swimming pool, or municipal buildings, adds to project profitability. Finally urban mitigation projects may offer unique opportunities to get to potentially very large emission reductions that are otherwise difficult and more costly to access through national policies alone (e.g. in the transport sector). As the cases demonstrate there are a few examples where OECD national or regional governments have recognised and are working closely with local authorities to raise awareness and solicit participation in carbon markets through the development of urban projects (NZ and Germany).

4.2.2 Co-benefits

Project "co-benefits" played an important role in the motivation to pursue and in the design of the case studies. Co-benefits can also help to justify additional financing needed for a project. The projects examined demonstrate often large and visible co-benefits, particularly in the urban policy areas of transport and waste management. These co-benefits include reduced traffic congestion, reduced electricity demand and pressure on the electricity grid – translating into greater local energy security, improved local air quality, and improved urban quality of life. For example, before the Transmilenio project was initiated the transportation system in Bogota was highly unsatisfactory (Echeverry et al, 2004). The Transmilenio rapid bus transit system increased public transport ridership and alleviated some of these traffic congestion and air quality problems. The landfill-gas-to-energy projects in São Paulo, Christchurch and Palmerston City also improved the quality of life for local residents by reducing methane emissions and odours from the landfill, as well as increasing local electricity generation capacity. Similarly in Ho Chi Minh City, where the Solar Water Heating (SWH) systems project is reducing demand for electricity from the grid and therefore the risk of blackouts, this is raising energy security in the area covered[18].

Some climate change mitigation projects were also designed to have poverty alleviation or other social co-benefits. For instance, the compact fluorescent light bulb programme in Mexico aims to support low- and middle-income households through the distribution of replacement bulbs free-of-charge. The timing of the São Paulo project was important from a social and political perspective – local residents had recently been campaigning against the landfill sites and wanted them closed down. The revenues from CER sales in São Paulo were used to create new green spaces and leisure areas in the run-down areas surrounding the landfill sites, so the co-benefits of this project went some way to responding the local communities' demands to improve the quality of life in the area.

Ultimately, the multiple co-benefits of these mitigation projects have helped to make these projects attractive to the urban authorities that host them. In some instances the co-benefits are the

[17] These projects have relatively high ratios of credits earned compared to overhead and transaction costs. Moreover, these projects used a proven technology and did not require new methodologies to be developed for approval by the CDM Executive Board or national authority. However the high profitability of these projects on their own might raise questions of additionality over the longer term. Presumably public policy could be designed over time to address the barriers that prevent these projects from developing on their own.

[18] At the beginning of the decade, electricity demand was estimated to be rising rapidly by around 10-12% per year (IGES, 2002).

principal selling point of the project to city authorities (e.g. in the case of CDM projects where GHG mitigation benefits are clearly secondary to the various co-benefits for local partners), which is distinctly different that purely private sector CDM projects. Indeed, *a priori*, one may be led to conclude that the smaller the share of total overall projects costs that is financed by carbon markets, the higher should be the concomitant public or private benefits in order to make the expenditure financially justifiable, although data are lacking to provide a robust quantification of these co-benefits for different project types (e.g. transport versus landfill gas destruction)[19].

Importantly, offset projects may also have a range of important spill-over co-benefits aside from the quantity of emissions directly reduced within the boundaries of any one project. This was the case in New Zealand landfill projects where local actors typically learned about carbon market finance and the landfill gas capture technology from the early movers. This resulted in cases where pre-existing projects were expanded using either the project revenues or non-Kyoto voluntary markets later on, or development of projects due to cost-savings even without carbon finance[20]. Spill-overs can also include increased awareness of the project in the media and general public. This can improve the opportunities for additional financial support for projects. For example, in the case of Transmilenio, CDM accreditation of the project increased the level of interest from financial institutions (Hidalgo *pers. comm.*, 2010). The importance of technology spill-overs and the change in the perceived risk of such project types are likely to be significant where cities are involved, since within a country, cities are likely to have relatively homogeneous infrastructure asset-types and projects working well in one location could be expected to be feasible in another location.

4.2.3 Private sector engagement to manage risk

Private sector engagement offered several advantages for many of these urban projects to manage financial risks, address technical and political barriers and, more generally, help to harness the efficiency of the private sector. With respect to financial risk management, private sector partners can be co-investors, provide loans, or even become an early credit purchaser (and thereby provide upfront financing)[21]. For example, in Bogotá, CAF helped finance the CDM-specific costs and provided the City of Bogota with a loan for the infrastructure. In addition, a public private partnership (PPP), named Transmilenio S.A., was formed between the City Hall and the private sector (consisting of bus suppliers, bus operators and ticket machine operators). In São Paolo, the "Biogas" joint venture invested in landfill gas collection equipment and power plants, while Unibanco invested in Bandeirantes power plant. In addition, an Emissions Reduction Purchase Agreement (ERPA) can leverage further funding for a project by guaranteeing a minimum revenue stream during the life of the project. It seems that contractual structures that stipulate sharing of the carbon revenue and financial risks between the partners do matter and may help to render projects economically and environmentally efficient (Teichmann, 2010, forthcoming).

City authorities can overcome some technical barriers by engaging with private sector technical and financial experts. The presence of locally-based economic and engineering consultants, with which the city had already worked and had an established relationship, were a common feature,

[19] Some institutional investors, like the World Bank, sometimes provide an economic assessment of these co-benefits.

[20] According to the carbon broker (Carbon Market Solutions), two councils initially won credits, but approximately 50 councils subsequently contacted that broker about applying the same technology.

[21] The private sector can be involved in urban projects by means of different contract designs, summarised under the general concept of Public-Private Partnership (OECD, 2008). These contracts range from short term service and management contracts to concessions or private joint ventures. A private service provider has generally very little responsibility as regards to the overall project performance and invests no capital in the project's infrastructure. On the contrary, long term concession and joint venture contracts usually stipulate that the private actor provides own capital and assumes investment and operational risks associated with the provision of the infrastructure services as well as the generation of CERs (the latter is settled in an ERPA).

particularly across the JI projects investigated (e.g. see the Christchurch, Palmerston, Timisaora, Lille metropolitan area, NRW). Interviewees on successfully completed projects frequently commented that they were happy or relieved to have had access to expertise. The perceived risk and cost of implementing a new kind of mitigation project was seen to diminish by the presence of local know-how and consulting advice which the city knew and trusted, compensating for capacity that was otherwise absent in the ranks of government. The combined skill set from the local government and consulting expertise were often sufficient to address key technical barriers that could otherwise have stalled the project.

Carbon price volatility is another source of financial risk that can be managed through a private or public intermediary: (e.g. Caisse des Dépôts in Lille, EnergieAgentur.NRW). Intermediaries can receive carbon credits, sell them on the market, and potentially provide some form of guaranteed cash flow to the project developers, as in Lille or North Rhine Westphalia projects. This allows project participants to build their project around this cash flow, thereby avoiding having to directly manage the carbon price risk (volatility of the carbon market is quite high). Intermediaries can also help identify, and in some cases guarantee, buyers for the emission reduction credits before the project starts (e.g. NRW, Lille metropolitan area).

Private sector partners can assume some of the technical and management barriers faced by cities in developing projects, by helping guide the project through technically complex CDM or JI preparation and approval process. This was clearly shown to be the case in the Mexico project and in North Rhine Westphalia project.

Having a private sector partner can also help a city authority to manage political risks. A commercial agreement with a private entity raises the costs and contractual difficulties of renege on a project and also forces government partners to reflect on their commitment to the project over its life. In this case, the city authorities (and national authorities) are more likely to see the project through regardless of possibly shifting political conditions and priorities (e.g. Transmilenio). However, private sector engagement in a project may come with a cost as well as companies will need to be paid to assume more risk. This in turn can limit the return on investment for projects, yet it just this engagement that may make it possible to move the project ahead.

4.2.4 Political will – local and national support – and multilevel governance

Political will appears to be a strong element in all projects, including strong linkages between local action and subnational or national level policy initiatives. Interviewees often cited the importance of having a high level of local political support.

Perhaps the most prominent example of the role of political support was the Transmilenio project, initiated by Enrique Peñalosa (Mayor of Bogota 1998-2000), who was an enthusiastic proponent of Bus Rapid Transit (BRT) systems and made the success of this project a high priority during his term. For several years the project also enjoyed support from subsequent mayors as public transportation remained high on the political agenda. Both Peñalosa and his successor, Antanas Mockus, are known for their tenure as Mayor of Bogotá during the initial phase of Transmilenio. More recently, the former mayors have capitalised on their environmental successes to join forces with the Green Party of Columbia and launch the presidential campaign of Mockus (Kogoy, 2010). In the Transmilenio case, the risk linked to the potential departure of a key participant was mitigated in part by the significant co-benefits the project had on improved traffic, thus making the project politically attractive for subsequent mayors. Not all cases included a political champion, however. In Mexico, the private sector approached the national government to support the energy efficiency project. This quickly gained political support as it provided a means to reduce the national subsidy payments to electricity users. Regardless of the political involvement, it is important to carryover expert knowledge of the project and carbon finance within the city authority, to help insulate the project from political changes.

Cities authorities are not profit-seeking like other private actors, but aim to minimize risk and to ensure outcomes for policy and public expenditure. Carbon credits for proven technologies like landfill gas projects, which have the advantage of high returns to overhead/transaction costs, can win political support more easily than other project types given that they carry limited financial and technical risk. Perhaps more importantly, a number of cases (e.g. NRW project and the NZ JI projects) demonstrate how support from regional or national government partners were essential in the project preparation stage, assuming many of the technical and financial costs of initiating a project, overcoming what would otherwise be difficult hurdles for local authorities to address on their own. In the case of the NZ programme, approval was virtually built into the programme through its more centralized design which in return reassured investors. For JI track 1 projects, the role of the national government is reinforced.

National support and linked up governance from local to national levels reassures investors and lowers urban project risk to investors. The more that city and national governments work together to define how a city project fits into the broader national climate mitigation strategy, the higher the likelihood for necessary project approval at national level. A key role for national governments in supporting cities to pursue innovative or risky projects through CDM and especially JI mechanisms is to clearly define those sought-after national scale benefits – both immediate and long term. This would prevent national governments from second-guessing the value of city projects or excessively focusing on a single evaluation criterion for urban scale projects that can prove to be too narrowly focused. These projects suggest that it may be in the interest of national authorities to sponsor methodology development or other harmonised tools (e.g. urban GHG accounting approaches) to prove the viability of urban mitigation projects or programmes.

4.3 Project overview

Table 6 provides an overview of the projects reviewed and of a selection of main features, including the roles of different institutions and actors in project development and financing. It highlights the role of urban authorities, of the national or regional governments, of the private sector and of other international or external project partners (i.e. those buying the offset credits).

It is clear from Table 6 that there are a number of different institutional models for urban carbon market project development and implementation. The patterns of leadership in project initiation and development, one of the key hurdles in access to the carbon market, is indicated in the table showing a diverse set of relationships from project to project. The leadership pull for a project rarely comes initially from the city government itself. Instead urban governments benefit from the support of other governmental partners. These partners can help them to develop and organise an urban offset project, confronting often large technical and legal complexities. In addition, private sector and international partners are often involved to help overcome financial hurdles for the projects.

The case studies examined highlighted that, while carbon credits can be a genuinely important source of finance for urban projects, they are not a magic bullet solution. Contrary to what is sometimes understood, the Kyoto carbon markets are not designed to pay for an entire cost of a new investment project that reduces emissions. Rather, they operate on the principle that carbon credits can be used by project developers to cover the surplus cost of opting for a more carbon-friendly technology as part of an existing installation or a planned investment. Thus, once a project that reduces emissions is operational, the largest share of overall project revenue is not necessarily provided by the carbon market (i.e. from sale of offset credits generated by the emissions reduced by the project), but is likely to come from other revenues flowing from projects, such as electricity or heat sales.

It was very difficult to gather public available data for the ten projects on the carbon revenue in comparison with the surplus cost of opting for a more carbon-friendly technology (or the decrease in payback period, or even the decrease in the internal return rate of a project, which would have been two relevant figures) as part of an existing installation or a planned investment. However, to illustrate the role of carbon revenue in the business model of a project, we provide here some interesting data[22]: over the 10 case studies, this expected carbon revenue stream varied widely from 50% to less than 15% of overall project costs. Landfill gas projects typically had carbon revenues paying the highest share of project capital costs (~50-100% of the capital costs), energy production and energy efficiency projects had carbon revenues covering approximately 20% of the total costs), and transport projects showed a lower carbon revenues (1-2% of operating costs). These results imply that, for many project types, carbon market financing is not sufficient to allow urban actors to pursue emissions reduction projects without coupling such financing with additional funding sources which finance the non-carbon aspects of the project. However it should be noted that it is difficult to draw robust conclusions from a diverse set of cases. As discussed in Ellis and Kamel (2007), there is wide variation of level of investment required across different project types, and even within project types. Moreover, since carbon revenues arrive after the project is operational and has begun reducing emissions, additional means must be found to meet the start up costs of a project. Thus, additional funding is typically needed in the form of additional revenues from new services, or additional public or private investment, which, in turn, implies the critical importance of project "co-benefits" for putting together a feasible overall financing structure.

Moreover, our case studies reveal large differences between the amount of expected carbon credits, and the amount of issued credits (see Annex 2): most projects received less than half of expected credits. This rate is much lower than the average rate for all CDM registered projects (88% of issuance success, from UNEP Risoe database) and all JI registered projects (84 % of issuance success from UNEP Risoe database). This can be explained by an initial overestimation of the project emission reductions, delays and difficulties to implement it, and the technologies used in our case studies.

The review also highlights the strong co-benefits associated with the projects, demonstrating the reason why urban governments are often keen to advance them – i.e. not principally for the GHG mitigation benefits but for the other amenities and benefits delivered by these projects. Co-benefits may be principally environmental, such as a cleaner urban environment and lower levels of congestion, or also social, such as the delivery of better access for poorer families to low cost electrical lighting or to more efficient transport. In at least one case (São Paulo), the project is delivering a revenue stream for the urban government to invest in local amenities, notably green spaces in areas surrounding the landfill where the project is located, to improve the quality of life of the local population. Indeed, the case studies examined here suggest that urban level policymakers frequently appealed to carbon finance as a means of solving a range of interconnected policy problems (e.g. waste global management, reduction of energy bills, cleaner environment), of which climate change was only one (e.g. Burwood Landfill Gas, Christchurch; Waste to Energy, Lille metropolitan area; Transmilenio, Bogota; Solar Hot Water heaters, Ho Chi Minh City).

[22] Data are lacking to provide for each project more relevant or consistent estimations (e.g. the role of carbon revenue in implementing the carbon-friendly project in comparison with other projects).

Table 6. Project overview

Project type, name, & location	Role of urban authority	Role of national or regional government	Private sector role or credit purchasing role	Other international partner role	Co-benefits	Carbon Finance [a]
Waste – Methane Capture to Energy						
Landfill Gas to Energy, Bandeirantes and São Joao; CDM; São Paulo, Brazil	Pro-active in project development; have rights to ½ of credits generated and sold them by auctioning	Limited role, acted as DNA	Joint venture -- "Biogas" -- created between 3 private companies with concession contract with city government for the methane.	KFW, Germany is purchaser of ½ of credits sold by Biogas	Job creation, odour reduction, improved safety, revenue raising for local amenities (e.g. green space)	High actual carbon revenues = ~ 100% of capital costs[b]
Landfill Gas to Electricity Projects, Mariannhill, La Mercy and Bisasar Road; CDM; Durban, South Africa	Municipality signed MoU with WB PCF; Provided technical oversight and operation of projects	Provided funding for upfront costs	Credits from Bisasar Road bought by Trading Emissions Plc	WB PCF – initiated PDD in return for credit purchase, developed methodology; AFD French development bank provided loan for upfront costs	Landfill odour management, displaces coal-fired electricity thereby improving air quality, job creation	Medium - high projected carbon revenues = ~50% of total costs[c]
Landfill Gas Utilisation Project; JI ; Christchurch City, New Zealand	Proactive in project identification and development.	Sponsored national programme to identify and develop projects (Track I)	A variety of private consultancies, provided important expertise, local broker helped with transactions. Buyer was hands-off investor for EU ETS obligations. No upfront purchase of credits by buyer.	*(no significant role)*	Energy savings, odour reduction, additional revenues used to achieve additional reductions	High projected carbon revenues = ~70% of capital costs[d]
Landfill Gas Utilisation Project; JI; Palmerston North City, New Zealand	Proactive in project identification and development.	Sponsored national programme to identify and develop projects (Track I)	A variety of private consultancies, provided important expertise, local broker helped find buyer, an institutional investor on behalf of Austrian Gov't. Some upfront purchase of credits by buyer.	Buyer was Austrian national government for Kyoto compliance.	Energy savings, additional revenues used to achieve additional reductions	Medium - high projected carbon revenues = >50% of capital costs[e]
Building Energy Production & Use, Including Energy Efficiency						
Solar Water Heating Systems Programme of Activities; CDM; Ho Chi Minh City, Vietnam	Established Energy Conservation Centre and provided funding	Vietnam Ministry of Industry and Trade provided funding for Energy Conservation Centre	MUMSS (Japanese investment bank) conducted feasibility study and collected data	Japan Ministry of Environment provided grant to MUMSS to collect data for PDD	Energy security	Medium projected carbon revenues = ~18-30% of capital costs[c]
Luz Verde/CUIDEMOS Mexico Programme of Activities for compact fluorescent lightbulbs; CDM; Puebla, Mexico	Project host	Co-sponsored project development through a grant	Private sector partner initiated project – partnered with national gov't; Local distribution facilities and awareness campaign sponsored by private sector	Eneco in Netherlands is credit purchaser; ING provided debt financing; Philips provided a grant for the light bulb supply	Poverty alleviation, reduced electricity subsidy payments by national government	High projected carbon revenues = ~100% of operating costs[f]

Project type, name, & location	Role of urban authority	Role of national or regional government	Private sector role or credit purchasing role	Other international partner role	Co-benefits	Carbon Finance [a]
NRW Programme of Activities for fuel switching and energy efficiency of boilers and heat productions; JI ; North Rhine Westphalia, Germany	Project host	Regional agency managed the entire project, including carbon aspect. Regional Gov't supported and financed project development phase. National Gov't verified methodology, as JI track 1	Private consultant developed methodology, Private and public sectors purchase credits	Rhonalpenergie-environnement as foreign partner, helps to obtain the LoA	Energy savings, reduced regional subsidy	Low - medium projected carbon revenues = ~5-20% of total costs
Combined Heat and Power Project; JI ; Timisoara, Romania	Guaranteed debt issuance of subsidiary to finance upfront project costs.	National government verified methodology, as JI track 1. Formed part of a Gov't scheme to launch domestic JI projects.	Some private expertise provided by domestic carbon market consultancy. But limited private sector involvement aside from some indirect debt financing	Swedish Energy Agency was the credit buyer. Found project through a call for tender process in the Baltic and Eastern European region as part of an existing Government policy to invest in region's energy sector.		Medium projected carbon revenues = ~15-20% of total costs[d]
Transport						
Transmilenio, Bus Rapid Transit; CDM; Bogota, Colombia	Mayors championed project, , provided funding for infrastructure	Financed project construction; promoted BRT systems elsewhere	Public private partnership -- Transmilenio S.A. -- formed between City Hall and private actors; also CAF – regional bank and credit buyer intermediary - financed project development	Netherlands VROM, ultimate credit purchaser	Public transport reliability and access; reduced air pollution; improved traffic congestion	Low projected carbon revenues = ~1-2% of operating costs[c]
Bus network fuel switching project from waste management; JI ; Lille metropolitan area, France	Local government championed the entire project, defined methodology	Help in methodology, and definition of additionality, as JI Track 1	Caisse des Depôts (French bank) forsees to purchase carbon credits, and acts as administrative and financial intermediary	Foreign partner for LoA	Reduced air pollution, fuel savings	Low projected carbon revenues = ~13% of capital costs

[a] Depending on data availability, carbon revenues are indicated as part of the total cost or the capital cost (and rarely the operating cost). This refers to projected carbon revenue (with the exception of São Paolo); however, issued credits are often less than projected (See Annex 2).

[b] Received CER auction proceeds for two years (2007-2008) for both landfills.

[c] Projected 7 year CER stream valued at 10€/tonne.

[d] Projected 5 year ERU stream valued at 5€/tonne.

[e] Own estimates, calculated based on the conservative assumption that ERUs were sold for at least 10 NZDs each. We also use the reported figures of 5-15% simple return on capital, and assuming that this return is shared between energy sold to grid (190 000 €) and energy savings (370 000 €) and carbon credits sales (680 000 €).. The latter two figures are reported on the council's website: http://www.palmerstonnorth.com/YourCouncil/NewsAndViews/MediaReleases/Detail.aspx?id=13254

f Projected 1 year CER stream valued at 10€/tonne.

4.4 Methodological limitations and suggestions for further work

The method used and results obtained from this analysis could be improved and built upon in future analyses of the role of city carbon finance projects in a number of ways. The analysis presented here was based on a small and highly diverse sample of urban projects. As already noted, this sample was chosen to be representative of interesting examples of projects in the CDM and JI involving city actors, and in doing so this study aimed to make a first step along a path to better understand the role of carbon markets in urban scale mitigation. However, relying upon such a heterogeneous and yet small sample (only 4 projects at the maximum for a single type) can make it difficult to draw more detailed conclusions about the challenges of accessing carbon finance and making projects work in specific categories of projects.

Firstly, the role of local and national governments, and in indeed the importance of the private sector, may be more different across country and projects types than the methodology used in this study may suggest. Indeed, even between developed countries in Europe, the legal, industrial and social context can arguably have an important influence on project possibilities. For instance, the drivers of success for carbon finance projects in energy efficiency in France are plausibly significantly different from those in Germany: the production system in both countries is very different, with a very high concentration of private utilities working for cities in France, and a more decentralised system with stronger involvement of city authorities in Germany.

Secondly, our study did not attempt to draw distinctions between privately originated and driven urban mitigation projects and those which had a more active role from local public authorities. Thus, further work looking more specifically at projects which isolate specific institutional environments, one or two urban sectors, and which attempts to draw distinctions between 'private' and 'public' urban projects could potentially improve upon the results offered here.

Thirdly, it is arguable that programmatic projects have improved the ability to unlock urban potential to reduce emissions in key categories of project types. As noted earlier, projects that involve technologies to improve energy efficiency in buildings and large scale (esp. modal shift) transport projects are among the most important areas where cities can reduce energy use and emissions. However, casting a wide net of projects led us to focus much less on the particular drivers of market access and project success in these important categories. Further work looking at projects in these sectors therefore has the potential to be particularly useful in complementing the findings of this study.

Lastly, the public financial data for the projects is sparse. Thus the cost analysis in this study is limited to examining the relationship of carbon credit revenue streams to total project costs, and sometimes only operating or capital costs. Should more financial data become available, it would be useful to examine the carbon credit revenue stream in relation to the additional costs of a carbon project. Further work could also focus on how carbon finance complements other financing streams such as taxes or budget lines.

5. CONCLUDING REMARKS ON LESSONS LEARNED AND THE WAY FORWARD

In concluding we attempt to answer the question raised at the outset: How have cities accessed carbon markets to date and what might we draw from this experience for the reform of future market mechanisms?

Use of the carbon market to co-finance urban mitigation projects or programmes remains very limited. As noted, out of 2,062 projects registered in the CDM to date, urban projects account for less than 4 %. This comparative analysis of 10 case studies suggests that, despite the variation in details and contexts, there are a number of common barriers and features of project risk that limit access to carbon markets by urban projects. In particular the analysis of the roles of different institutional features, actors and project financing structures reveals a number of motivating factors or drivers of success. From this we attempt to draw out lessons for future of market mechanisms.

5.1 Lessons learned from cities in the existing carbon market: overcoming barriers, tackling risk and key features of success

The previous section highlighted that there is no dominant institutional model across the case studies. For instance, political leadership was an important element in many cases, but the source of that leadership varies. Local authorities were typically instrumental in the initial decision to exploit carbon market financing, but the ongoing leadership for these projects has only occasionally come from the urban government, and often stems from other governmental partners, international institutions or the private sector. Further, the case studies demonstrated that while carbon credits can be an important source of finance for urban projects, the revenue from carbon credits is not necessarily significant compared with other sources of revenue for the project. The importance of additional sources of overall project financing, whether public or private, was underscored by the important role which additional "co-benefits" played in the motivation of many projects.

Despite the differences from project to project, overall the analysis reveals four key clusters of motivating factors that drive success for these urban carbon finance projects (Table 7). Depending on the project and the context, some factors are more important than others.

Table 7. Motivating Factors - Drivers of Urban Project Success

Project Element	Conditions for Carbon Market Access & for Project Success
Project profitability and type/suitability	✓ Suitable project types for city authorities ✓ Use of existing or simple methodologies/technologies ✓ Projected profitability
Co-benefits	✓ Existence of high local co-benefits
Private sector engagement	✓ Risk management through private sector engagement e.g. for technical expertise and financial risk management
Political will and strong multi-level governance	✓ Local political support ✓ Alignment with national climate strategy ✓ Support from national or regional government for methodology and project development ✓ Engagement of international partners

5.2 Looking forward: supporting low carbon urban development

Achieving low carbon development will hinge on the ability of cities to manage emissions through cleaner investment in innovatively built infrastructure, transport, water resources and waste management programmes in the coming decades (OECD 2010 forthcoming; World Bank 2010b). As we have argued in Section 1, given rapid urbanization and growth trends in many developing countries, the ability for city authorities to access carbon finance to support investments in key areas could quicken the pace of low carbon development and help to avoid lock-in to high emission pathways. While there are many existing financial tools available for financing urban GHG mitigation projects (e.g. taxes, subsidies), city budgets may be under increased pressure in response to mitigation policies, rising fossil energy prices and fiscal budget tightening (OECD, 2010 forthcoming).

Carbon markets could play a key role to fill the financing gap and leverage more private sector investment in the direction of low carbon development. Yet the case studies underscore how institutional complexities and the lack of capacity in city governments to develop projects under the current system slow or limit the access of urban authorities and viable urban projects to carbon markets today. This section considers the forward looking question: *How might market mechanisms be better adapted in the future such that they could support ambitious low carbon, urban development?*

Although the scale of the carbon market today is large (103 billion € in 2009, World Bank 2010a), the evidence presented in the preceding sections of this paper has shown that the carbon finance market remains a cumbersome and infrequently used instrument to support mitigation within the broader context of urban development planning. Boosting the scale of access to carbon markets for urban mitigation projects will require addressing at least two inter-related issues:

- Increasing the volume and/or size of urban projects, such as through 'programmatic' investment in urban mitigation rather than project by project investment

- Accelerating the pace of project development and approval, for example by simplifying the project development phase to lower the up-front technical risks and lower barriers to carbon market access (simplifying methodologies, additionality proof, verification process, etc.) for cities

If the challenges faced by urban mitigation projects are not addressed, either in the existing market mechanisms or new mechanisms, cities may continue to use traditional funding (loans, subsidies, etc.) without using new sources of financing, or may try to be active in the voluntary market.

Looking forward, there are three principal options that might be used to address these issues, each of which is a variation on the JI and CDM markets that we have today:

- Programmatic or urban sectoral projects,

- Use of domestic offset programmes, and

- Cap and trade approaches.

Particularly if the sector targeted through urban mitigation is not covered by national policies – such as in the urban transport or the waste management sector – there may be important synergies to be captured by encouraging urban mitigation through access to carbon markets or by adding such actions to the bundle of national policies already in place.

A programmatic approach is one way to increase the volume of urban projects by consolidating some of the project risk and streamlining the approach to address barriers to action, as it would group small point-source projects together and thus expand the scale of activity covered in a mitigation project (see Ellis, 2006). This approach allows for a scaling-up of activity volume under one methodology and raises the profitability of the project by lowering the start up costs, as explained for the North Rhine Westphalia programme, Section 3.2.4. The Programme of Activities (PoA) examined in this study (Luz Verde in Puebla, Solar Water Heating Systems in Ho Chi Minh City, and NRW) illustrated the benefit of grouping small projects together to achieve larger CER/ERU streams. Projects have to be similar in order to use the same methodology: therefore a programmatic approach is more appropriate for standardised projects (and not for specific project as in transport sector for instance). However new developments in JI Programme of Activities[23] show that a programme can cover several different technical options and not only one. A prime example is the JI German PoA "Active Climate Protection - CO_2 Bonus natural gas" which covers roof insulation and exterior wall insulation, renewal of windows, switch to less carbon-intensive fuels, and change of user behaviour.

The programmatic approach is particularly adapted to urban projects, as there are many small but similar individual projects. An interesting way of development is regional programs (like the North Rhine Westphalia project) that can gather numerous individual projects at the city scale level in the same region. It may be a first step to scale up carbon market finance to support urban mitigation, and it may limit some of the methodological risk associated with project development. Another approach is a city-wide PoA (as proposed in World Bank, 201b), which allows for grouping of diverse projects within a city. Yet ultimately this approach is still subject to the constraints inherent in the CDM/JI mechanisms. For example, DOE liability issues have been slowing CDM PoA approvals. Indeed, buyers of credits in the CDM market tend to look for larger, low-cost, low-risk projects (Ellis and Kamel, 2007). Thus other avenues could be explored for urban mitigation projects, such as domestic offset mechanisms and participation in national cap and trade systems.

Domestic offset programmes, which are more flexible than JI or CDM as they do not fall under the specific framework of the Kyoto Protocol, could be used to support low carbon urban renovation and development. This could be a way of scaling up and accelerating the pace of emission reductions, and would not require any fundamental changes to the international regulatory system but would be a measure that national governments could opt to undertake today. It is the prerogative of national governments to determine if such an option is useful and if so to put it in place. Such a system may be most clearly attractive where a cap-and-trade policy framework is already in place domestically, in which case domestic offsets from urban projects that are outside of the "capped entities" could be used to enhance cost-effectiveness of achieving a national cap. This is the case in three of the host countries from our sample of projects (France, Germany and Romania) where such a system is technically already in place, and which allows for use of the JI mechanism for domestic projects. In Europe, Article 24a of the Emission Trading Directive (2009/29/EC) foresees domestic offset projects after 2012, in case JI does not continue. In the US, many legislative proposals for a national cap-and-trade system include a domestic offset component. While urban projects are not mentioned explicitly, some proposals suggest that they would be eligible for domestic offset markets, e.g. through methane capture from landfills (Kerry-Lieberman, 2010). If a compatible accounting system between local and national inventories were in place to avoid double-counting, this could be an interesting option for city authorities to generate such domestic offsets and revenue streams to finance mitigation actions.

Another way to develop low carbon solutions is to use a cap-and-trade approach, which is not a project-basis but rather a more global approach to accelerating the pace of urban emission reductions.

[23] See the JI PoAs guidelines on http://ji.unfccc.int/Sup_Committee/Meetings/014/Reports/Report.pdf

Tokyo is the first city to have adopted a stand-alone GHG cap-and-trade program (see Box 4).[24] While this is one option to scale up emission reductions within a city, it may have limited options beyond a one-off scheme. City trading schemes could potentially be linked with other city or regional schemes, but this again would require consistent accounting methods to avoid double-counting of emission reductions and to accurately assess mitigation opportunities in designing such an emissions trading scheme. Further research is needed to evaluate the potential of this mechanism worldwide, and their key conditions of success.

Box 4. Tokyo Emission Trading System

Tokyo, the world's largest city, is responsible for administering a jurisdiction of 12 million inhabitants. Many of the city's mitigation measures were designed to meet self-imposed emissions targets (World Bank, 2009b). The Tokyo Metropolitan Government has proposed to the Japanese Ministry of Environment and Ministry of Economy Trade and Industry that a Japanese national emission trading system should target only very large facilities, while cities should be responsible for targeting smaller facilities (World Bank 2010c)

In 2007, the city of Tokyo has taken the lead in regulating municipal emissions by introducing the first mandatory cap and trade system in Japan as part of its climate change strategy (City of Tokyo 2008). Starting in 2010, the Tokyo cap and trade system is targeting 1255 private organisations from the industrial and commercial sectors. Office buildings, factories, department stores, hospitals and hotels are covered by the Tokyo ETS. This is the first ETS in the world to have such a territorial approach (Tokyo Metropolitan Government, 2007). The ETS cap will be established according to Tokyo's own emission reduction target, a 25% reduction by 2020 from the 2000 level (Tokyo Metropolitan Government, 2007). Tokyo ETS was approved by business groups, companies, NGOs and Tokyo's Chamber of Commerce and Industry during a vast public consultation (City of Tokyo, 2008). Monitoring and reporting will be done on an annual basis. However, as it was set up only in April 2010, data are not yet available to analyse it.

Source: OECD (2010 forthcoming)

National governments could play an essential role to make necessary carbon market reforms happen. With respect to methodology development for programmatic CDM, national governments or international donors could work in tandem with urban authorities to provide financial and technical support for the development of relevant urban methodologies. Regarding streamlining of project development and verification rules, national governments, through the UNFCCC, have influence on the decisions taken by the Executive Board of the CDM and they could make sure that attention is given to the specific challenges of urban projects.

At the local scale, national governments could also play a key role in diffusing information and knowledge about carbon finance, and providing useful "capacity building". They can also encourage pilot projects and organise the diffusion of expertise about carbon finance projects.

For all of these options, a fundamental step that could assist city governments to work more effectively with national governments to realise mitigation synergies at large scale would be the development and use of harmonised GHG inventory or emission accounting methods (Corfee-Morlot *et al*, 2009; Kennedy *et al*, 2010; World Bank, 2010b) at the local scale. Advancing such methods may require financial, technological and capacity support and would need national government approval, ideally in an international process to promote harmonisation. City-scale inventories that are consistent with national inventories could facilitate accounting across levels of government. This would help to avoid double counting of emissions from cities vis-a-vis other entities that may be covered in other carbon market activities (e.g. the power sector or industrial entities that are already under the EU ETS) and in this way facilitate estimation of urban baselines and the "additional" reduction that urban mitigation projects and programmes might offer. Importantly, verification and approval of CDM urban projects could be

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24 Other cities have experience with cap-and-trade schemes for local pollutants (e.g. Chicago, Los Angeles, and Santiago).

accelerated if GHG accounting tools for urban scale emissions were standardised and harmonised with IPCC national inventory guidelines. Further, as city inventories become more refined and comparable, cooperation between cities on climate change activities can improve (D'Avignon *et al*, 2010). While some steps have been taken to move in this direction, an internationally agreed framework and methodology for city inventories does not yet exist (Dhakal and Shrestha, 2010; OECD 2010 forthcoming).

Over time, the goal is to mainstream urban low carbon investments. A key to long-term sustainability will be to render investments in urban low-carbon development self-sufficient, profitable and competitive with other higher carbon options over time. In this context, carbon offset markets must be seen as a transitional instrument for cities – one that accelerates and brings forward in time investment in low carbon urban infrastructure and programmes to make this happen. Once profitable on their own, urban investments should become part of the mainstream core of development activity, in other words part of the business as usual baseline.

To conclude, in future, national or regional governments may want to position to be a more pro-active partner to support access of urban authorities and relevant urban scale programmes and projects to the carbon market. This might occur by supporting reform of project mechanisms to give more access to urban mitigation activities and/or through the development of key programmatic methodologies that cover essential urban sectors (e.g. transport, waste, built infrastructure). An essential stepping stone could be for national governments to provide tools that will facilitate consistent GHG accounting across spatial scales as well as to support efforts to build capacity at local scale to identify mitigation opportunities and to better access carbon market finance for these opportunities.

GLOSSARY OF ACRONYMS

AAU	Allowance Amount Unit
BRT	Bus Rapid Transit
CDM	Clean Development Mechanism
CDM EB	Clean Development Mechanism Executive Board
CER	Certified Emission Reduction
CFL	Compact Fluorescent Light Bulb
DFP	Designed Focal Point
DNA	Designated National Authority
DOE	Designated Operating Entity
ERPA	Emissions Reduction Purchase Agreement
ERU	Emission Reduction Unit
EU ETS	European Union Emission Trading Scheme
GHG	Greenhouse gas
ITL	International Transaction Log
JI	Joint Implementation
JISC	Joint Implementation Supervisory Committee
LFG	Landfill Gas
MRV	Measurable, Reportable and Verifiable
MoU	Memorandum of Understanding
PoA	Programme of Activities
PDD	Project Designed Document
PPP	Public Private Partnership
UNFCCC	United Nations Framework Convention on Climate Change

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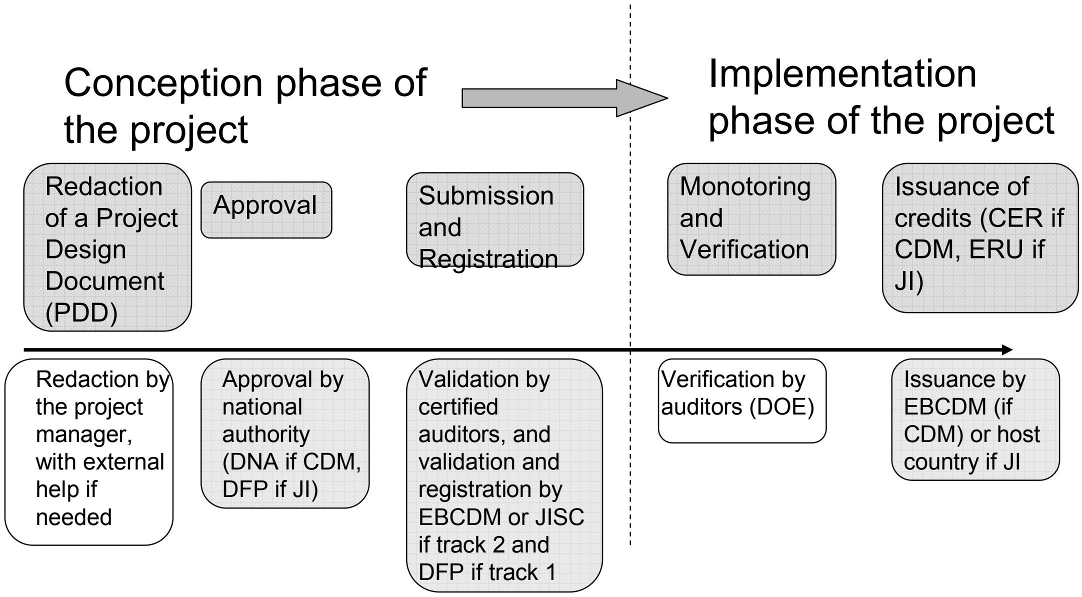
ANNEX 1. DETAILS ON CDM AND JI MARKET MECHANISMS

Figure 22 briefly explains the whole administrative process for CDM and JI projects.

Figure 22. CDM or JI administrative process



CER : Certified Emission Reduction
DNA : Designed national authority
DFP : Designed focal point
DOE : Designed Operational Entity
EBCDM : Excecutive Board of CDM
ERU : Emission Reduction Units
JICS : JI Supervision Commitee

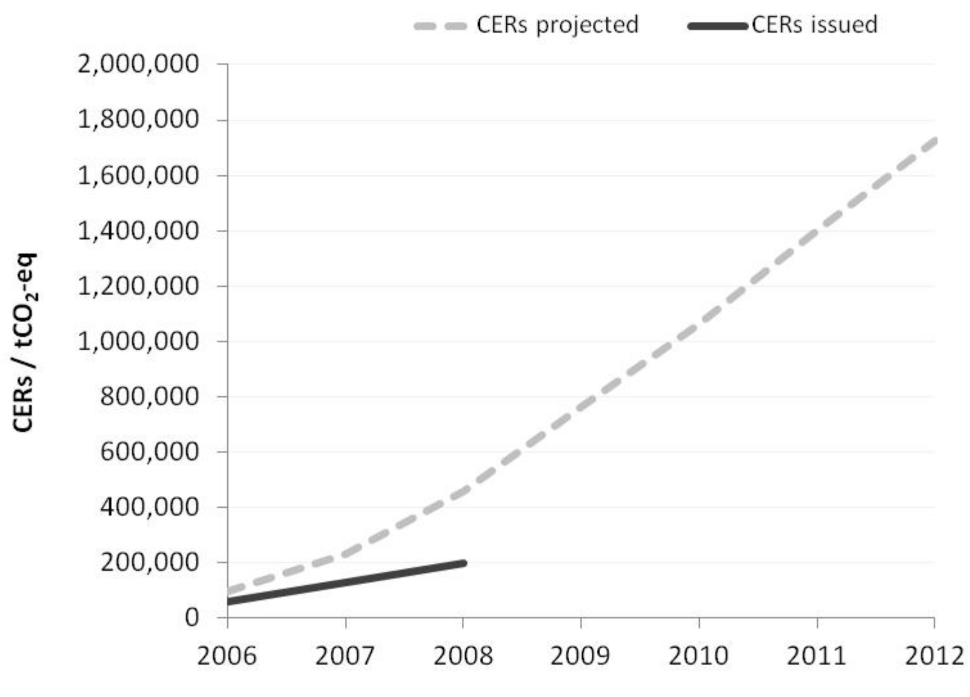
Source: UNFCCC

ANNEX 2. AMOUNT OF CARBON CREDITS PROJECTED VS. ISSUED

For CDM and JI cases where CERs or ERUs have been issued and data was available, the comparison of projected versus actual credits issued can be made.[25] In these, projected amounts were significantly higher than issued amounts (with the exception of Christchurch), reflecting a variety of risks, including project delays and technical difficulties.

For Transmilenio in Bogota, the actual amount of CERs received has been 30-60% less than the amount projected in each year (Figure 23). This is largely due to a lower than expected ridership, potentially due to a combination of optimistic projections, lower-than-expected shifts in transportation mode, and construction and operational difficulties. The actual ridership in 2006 was 94 million people, versus a projected 147 million (Millard-Ball, 2008).

Figure 23. Comparison of cumulative CERs projected and issued for Transmilenio CDM project

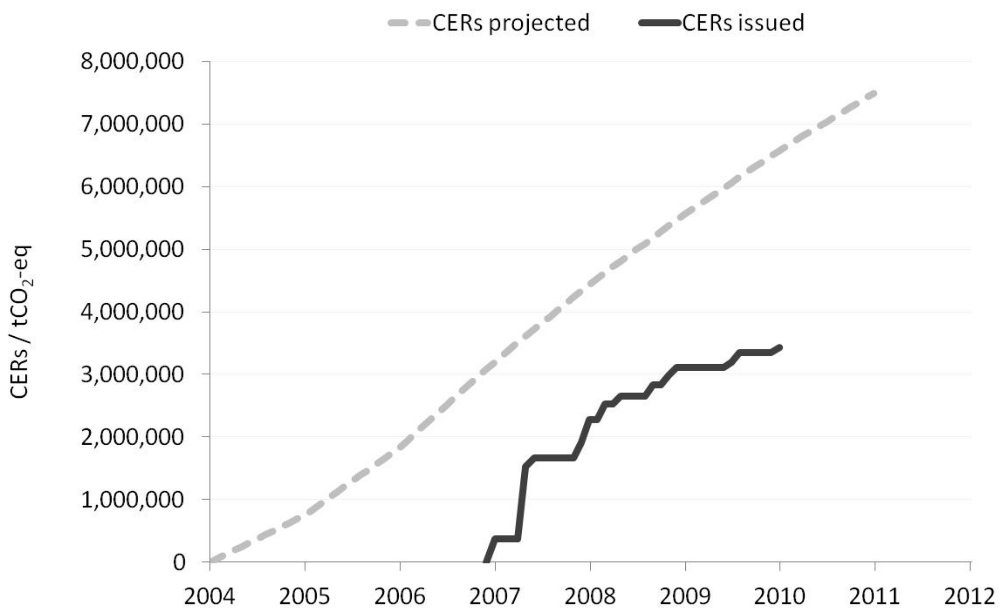


Source: UNFCCC, 2006a; UNFCCC, 2010a

Likewise, the cumulative amount of CERs issued to date for the Bandeirantes landfill site in São Paolo have been significantly less than the amount projected (Figure 24). The cumulative CERs issued are approximately 50% of those projected.

[25] Cases not present here have either not yet been issued CERs, or the project is in an early phase or no data was yet available.

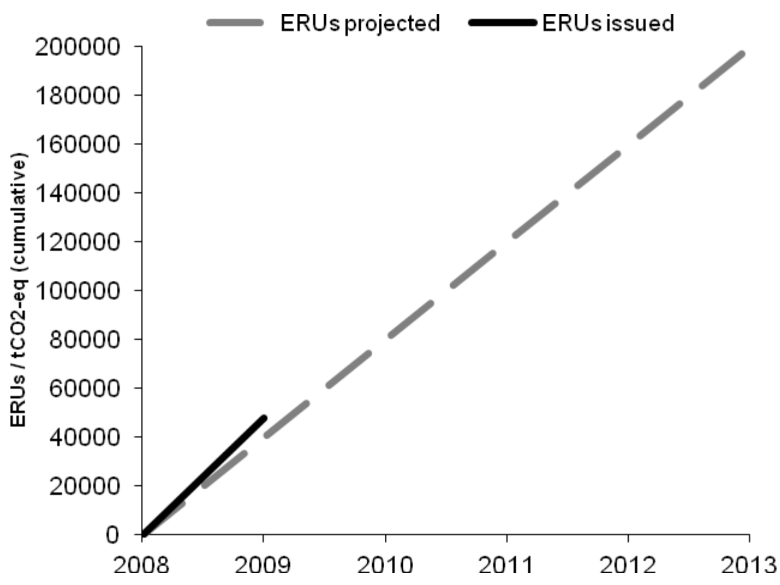
Figure 24. Comparison of cumulative CERs projected and issued for Bandeirantes Landfill-gas-to-energy CDM project



Source: UNFCCC, 2005; UNFCCC, 2010b

In contrast, the Christchurch JI project has actually been issued slightly more ERUs that projected, as shown in Figure 25.

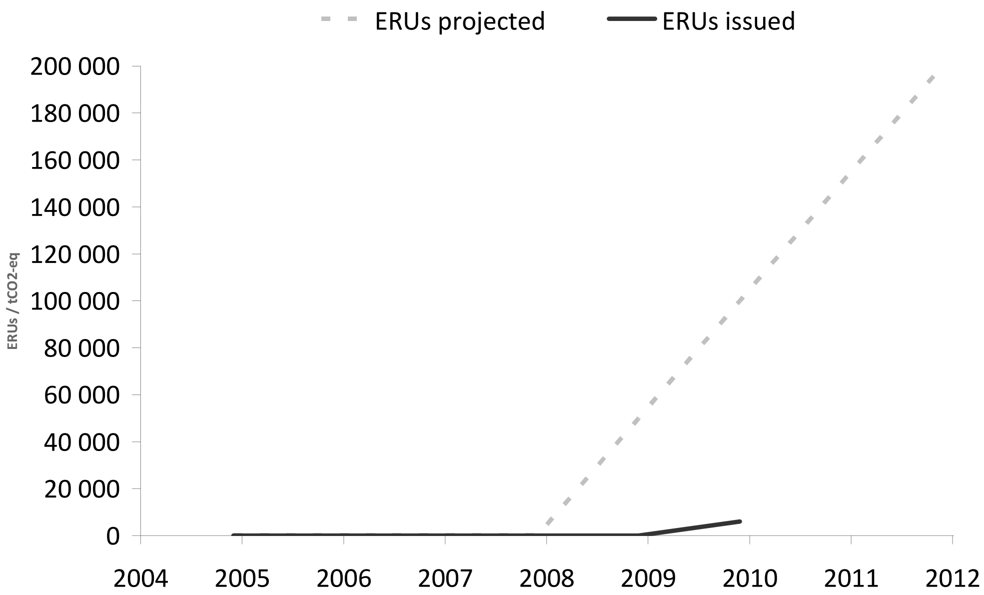
Figure 25. Comparison of cumulative ERUs projected and issued for Christchurch JI project



Source: UNEP Risoe (01/08/2010)

Figure 26 shows the amount of issued ERUs for the North Rhine Westphalia JI project was far less than expected (only 10%), as the number of boilers and heat production were less than initially expected. This illustrates one of the risks of a programmatic approach.

Figure 26. Comparison of cumulative ERUs projected and issued for North Rhine Westphalia JI Program of activities



Source: M Muller (2010)