Appendix 4

Metrics for accounting for multiple benefits of building energy efficiency

(GBPN Briefing Note)

Prepared for: C40 – PBSEEN¹ and Green Growth Networks By: Dr. Peter Graham, Niamh McDonald & Jens Laustsen – GBPN Global Centre, Paris 10th June 2014

PBSEEN asked GBPN to prepare this brief on metrics and methodologies for accounting for the multiple benefits of building energy efficiency programs, with a focus on those most relevant to cities in the PBSEEN network. A brief summary of multiple benefits issues and associated indicators was prepared for discussion and prioritization by cities in January 2014. The full summary is included in annex 1. The outcomes of calls with cities led to the following issues being prioritized for further work:

- Job Creation
- Economic Competitiveness
- Poverty Alleviation
- Climate Change Mitigation
- Health & Well-being

At the request of C40, GBPN has further identified indicators that have been and can be used to assess these issues and what the data requirements are. Where possible we have provided examples of relevant data sources and work being done by cities to calculate co-benefits of building energy efficiency programs.

The following table presents an overview of some contemporary approaches to assessing the five key issues above. It can serve as a basis for discussion between cities on developing a basic framework for calculating co-benefits of building energy efficiency programs in cities. This summary will be presented during the upcoming PBSEEN workshop in Tokyo on 19th June.

¹ The C40 Private Building Efficiency Network was known as the Private Sector Buildings Energy Efficiency Network (PSBEEN) until July 2014.

From this session we would like to discuss whether cities are interested in moving forward to develop a more detailed project to produce a roadmap for calculating the multiple benefits of building energy efficiency efforts in C40 cities.

The key take-away from this brief review is that despite this being a relatively new field, enough work has been done already to support developing common platform of metrics and methodologies for assessing co-benefits of energy efficiency programs in cities. There are however, challenges including data quality and availability, the effectiveness of policy design and implementation, and factoring in rebound-effects. Such a platform could be developed as follows:

Phase One: Methodology Development

Development of draft methodology to assess multiple-benefits based on the small number of key issues/indicators prioritized by Cities in the network.

Phase Two: Pilot of the Methodology with one or small number of leading cities

Based on the outcomes of phase one, engage with key cities to apply the draft methodology to assess the five key multiple-benefits from building energy efficiency programs.

Phase Three: Complete the Common Framework

Using expert and stake-holder groups involved in the pilots, per review the results and refine the final framework. Then document and implement the tool and write the first report.

	Table. Priority	benefits and	associated	indicators
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Benefit	Indicators	Metric	Data/Method	Examples
Job Creation	Direct improvement in employment rates through job creation Indirect improvement in employment rates as a result of increased spending. Induced employment as a result of new workers spending earnings.	Jobs/\$ invested Jobs/energy saved	Input-output data US: IMPLANv3 EU: Euro-Stat Current studies on employment from EE (several of these) (Direct employment + Indirect employment x induced employment multiplier) – jobs lost in energy sector = Net Jobs	EU: Net impact of about 17 to 19 jobs created for every million Euros spent on energy efficiency interventions (BPIE, 2011). US: Rating & disclosure policies could create 59,000 net new jobs by 2030 (IMT, 2011)
Health and Well-being	Improved physical health (IEQ) - Change in rates respiratory illnesses such as asthma & pulmonary infections.	Public health savings/\$ invested Change in QUALYs/ measure installed Value of health saving/measure installed (\$- NPV)	Benefit/Cost Analysis Cost of implementation: Savings in public health spending Use of epidemiological evidence to capture the relationship between a change in exposure to cold/internal pollutants and certain negative health outcomes paired with a 'life table' model to estimate patterns of survival in the population (UK Dept of Energy & Climate Change, 2013).	Euro 25-67Bn/pa indirect cost-benefit for cost-effective renovation of heating & insulation (Næss-Schmidt et al. 2012) Quality adjusted life years (QUALY) saved per measure installed: Cavity wall insulation – 0.049, Solid wall insulation – 0.036, Replacement boiler – 0.009 (UK Dept of Energy & Climate Change, 2013) Value of health saving per measure installed (£-NPV): Cavity wall insulation: £969, Solid wall insulation: £969, Solid wall insulation - £742, Replacement boiler – £303. (UK Dept of Energy & Climate Change, 2013)

Benefit	Indicators	Metric	Data/Method	Examples
Health and Well-being (Continued)	Reduced local air pollution	Public health savings/\$ invested Change in QUALYs/ measure installed or action taken	 Benefit/Cost Analysis Input mix of energy production Pollution emissions from different inputs Health value of reduced pollution Health benefit value per ton of emissions (Benefit/ton or BPT) 	Euro 1.9-2.86bn by 2020 from reduced electricity production (Næss-Schmidt et al. 2012) Average monetized benefit of a marginal change in pollutant or pollutant precursor emissions and consequent health impacts (U.S. EPA, 2011) Shanghai: BAU of economic growth compared with three alternative scenarios: energy efficiency improvements (average 2% annual improvement across all energy end use sectors), switching coal and oil for gas use for final sectors and wind electricity generation. (Chen et al., 2007)
	Fewer work/school days lost to illness	No. sick days/occupant/year Perceived Productivity	Survey Building stock area Building occupancy rates Base-line & time-series occupant surveys IEQ Monitoring 	CH2 Melbourne: Excellent IEQ improved perceived productivity by 10% above base-line (Paevere & Brown, 2008).

Table. Priority benefits and associated indicators (Continued)

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Benefit	Indicators	Metric	Data/Method	Examples
Economic Competitiveness (Green Growth)	Green GDP growth Increased competitiveness Energy Savings	 Green GDP Genuine Progress Indicator Energy Intensity/Capita Net positive impact on public budgets 	GG rate: overall GDP GDP - cost of pollution \$net income/kWh/yr Gross Value Add (GVA) of new employment Decrease in unemployment benefits/increase in tax- base resulting from net job creation (fiscal multipliers) Direct energy savings from publicly owned buildings	Danish National bank paper on improved efficiency and increase in oil price = savings equals to 2.5 euro competition benefit per hour of work
Poverty Alleviation	Reduction in energy poverty Decreased energy cost to households Increased access to sustainable energy services	Change in population below the fuel poverty line. \$Energy cost: Household income Solar PV/HW installed as % of total energy supply \$/kW green power purchased/yr as % total energy demand Access to smart-grids	Survey/Statistical Analysis Utility & population data Input-Output data Total Building-stock/by building type Residential occupancy/type	The investment of £4.6bn results in the application of measures to 2.5 million (all fuel poor) households, eliminating fuel poverty in 71% of households and alleviating it significantly in the remaining 29%. The GVA or economic benefit of this activity to UK plc stands at £1.2bn. (Centre for Sustainable Energy, 2008)

Table. Priorit	y benefits and associated indicators (Continued)	
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Benefit	Indicators	Metric	Data/Method	Examples
Climate Change Mitigation	Reduced annual building energy and GHG intensity Reduced total annual building energy demand/emissions	kWh/floor area/yr kWh/per capita/yr kWh/occupant/yr (residential) $C0_2^{-e}$ /floor area/yr $C0_2^{-e}$ /per capita/yr $C0_2^{-e}$ /occupant/yr (residential) GJ/yr/building type $C0_2^{-e}$ /yr/building type	Top-Down: IEA & National Data-Sets Bottom-Up: Post-Occupancy/rating & disclosure building data Utilities Data Common-Carbon Metric GHG Protocol ULI-Greenprint Reports ICLEI/C40 - Tools	Energy efficiency measures can contribute 44% of the carbon abatement needed by 2035 to reach international climate change targets (IEA, 2013) Chicago – report emissions savings in # of automobile [and home] equivalents.

Appendix 4-A:

Briefing Note - Multiple Benefits of Building Energy Efficiency

Prepared for: C40 – PBSEEN and Green Growth Networks By: Niamh McDonald & Jens Laustsen – GBPN Global Centre, Paris. 17th January 2014

There are many benefits in energy efficiency and particular of energy efficiency in buildings. For most actors the direct economic benefits of energy savings might be of lower priority than many other benefits. A number of recent studies have identified a variety of benefits that building energy efficiency programs offer. These range from energy security and job creation, to health and well-being. We therefore use the term in Multiple Benefits rather than Co-Benefits in this briefing, which outlines some key indicators that may be relevant to C40 network members. The following is drawn from recent work in this field, in which GBPN has been involved.



Diagram of Multiple Benefits

Source: The multiple benefits of energy efficiency (IEA Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements)

Table of benefits and associated indicators

Job Creation	Improvement in employment rates through job creation	National /
	Indirect improvement in employment rates as a result of	Local (City
	surplus consumer spending.	Level)
	• Net impact of about 17 to 19 jobs created	
	for every million Euros spent on energy efficiency	
	interventions (BPIE, 2011).	
Energy Security	Less dependency on imported fuels	National
	• Fewer issues relating to availability and accessibility of	
	energy	
	Reduced vulnerability to price increases	
Health and Social	Personal benefits	Individual/
	Improved physical health, including alleviation of chronic	Community
	and acute respiratory disease, cardiovascular disease,	
	allergies, arthritis and rheumatism – due to improved	
	indoor and outdoor air quality and reduction of aggravating	
	factors such as damp, mould and drafts	
	Reduced risk of accidents and injuries, particularly	
	among the elderly	
	Improved mental health, primarily linked to the	
	reduction of stress arising from improved energy	
	affordability	
	Reduction in excess morbidity and excess winter deaths	
	Better educational attainment associated with improved	
	internal dwelling temperatures and reduced forced mobility	
	(need to move house for reasons of affordability), stemming	
	from a more secure home environment	
	Impacts on personal assessment of status within the	
	broader community	

	Community/societal benefits	Individual/
	Reduced local air pollution from transport emissions	Community
	Fewer work/school days lost to illness	
	Improved visual amenity (linked to dwelling	
	improvements) and community spirit	
	Reduced crime rates	
	(Summary of IEA Multiples Benefits workshop on Health & Well-being	
	attended & contributed to by GBPN)	
Macro Impacts	• GDP growth,	National
	Job creation	
	Trade flows	
	Price effects	
	Welfare effects	
	Increased national competitiveness	
	(Summary of IEA Multiples Benefits workshop on Health & Well-being	
	attended & contributed to by GBPN)	
Reduced costs to	Lower expenditure on fuel	National
the exchequer	Reduction in fuel subsidies	
	Reduced expenditure on health	
Poverty Alleviation	Reduction in energy poverty and issues relating to	National / City
	energy access	Level
	 Increased disposable income due to less money spent on fuel. 	
Climate Change	Energy efficiency measures can contribute 44% of the	International
Mitigation	carbon abatement needed by 2035 to reach international	
	climate change targets (IEA, 2013)	
	Energy efficiency a cost efficient way to deal with GHG	
	reductions.	

- Direct and indirect savings can accrue from energy efficiency measures.
- Savings on health and well-being could in some cases the same or higher than the direct savings in energy costs
- The benefits of energy efficiency can be either public or private and nature.



Figure 1. Effects of energy efficient renovation of buildings in Europe.

Source: Copenhagen Economics.





Reference List

Building Performance Institute Europe. 2011. *Europe's Buildings Under the Microscope*. BPIE, Brussels. www.bpie.eu/eu_buildings_under_microscope.html

Burr, Majersik, Sellberg, Garrett-Peltier (IMT). 2011. *Analysis of Job Creation and Energy Cost Savings from Building Energy Rating & Disclosure Policy*. Institute for Market Transformation & Political Economy Research Unit, University of Massachusetts, March

Centre for Sustainable Energy. 2008. *How Much? The Cost of Alleviating Fuel Poverty.* http://www.cse.org.uk/downloads/file/how_much.pdf

Chen, C., B. Chen, B. Wang, C. Huang, J. Zhao, Y. Dai, and H. Kan. 2007. *Low-carbon energy policy and ambient air pollution in Shanghai, China: a health based economic assessment.* Science of the Total Environment 373(1): 13-31.

Department of Energy & Climate Change. 2013. Fuel Poverty a Framework for Future Action. https://www.gov.uk/government/uploads/system/uploads/attachment_data/ file/211180/FuelPovFramework.pdf

Paevere & Brown. 2008. Indoor Environment Quality and Occupant Productivity in the CH2 Building: Post-Occupancy Summary. Report No. USP2007/23, CSIRO, March

Næss-Schmidt, Hansen, Utfall Danielsson (Copenhagen Economics). 2013. Benefits of investing in energy efficiency renovations. Commissioned by Renovate Europe. http://www.renovate- europe.eu/uploads/Multiple%20benefits%20of%20EE%20 renovations%20in%20buildings%20-%20Appendix%20only.pdf

Ryan, L., Campbell, N. (IEA). 2013. *Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements.* International Energy Agency. Insights Series.

USEPA. 2011. Assessing the Multiple Benefits of Clean Energy: a resources for states. EPA-430-R-11-014, Washington, D.C.: U.S. EPA.