

*A Pilot International Survey on  
Expert Views of Effective Actions to  
Reduce Climate Change Impacts in  
the Built Environment Sector*

International Initiative for a Sustainable Built Environment

22 November 2015



## A. Survey intent, design and example of response

The attached survey form and related documents are the result of a month of active e-mail discussions.

The purpose has been to solicit views from our key members and contacts on the possible measures that could be implemented in their regions to reduce the impact of the built environment on climate change. Obviously this is a complex issue and we do not expect to identify quick or easy solutions, but we do think that it will be very useful to obtain ideas from our members who have a clear understanding of the situation and of possible measures that would be appropriate for their regions.

This survey has been undertaken as part of iiSBE's activities in support of Buildings Day at COP21, which will take place on 03 December. We are also likely to have opportunities next year to present and discuss the results at SBE16 conferences during 2016.

Major contributions were made in the development of this survey by several iiSBE members, including Hal Levin, Jean Cinq-Mars, Mark Gorgolewski, Rosamund Hyde, Ronald Rovers, Wynn Cam and others.


The survey instrument was developed in an Excel file, with drop-down click boxes to allow users to select responses from a menu of items. Each file allowed respondents to complete up to 3 records.

The survey was distributed to a sample of about 400 researchers and professionals during October and November 2015, and over 50 responses were received from North America, Latin America, Europe and Asia, most containing 2 or 3 completed records. 120 records were included in this pilot study.

The PDF below shows a random sample of a response to the survey. More detail on findings and independent and dependent variables are shown in the pages immediately following.

For more information or a copy of the Input File, contact <info@iisbe.org>.

### iiSBE COP21 Input Form



<p>Names and e-mails are withheld</p>	<p>Your name <input type="text" value="abc"/></p> <p>Your e-mail <input type="text" value="xyz"/></p> <p>Company or organization name <input type="text" value="University of southern region"/></p>	<p>This form is intended to record your views on up to 3 actions that you believe should be taken to reduce climate change impacts, and your assessment of their effectiveness. Enter text in yellow fields and click on blue boxes to select appropriate values.</p> <p>Your profession / activity <input type="text" value="Educator / Academic"/></p>
	11-Oct-15	
	<b>Proposal for Actions to reduce Climate Change impacts in developed countries</b>	
	Action	
	<input type="text" value="Implementation of property taxes that incentivize efficient urban development"/>	
	Potential effectiveness	Applicable country location(s)
	<input type="text" value="Positive impacts have been documented in many real-world applications"/>	<input type="text" value="4"/> <input type="text" value="This choice is related to developing countries"/>
	Relevant key actor types	Applicable urban type(s)
	<input type="text" value="Municipal government"/>	<input type="text" value="All types"/>
	Comments (or enter an alternative Action not on the list)	
<p>Most comments are shown in Section D.</p>	<input type="text" value="In general developers, owners and the public in general are more inclined to change when costs and or incentives are involved."/>	

## B. Mitigation actions identified in survey, sorted by type of Action

Action	Count	Avg. score	count x score
Economic Instrument			
Support for public procurement of low-carbon sources of energy	6	3.8	23.0
Implementation of carbon cap-and-trade schemes.	8	2.8	22.0
Implementation of carbon taxes with sliding scale based on emissions and redistribution scheme to end users	6	3.0	18.0
Implementation of property taxes that incentivize efficient urban development	6	2.3	14.0
Implementation of carbon taxes with sliding scale based on emissions	3	4.3	13.0
Support for local procurement of energy and materials.	2	2.0	4.0
Technical Development			
Implementation of energy and emission retrofits in public, commercial and residential buildings	8	3.9	31.0
Support for energy performance contracting including target values for emissions	3	4.3	13.0
Adoption of green roofs and other measures to reduce heat island effect	4	2.3	9.0
Development of local public transportation systems in small urban areas	2	3.5	7.0
Support for urban and/or rooftop agriculture	1	3.0	3.0
Regulatory			
Adoption of building regulations that include energy, emissions and water performance requirements.	17	3.9	66.0
Limitation of fuels and energy from high-carbon sources	9	3.6	32.0
Small urban area performance requirements for energy, emissions, water, local renewables etc.	7	2.4	17.0
Establishment of solar rights in zoning regulations.	3	2.0	6.0
Methods and tools			
Establishment of public multi-variable performance datasets including data on embodied energy and operational energy and emissions.	6	3.2	19.0
Implementation of building performance multi-variable rating systems adapted to location.	4	3.8	15.0
Support for Environmental Product Declarations (EPD) for materials.	2	3.0	6.0
Adoption of Integrated Design Process (IDP) guidelines, adapted to location and building types	3	2.3	7.0
Education / information / training			
Support for training programs focused on built environment sustainability issues for designers, builders and real estate professionals.	6	4.0	24.0
Support for high-performance demonstrations and pilot projects.	5	4.4	22.0
Support for performance education programs for occupants and users of various building types.	4	3.5	14.0
Implementation of whole-building high performance design guidelines adapted to location.	2	4.5	9.0
Support for education programs focused on built environment sustainability issues, in secondary schools and university undergraduate programs.	3	2.0	6.0
<i>Respondents were provided with a list of 24 possible actions and were asked to select up to 3 of them and to score them on a scale of effectiveness, from 1 to 5.</i>	Total	120	
	Average		3.2
			16.7

### C. Mitigation actions sorted by count x average score

Action	Count	Avg. score	count x score
Adoption of building regulations that include energy, emissions and water performance requirements.	17	3.9	66.0
Limitation of fuels and energy from high-carbon sources	9	3.6	32.0
Implementation of energy and emission retrofits in public, commercial and residential buildings	8	3.9	31.0
Support for training programs focused on built environment sustainability issues for designers, builders and real estate professionals.	6	4.0	24.0
Support for public procurement of low-carbon sources of energy	6	3.8	23.0
Implementation of carbon cap-and-trade schemes.	8	2.8	22.0
Support for high-performance demonstrations and pilot projects	5	4.4	22.0
Establishment of public multi-variable performance datasets including data on embodied energy and operational energy and emissions.	6	3.2	19.0
Implementation of carbon taxes with sliding scale based on emissions and redistribution scheme to end users	6	3.0	18.0
Small urban area performance requirements for energy, emissions, water, local renewables etc.	7	2.4	17.0
Implementation of building performance multi-variable rating systems adapted to location.	4	3.8	15.0
Implementation of property taxes that incentivize efficient urban development	6	2.3	14.0
Support for performance education programs for occupants and users of various building types.	4	3.5	14.0
Implementation of carbon taxes with sliding scale based on emissions.	3	4.3	13.0
Support for energy performance contracting including target values for emissions	3	4.3	13.0
Adoption of green roofs and other measures to reduce heat island effect	4	2.3	9.0
Implementation of whole-building high performance design guidelines adapted to location.	2	4.5	9.0
Adoption of Integrated Design Process (IDP) guidelines, adapted to location and building types	3	2.3	7.0
Development of local public transportation systems in small urban areas	2	3.5	7.0
Establishment of solar rights in zoning regulations.	3	2.0	6.0
Support for education programs focused on built environment sustainability issues, in secondary schools and university undergraduate programs.	3	2.0	6.0
Support for Environmental Product Declarations (EPD) for materials.	2	3.0	6.0
Support for local procurement of energy and materials.	2	2.0	4.0
Support for urban and/or rooftop agriculture	1	3.0	3.0
Respondents were provided with a list of 24 possible actions and were asked to select up to 3 of them and to score them on a scale of effectiveness, from 1 to 5.	Total	120	
	Average		3.2
			16.7

## **D. Selectable action alternatives for the survey file**

The following options for Action and Effectiveness responses were included in the click-down fields.

1. Implementation of carbon cap-and-trade schemes.
2. Implementation of carbon taxes with sliding scale based on emissions
3. Implementation of carbon taxes with sliding scale based on emissions and redistribution scheme to end users
4. Implementation of property taxes that incentivize efficient urban development
5. Limitation of fuels and energy from high-carbon sources
6. Support for public procurement of low-carbon sources of energy
7. Support for urban and/or rooftop agriculture
8. Establishment of solar rights in zoning regulations.
9. Support for local procurement of energy and materials.
10. Establishment of solar rights in zoning regulations.
11. Development of local public transportation systems in small urban areas
12. Small urban area performance requirements for energy, emissions, water, local renewables etc.
13. Implementation of energy and emission retrofits in public, commercial and residential buildings
14. Adoption of green roofs and other measures to reduce heat island effect
15. Support for energy performance contracting including target values for emissions
16. Adoption of building regulations that include energy, emissions and water performance requirements.
17. Support for Environmental Product Declarations (EPD) for materials.
18. Implementation of building performance multi-variable rating systems adapted to location.
19. Implementation of whole-building high performance design guidelines adapted to location.
20. Adoption of Integrated Design Process (IDP) guidelines, adapted to location and building types
21. Establishment of public multi-variable performance datasets including data on embodied energy and operational energy and emissions.
22. Support for performance education programs for occupants and users of various building types.
23. Support for education programs focused on built environment sustainability issues, in secondary schools and university undergraduate programs.
24. Support for training programs focused on built environment sustainability issues for designers, builders and real estate professionals.
25. Support for high-performance demonstrations and pilot projects.

Scale for potential effectiveness

1. Evidence of positive impact is limited, but this is a potentially useful action
2. Modeling predicts significant potential positive impacts
3. Positive impacts have been documented in some real-world applications
4. Positive impacts have been documented in many real-world applications
5. Major positive impacts and cost-effectiveness has been documented in many real-world applications

## E. Comments made by respondents related to selected actions

### Implementation of carbon cap-and-trade schemes.

- The EU has successfully reduced GHG emissions from large industrial emitters.
- International legislation is missing key actor - with realistic pricing of CO2 eq emissions and clear targets, ...companies will show more enthusiasm for developing low-emissions solutions.
- The Cap and Trade scheme, coupled with regulation, can be used to generate funds that would ease the costs required to meet the regulations.
- Under the condition that it (the cap) is lowered over time each year
- We absolutely need a significant financial lever to address carbon emissions in capitalist societies. Cap-and-trade programs represent the most promising to date.
- Cap and trade may be most effective with investment in lesser-developed countries with potential higher emissions.

### Implementation of carbon taxes with sliding scale based on emissions.

- Try Citizens Climate lobby "Fee and Dividend" Policy - essential components carbon priced as enters economy with NO EXCEPTIONS - Dividend Pool shared per capita, "Border Adjustment" tariffs imposed on imports from countries with no/lower carbon prices (This forces the exporting country to adopt the same carbon price as the importing country, the importing country has a strong incentive to set high carbon prices (not cheated low as in Cap and Trade) and creates the de-facto carbon market.
- Carbon credit systems ... don't really work and are used to allow government finance of major hydroelectric dams, ( which then support aluminum production in Canada and Brazil for example) which... is a terrible idea. Of course that might be just a very local concern because of where I live (B.C., Canada), but that, I believe, is the real reason they were so quickly adopted here. People will always find a way to game the system, so if what we actually want is low carbon fuel at the outlet, then let's just start banning some fuels altogether, and controlling the use of the allowed fuels to highest and best use, through legislation.
- Applies to all decision makers from governments through investors and developers to end users. Easy to manage. Allows freedom of choice on how to achieve objectives. Allows market to work and achieve sustainable development goals.

### Implementation of carbon taxes with sliding scale based on emissions and redistribution scheme to end users.

- Try Citizens Climate lobby "Fee and Dividend" Policy - essential components carbon priced as enters economy with NO EXCEPTIONS - Dividend Pool shared per capita, "Border Adjustment" tariffs imposed on imports from countries with no/lower carbon prices (This forces the exporting country to adopt the same carbon price as the importing country, the importing country has a strong incentive to set high carbon prices (not cheated low as in Cap and Trade) and creates the de-facto carbon market.
- Particularly effective in countries with low oil prices which would allow implementation without major opposition and restore more positive paybacks to efficiency and fuel switching projects.
- This is the most effective method to achieve significant results without excessive intervention.
- Regarding "implementation of carbon taxes with sliding scale based on emissions in redistribution scheme to end users" and "implementation of carbon cap-and-trade schemes", it would be great to include in your analysis the percentage of the respondents from developed and developing nations to see that if the respondents from developing nations give positive response to these actions, due to the potential benefits to developing nations from such actions trans-nationally.

## Adoption of building regulations that include energy, emissions and water performance requirements.

- We have to publish at least the average energy consumption, emission, water usage of 1 m<sup>2</sup> of different building types.
- By adopting stricter energy & water performance standards into building code, industry will have no choice but to adapt.
- This action item has the highest frequency and the above-average score of 3.8. If the majority of these respondents were from the government sector, the reason is self-explanatory. However, if the majority of the respondents are from the built-environment-related professionals or property developers, this finding would be disheartened due to the re-active (instead of proactive) attitude of the relevant stakeholders in the current practice.
- Through my work I am seeing a new urgency around water and the preservation of freshwater. There are three connected points here, the first is that our oceans are the source of half of our oxygen and need to be healthy to support a healthy atmosphere. The second point is that only 1% of all water on the planet is available freshwater, including all lakes and rivers and aquifers, while the rest is locked up in icecaps and oceans. What this means is that every time we deplete an aquifer, or watershed lake system, run it through our wastewater treatment and return it to a saline environment, we lose freshwater and upset the ocean balance to some extent. Finally the third and connected thought is that as we pave and build our new coastal cities, so that 80% of us can live there by 2030, we eliminate the biomass that holds the surface freshwater and supports the rain cycles, and move toward desertification through drought.
- France has one of the most aggressive new building EE targets around, at 50kw/m<sup>2</sup>/year. When I met with French government officials several years ago, I asked them how they would enforce the target, and they replied that the insurance industry would. I have not had the opportunity to follow up, but if insurers were to do spot checks on building designs before financing was complete, that would likely be more effective than the overworked, under trained local inspectors. Further, if the insurance did not have to payout on a claim where the building could be proven to not comply with the target, there would be a strong lever to ensure persistent performance. Two colleagues and I bid on a City of Toronto RFP where I proposed to look into the French system, but we lost the bid and the work has not been done.
- Should extend beyond energy and GHGs to cover other atmospheric emissions, water, soil and species, and health issues. Forces the uninformed and laggards to learn how to do the right thing vs. short term profits.
- No voluntary action will ever achieve what regulation can.

## Limitation of fuels and energy from high-carbon sources.

- For buildings, the level of required fuel cost increase to make the required capital investments have <5 year financial paybacks is in the order of 4x current rates. This is politically untenable... Note that Ontario Canada is moving towards a combination of Cap and Trade and regulation in order to meet its targets.
- Develop and disseminate info on battery-assisted solar PV systems for off-grid energy independence
- Decarbonization of electricity will become more important as climate heats up, transportation switches to electricity from gasoline.
- This action enjoys second highest frequency among the respondents and is with an above-average score of 3.8. This action can be seen as external factors beyond the design and development of buildings, and thus should not receive such a frequent attention and high score.
- All fuel should have source identified at purchase point

## Small urban area performance requirements for energy, emissions, water, local renewables etc.

- With this action, public awareness of the urgency of action to limit climate change as much as possible is raised, having a possible large spin-off in this field coping with occupant behavior.
- Real life examples: Supply of 100% renewable energy in Bo01 (ca 2000 residents); Climate Contract Hyllie (establishment of smart grid based on renewable energy; under construction with aim to house 10-15 000 in 2030), Malmö
- Requirements have to be mandatory, e.g by including the requirements in sales contracts for properties. --> Applicability is limited to municipal properties.
- Some discussions had conducted interesting predictions, which proposed the "De-centralized Urban system concepts integrated with double systems - eco-infrastructure system and emergently engineering based system"
- Preparedness and expertise at local level.
- No voluntary action will ever achieve what regulation can.

## Support for local procurement of energy and materials.

- Incentives for renewable sources of energy uses
- Response assumes that 'materials' also includes goods, resources and e.g. food, in order to reduce emissions from transport. EU procurement rules make procurement at local level currently difficult.

## Implementation of energy and emission retrofits in public, commercial and residential buildings.

- The existing building stock overwhelms new construction with respect to energy and emissions. However, this activity has marginal economic attractiveness in many cases in terms of return as well as financial resource constraints. A partnership between government, owners, and investors is required to overcome these barriers.
- Convincing building owners of the long-term investment is crucial. One of the main challenges is the non-functioning financial mechanisms as investments cannot necessarily be matched by increased rent.
- This action is most effective if the municipal government takes the lead in implementing demonstration projects with proven energy efficiency and emission reduction and/or lessons learnt; and follows by rolling out financial supports to incentivize existing building owners / tenants to implement energy and emission retrofits in their buildings. When the take up rate is good, the government can gradually reduce ... the financial incentive.
- Assuming that (Implementation of carbon cap-and-trade schemes) and (Support for training programs focused on built environment sustainability issues for designers, builders and real estate professionals) take place, this is the next most important, because of the necessity of avoiding emission associated with building demolition & new materials + concentrating development in urban areas (where most existing buildings are).

## Support for energy performance contracting including target values for emissions

- Financial support related to mandatory target values. e.g. significant solar energy feed-in tariff. Financial resources (would come) from carbon taxes.

## Adoption of green roofs and other measures to reduce heat island effect.

- Especially applicable to areas with warm summers.
- Adoption of storm water credit system simliar to carbon credit system



### Support for urban and/or rooftop agriculture

- Self-production and minimum food provision during emergency

### Development of local public transportation systems in small urban areas

- Encourage off site work i.e. at home or form de-centralized offices to reduce the need drive or move

### Establishment of solar rights in zoning regulations.

- Will work in combination with the other 2 (Carbon cap-and-trade schemes and building regulations).
- Must also be connected to increase in biomass and stormwater re-use to avoid drought effects

### Implementation of property taxes that incentivize efficient urban development.

- In general developers, owners and the public in general are more inclined to change when costs and or incentives are involved.
- Urban environments will be critical in achieving GHG reductions moving forward. High density populations allow for effective transportation planning, such as, public transportation, bike lanes and car sharing. High density cities / (multi-unit residential) accommodations are also more efficient than one-off homes and can utilize systems such as district energy to maximize energy performance.
- Review and adapt land use plans to encourage urban densification.

### Establishment of public multi-variable performance datasets including data on embodied energy and operational energy and emissions.

- Actors need basic data to react to carbon taxes and regulations. This allows actors without the specialized education and knowledge ... to be informed and make decisions themselves. This enables rapid implementation by having many actors sufficiently informed.

### Implementation of building performance multi-variable rating systems adapted to location.

- In Europe, all buildings are rated for energy performance, with each building certified with a rating A-E. This means building energy performance is an important consideration when buying or selling a property.
- Mandatory Labeling

### Implementation of whole-building high performance design guidelines adapted to location.

- Successful implementation of this proposed action would require the participation and support of many more actors beyond the above relevant key actors, including developer(s), occupants/users, investor(s), etc.

### Adoption of Integrated Design Process (IDP) guidelines, adapted to location and building types

- Such adoption can lead to a significant improvement of basic knowledge of all stakeholders

### Support for Environmental Product Declarations (EPD) for materials.

- After coping with energy related issues, material related issues will have to be covered, and EPD and similar tools are needed.

Support for training programs focused on built environment sustainability issues for designers, builders and real estate professionals.

- Professionals in a global market need to come up to par with professional standards in developed countries, which have already introduced stricter certification systems.
- This action is most effective if the municipal government takes the lead in implementing demonstration projects with proven energy efficiency and emission reduction and/or lessons learnt; and follows by rolling out financial supports to incentivise existing building owners / tenants to implement energy and emission retrofits in their buildings. When the take up rate is good, the government can gradually reduce ... the financial incentive.
- Where: population centers. Who: workers, who often have the greatest opportunity to influence building performance. What: Integrated Design & Delivery.

Support for performance education programs for occupants and users of various building types.

- The development of a comprehensive benchmarking service (as exists for occupancy costs) allows gives business the tools to measure their performance relative to their peers, supporting a general improvement in performance.
- The "danger" of going (too) fast with legislation is that occupants (and designers) are confronted with buildings that work completely differently than before. If they (for example) do not pull down the sunshades, it will be too hot for a few days because there is no active cooling.

Support for high-performance demonstrations and pilot projects.

- Pilot projects are important to showcase innovation and good practice.
- By having an example end user can understand the benefits s/he will get.
- This is very much in support of the point above (Support for training programs focused on built environment sustainability issues...). If modeling and benchmarking can be promoted as the norm rather than the rare exception then the body of evidence and data sets available will expand rapidly delivering detailed case studies of multiple building types, sizes and locations. This is vital to transcend the boundary between those limited numbers of professionals, academics and regulators who understand the issues / challenges / solutions and the vast numbers in the global industry who focus only on a profit on each project.
- The example of Brussels where demo buildings (BatEx) received a substantial subsidy (the owner 90% and the designers 10%) shows that huge improvements are possible in just a few years if the government includes designers in the process. Because of the success of this BatEx, legislation (on energy) is now much more stringent than in the rest of Belgium.

## F. Analysis and Conclusions

The sample of 120 responses is too small to make detailed analysis possible, but some simple conclusions can be drawn:

- The survey design was generally accepted as being a useful way for researchers and professionals to provide a field-level view of desirable courses of action.
- It was decided to describe Action choices in a very condensed form. This has the advantage of facilitating the selection of responses, but inevitably creating certain ambiguities about the exact meaning of each item. In the next version of this survey, this approach will be reconsidered, to see if more detailed descriptions of each measure would be a better approach.
- If reference is made to section C, it will be seen that Action count scores are weighted by the average effectiveness score for each Action. The result of ranking Actions according to this method is that *Adoption of building regulations that include energy, emissions and water*

*performance requirements* is seen as by far the most attractive option, with more than twice the weighted points of the next item, *Limitation of fuels and energy from high-carbon sources*. Performance-based retrofits in third place.

- Some Actions overlapped excessively. For example, there were three Action items for carbon reduction (Cap-and-trade, emissions-based taxation and a third emissions-based tax with a redistribution scheme). The choice between these three specific items weakened the response for this type of measure.
- Respondents provide many interesting comments (see Section E) that will also be considered in the design of the 2016 survey.

We welcome comments and suggestions.

Nils Larsson

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