EVALUATING PUBLIC POLICY MECHANISMS FOR CLIMATE CHANGE MITIGATION IN BRAZILIAN BUILDINGS SECTOR

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PREMISSAS

A principal hipótese de trabalho é que a disseminação de práticas e de tecnologias mais eficientes e baseadas em fontes renováveis é parte de estratégias de estabilização da concentração atmosférica de GEE e que existe a necessidade de se determinar as melhores rotas tecnológicas para orientar políticas públicas na área de energia.

Para o formulador de políticas não basta identificar tecnologias e setores. É necessário também indicar os mecanismos para implementar a ação.

ESFORÇOS DE MITIGAÇÃO

Emissões de origem Energia

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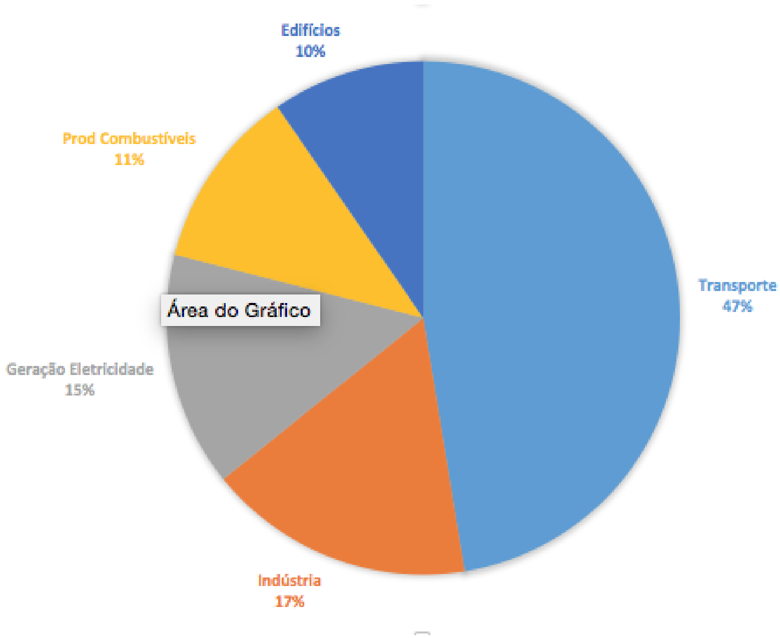
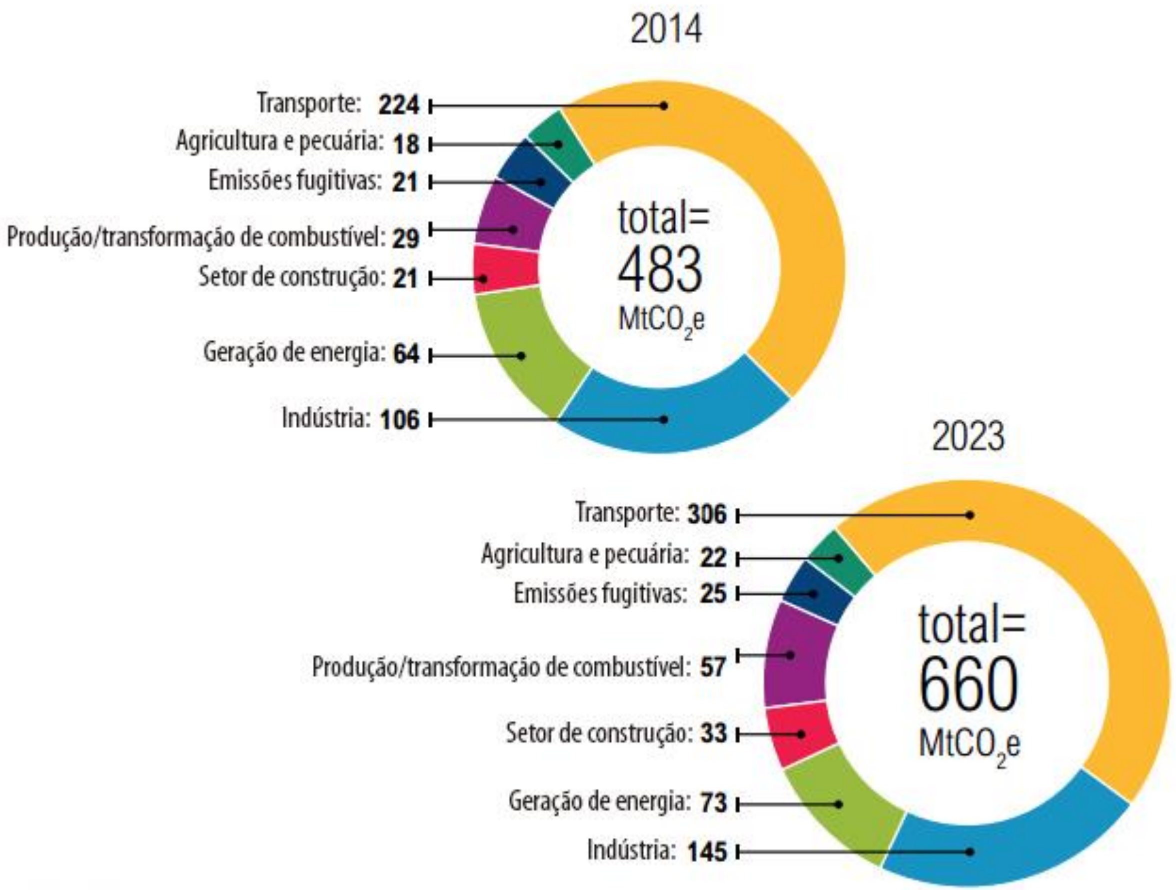
Desafio: manter alta participação de FR (Oferta) e investir em infra-estrutura eficiente (Demanda)

- Transportes
- Indústria
- Edificações



Emissões de gases do efeito estufa relacionadas a energia em 2014 e projeções para 2023



Fonte: EPE, 2014

ORIGINAL PROPOSAL

Original title: The evaluation of energy efficiency and CO_2 abatement potentials according to different technology dissemination policies: guidelines to policy-makers

Original proposal: Industrial, transportation and Buildings

Actual research: **Buildings sector & Energy efficiency & Onsite generation** with renewable energy. Development of methods to combine technology assessment & policy impacts

APPROACH

This work applies energy planning method known as Integrated Resources Planning (IRP), a multi-criteria analysis (MCA) and marginal abatement cost curves (MACC) to evaluate public policies mechanisms to promote the dissemination of EE and RES technologies in Brazilian buildings sector.

The objective is to bring together the advantages of these methods in order to provide more valuable insights to policy makers

OBJECTIVES

Estimate potential energy and CO_2 savings up 2030 for the Brazilian building sector

Create portfolio of technologies and dissemination policies (interventions on the demand side) ranking best oportunities according to relevant public policies criteria:

- Efficient technologies: appliances and building codes
- On site RE generation technologies

CO2 EMISSIONS FROM BRAZILIAN BUILDINGS

44% total electricity (2010)

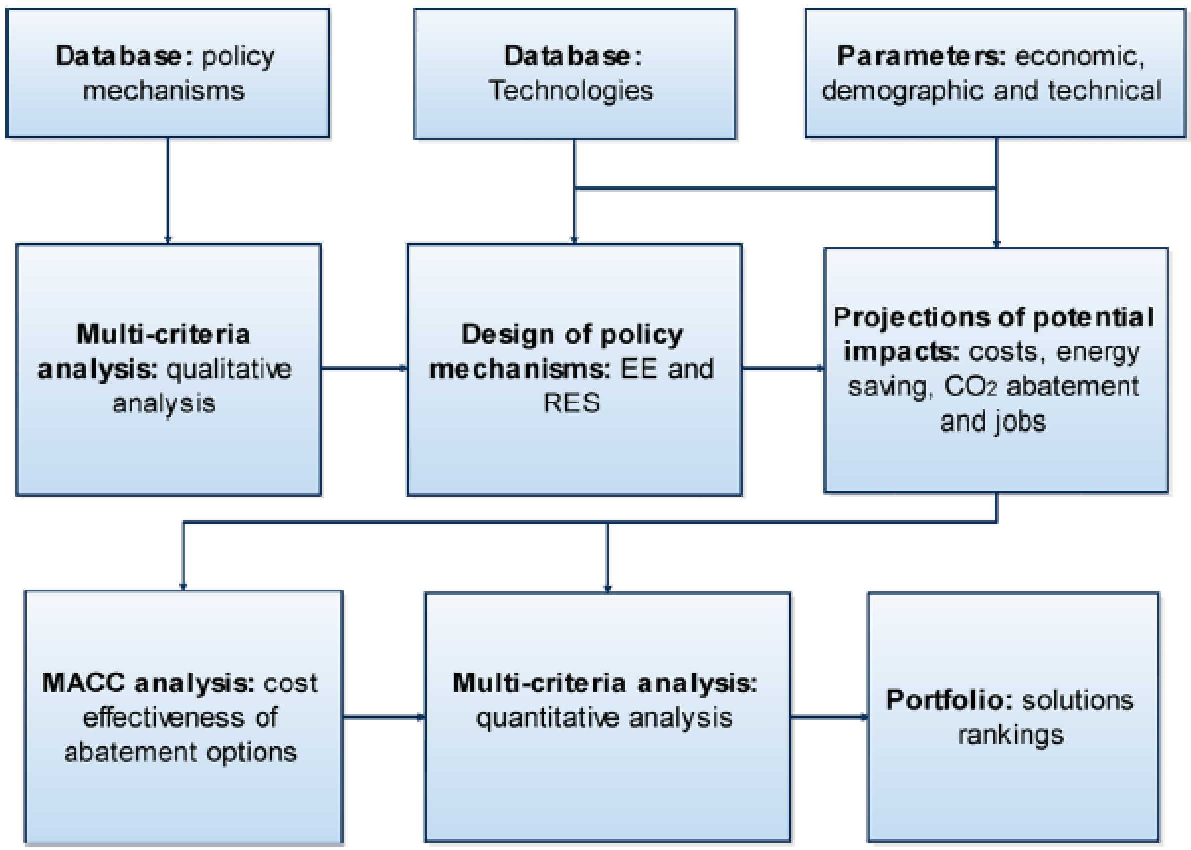
Sector	Emission source	1990		2005		2010	
		1000 t	(%)	1000 t	(%)	1000 t	(%)
Residential	Electricity	1,376	9.1	2,354	13.2	6,386	29.2
	Fuels	13,818	90.9	15,484	86.8	15,484	70.8
	Total	15,194		17,838		21,870	
Commercial	Electricity	674	24.5	1,513	43.6	4,105	67.8
	Fuels	2,075	75.5	1,954	56.4	1,954	32.2
	Total	2,749		3,467		6,059	
Public	Electricity	513	50.1	926	34.7	2,179	55.6
	Fuels	510	49.9	1,739	65.3	1,739	44.4
	Total	1,023		2,665		3,918	
Total	Electricity	2,563	13.5	4,793	20.0	12,670	39.8
	Fuels	16,403	86.5	19,177	80.0	19,177	60.2
	Total	18,966		23,970		31,847	

PROJECT WORKFLOW

Data inputs

Process/ Modellin g work

Analysi s/



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SELECT POLICY MECHANISMS

Regulatory and control mechanisms

- Technical standards for appliances, regulated procurement schemes, building codes, compulsory investments, tariffs

Economic/market-based instruments

- Financing mec
  cooperatives

Fiscal instrum

- Carbon taxes,

Support, infor

Funding mechanisms

- 14 different policy mechanisms for EE interventions
- 6 different policy mechanisms for RE onsite generation

SELECT TECHNOLOGIES FOR MINIMUM EFFICIENCY PERFORMANCESTANDARDS (MEPS)

19 different combinations of technologies (EE and RE) and policy mechanisms

Se[illegible]	[illegible]	[illegible]	[illegible]
Resi[illegible]	[illegible]	[illegible]	[illegible]
Resi[illegible] Pub[illegible] Com[illegible]	[illegible]	[illegible]	[illegible]n
Resi[illegible]	[illegible]	[illegible] incandescent and prohibit their manufacture and sale	[illegible]e [illegible] from 2014
Residential, Public and Commercial	Standby (Eletronic devices)	Nonexistent	1W as maximum of power in standby mode starting from 2014
Public and Commercial	Tubular fluorescent lamps	Nonexistent	Fluorescent lamps T5 and electronic ballasts as technological standard starting from 2014

QUALITATIVE CRITERIA OF TECHNOLOGIES & POLICY MECHANISMS

Previous experience

Mitigation potential

Implementation aspects (easy, difficult)

Societal cost

Consumer cost

Social-economic developmental goals

MITIGATION IMPACTS OF SELECT INTERVENTIONS

Residential buildings - R (cumulative total from 2014 to 2030)			Commercial buildings - C (cumulative total from 2014 to 2030)			Public buildings - P (cumulative total from 2014 to 2030)		
Mechanism	**Energy saving potential (TWh)**	**Abatement potential[4] (Million tonnes of CO_2)**	**Mechanism**	**Energy saving potential (TWh)**	**Abatement potential (Million tonnes of CO_2)**	**Mechanism**	**Energy saving potential (TWh)**	**Abatement potential (Million tonnes of CO_2)**
P[1] REF R	9.67	0.90	**P AC C**	269.76	25.10	**P AC PUB**	67.44	6.27
P AC R	5.49	0.51	**P LAMP C**	65.90	6.13	**P LAMP P**	17.35	1.61
P LAMP R	165.62	15.41	**P STB C**	35.15	3.27	**P STB P**	11.12	1.03
P STB R	59.33	5.52	**COD ENV C**	3.54	0.33	**RC STB P**	12.88	1.20
COD[2] AQS R	69.38	6.45				**RC LAMP P**	1.81	0.17
						COD ENV P	0.15	0.01
Total	**321.22**	**29.74**	**Total**	**374.35**	**34.83**	**Total**	**110.76**	**10.30**

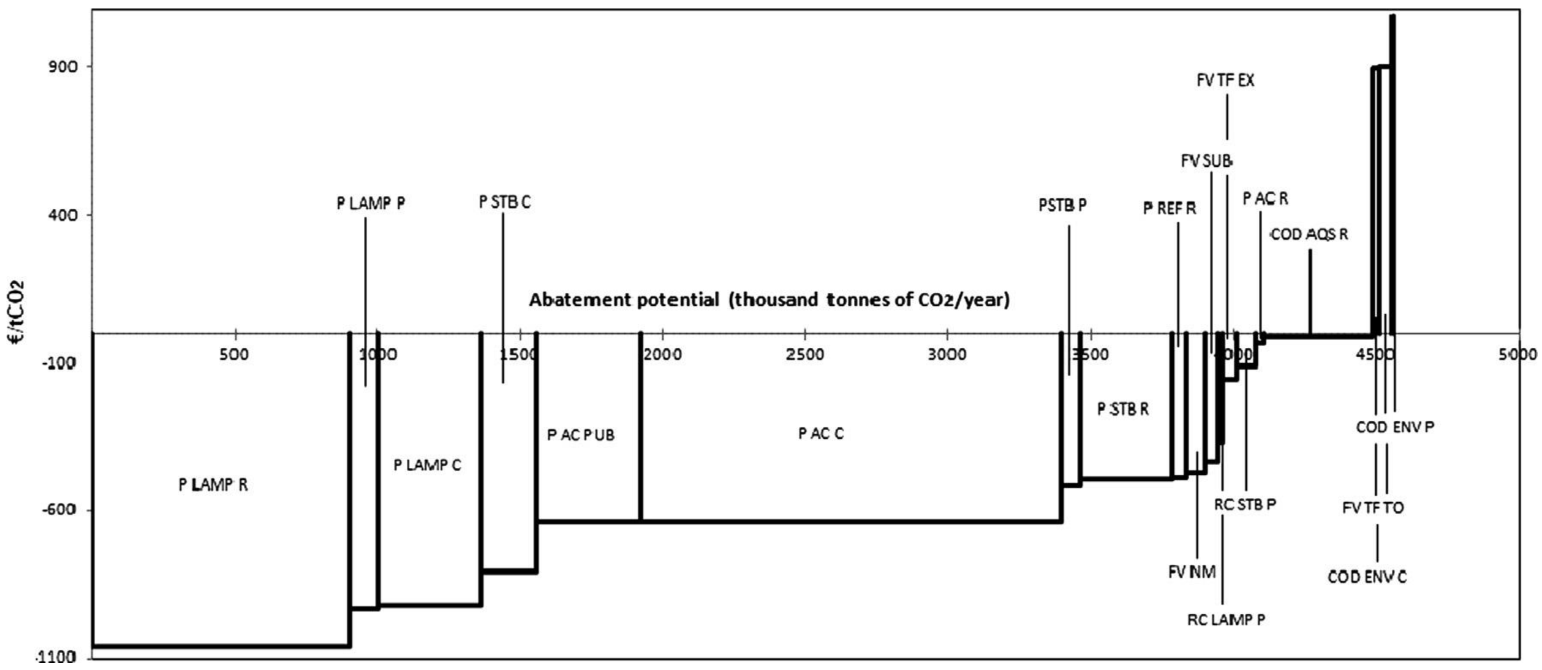
[1] P means Minimum energy performance standards; [2] COD means energy efficiency codes; To estimate the weight of buildings electricity consumption in CO_2 emissions from power generation we apply an emission factor of 0.080tCO2e per megawatt hour that is an average of official assumptions in the PNE 2030 (EPE, 2007) and an loss factor for the Brazilian Interconnected System of 15% (EPE, 2011).

EXAMPLE: QUALITATIVE ANALYSIS OF TECNOLOGIES + POLICY MECHANISMS (MCA)

Tabela 12 – Matriz de avaliação multicritério

Mecanismo	Custo Soc	Mitigação	FacI	PotGEmp
Função objetivo	Minimizar	Maximizar	Maximizar	Maximizar
P LAMP R	(2.831)	906.399	10	-
P LAMP P	(2.489)	94.954	3	-
P LAMP C	(2.458)	360.648	3	-
P STB C	(2.144)	192.363	3	-
P AC PUB	(1.707)	369.069	4	-
P AC C	(1.707)	1.476.274	4	-
PSTB P	(1.371)	60.875	3	-
P STB R	(1.310)	324.685	3	-
P REF R	(1.305)	52.937	7	-
FV NM	(1.261)	60.990	10	38.661
FV SUB	(1.151)	47.551	2	31.453
RC LAMP P	(982)	15.287	3	-
FV TF EX	(407)	47.551	1	31.453
RC STB P	(299)	70.512	2	-
P AC R	(80)	30.069	7	-
COD AQS R	(20)	379.696	3	30.000
COD ENV C	2.393	19.394	3	500
FV TF TO	2.408	47.551	1	31.453
COD ENV P	2.857	837	3	500

RESULTS: MARGINAL CARBON ABATEMENT COSTS



RESULTS: ENERGY SAVINGS CO2 SAVINGS

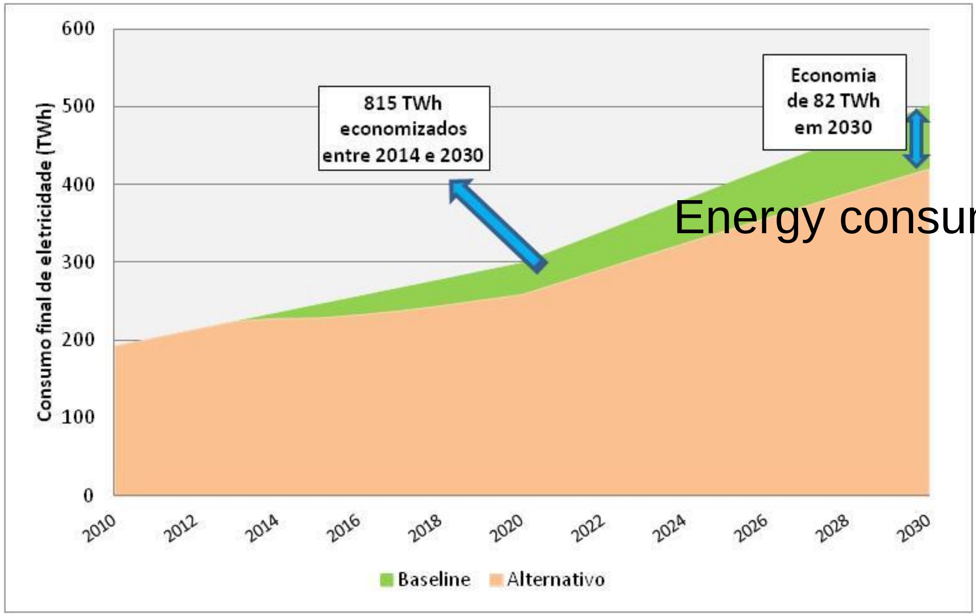
Residential buildings—R (cumulative total from 2014 to 2030)			Commercial buildings—C (cumulative total from 2014 to 2030)			Public buildings—Pb (cumulative total from 2014 to 2030)		
Mechanism	Energy saving potential (TWh)	Abatement potential[d] (Million tonnes of CO_2e)	Mechanism	Energy saving potential (TWh)	Abatement potential (Million tonnes of CO_2e)	Mechanism	Energy saving potential (TWh)	Abatement potential (Million tonnes of CO_2e)
P[a] REF R	9.67	0.90	P AC C	269.76	25.10	P AC Pb	67.44	6.27
P AC R	5.49	0.51	P LAMP C	65.90	6.13	P LAMP Pb	17.35	1.61
P LAMP R	165.62	15.41	P STB C	35.15	3.27	P STB Pb	11.12	1.03
P STB R	59.33	5.52	COD ENV C	3.54	0.33	RC STB Pb	12.88	1.20
COD[b] AQS R	69.38	6.45				RC LAMP Pb	1.81	0.17
FV NM	11.72	0.95				COD ENV Pb	0.15	0.01
FV (other)[c]	9.15	0.74						
Total	330.36	30.48	Total	374.35	34.83	Total	110.76	10.30

[a] P means Minimum energy performance standards.
[b] COD means energy efficiency codes.
[c] Other FV refers to the application of only one of the options beyond net metering (subsidies or feed-in tariff).
[d] To estimate the weight of buildings electricity consumption in CO_2e emissions from power generation we apply an emission factor of 0.080tCO_2e per megawatt hour that is an average of official assumptions in the PNE 2030 (EPE, 2007) and an loss factor for the Brazilian Interconnected System of 15% (EPE, 2011).

RANKING OF OPTIONS

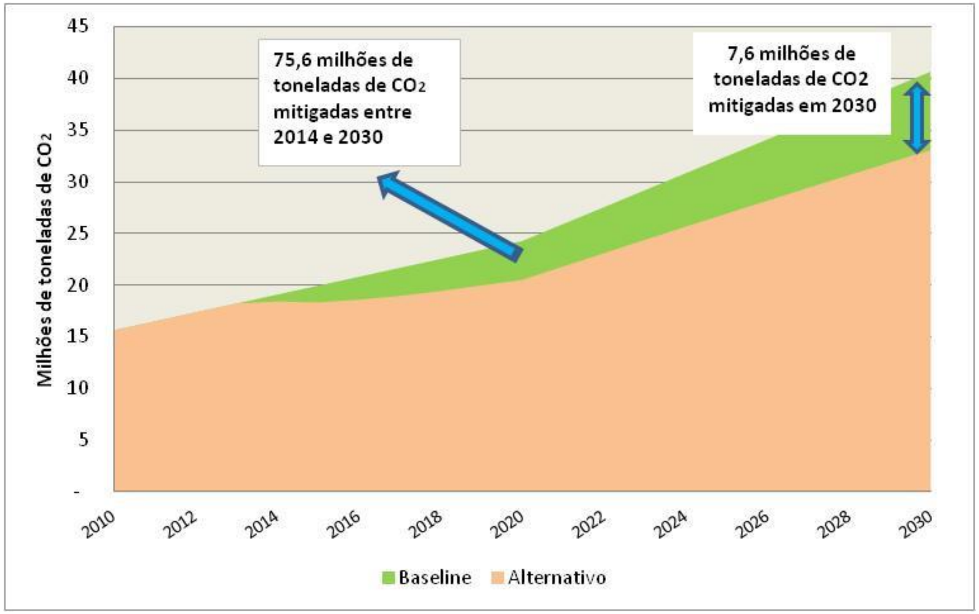
Ranking	MACC	MCA
1°	P LAMP R	P LAMP R
2°	P LAMP P	FV NM
3°	P LAMP C	P STB C
4°	P STB C	P AC C
5°	P AC PUB	P LAMP C
6°	P AC C	P STB R
7°	PSTB P	P AC PUB
8°	P STB R	P LAMP P
9°	P REF R	COD AQS R
10°	FV NM	PSTB P
11°	FV SUB	P REF R
12°	RC LAMP P	FV SUB
13°	FV TF EX	P AC R
14°	RC STB P	FV TF EX
15°	P AC R	RC STB P
16°	COD AQS R	COD ENV C
17°	COD ENV C	FV TF TO
18°	FV TF TO	RC LAMP P
19°	COD ENV P	COD ENV P

RESULTS: ENERGY SAVINGS FROM THE SUGGESTED PORTFOLIO



Energy consumption in buildings

RESULTS: CO2 SAVINGS FROM THE SUGGESTED PORTFOLIO



KEY FINDINGS (1)

The MCA results show that the mechanisms to foster distributed RES and solar water heaters are better ranked than in MACC analysis, where only cost-effectiveness of each option is evaluated.

KEY FINDINGS (2)

There is a significant cost effective potential that could be reached through alternative mechanisms not implemented yet in the country, such as public procurement regulation and building codes

KEY FINDINGS (3)

Minimum energy performance standards (MEPS) could be broader in scope and more stringent and include the use of energy in standby mode and tubular fluorescent lamps.

- In particular, some important appliances such as large air conditioning devices should have more aggressive MEPS.

PUBLICATIONS

Melo, C. A.; Jannuzzi, G. M. (2015) Cost-effectiveness of CO2 emissions reduction in Brazilian building sector - Energy Efficiency (Print), v. 08, p. 014/9322,.

Melo, C. A.; Jannuzzi, G. M.; Tripodi, A. (2013). *Evaluating public policy mechanisms for climate change mitigation in Brazilian buildings sector - Energy Policy* v. 61, p. 1200-1211,.

Jannuzzi, G.M. & Melo, C.A., (2012). *Grid-connected photovoltaic in Brazil: Policies and potential impacts for 2030. Energy for Sustainable Development* 17 (2013) 40–46

Jannuzzi, G. M.; Melo, C. A.; Tripodi, A (2012). On-site renewable energy systems: the potential for buildings in Brazil. Planet Under Pressure. March, Excel London, UK.

Jannuzzi, G. M. ; Melo, Conrado Augustus de ; Tripodi, A. (2012). Políticas públicas para promoção da eficiência energética e microgeração renovável em edificações no brasil: uma análise multicritério. International Energy Initiative - América Latina, (Energy Discussion Paper).

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