CONCLIMA
Conferência Nacional de Mudanças Climáticas

UNICAMP

Evaluating public policy mechanisms for climate change mitigation in Brazilian buildings sector

Gilberto M Jannuzzi

Conrado A Melo

Aline T Causo

FAPESP
1a Conferência Nacional de Mudanças Climáticas Globais São Paulo
09 a 13/09/2013 - FAPESP - São Paulo

REDE CLIMA · INCT · FAPESP MUDANÇAS CLIMÁTICAS · INPE · Ministério da Ciência, Tecnologia e Inovação · GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

Premisses

- This research assumes that wider use of energy efficiency (EE) and renewable energy sources (RES) technologies are very interesting strategies that, besides contribute towards the global efforts in stabilizing the atmospheric concentration of GHGs, can provide economic benefits.

Mitigation efforts

- GHGs emissions from the Energy sector in Brazil: relatively small by international standards, but increasing steadily.
- Challenge: maintain high participation of ER and invest in more efficient energy-infrastructure – specially on the DEMAND SIDE
  - Transportation
  - Industry
  - Buildings

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

UNICAMP

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

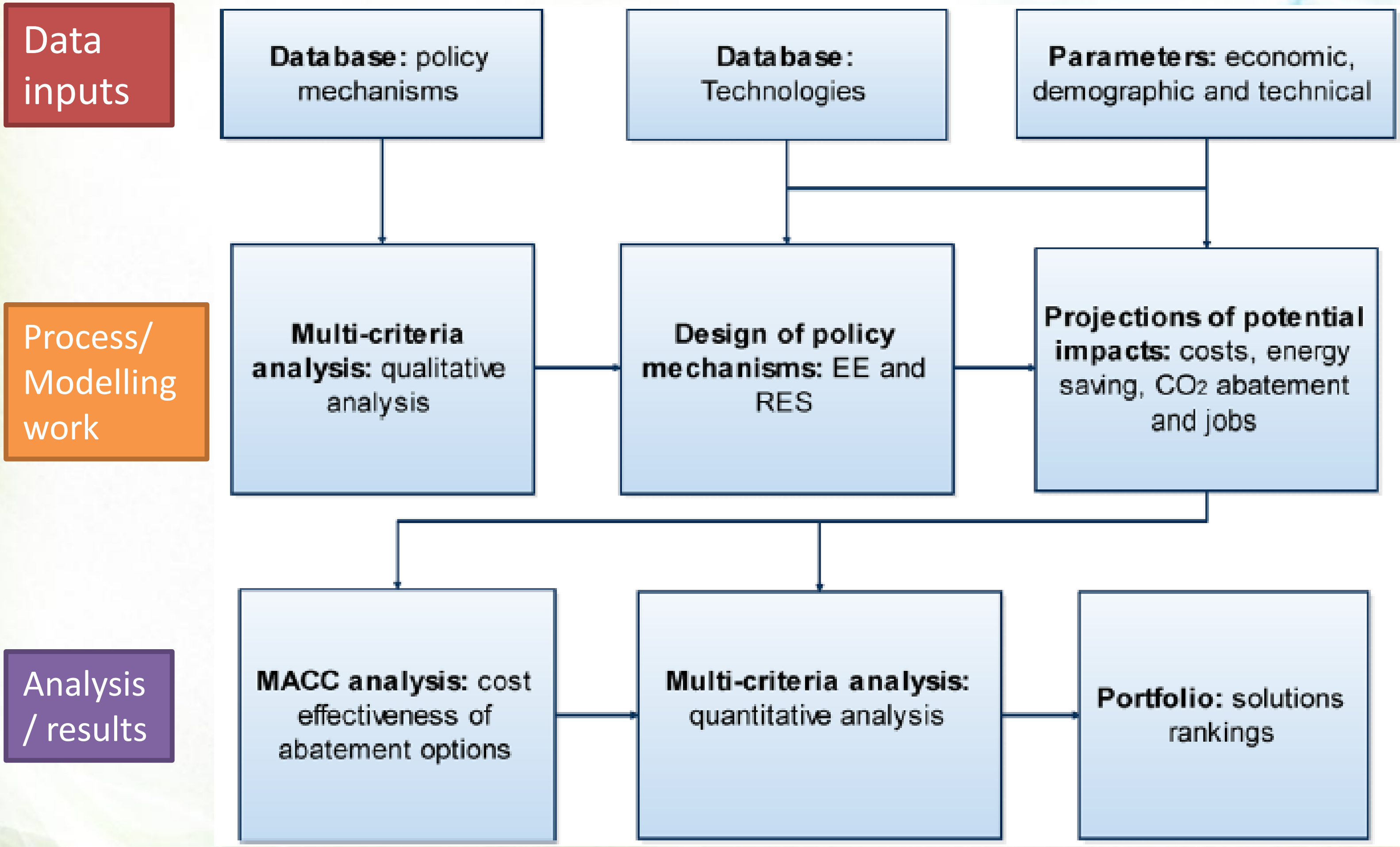
- Estimate potential energy and CO_2 savings up 2030 for the Brazilian building sector
- Create portfolio of technologies and dissemination policies (interventions on the demand side) ranking best oportunities according to relevant public policies criteria:
  - Efficient technologies: appliances and building codes
  - On site RE generation technologies

CO_2 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



Select policy mechanisms

- Regulatory and control mechanisms
  - Technical standards for appliances, regulated procurement schemes, building codes, compulsory investments, tariffs
- Economic/market-based instruments
  - Financing mechanisms, rebates, ESCOs, cooperatives
- Fiscal instrume
  - Carbon taxes,
- Support, inforn
- Funding mecha

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

Select technologies for Minimum Efficiency PerformanceStandards (MEPS)

Sector	Appliances	Baseline - Current MEPS regulamentation	Alternative scenario assumptions
Residential	Refrigerators	Ordinance MME-MCT-MDIC 362/2007 - Establishes maximum levels of energy consumption for refrigerators and freezers.	The current A rating of PBE Label as standard of maximum consumption starting from 2014
Residential, Public and Commercial	Ai	Ordinance MME-MCT-MDIC 364/2007 -	The current A rating of PBE Label as f energy efficiency from 2014
Residential			ndard that prohibits the cent light bulbs starting om 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

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

Qualitative criteria of technologies & policy mechanisms

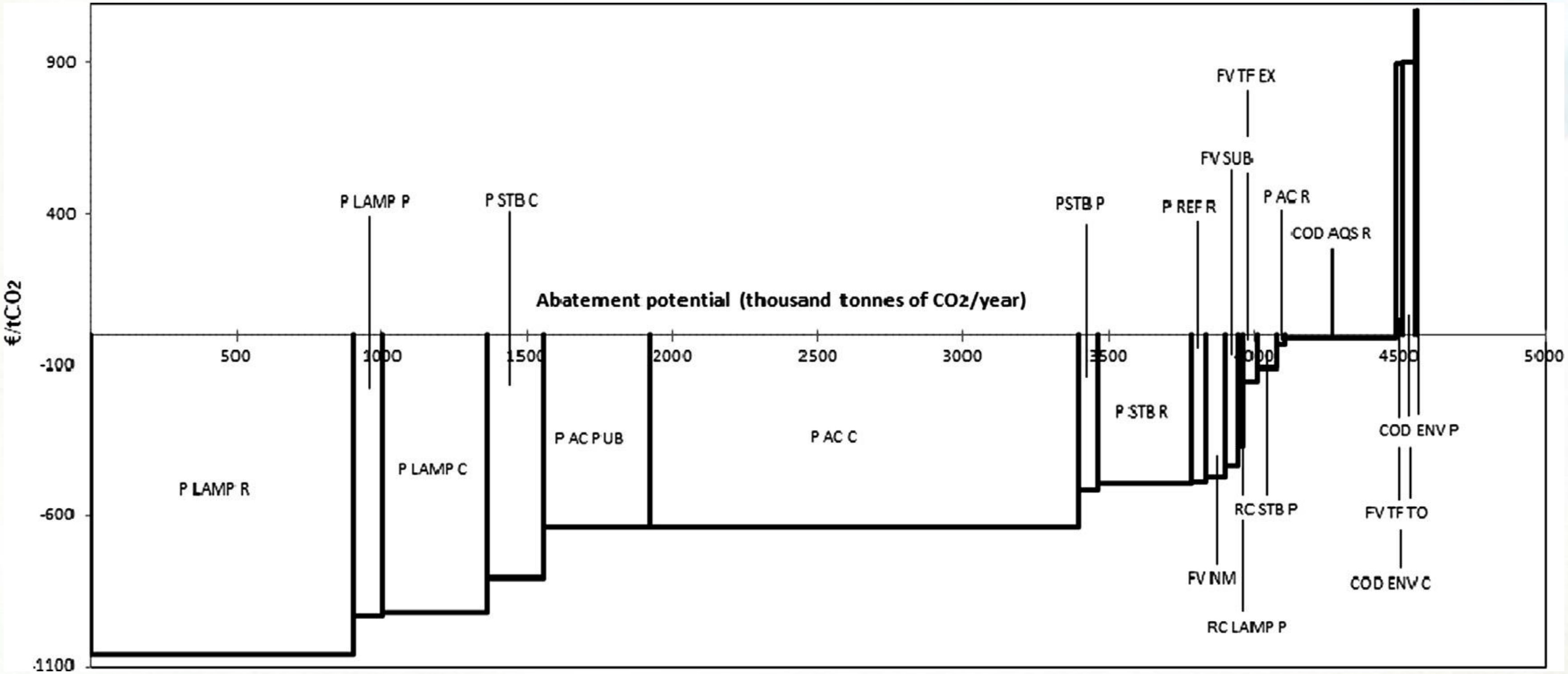
- Previous experience
- Mitigation potential
- Implementation aspects (easy, difficult)
- Societal cost
- Consumer cost
- Social-economic developmental goals

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).

Results: Marginal Carbon Abatement Costs



Example: Qualitative analysis of tecnologies + policy mechanisms (MCA)

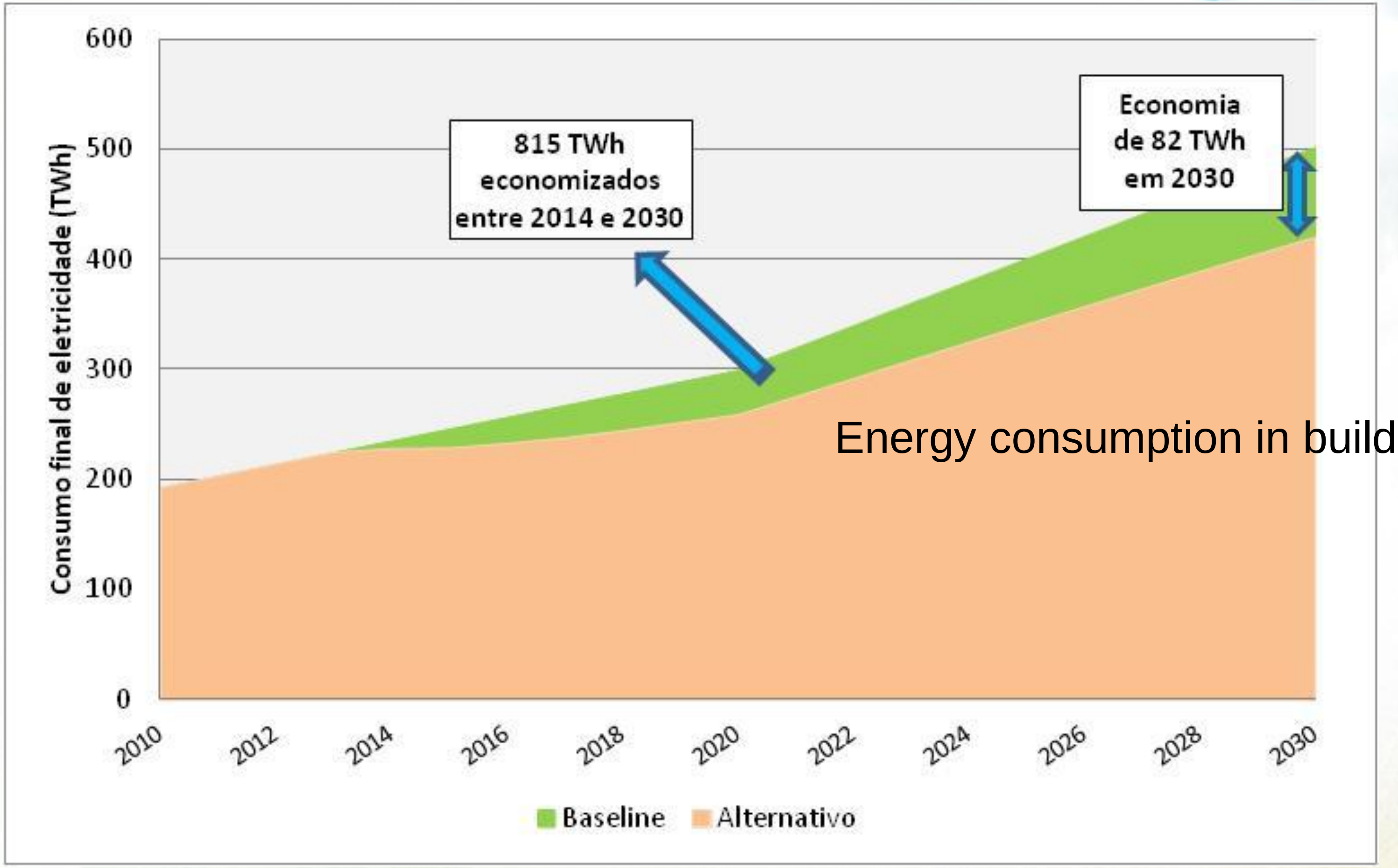
Tabela 12 – Matriz de avaliação multicritério

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

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

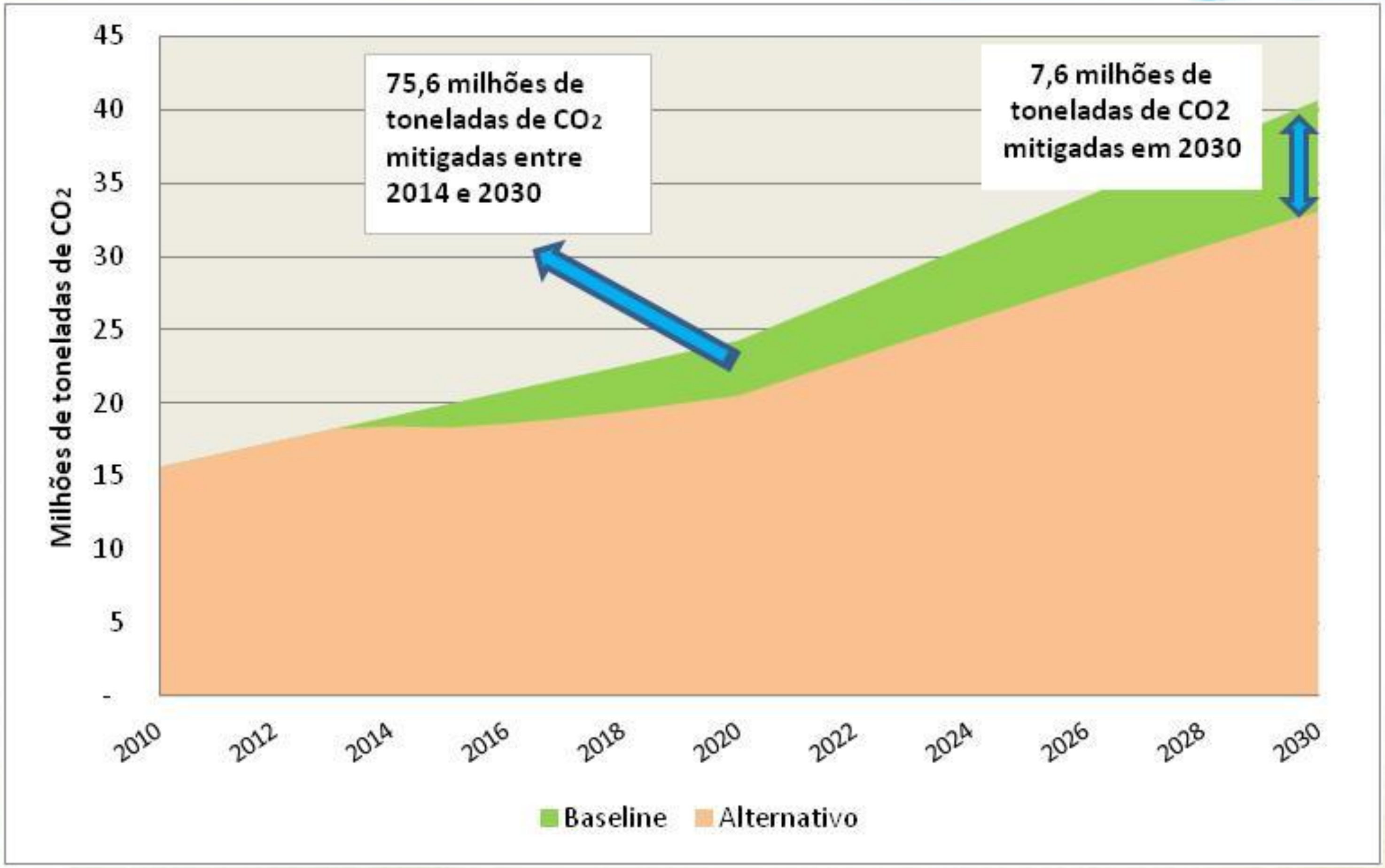


Energy consumption in buildings

CONCLIMA
Conferência Nacional de Mudanças Climáticas

Results: CO2 savings from the suggested portfolio

UNICAMP



REDE CLIMA
INCT
FAPESP MUDANÇAS CLIMÁTICAS
INPE
Ministério da Ciência, Tecnologia e Inovação
GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

UNICAMP

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.

CONCLIMA
Conferência Nacional de Mudanças Climáticas

jannuzzi@fem.unicamp.br

FIM