MAPS Chile

Opciones de Mitigación para Enfrentar el Cambio Climático

Phase 2 Results and Preliminary Results of Phase 3

Carlos Benavides Farías

September 2015

Gobierno de Chile

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Phases of MAPS-Chile

2011 2012 2013 2014 2015

Phase 1

✓Baseline 2007-2030
✓Requerid By Science Scenario (RBS)

Phase 2

✓Baseline 2013-2030
✓Mitigation Actions
✓Mitigation Scenarios
✓Macroeconomic impact of scenarios

Phase 3

✓Refining Results of Phase 2
✓Assessment of CO-Impacts
✓Effect of Mitigation Actions on Income Distribution Effects
✓Long Term Mitigation (2050)

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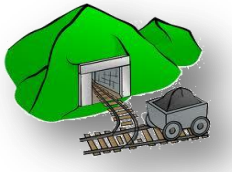
Modeled Sectors

CPR

Forestry and Land Use

Transport & Urbanism

Agriculture and Land Use



Minning & Other industries

Electricity generation

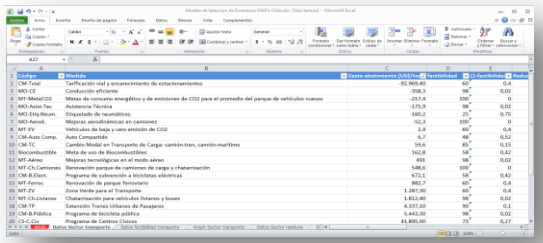
Waste

Scenario building methodology (effort level)

Previous preparation

MA Library (96+)

Exhaustive MA list



MA spreadsheet

Nombre	Subsector	Emisiones reducidas	Región
Promoción de la calificación energética de viviendas existentes	Residencial	Directa: CO2 producto de reducción de consumo calefacción.	Nacional

Descripción de la medida

- Promoción de la Calificación energética de viviendas existentes, cuyo parque se estima en aproximadamente 5 millones de viviendas a nivel nacional. Este etiquetado sería requerido tanto para acciones de compra-venta como de arriendo de inmueble. Esto se haría a través de la promoción de un etiquetado que sería requerimiento para acceder a préstamos de reacondicionamiento, para la venta de la propiedad y para arriendo.

Antecedentes nacionales e internacionales

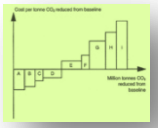
- En la actualidad ya existe una metodología de calificación de vivienda existente, y que empezará a ser promovida de forma voluntaria. La propuesta del consultor es que se transforme en obligatoria para las transacciones de venta, arriendo y para la solicitud de préstamos de reacondicionamiento.
- En general se aprecia que es una estrategia ampliamente usada a nivel internacional, siendo de carácter más obligatorio en varios países de la UE, y de carácter voluntario en EEUU, pero que adicionalmente se ha transformado en requisito para obtener subsidios y préstamos de mejoras.

Nivel de implementación

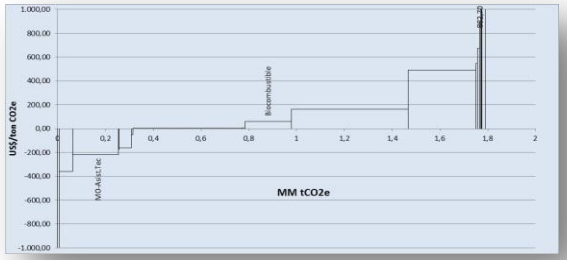
Se implementaría en forma posterior a que se inicie la obligatoriedad de implementación para vivienda nueva. Sería obligatoria para todas las transacciones de vivienda existente (transparentar el nivel de consumo energético), para arriendo y para solicitar préstamos de reacondicionamiento con tasas blandas o cualquier otro programa de gobierno que beneficie la eficiencia energética de viviendas.

Instrumentos público/ Iniciativa privada/Financiamiento

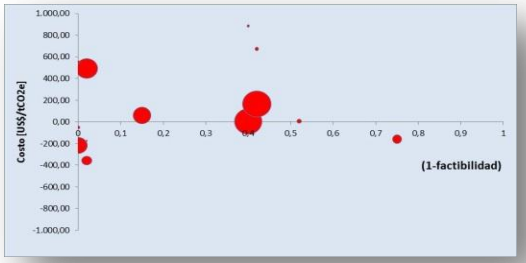
- Campaña de desarrollo y difusión del etiquetado a nivel nacional.
- Norma que establezca la obligatoriedad de obtención de etiqueta para la venta de viviendas, arriendo y para la solicitud de créditos de reacondicionamiento energético .
- Subsidio al propietario para la obtención del etiquetado.



MAC curves by sector



Graph (abat.C, feasibility) by sector



SBT6 October, 2013

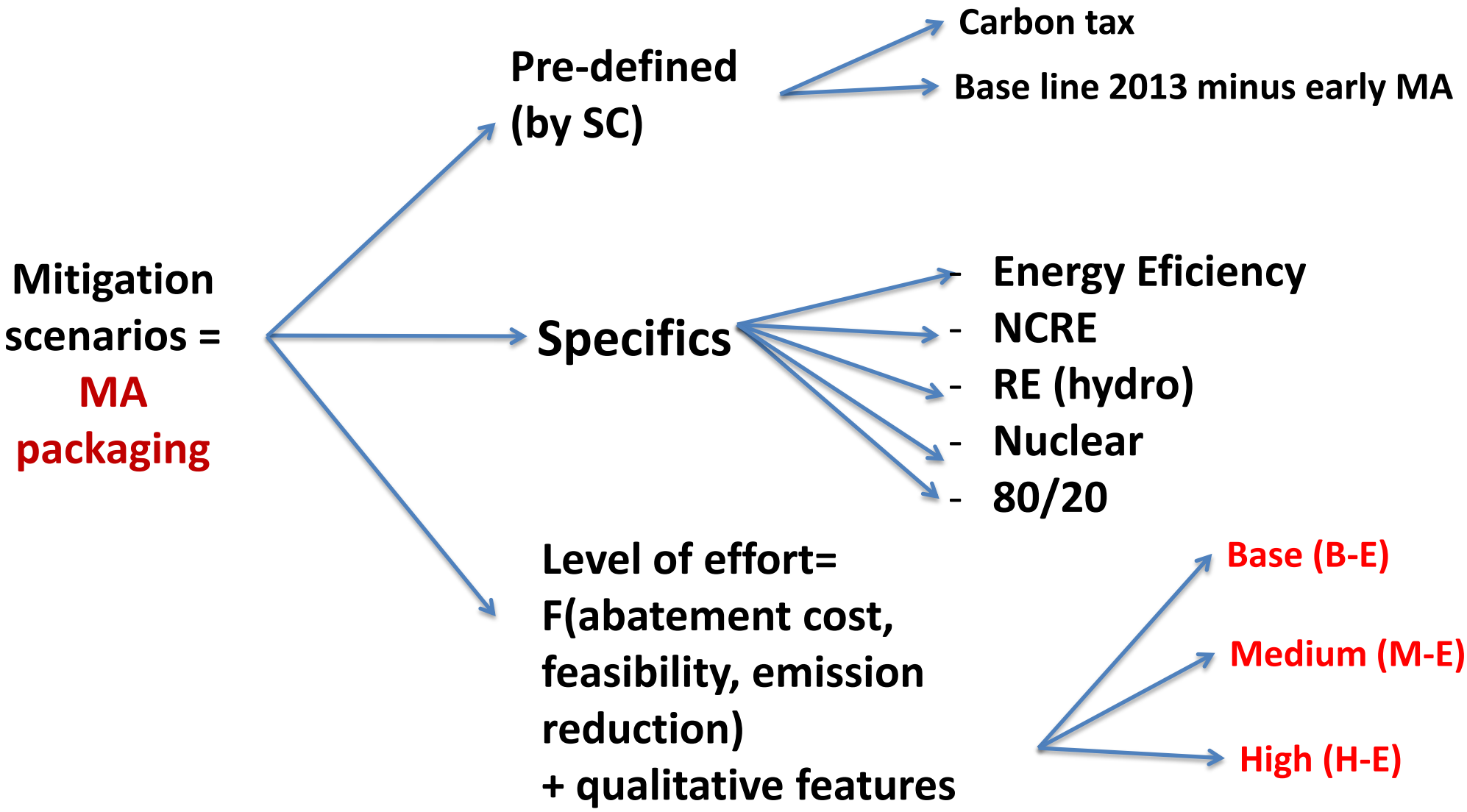
Sectoral work

Multi-sectoral work

Plenary

Mitigation scenarios = MA packaging

Mitigation scenarios



Mitigation actions: Electricity Generation Sector

	Mitigation action	B-E	M-E	H-E	NCRE	RE	80/20
Non-conventional renewable energy (NCRE)	Increase quota of NCRE (from 20/25 to 30/30)						
	Create incentives to small hydroelectric generation	N2	N2	N2	N2	N2	N2
	Electricity generation in dams used for irrigation in the agriculture	N2	N2	N2	N2	N2	N2
	Create incentives to wind generation.	N1	N1	N2	N2	N2	N2
	Create incentives to geothermal generation			N2	N2	N2	N2
	Electricity generation from forestry biomass			N2	N2	N2	N2
	Create incentives to CSP		N1	N2	N2	N2	N1
	Create incentives to PVP			N1	N1	N1	
	Storage system						
Exploit the hydroelectric resource of the extreme south							
Interconnection regional							
Clean coal							
Carbon Capture and Storage (CCS)							
Decrease transmission loses							
Nuclear energy				N1			

Mitigation actions: Transport sector

		Mitigation action	B-E	M-E	H-E	EE	80/20
Passenger transport	Technological improvements	Target CO_2 emission for new cars	N1	N3	N3	N2	
		Efficient labeling of tires for light vehicles	N1	N2	N3	N2	
		Zero or low emission vehicles (ZLEV)		N1	N2		
		E-mobility Readiness for cabs		N1	N2		
		Green-zone		N1	N2		
		Technological improvements in air mode		N2	N3	N2	
		Light vehicle scrappage		N1	N2		
		Public bicycle program		N3	N3		
	Modal shift	Bicycle Infrastructure mode	N1	N3	N3		N3
		Electric bikes	N3	N3	N3		
		Urban Rail Expansion		N2	N3		
		Bus Rapid Transit in Santiago	N1	N2	N3		
		Road pricing		N1	N2		
Freight transport		Aerodynamic improvements for trucks	N1	N2	N3	N2	
		Scrapping trucks		N1	N2		
		Renewal of freight rails		N1	N2	N1	
		Technical assistance	N1	N2	N3	N2	
		Fuel efficient Driving	N1	N2	N3	N2	
		Shift from road to waterway			N1		
		Shift from road to rail			N1		

Mitigation actions: Industry and Mining Sector

Mitigation actions	B-E	M-E	H-E	NCRE	RE	EE	80/20
NCRE use in industries		N1	N1	N1	N1		
Development of NCRE sources and to inject energy to grid		N1	N1	N1	N1		
Use NCRE for thermal process		N1	N1	N1	N1		
Cogeneration		N1	N1			N1	N1
Shift to low emission fuels		N1	N1				N1
CO_2 capture			N1				
Replace electric motors		N1	N1			N1	
MEPS motors	N1	N1	N1			N1	
Energy audits	N1	N1	N1			N1	
Energy Management Systems	N1	N1	N1			N1	N1
efficiency Energy in mining projects		N1	N1			N1	
MEPS others		N1	N1			N1	
Heat recover		N1	N1			N1	N1
Energy efficiency in mining transport	N1	N1	N1			N1	
Potential Energy Recovery		N1	N1	N1	N1		

Mitigation actions: Comercial, Public and Residential Sector

Mitigation action	Base	Medium	High	NCRE	RE	EE	80/20
Increase in thermal regulation requirements	N1	N1	N1			N1	
Energy rating of existing homes	N1	N1	N1			N1	
Energy rating of new homes	N1	N1	N1			N1	
Program replacement aerators	N1	N1	N1			N1	
Program adoption of solar thermal systems	N1	N1	N1	N1	N1		
MEPS residential refrigerators	N1	N1	N1			N1	
MEPS for residential lighting	N1	N1	N1			N1	
MEPS commercial refrigerators	N1	N1	N1			N1	
Labelling and MEPS for Fluorescent Lamps and Ballasts	N1	N1	N1			N1	
Labelling Washers	N1	N1	N1			N1	
MEPS for Refrigerators	N1	N1	N1			N1	
Residential electricity Self supply (net-billing)		N1	N1	N1	N1		

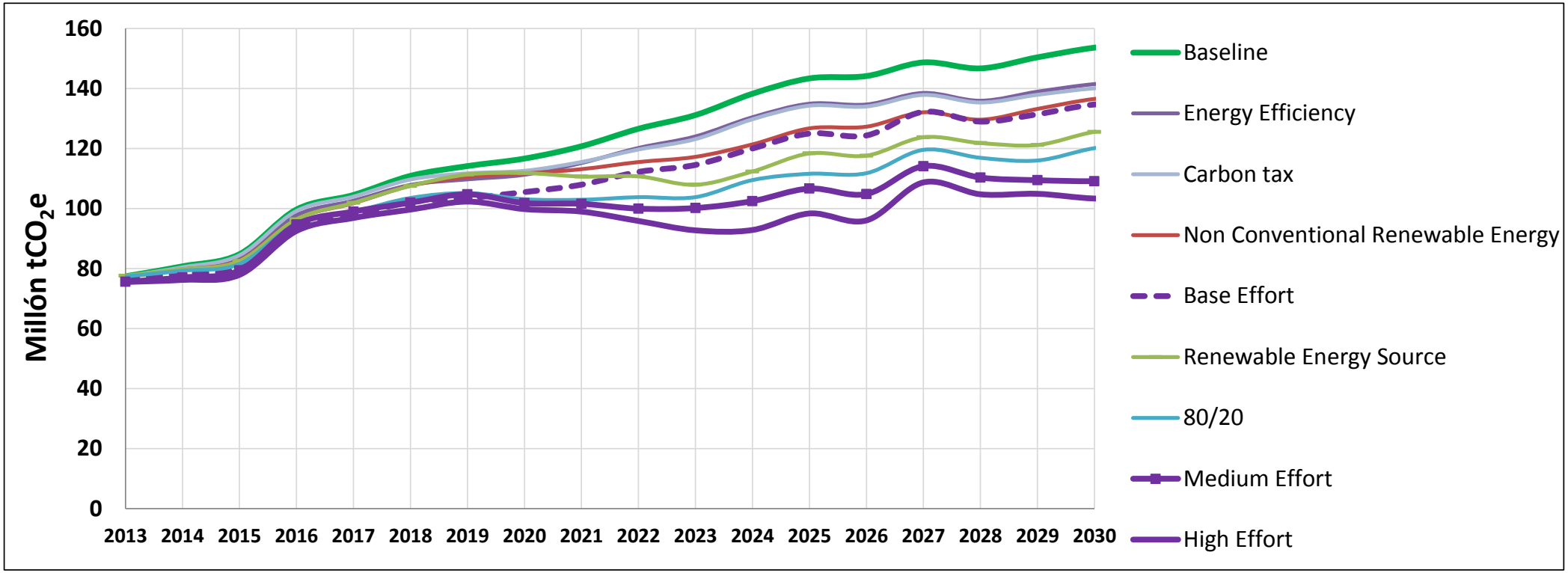
Mitigation actions: Forestry Sector

Mitigation action	B-E	M-E	H-E	NCRE	RE	80/20
Recovering degrade native forest		■	■			
Forestation promotion	■	■	■			■
Wood building and Harvesting wood products (HWP)		■	■			
Increasing productivity of forest plantation through technology		■	■			
Ilegal wood cutting reduction in native forest						
Energy generation from forest biomass		■	■	■	■	
Agro-forestry sistems		■	■			

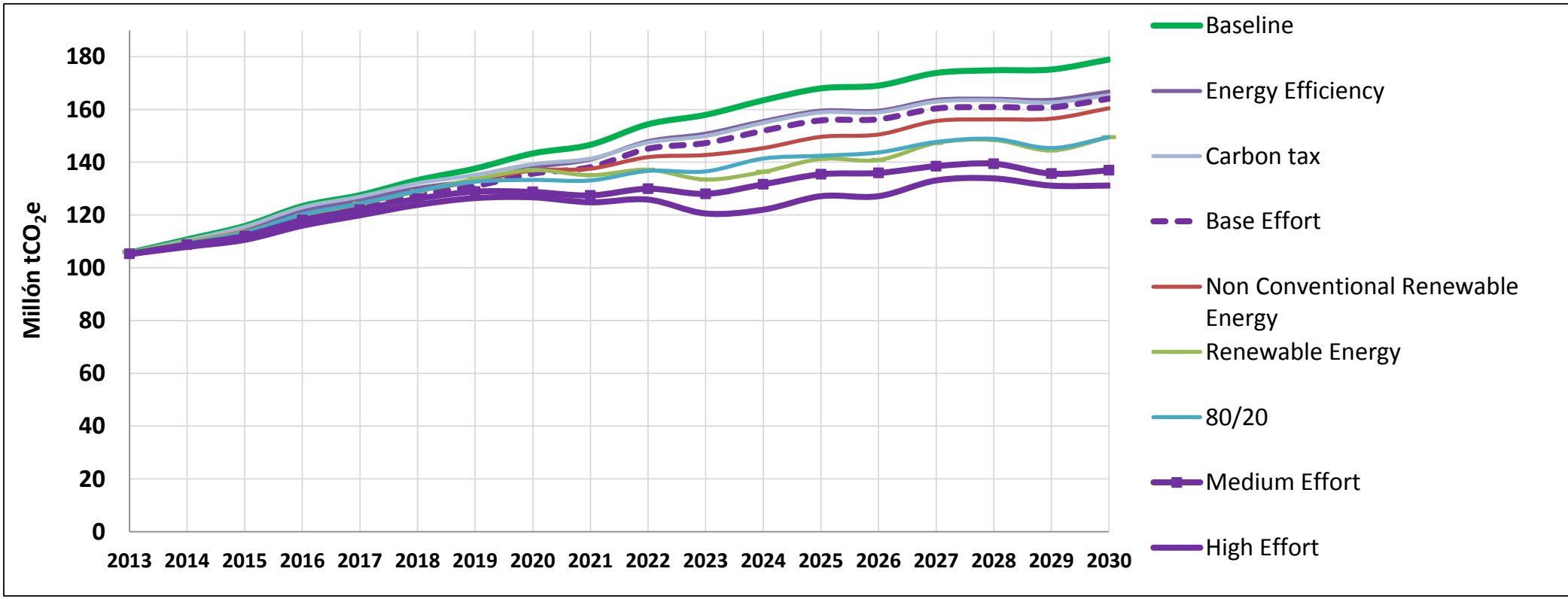
Mitigation actions: Agriculture Sector

Mitigation action	B-E	M-E	H-E	NCRE	RE	80/20
Improving cows diet	■	■	■			
Fertilizer with nitrogen inhibitors	■	■	■			
Organic agriculture		■	■			
Zero tillage			■			
Biodigestors		■	■			
Plant genetic improvement			■			
Soil incorporation of organic matter stabilized			■			
Use of NCRE in agriculture irrigation		■	■	■	■	

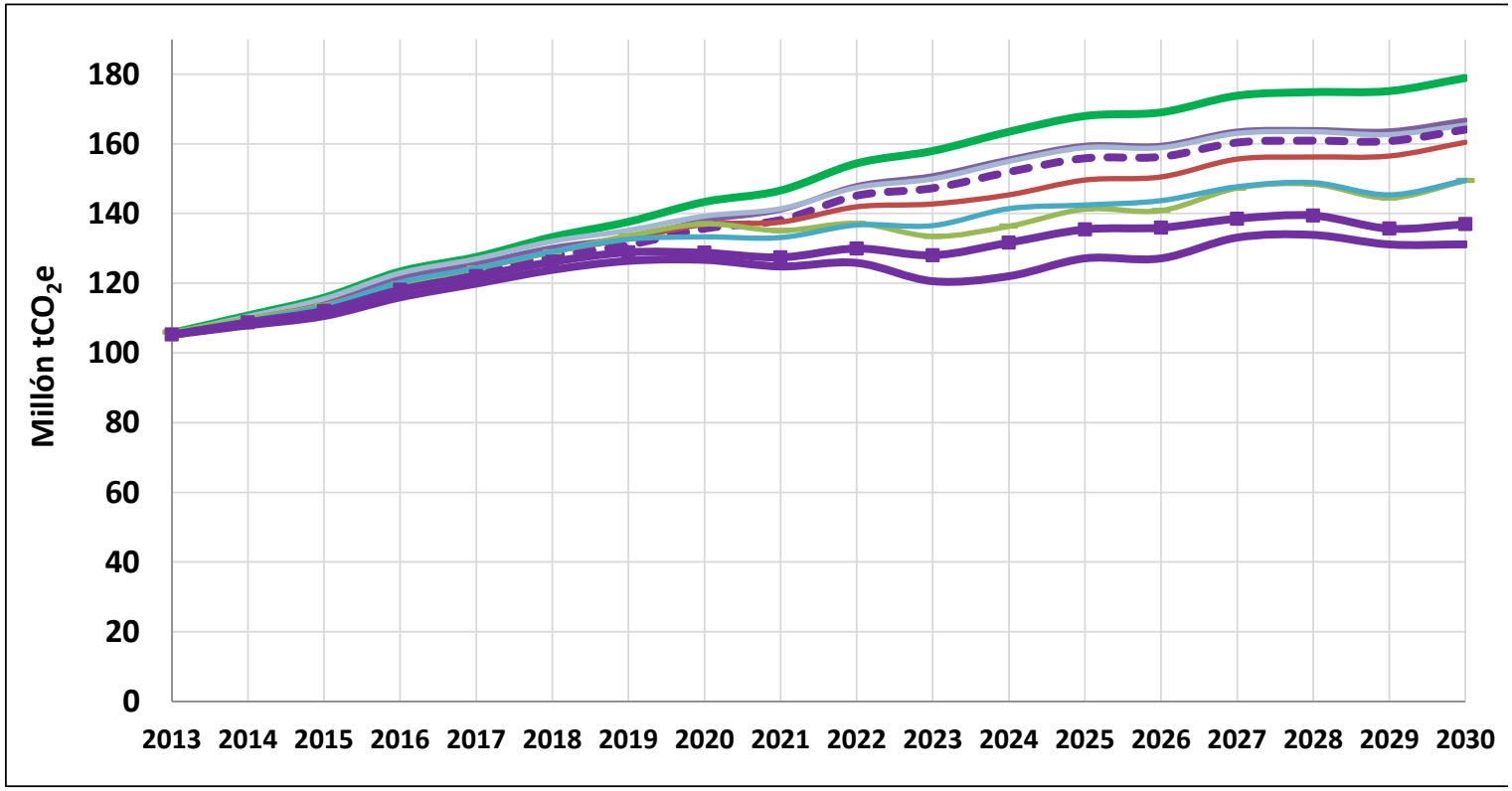
Results: GHG Emission Projections for every scenario



Results (without forestry sector)



Results (without forestry sector)

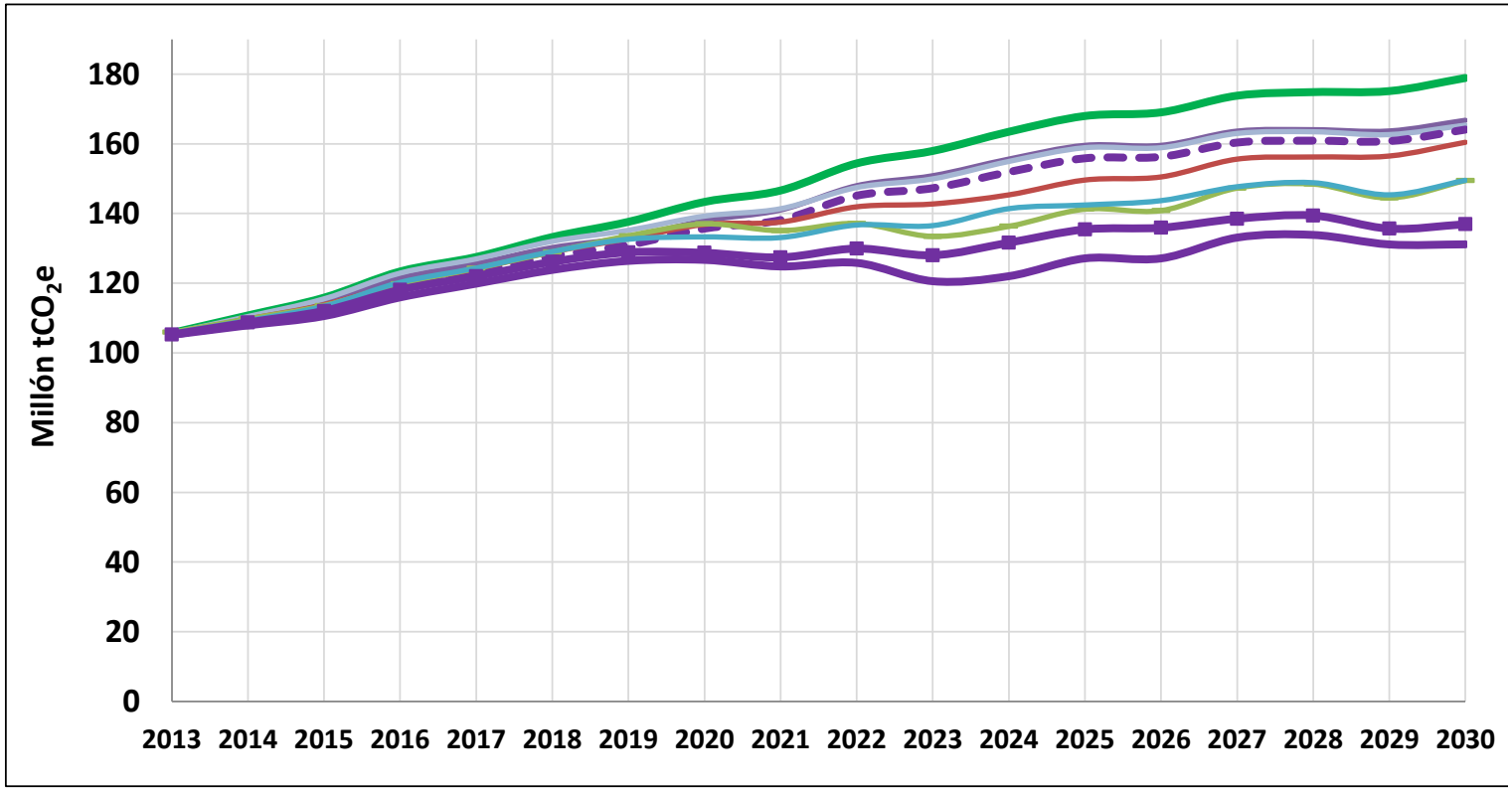


emission reduction

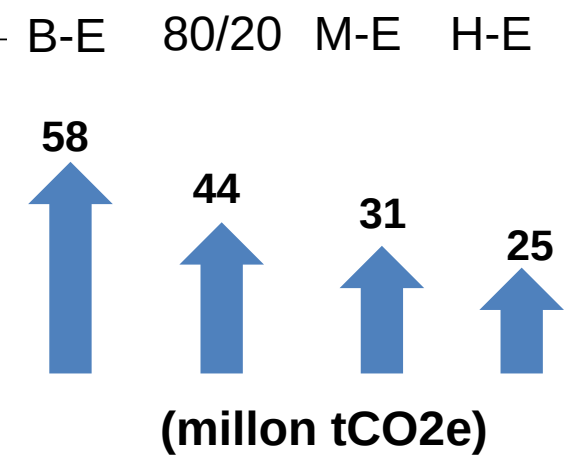
B-E	80/20	M-E	H-E
15	29	42	46

(millon tCO2e)

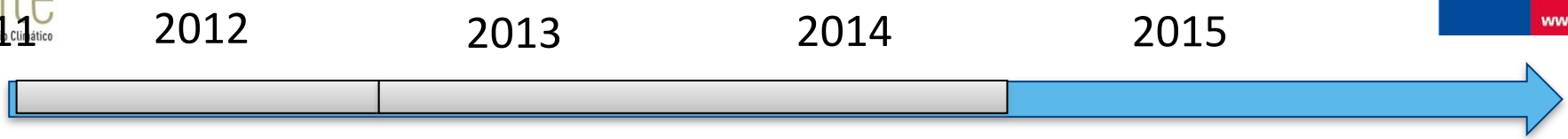
Results (without forestry sector)



emission budget (2030-2013)



Phases of MAPS-Chile



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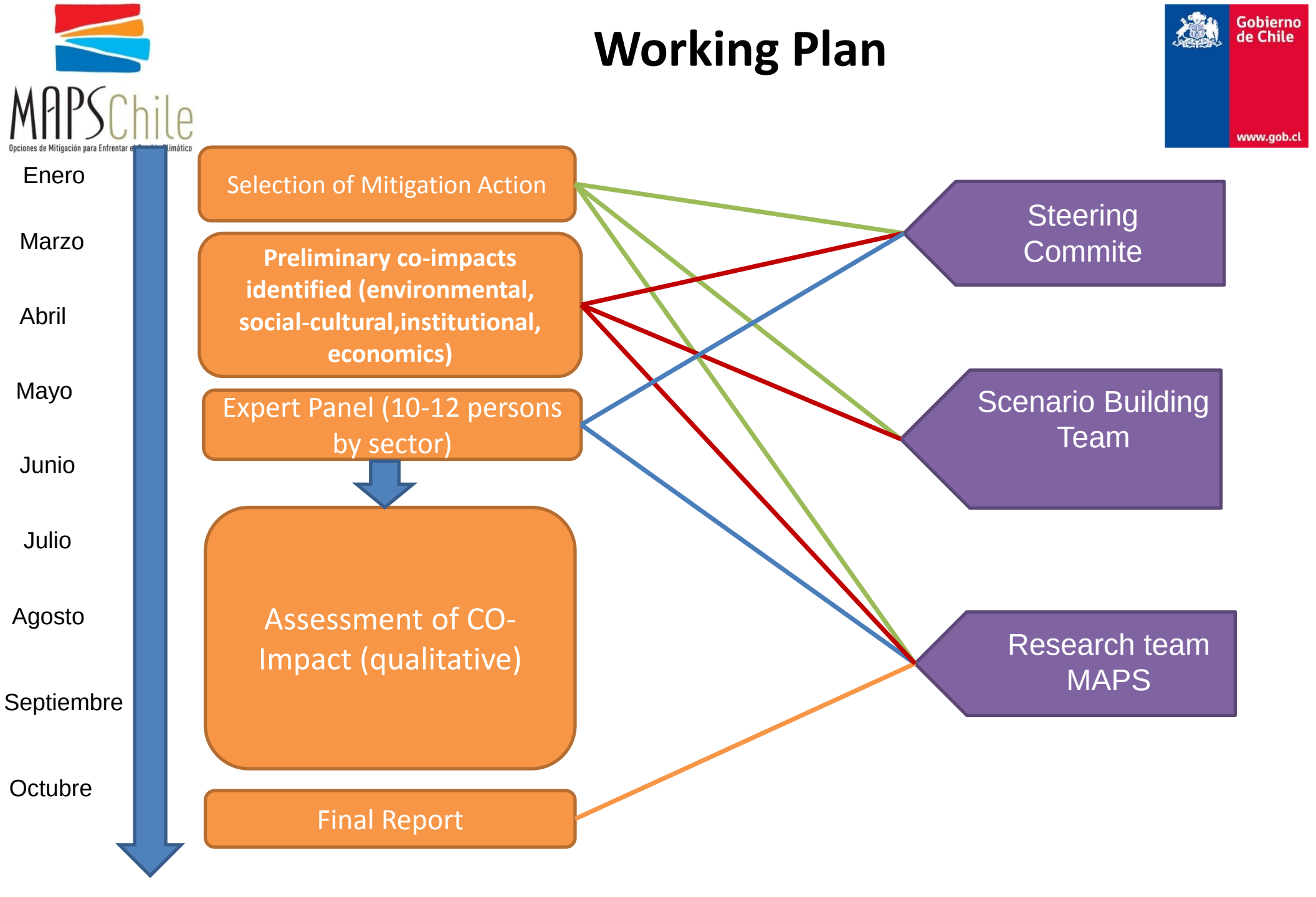
(Work in Progress)

Methodology

- More than 96 mitigation actions were analyzed in Phase 2
- A little group of mitigation actions were selected (due to time and budget constraint) -> 11 mitigation actions selected
- Dimensions of CO-Impacts: Environmental, social-cultural, institutional-political, social-economic
- CO-Impacts are evaluated by a Expert Panel (1 by sector, 10-12 people by Panel) using a qualitative criterium

Working Plan



Selected Mitigation Actions

Sector	Mitigation Action
Electricity Generation	Exploit the hydroelectric resources of the extreme South of Chile (Aysén)
	Clean Coal
Transport	CO2 target for new vehicles
	Infraestructure to Bus Rapid Transit (BRT)
	Extension urban passenger trains
CPR	Energy Rating and Thermal Reconditioning of Existing Housing
	Residential Electricity Self Supply
Industry and Mining	Energy Managment System
Forestry	Forestatation Promotion
Agriculture	Carbon sequestration in agricultural soils by applying organic matter
Waste	Composting plant

Example of CO-Impacts: CO2 target for new vehicles

Dimension	CO-Impact
Environmental	Reduction of local emissions (NOX, SO2, PM2.5, PM 10)
Environmental	Decrease of noise
Social-Cultural	Decrease of disease related to air quality
Institutional-Political	Contribute to the sectorial politic objetives
Social-Economic	Increase electric demand
Social-Economic	Contribute to local economy
Social-Economic	Increase cost of vehicles
Social-Economic	Decrease equity

Example of Co-Impacts: Infraestructure to Bus Rapid Transit (BRT)

Dimension	CO-Impact
Environmental	Reduction of local emissions (NOX, SO2, PM2.5, PM 10)
Environmental	Decrease of noise
Social-Cultural	Increase/Decrease travel time
Social-Cultural	Decrease of diseases related to air quality
Social-Cultural	Increase spatially segregated
Institutional-Political	Increase/Decrease traffic congestion
Institutional-Political	Increase use of public transport
Institutional-Political	Contribute to the sectorial politic objetives
Social-Economic	Valuation / Devaluation of land use
Social-Economic	Increase equity

Example of CO-Impacts: Energy Rating and Thermal Reconditioning of Existing Housing

Dimension	CO-Impact
Environmental	Increase/Decrease respiratory diseases and premature deaths
Social-Cultural	Increase thermal comfort
Institutional-Political	Promote intitucional capacity to adapation to climate change
Social-Economic	Decrease energy expenses
Social-Economic	Creating new markets (energy rating)
Social-Economic	Market transparency when people will buy a new house

Some Comments

- In order to assess CO-Impacts (Phase 3), more detailed information is required than the information used to evaluate CO2 emission reduction and abatement cost (Phase 2)

- Some of the co-impacts depend on how the mitigation is (or will be) implemented

- For example, conflict with the communities, impact on biodiversity, etc. of energy projects depends on how the project is developed in every stage

Annex

Mitigation actions: Transport sector

Mitigation action	Abatement cost (US$/tCO2)	Average Annual emission reduction (MM tCO2)	Comulative Annual emission reduction (MM tCO2)
Bycicle Infrastructure mode (Level 3)	-260	0.5	0.5
Fuel efficient driving (Level 3)	-259	0.0	0.5
Aerodynamic improvement for trucks (Level 3)	-193	0.1	0.6
Shift from road to waterway (Level 3)	-182	0.07	0.7
Technical asistance (Level 3)	-159	0.05	0.7
E-mobility for cabs (Level 2)	-128	0.0	0.8
Efficient labeling of tires for light vehicles (Level 3)	-107	0.1	0.9
CO2 target for new vehicles (Level 3)	**-98**	**2.1**	**3.0**
Scrapping trucks (Level 2)	-67	0.0	3.0
Shift from road to rail (Level 3)	-42	0.03	3.1
Technologycal improvement in air mode (Level 3)	90	0.3	3.4
Green zone (Level 2)	198	0.0	3.4
Bus Rapid Transit in Santiago (Level 3)	**261**	**0.2**	**3.6**
Zero o low emission vehicles (Level 2)	303	0.6	4.2
Electric bikes (Level 3)	555	0.0	4.2
Renewal of freight rails (Level 2)	651	0.0	4.2
Road pricing (Level 2)	791	0.0	4.2
Light vehicle scrappage (Level 2)	820	0.00	4.2
Bus Rapid Transit in Santiago (Level 3)	841	0.1	4.3
Public bycicle program (Level 3)	3,948	0.0	4.3
Urban rail expansion (Level 3)	**4,875**	**0.02**	**4.3**

Mitigation actions: CPR sector

Mitigation action	Abatement cost (US$/tCO2)	Average Annual emission reduction (MM tCO2)	Comulative Annual emission reduction (MM tCO2)
MEPS for residential lighting	-182	0.5	0.5
Replacement aerator program	-98	0.2	0.7
Increase in thermal regulation requirements	-77	0.1	0.8
MEPS for commercial refrigarators	-71	0.19	1.0
MEPS for residential refrigarators	-45	0.10	1.1
Residential electricity self supply (net-billing)	13	0.2	1.3
Program adoption of solar thermal systems	50	0.3	1.5
Energy Rating and Thermal Reconditioning of Existing Housing	202	0.2	1.8
Energy Rating and Thermal Reconditioning of New Housing	303	0.1	1.9
Labelling and MEPS for fluorescent Lamps and Ballasts	315	0.004	1.9
MEPS for washers	7,890	0.004	1.9

Mitigation actions: Waste sector

Mitigation action	Abatement cost (US$/tCO2)	Average Annual emission reduction (MM tCO2)	Comulative Annual emission reduction (MM tCO2)
Composting at homes (Level 3)	-30	0.01	0.0
Composting of municipal solid waste from fairs (Level 3)	-14	0.1	0.1
Electricity generation from biogas capture	0	0.1	0.2
Injection of biogas into the natural gas grid	1	0.1	0.2
Thermal utilization of biogas	7	0.1	0.4
Increase biogas capture and burning using torches (Level 1)	9	1.0	1.3
Biological mechanical treatment of waste	15	1.2	2.5
Composting plant (Level 3)	17	0.1	2.6
Anaerobic digestion plants based on municipal solid waste (Le	24	0.2	2.8
Increasing recycling rates (Level 2)	353	0.1	2.9

Mitigation actions: Industry and Mining

Mitigation action	Abatement cost (US$/tCO2)	Average Annual emission reduction (MM tCO2)	Comulative Annual emission reduction (MM tCO2)
Inversión en energías renovables para usos térmicos en la industria y minería, nueva y existente	-99	0.4	0.4
Restricción a la entrada de motores eléctricos ineficientes, mediante estándares mínimos de efic	-69	0.2	0.6
Impulso al uso eficiente de la energía en la industria, a través de la realización de auditorías ene	-62	0.7	1.2
Sistema de Gestión de la Energía	**-54**	**1.0**	**2.2**
Recambio de motores eléctricos en el sector industrial y minero	-53	0.0	2.3
Promoción de la aplicación de un estándar (voluntario) de criterios de eficiencia energética en nu	-11	0.6	2.9
Implementación de sistemas para recuperar excedentes de calor de procesos térmicos, en la indu	3	0.1	3.0
Implementación de medidas de eficiencia energética para el transporte en la minería	6	0.9	3.9
Restricción a la entrada de mediante estándares mínimos de eficiencia (MEPS)	19	0.2	4.1
Desarrollo de proyectos de autogeneración de energía eléctrica con ERNC en plantas industriales y mir	25	0.3	4.5
Impulso de la industria minera a proyectos de generación eléctrica con ERNC en el mercado eléctrico y	30	0.3	4.7
Instalación de cogeneración para plantas existentes	98	0.3	5.0
Instalación de sistemas de captura y almacenamiento de CO2 (CAC) en subsectores de alta intensidad	103	0.1	5.1
Incentivo al uso de combustibles convencionales de bajas emisiones de GEI para usos térmicos en el se	159	0.2	5.3
Recuperación de energía potencial de caídas de material en la minería	619	0.1	5.4
Fomento a la utilización de combustibles no convencionales de bajas emisiones de GEI para usos térm	650	0.1	5.5

Mitigation actions: Agriculture

Mitigation action	Abatement cost (US$/tCO2)	Average Annual emission reduction (MM tCO2)	Comulative Annual emission reduction (MM tCO2)
Utilización de energías renovables no convencionales en agricultura (ERNC) en riego	-29	0.1	0.1
Secuestro de carbono en suelos agrícolas por aplicación e incorporación de materia orgánica est	-20	0.1	0.2
Uso de fertilizantes con inhibidores del ciclo del nitrógeno	0	0.1	0.3
Secuestro de carbono atmosférico por los suelos, mediante la cero labranza	2	0.0	0.3
Fomento a la agricultura orgánica	14	0.1	0.4
Implementación de biodigestores	20	0.1	0.4
Mejoramiento de la dieta de alimentación en bovinos	25	0.2	0.6
Mejoramiento genético vegetal	62	0.0	0.7

Mitigation actions: Electricity generation sector

Mitigation action	Abatement cost (US$/tCO2)	Average Annual emission reduction (MM tCO2)
Gestión de la Demanda: Disminución del voltaje	-49	0.2
Interconexión regional	-12	3.4
Disminución de Pérdidas Eléctricas	-7	2.1
Generación eléctrica en obras de riego (Nivel 2)	-7	1.1
Expansión Hidroeléctrica en Aysén	-3	16.4
Incentivo a Energía Nuclear (Nivel 1)	-1	5.9
Incentivo a una tecnología específica ERNC - Mini-hidro (Nivel 2)	-1	2.8
Modificación de la Ley ERNC: 30/30	0	5.3
Norma o incentivo a tecnologías a carbón más limpias	1	3.0
Incentivo a una tecnología específica - Geotérmica (Nivel 2)	3	5.0
Incentivos a tecnología especifica - Eólica (Nivel 2)	4	16.4
Sistema de almacenamiento de energía (Nivel 1 - Eólico)	5	4.4
Incentivo a una tecnología específica – Solar Fotovoltaica (Nivel 2)	7	10.3
Aumento sustantivo de la generación con GNL (Subsidio GNL)	9	3.8
Sistema de almacenamiento de energía (Nivel 2 - Solar)	9	1.4
Incentivo a una tecnología específica – Concentración Solar (Nivel 2)	23	6.6

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