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Low Carbon Options and GHG Abatement Potential in Agriculture and Energy using Sectors in Nepal

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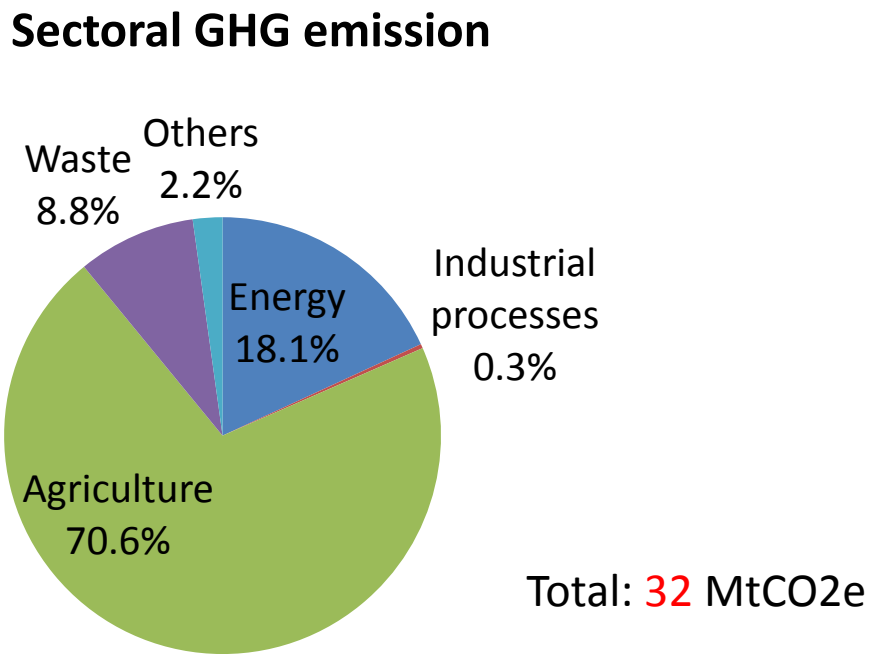
Sectoral GHG emission mix in 2010



Sources: IEA (2012)

- Agriculture has the highest share in the national GHG emission in 2010
- Energy using activities account for 18.1%

Methodology

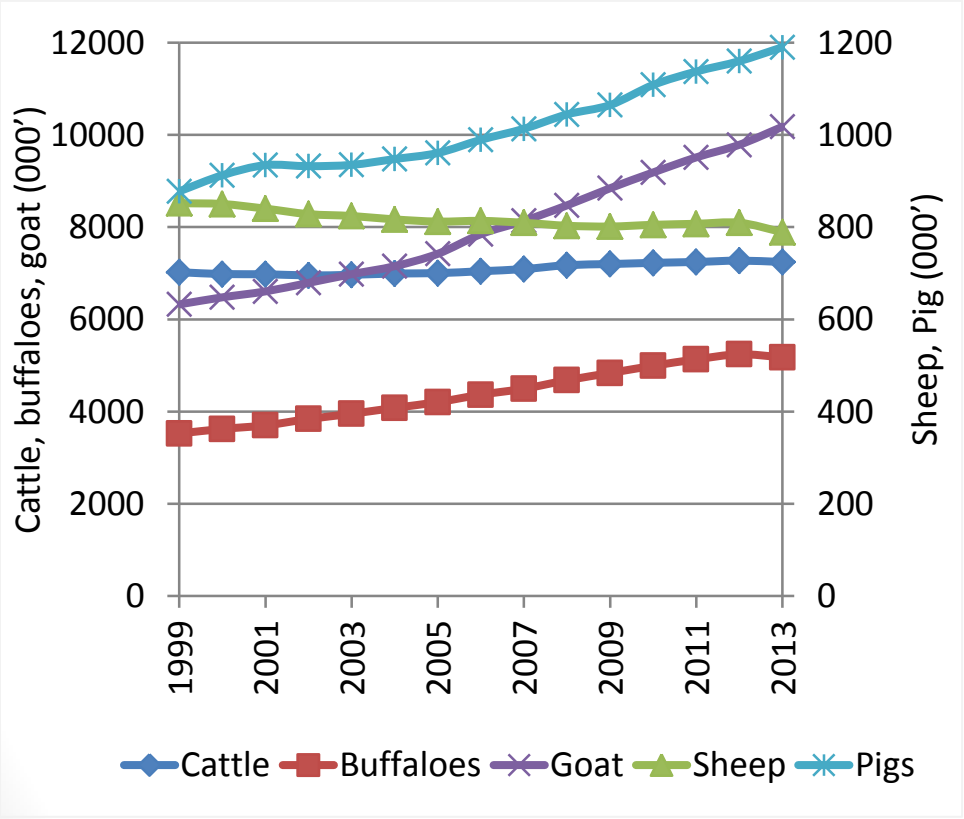
- AFOLU-B model for agriculture sector
- AIM/Enduse for energy using sector

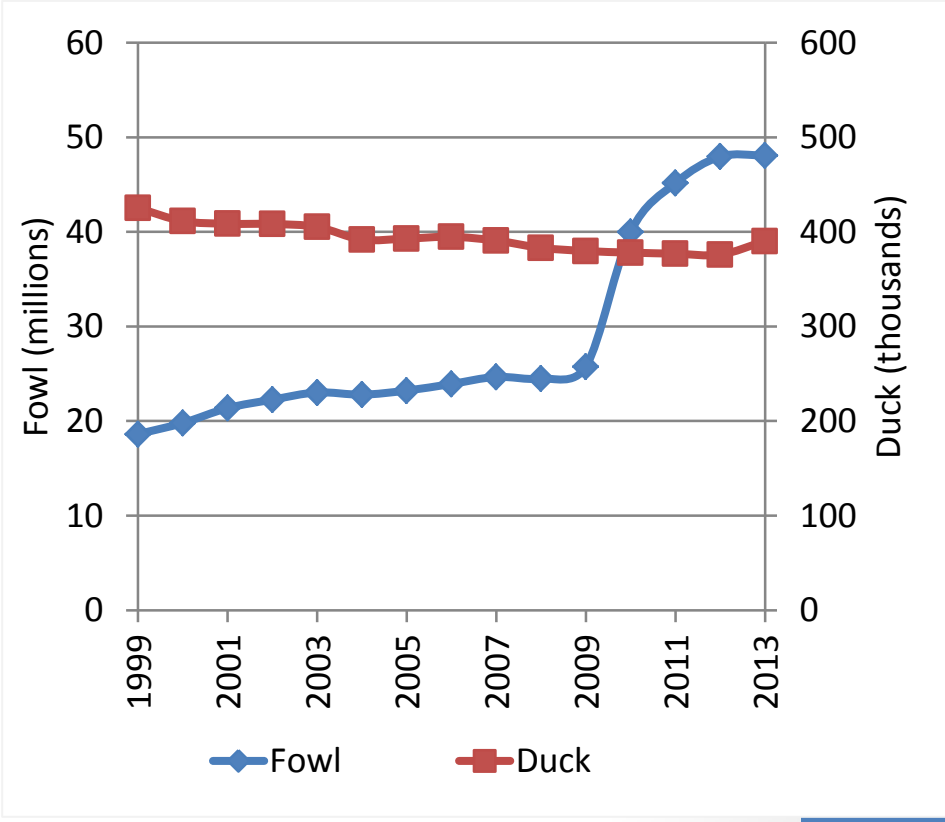
Scenarios considered

- BAU, no-regret and four GHG emission tax scenarios with tax rates of
  - 10 USD/tCO2e (CT10)
  - 100 USD/tCO2e (CT100)
  - 300 USD/tCO2e (CT300)
  - 500 USD/tCO2e (CT500)

GHG Mitigation from Agriculture Sector

Growth in Livestock during 1999-2013



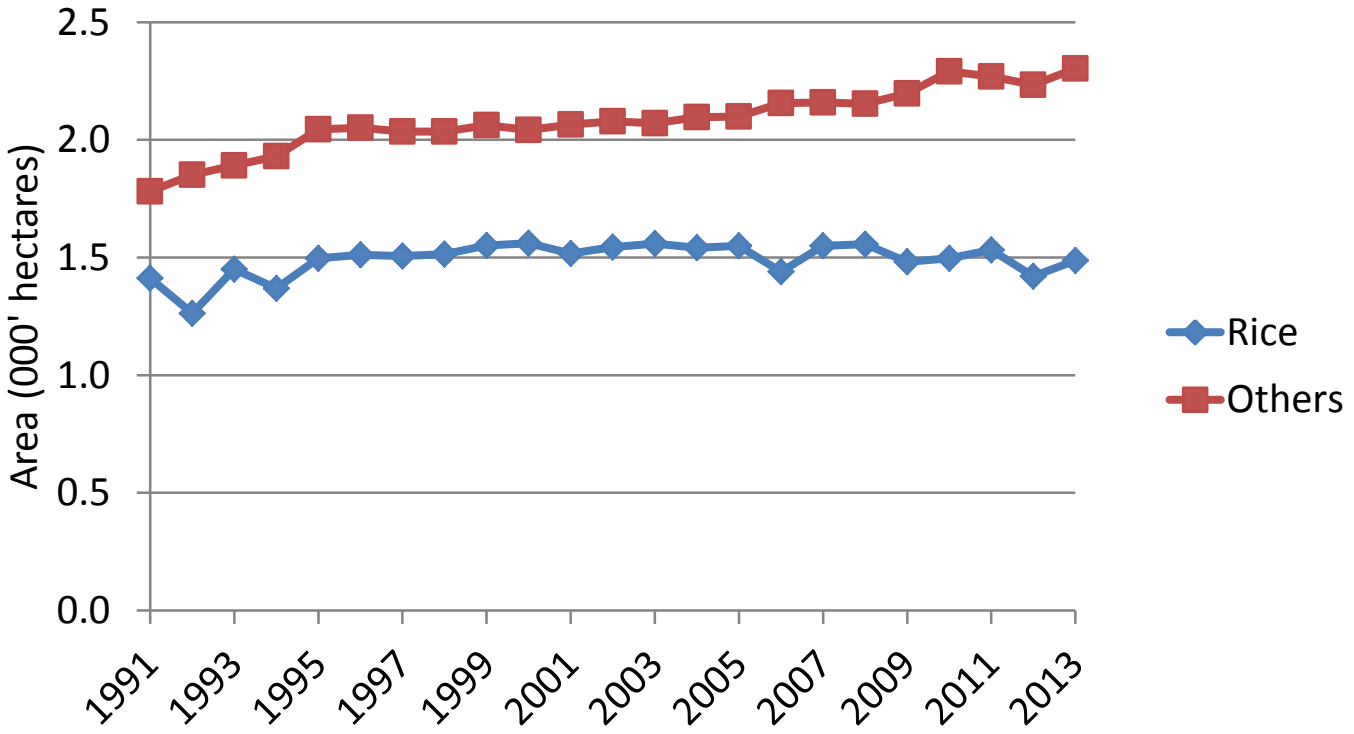


- AAGR
- Cattle : 0.2%
- Buffalo: 2.8%

- Goat: 3.5%.
- Pig: 2.2%

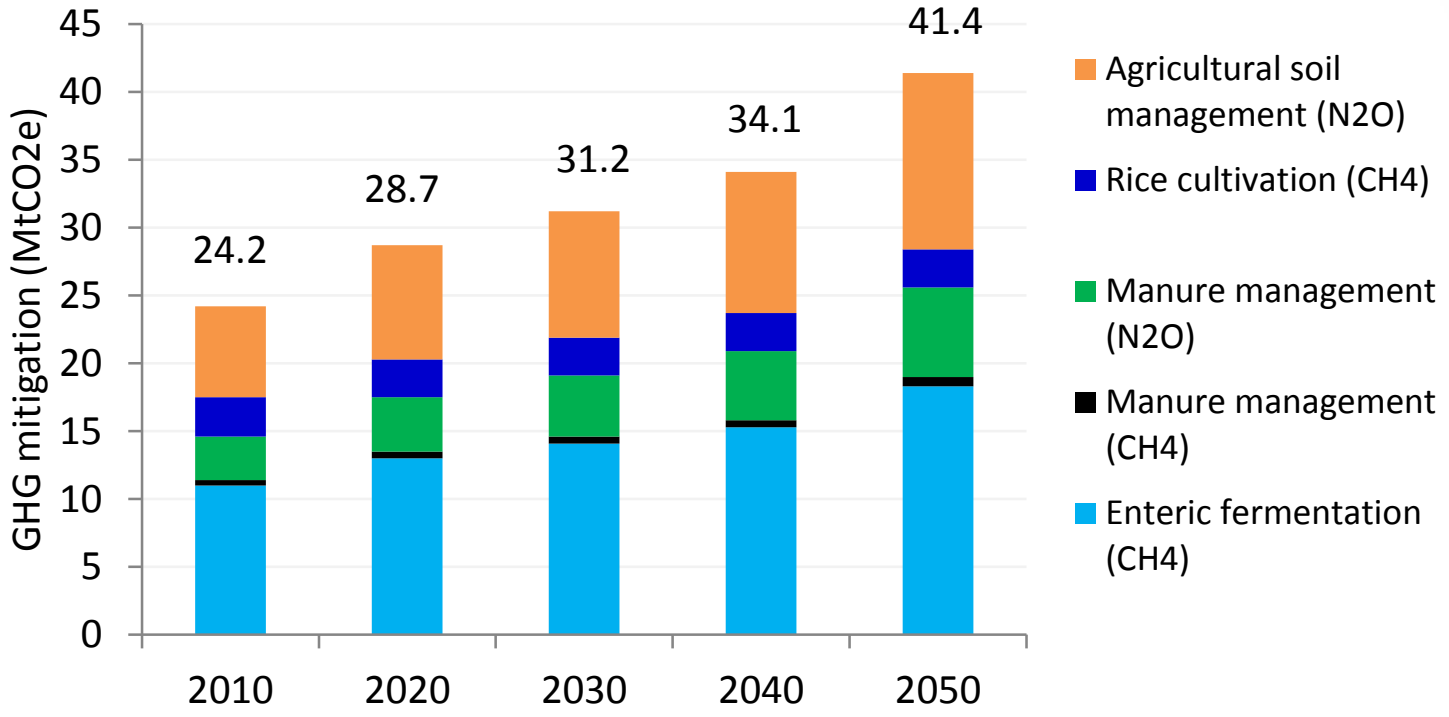
- AAGR
- Fowl: 7.7%
- Duck: -0.6%

Growth in cultivated area during 1999-2013



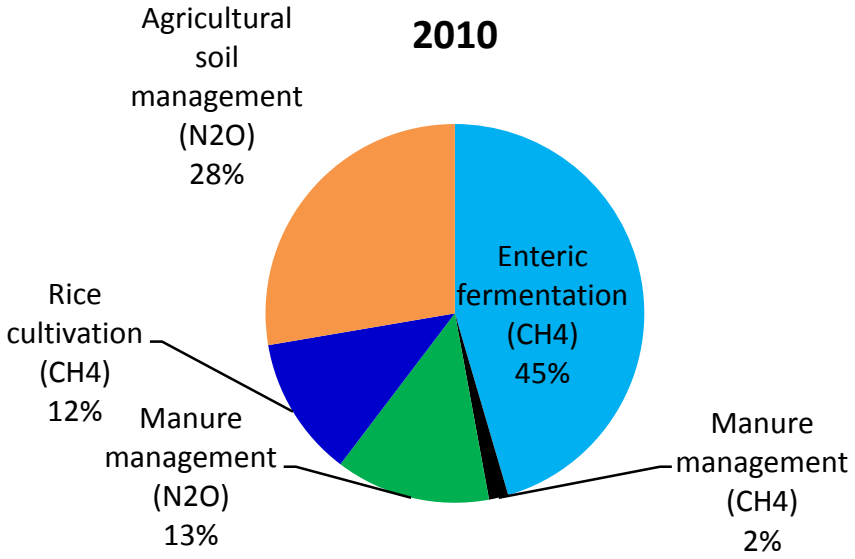
- AAGR
- Rice: 0.2%
- Other crops: 1.1%

GHG emission from agriculture during 2010-2050 in BAU case

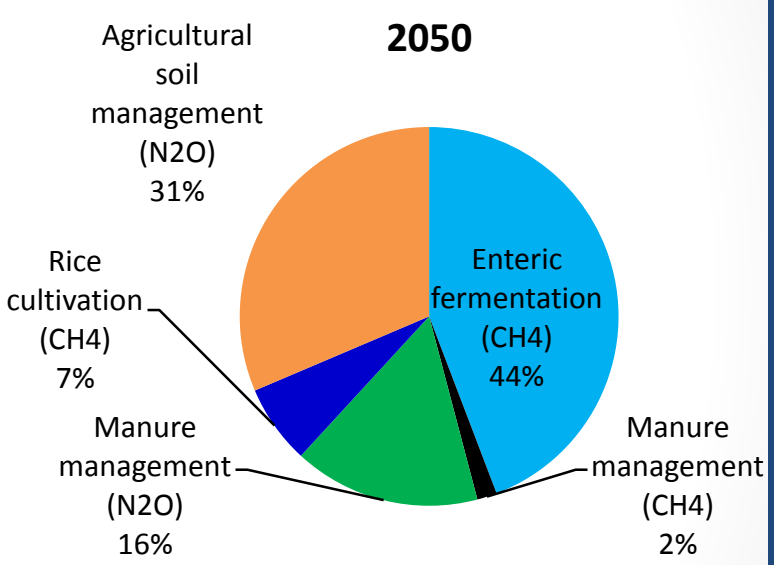


- Total emission increases at CAGR of 1.4%.
- CH4 Emission from rice cultivation remains almost constant
- During 2010-2050, emission increase by
  - CH4 from enteric fermentation: 70%
  - CH4 from manure management: 80%
  - N2O from manure management: 110%
  - N2O form agricultural soils: 90%

Structure of GHG emission in agriculture in BAU case



Total: 24.2 MtCO2e



Total: 41.4 MtCO2e

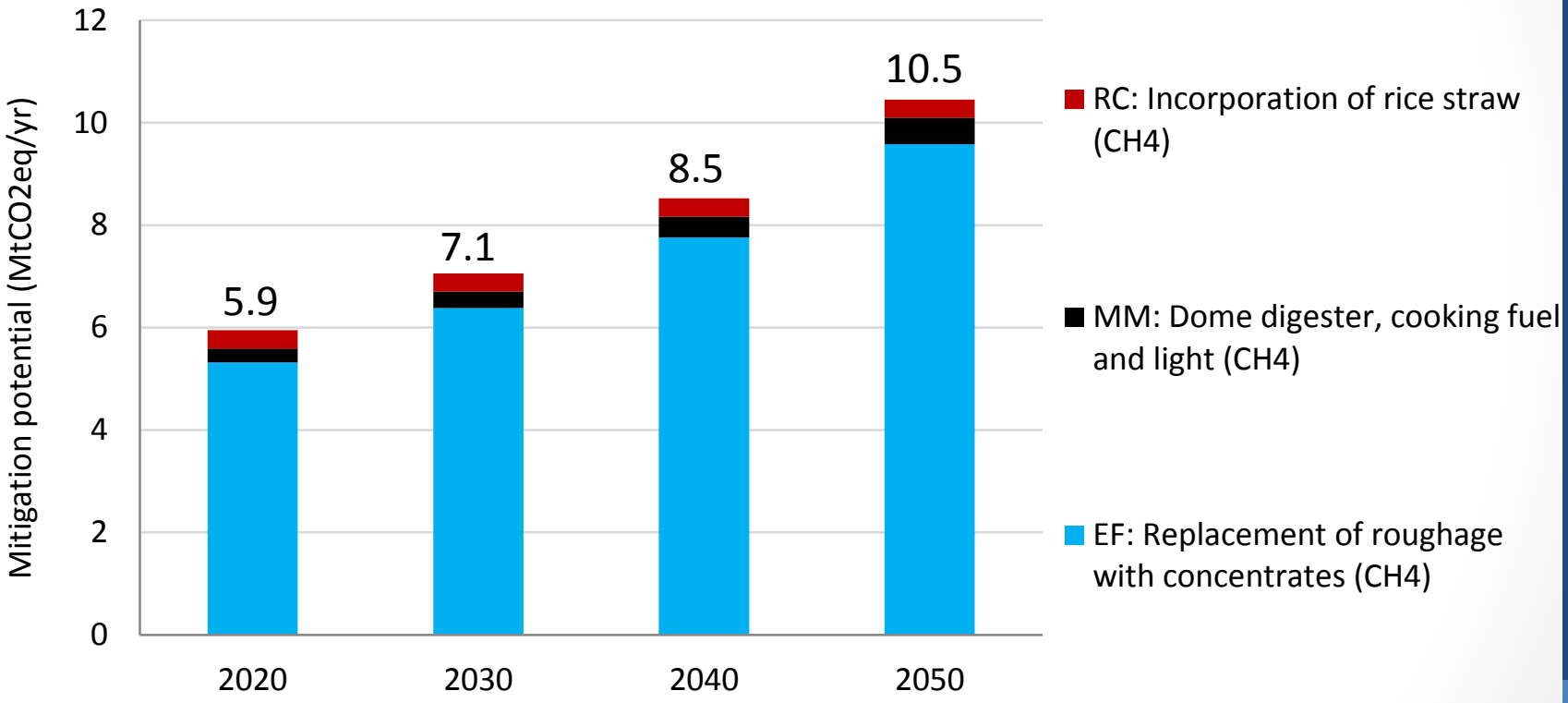
- Enteric fermentation and agri. soil management- the two largest contributors
- Emission related to agricultural soil management increases from 28% to 31%
- Share of N2O from manure management increases from 13% to 16%.
- Share of CH4 from rice production **decreases** from 12% to 7%.

The set of mitigation options varies with the emission tax rate

	CT0	CT10	CT100	CT300	CT500
EF1: High genetic merit (CH4)					
EF2: Replacement of roughage with concentrates (CH4)					
MM1: Daily spread of manure (CH4)					
MM2: Dome digester, cooking fuel and light (CH4)					
RC1: Midseason drainage (CH4)					
RC2: Off-season straw (CH4)					
ASM1:High efficiency fertilizer application (N2O)					
ASM2: Tillage and residue management (N2O)					
ASM3: Slow-release fertilizer (N2O)					

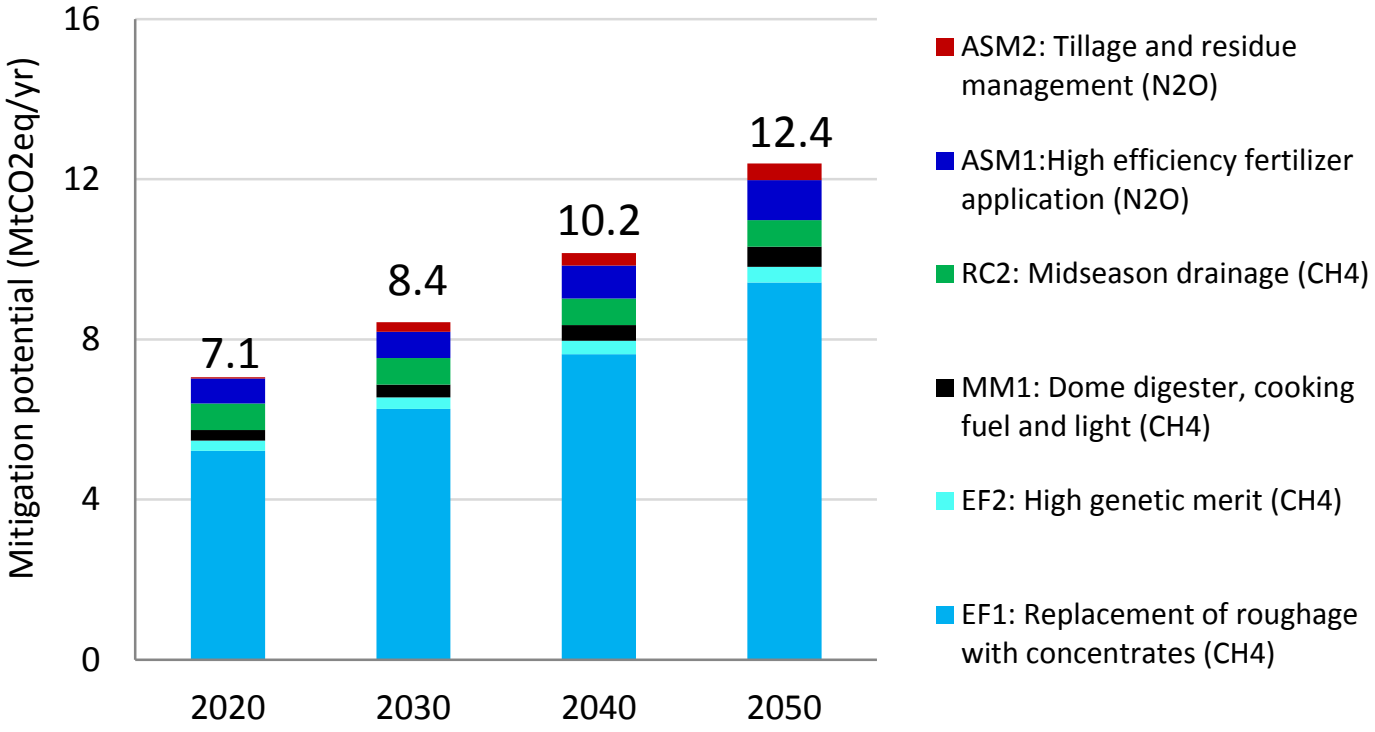
*EF - Enteric fermentation, MM- Manure management
RC -Rice cultivation, ASM- Agricultural soil management

GHG mitigation potential of no-regret options during 2020-2050



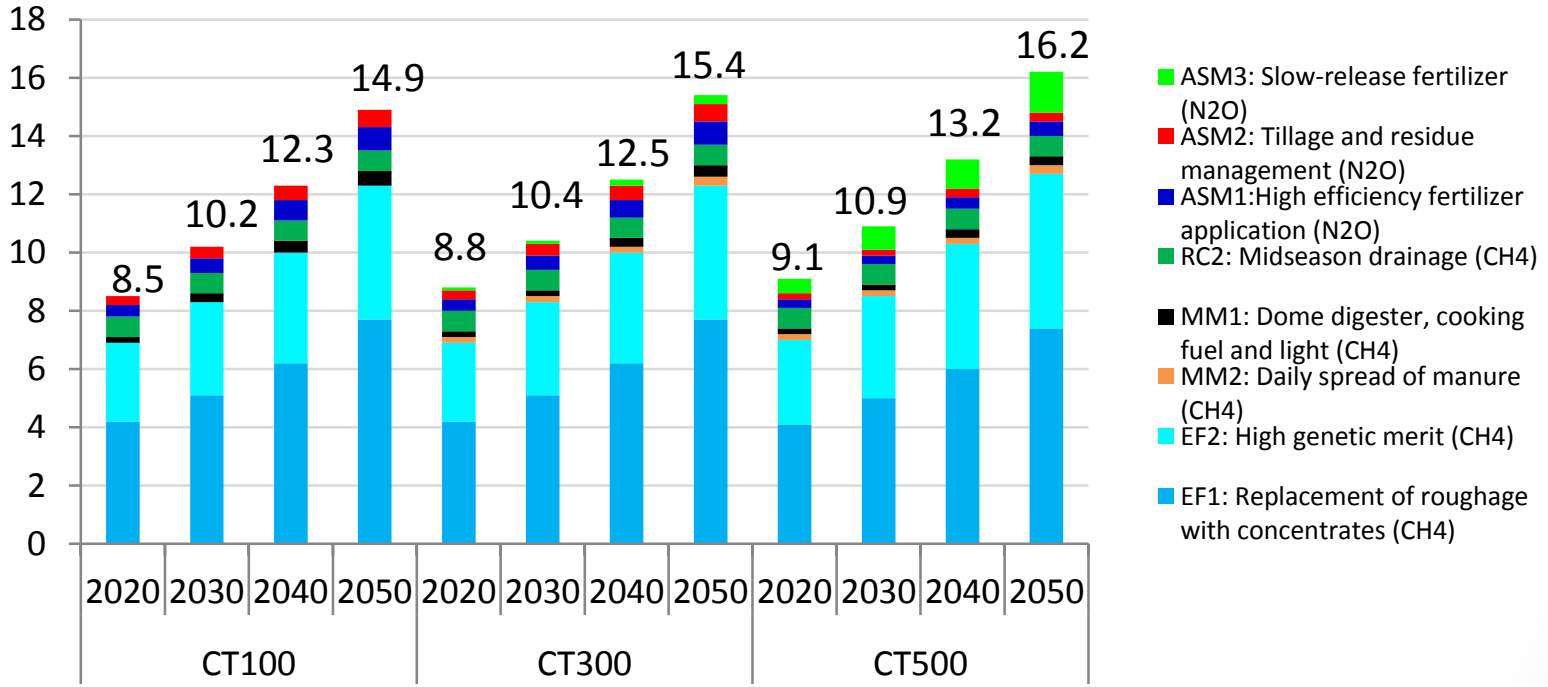
- Mitigation potential nearly doubled during the period
- Enteric fermentation has the highest mitigation potential
- Shares in agriculture sector GHG mitigation in 2050
  - Live stock management: 97%; Rice cultivation: 3%

GHG mitigation potential at $10/tCO2e



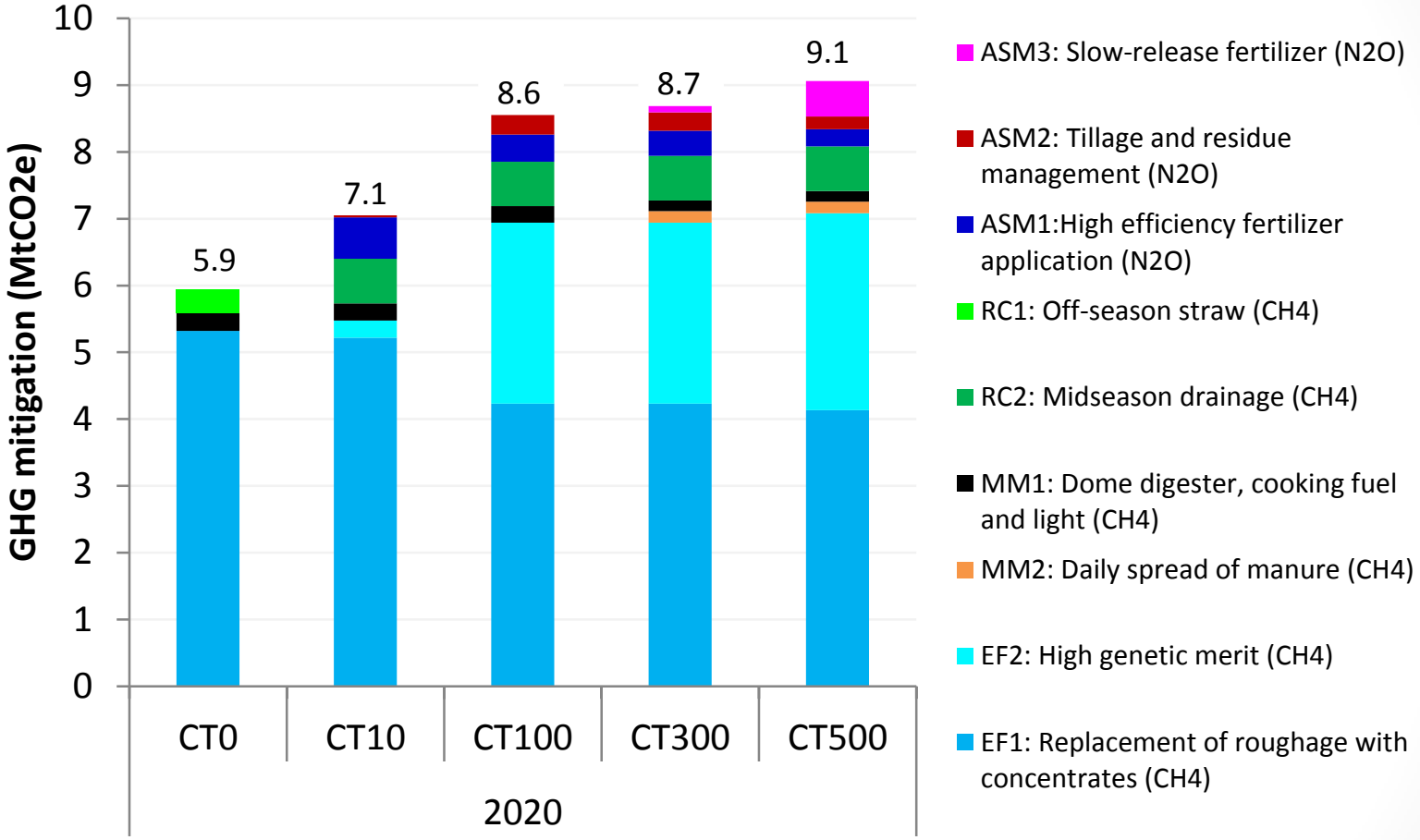
- Mitigation potential is highest in enteric fermentation.
- In 2050, share in total agriculture sector mitigation
  - Enteric fermentation: 79%; Rice cultivation:5%
  - Agricultural soil management: 11%; Manure management: 4%

Would GHG mitigation potential increase significantly at $100, $300, $500 per tCO2e?



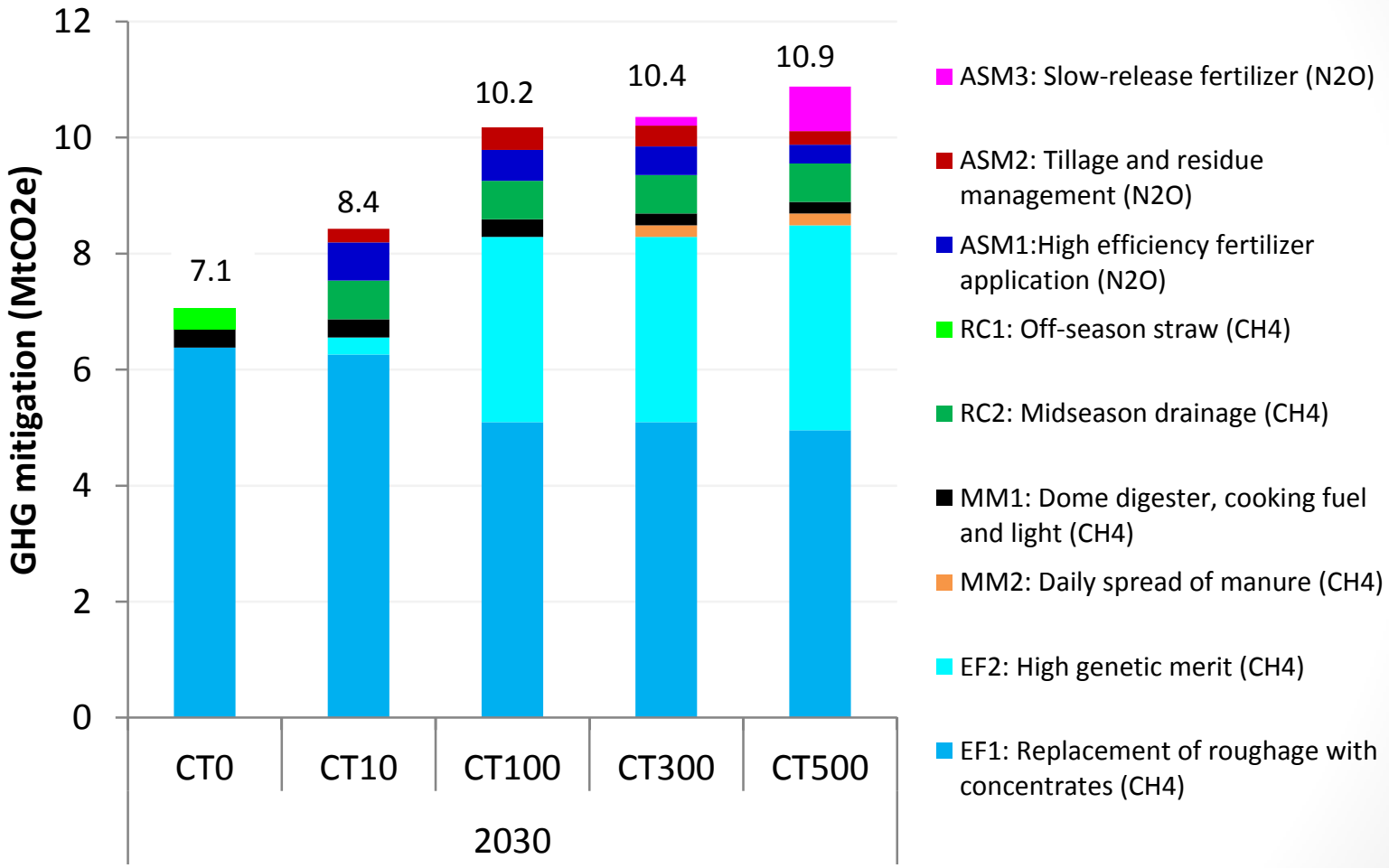
- **Overall, there is relatively small increase in abatement potential at high tax rates.**

GHG mitigation options and potential in 2020



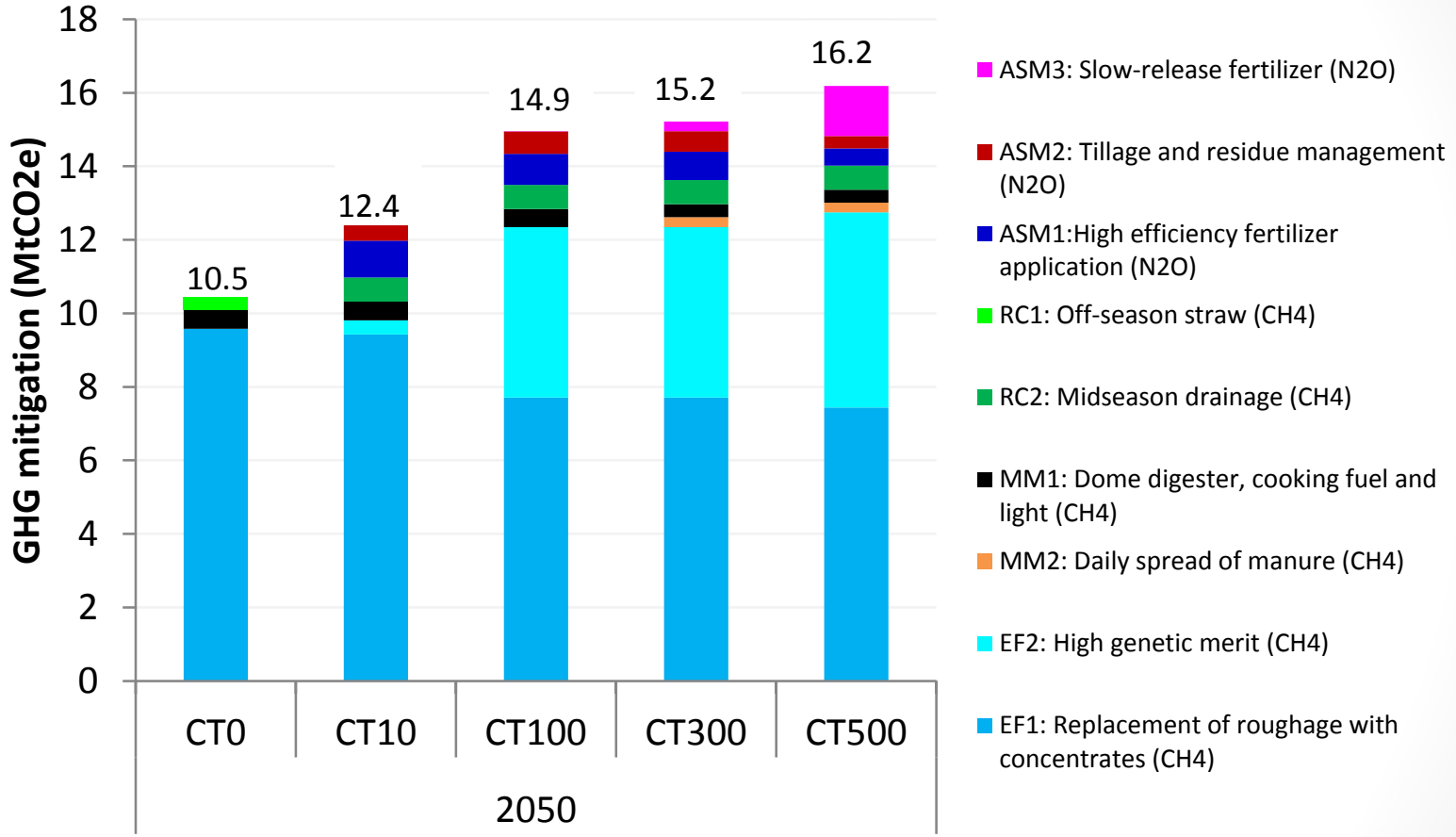
- Total mitigation potential does not change significantly after CT100
- Highest share of EF in mitigation; its share decreases with the emission tax.
- No change in RC related mitigation after CT10.

GHG mitigation options and potential in 2030



- The mix of mitigation options varies with the tax rate.
- At a particular tax rate, the mix remains unchanged during 2020-2050.

GHG mitigation options and potential in 2050



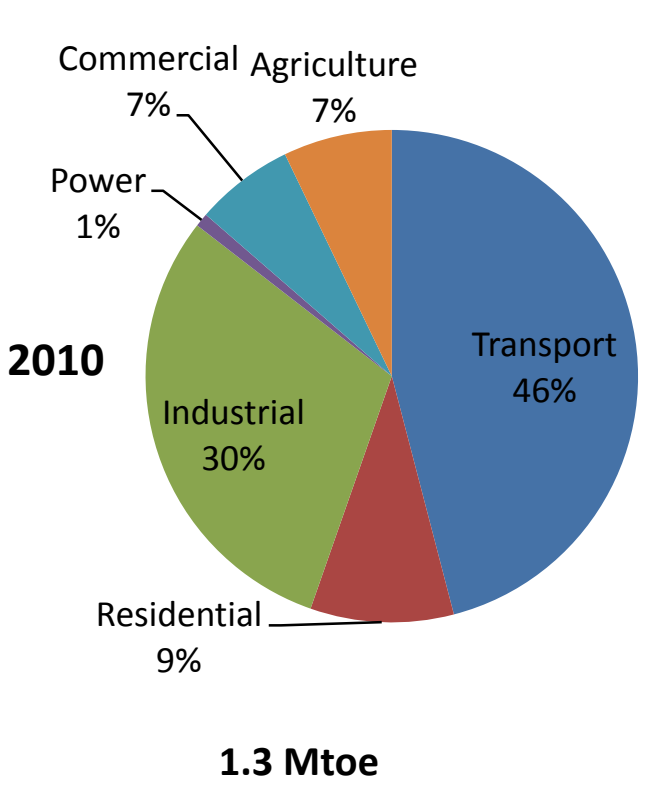
- Relatively small change in mitigation above the tax rate of $100/tCO2e.
- In 2050, GHG emissions decrease by
  - 25% with No-regret options
  - 30% with CT10
  - 36% with CT100, 37% in CT300 and 39% in CT500

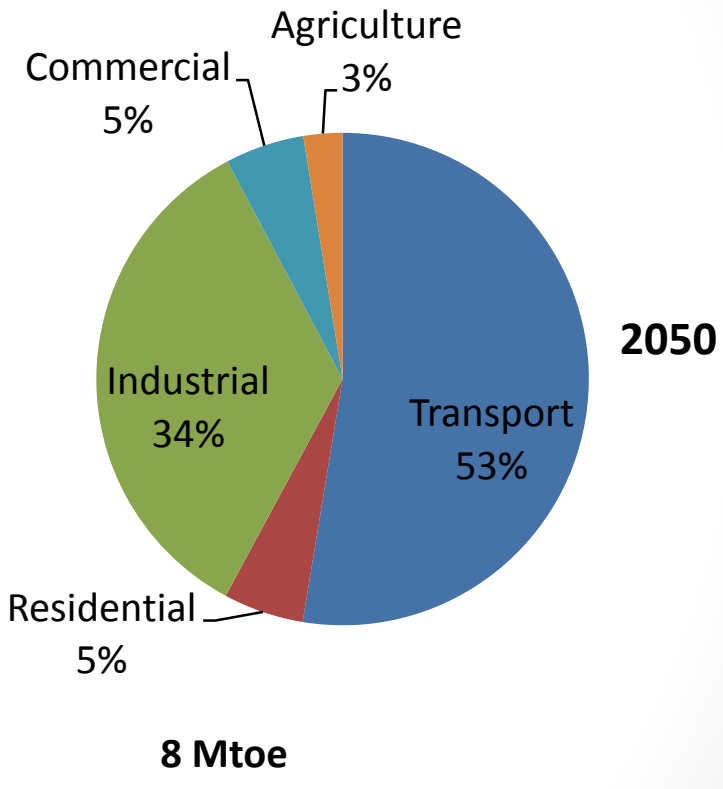
Emission Mitigation from energy using sectors

Economic and demographic growth considerations

- Medium variant of population projection (36% higher population by 2050 as compared to 2010)
- .Share of urban population to increase from 17% to 36% during 2010-2050
- GDP growth rate: 4% (2010-2015) and 5.56% (2015-2050)

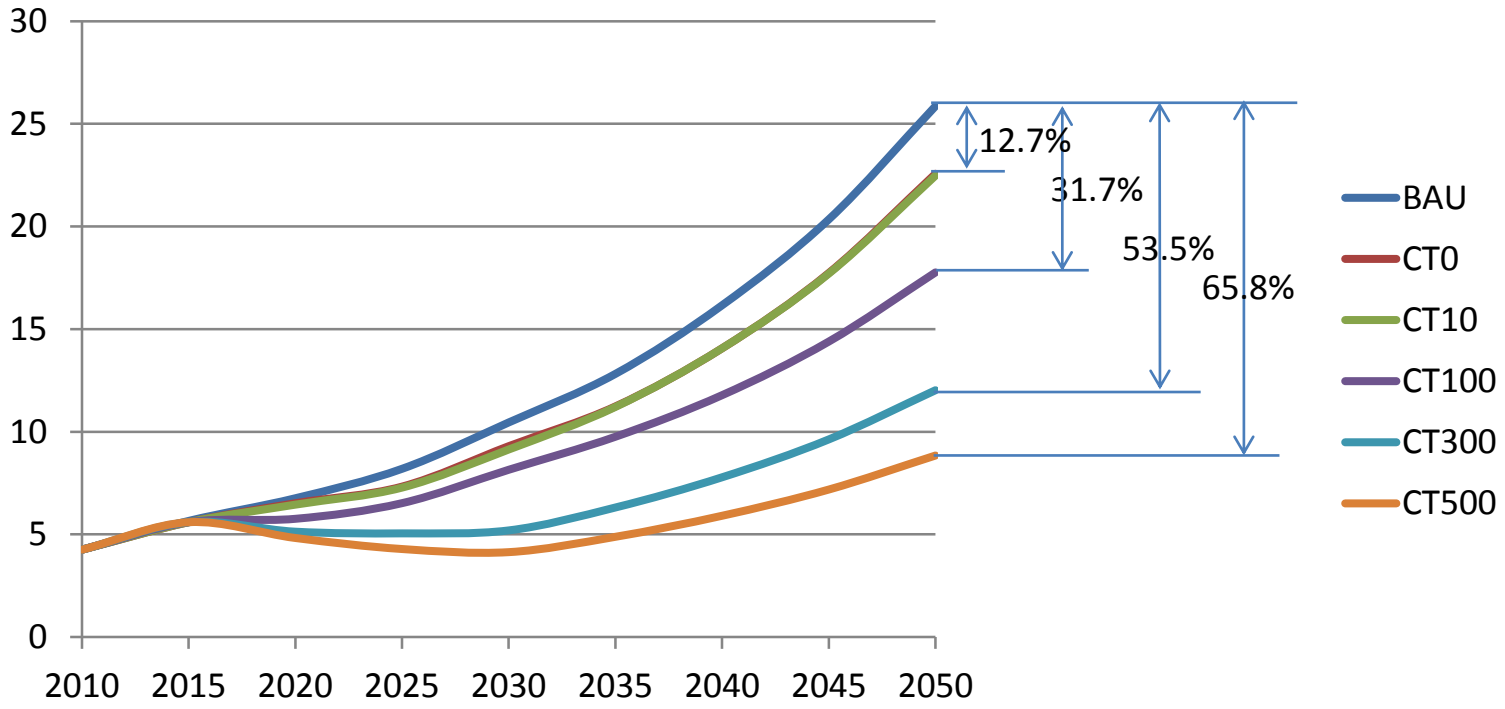
Sectoral Shares in Fossil Fuel Consumption in BAU scenario





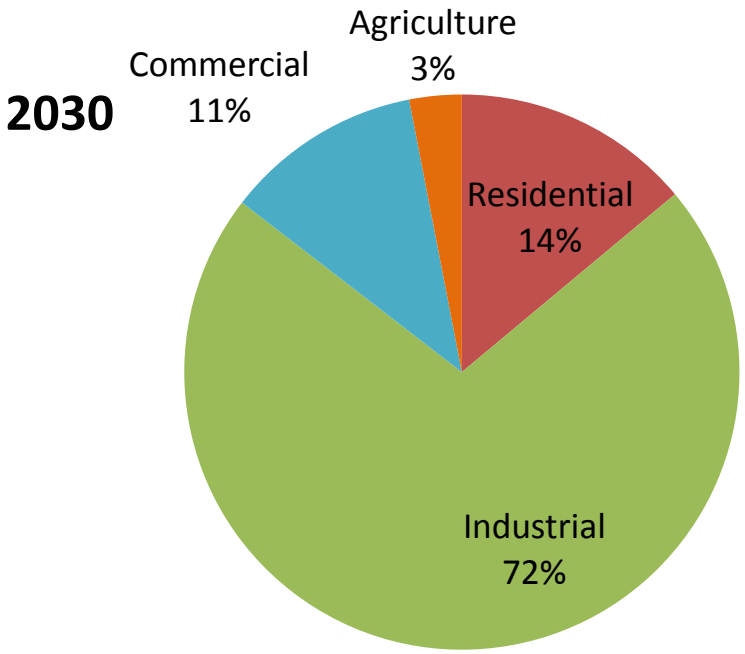
- Fossil fuel consumption increases by almost 5 times in 2050.
- Transport and industry – the two highest fossil fuel consuming sectors & their shares would be increasing.

GHG Emission in Different Scenarios

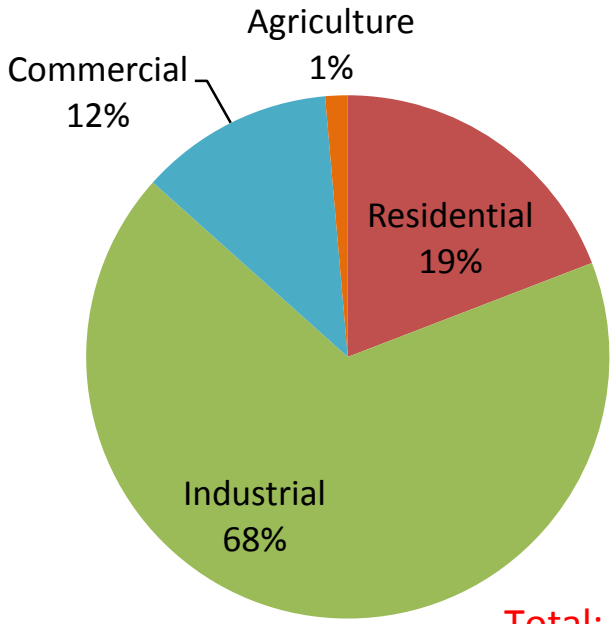


- **Emission increases from 4.3 MtCO2e in 2010 to 25.9 MtCO2e in 2050 in the BAU case.**
- **Cumulative GHG reduction during 2010-2050 in CT0, CT10 would be 10.8%, 11.1%, respectively**
- **At CT100, CT300 and CT500 it would be 23.3%, 44.1% and 53.9% respectively**
- **➔ low emission tax elasticity of GHG reduction.**

Sectoral Shares in GHG mitigation by no-regret options in 2030 and 2050



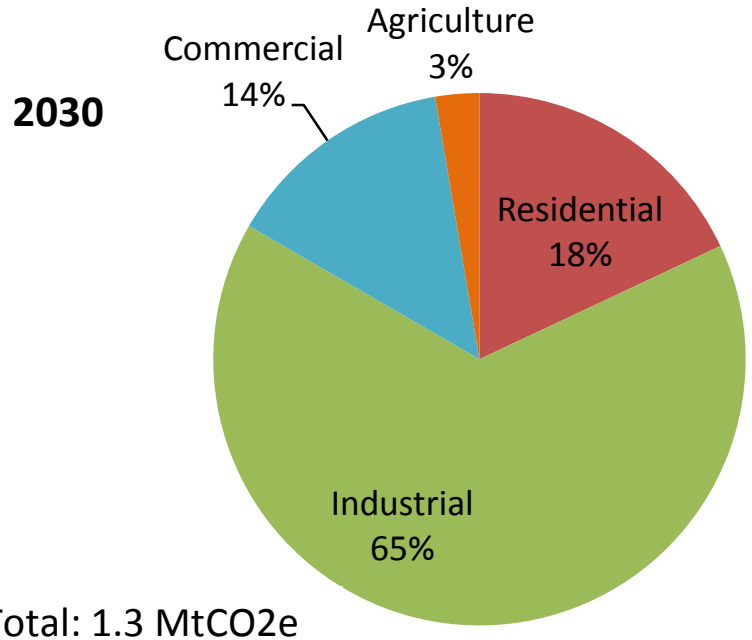
Total: 1.2 MtCO2e



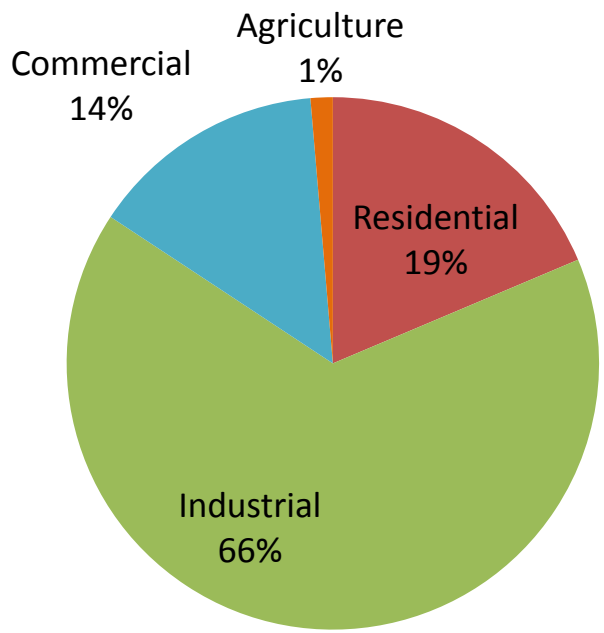
Total: 3.3 MtCO2e

- Industrial sector ranks the first in no-regret mitigation, then residential and commercial.
- Shares of industrial and agriculture sector decrease by 2050
- Shares of residential and commercial sectors increase by 2050

Industrial and Residential sectors - the main abatement options at $10/tCO2e



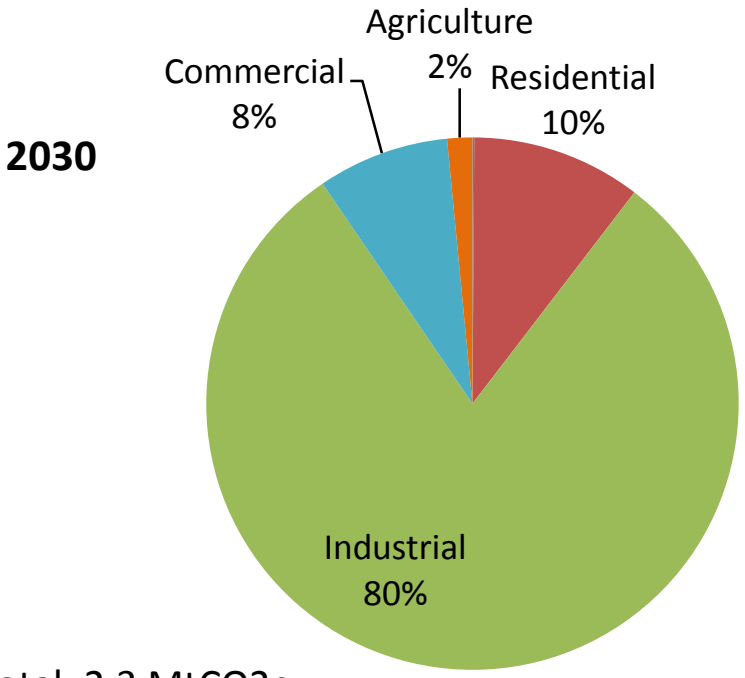
Total: 1.3 MtCO2e



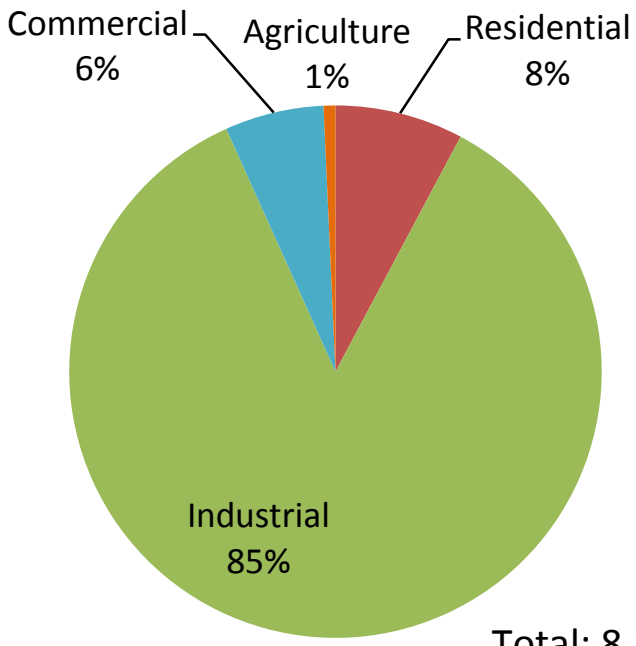
Total: 3.4 MtCO2e

- Sectoral ranking in GHG mitigation similar as in CT0.
- Share of industrial and agricultural sector decreases in 2050
- Share of residential and commercial increases in 2050

Industrial and Residential sectors - the main abatement options at $100/tCO2e



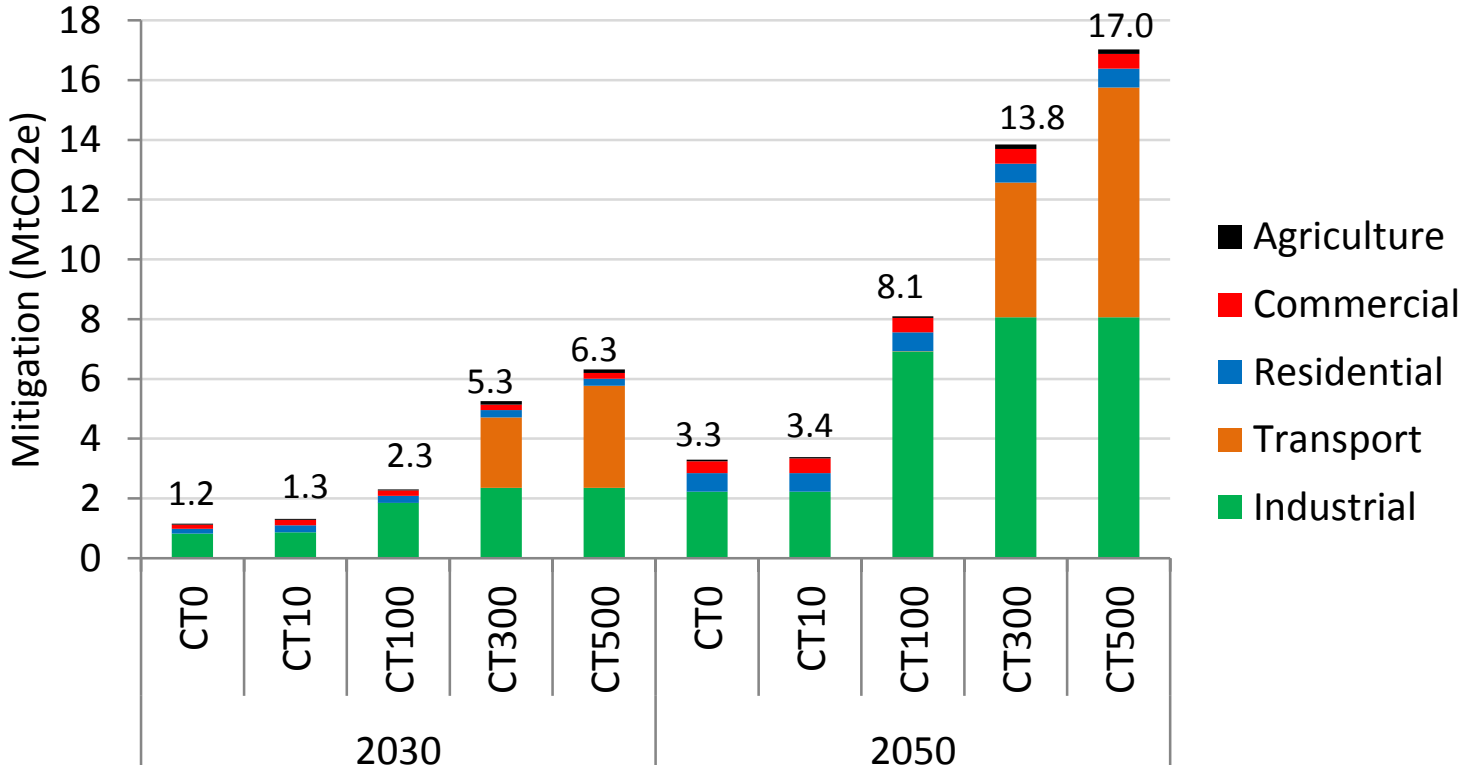
Total: 2.3 MtCO2e



Total: 8.1 MtCO2e

- Sectoral rankings similar as in no-regret case
- Increased share of industrial sector
- Reduced shares of residential, commercial and agricultural sectors

Transport options not attractive till $100/MtCO2e



- At CT0 sectoral shares in GHG mitigation in 2030:
  Industrial: 72%; Residential: 14%; Commercial: 12%; Agriculture: 3%
- At CT500, in 2030, share in mitigation from
  Transport : 54%, Industrial: 37%; Residential: 4%; Commercial: 3%; Agriculture: 2%

Cost-effective mitigation options in residential and commercial sectors

	Emission tax ($/tCO$_2$e)				
	CT0	CT10	CT100	CT300	CT500
Cost-effective options	Biogas cooking				
	Electric cooker				
	EE LPG stove				
	Solar water heater				
	Energy efficient bulbs (CFL & LED)				

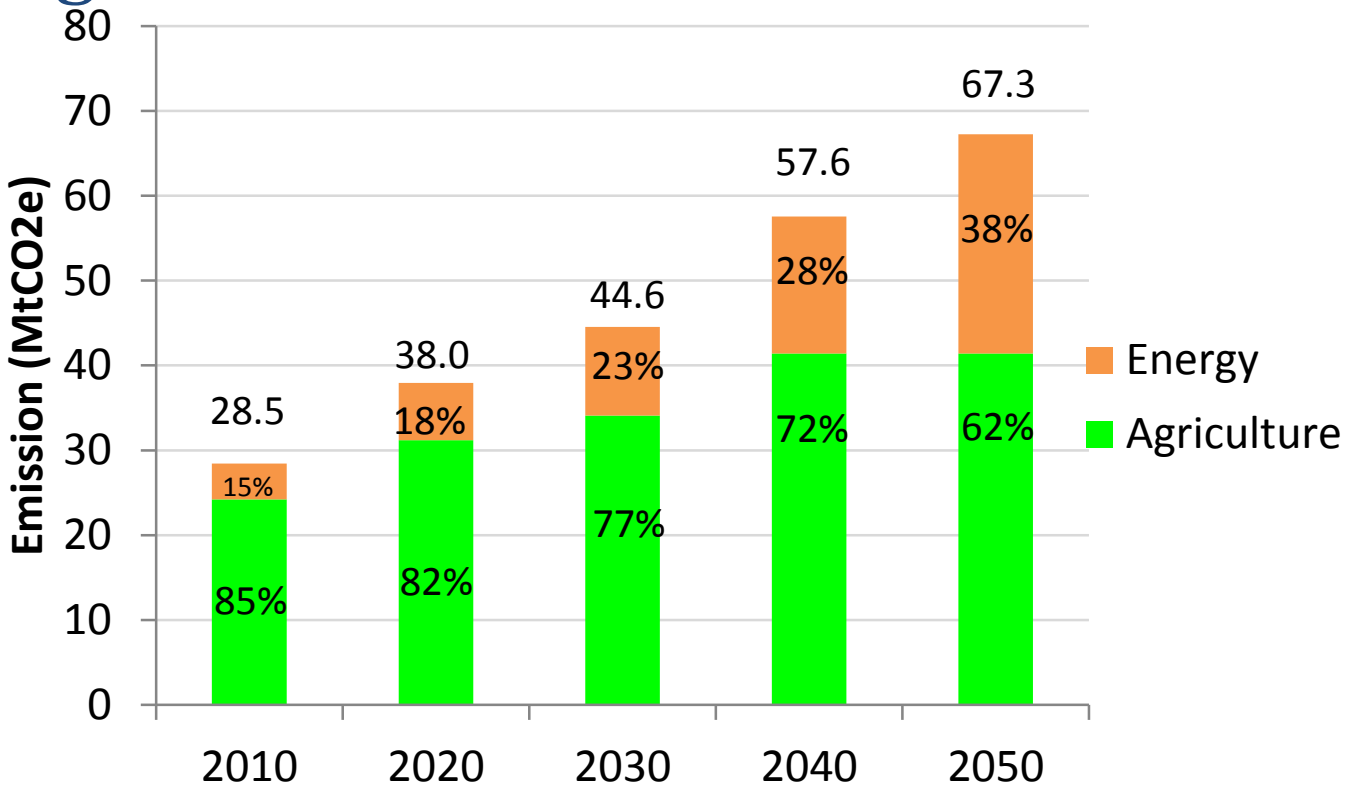
Cost-effective mitigation options in industrial sector

	Emission tax ($/tCO$_2$e)				
	CT0	CT10	CT100	CT300	CT500
Cost-effective options	Electric motor (motive power)				
	Improved fixed chimney brick kiln				
				VSBK in brick industry	
	Energy efficient coal boiler				
			Biomass boiler		
				CCS in cement industry	

Cost-effective mitigation options in transport sector

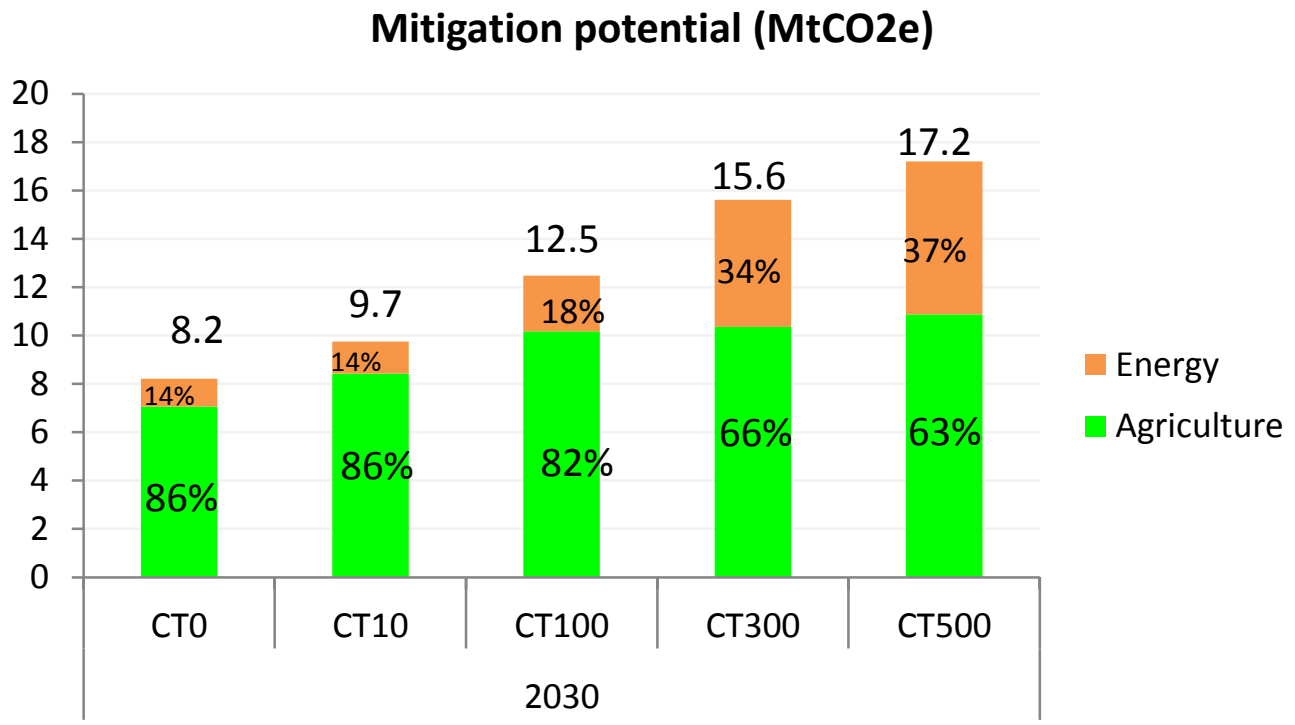
	Emission tax ($/tCO$_2$e)				
	CT0	CT10	CT100	CT300	CT500
Cost-effective options				Biofuel vehicles	
				Electric vehicles	
					Electric railway

Total Emission from Agriculture and Energy using Sectors in BAU



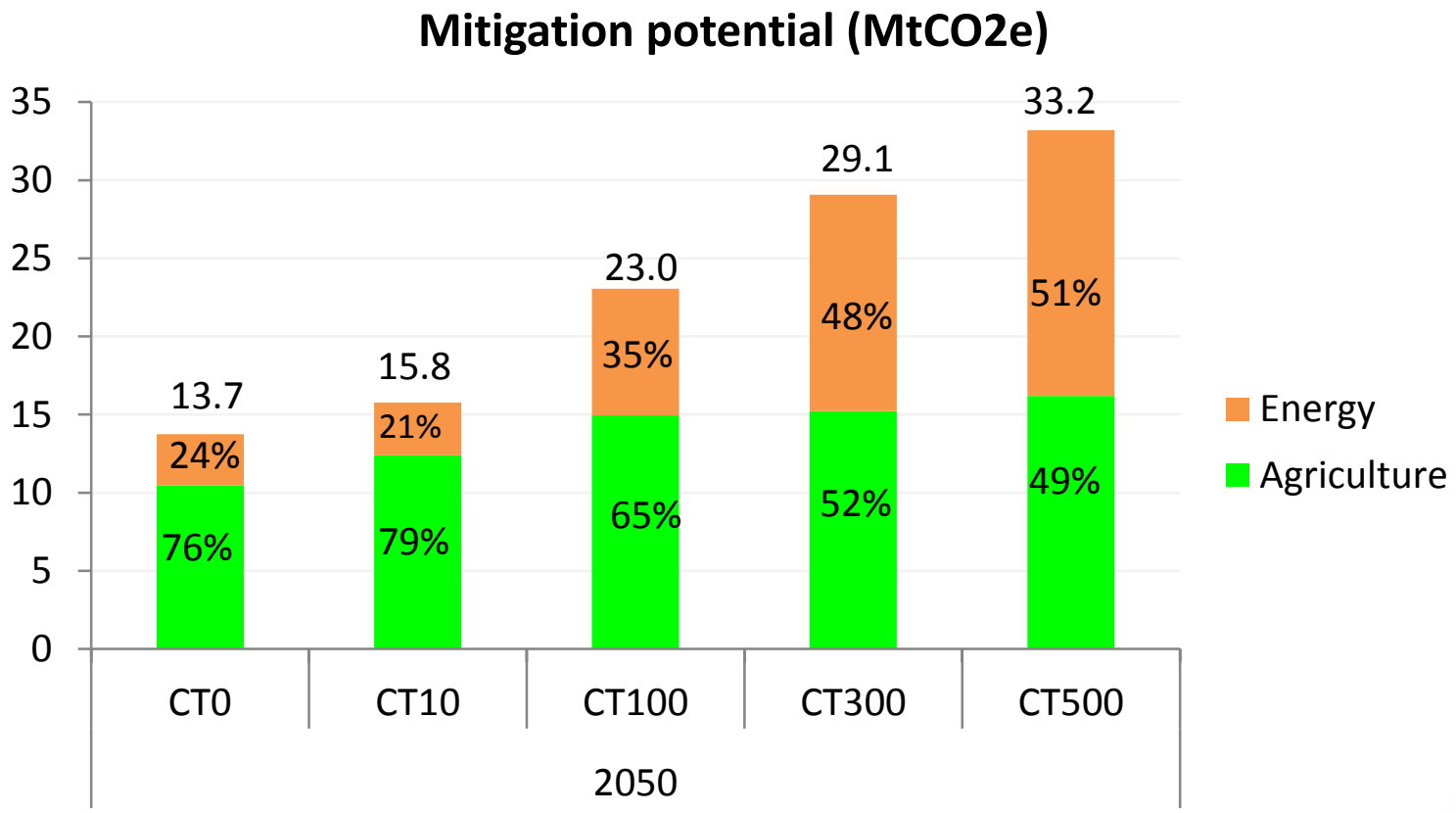
- Total emission would increase from 28.5 MtCO2e in 2030 to 67.3 MtCO2e in 2050.
- Energy related emission increases by 5.1 times during 2010-2050
- Agricultural emission increases by 70% during 2010-2050

Mitigation potential from Agriculture and Energy using sectors in 2030



- Mitigation potential ranges from 12% in CT0 to 26% in CT500 in 2030.

Mitigation potential from and Agriculture and Energy using sectors in 2050



- Mitigation potential ranges from 20% in CT0 to 49% in CT500 in 2050.

Conclusion

- The share of energy using sectors in total emissions is low (18% in 2010) at present but increasing rapidly. By 2050, the share of energy using sectors will be 38%.
- Agriculture and energy using sectors would emit a total of 44.6 MtCO2e in 2030 and 67.3 MtCO2e by 2050.
- Mitigation potential ranges from 12% in CT0 to 26% in CT500 in 2030; it ranges from 20% in CT0 to 49% in CT500 in 2050.
- Major no-regret mitigation options in agriculture
  - Enteric fermentation: Replacement of roughage with concentrates
  - Manure management: Dome digester
  - Rice cultivation: Incorporation of rice straw
- Major no-regret mitigation options in energy sector
  - Electric cooking
  - Solar water heater
  - Electric motors
  - Improved Fixed Chimney Brick Kiln

Thank you