

20<sup>th</sup> AIM International Workshop  
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# **Analyses of Some Low Carbon Scenarios: Case of Nepal**

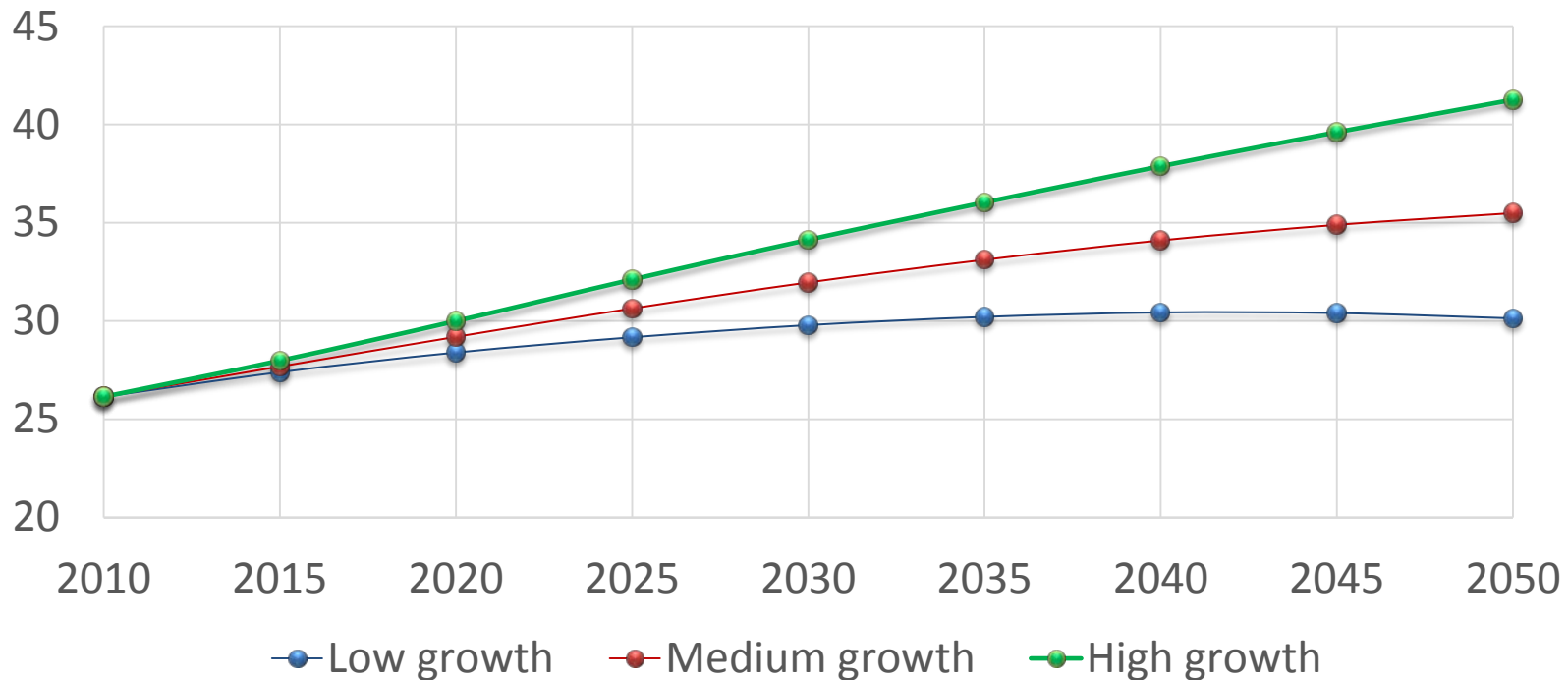
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Lalitpur, Nepal

# Presentation Outline

- Background
- Objective
- Scenario Description
- Effects of Carbon Tax
- Conclusion

# Population Growth

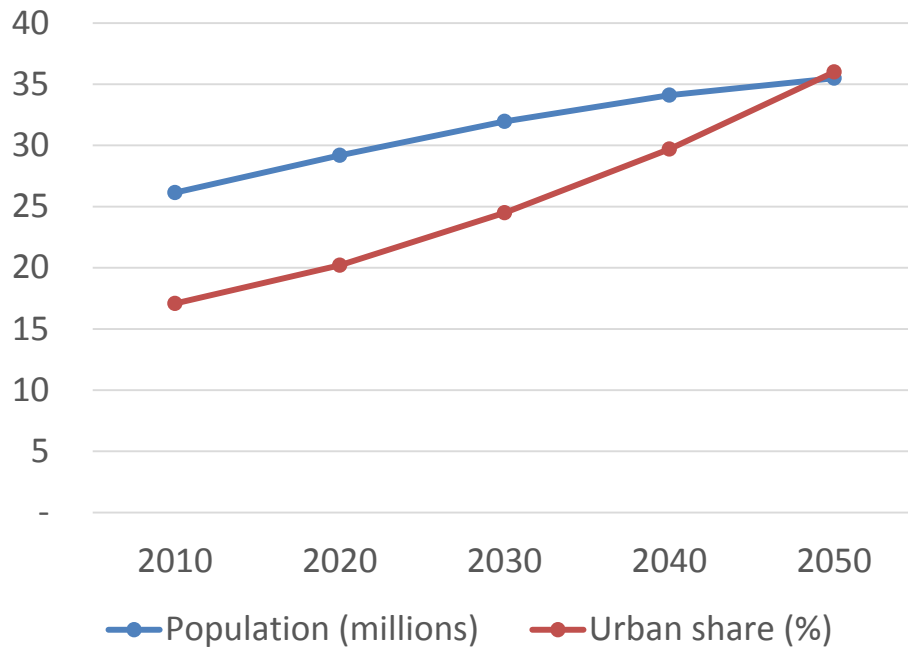
Population (millions)



- Three growth scenario projected by UN Population Division (UNPD)
- Population will increase by 0.15, 0.36 and 0.58 times during 2010-2050 in low, medium and high variant growth rate.

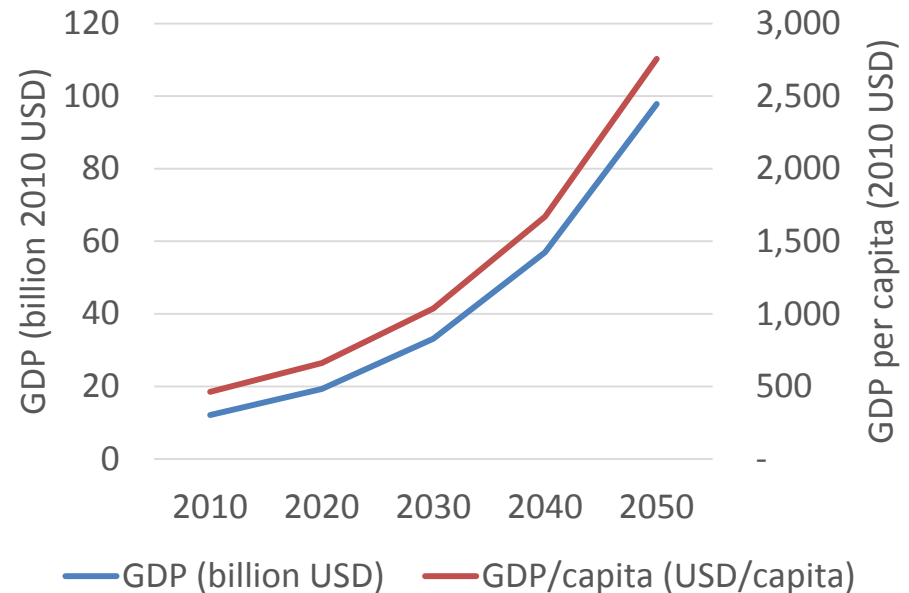
# National Economic and Demographic Trend

## Demographic Projection



- Share of urban population will increase from 17% in 2010 to 36% in 2050.

## Economic Projection



- GDP growth: 4% p.a. (2010-2015)  
5.56% p.a. (2015-2050)
- GDP/capita to increase by 5 folds

# Objectives

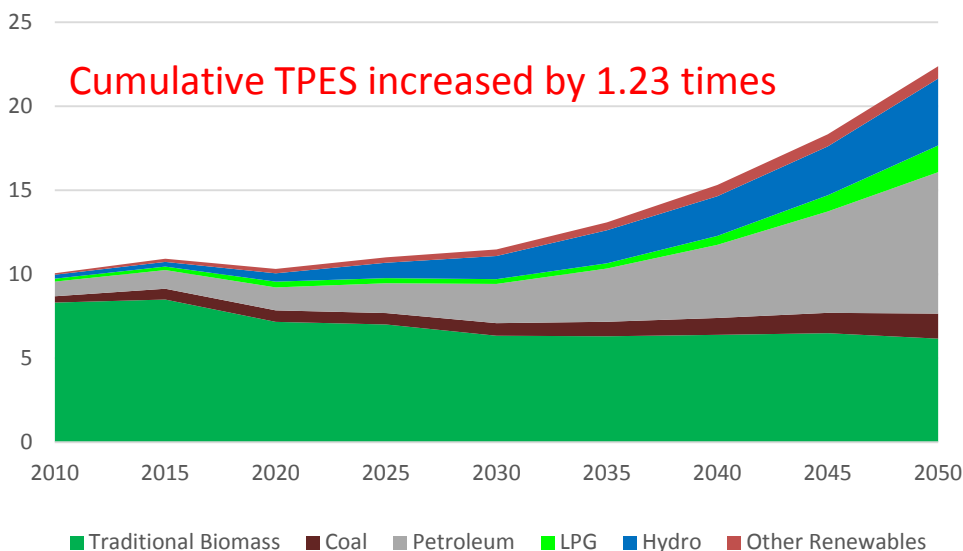
- To analyze the effects of carbon tax on energy mix and GHG emission reduction
- To identify cost effective low carbon options in different carbon tax scenarios

# Scenario Description

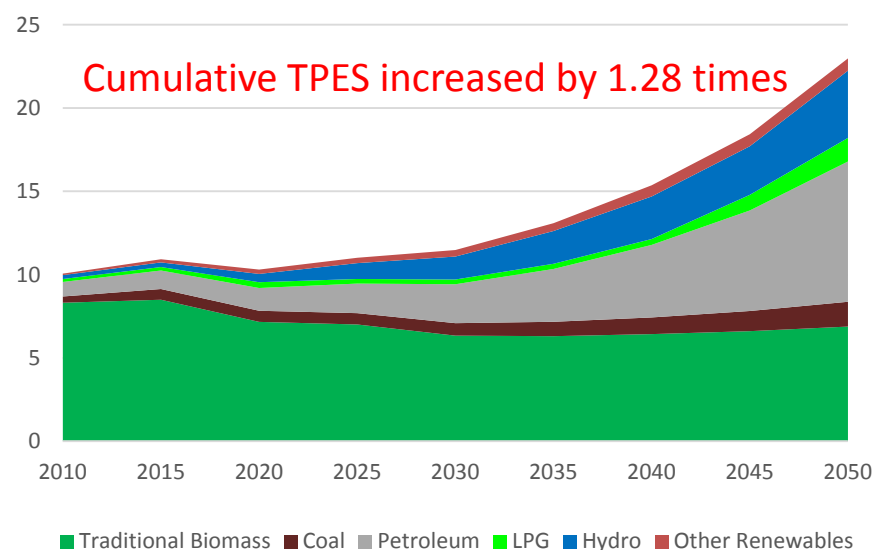
- One business as usual scenario (base case) and three carbon tax scenarios
- Carbon tax scenarios include
  - 3 AME carbon tax paths (starting from 2017)
    - 10 USD/tCO<sub>2</sub>e @ 2020 (CT10) increasing at 5% p.a.
    - 30 USD/tCO<sub>2</sub>e @ 2020 (CT30) increasing at 5% p.a.
    - 50 USD/tCO<sub>2</sub>e @ 2020 (CT50) increasing at 5% p.a.

# Primary Energy Supply

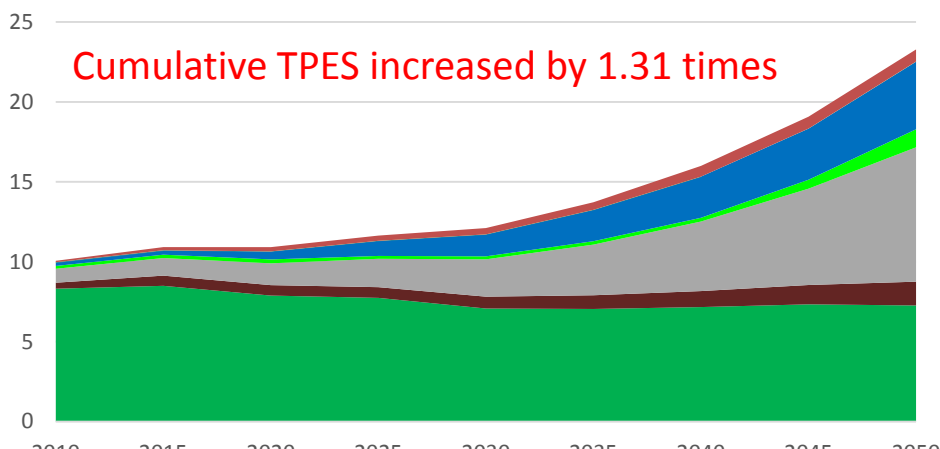
Base case (Mtoe)



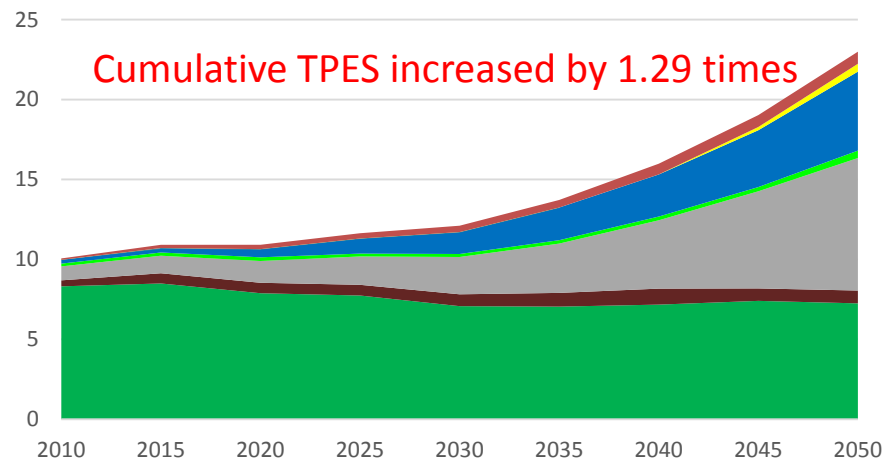
CT10 case (Mtoe)



CT30 case (Mtoe)



CT50 case (Mtoe)



# Primary Energy Supply

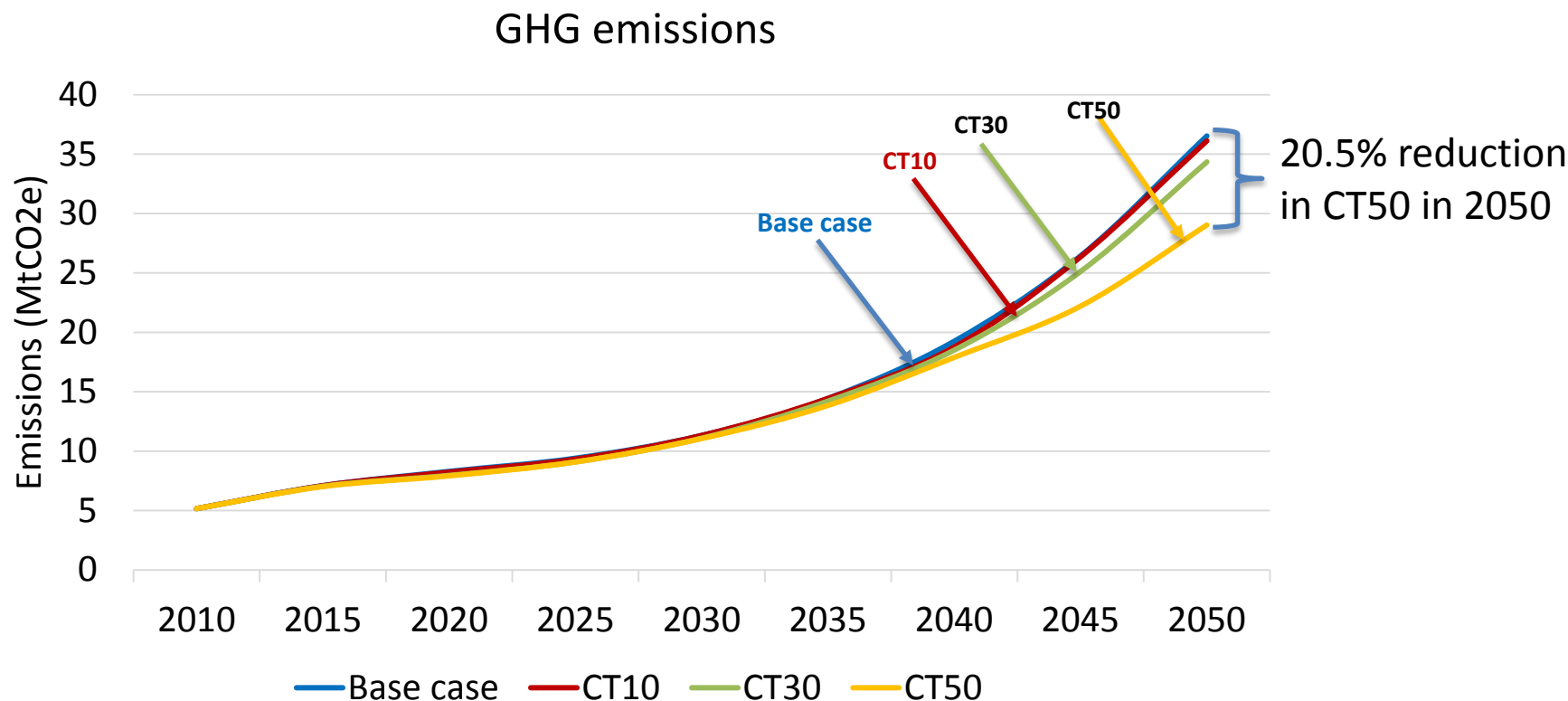
- In the base case,
- TPES increases by 1.23 times in 2050
- Traditional biomass decreases in 2050 by 30% compared to 2010.
- Coal, petroleum, LPG, hydro and other renewables increases by 3, 8.7, 8.1, 15.9 and 7.4 times in 2050 compared to 2010.
- In CT10,
- TPES increases by 1.28 times in 2050
- Biomass and hydropower use in 2050 increases by 12% and 1% compared to the base case
- No significant change in other renewables, coal and petroleum
- LPG use decreases by 11%



# Primary Energy Supply

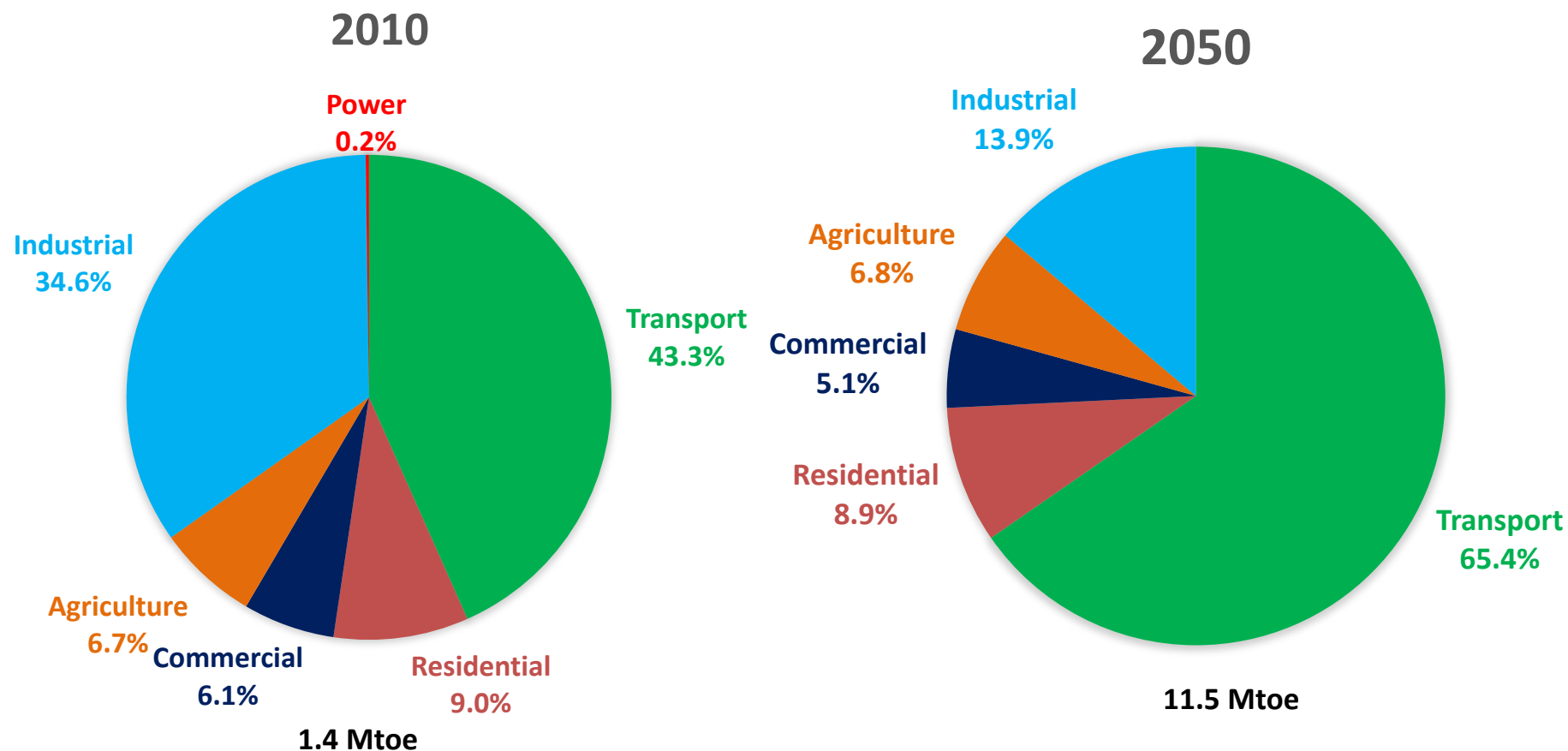
- In CT30,
  - TPES increases by 1.31 times in 2050
  - In 2050, Biomass use increases by 18% compared to the base case
  - Similarly, hydro and other renewables use increases by 6% and 3% respectively compared to the base case
  - There is not significant change in coal and petroleum. LPG use decreases by 29%
  - Biofuel has a share of less than 1% in Primary Energy in 2050
- **In CT50**
  - TPES increases by 1.29 times in 2050
  - In 2050, biomass use increases by 18% compared to the base case
  - Similarly, hydropower and other renewables use increases by 24% and 3% respectively
  - Coal and petroleum decreases by 46% and 2% respectively. LPG use decreases by 71%
  - Biofuel has a share of 2.1% in Primary Energy in 2050

# GHG Emission in Different Scenarios



- Cumulative GHG reduction in CT10, CT30 and CT50 are 1%, 4% and 9.5% respectively
- In 2030, GHG reduction in CT30 and CT50 are 2% and 2.3% respectively.
- In 2050, GHG reduction in CT10, CT30 and CT50 are 1%, 6% and 20.5% respectively <sup>10</sup>

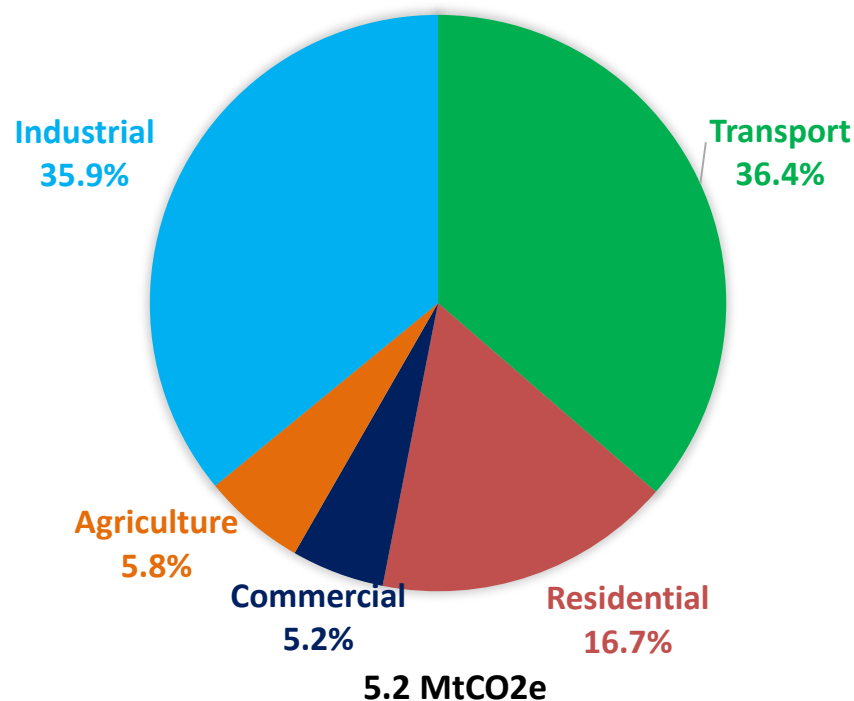
# Sectoral Shares in Fossil Fuel Consumption in Base case



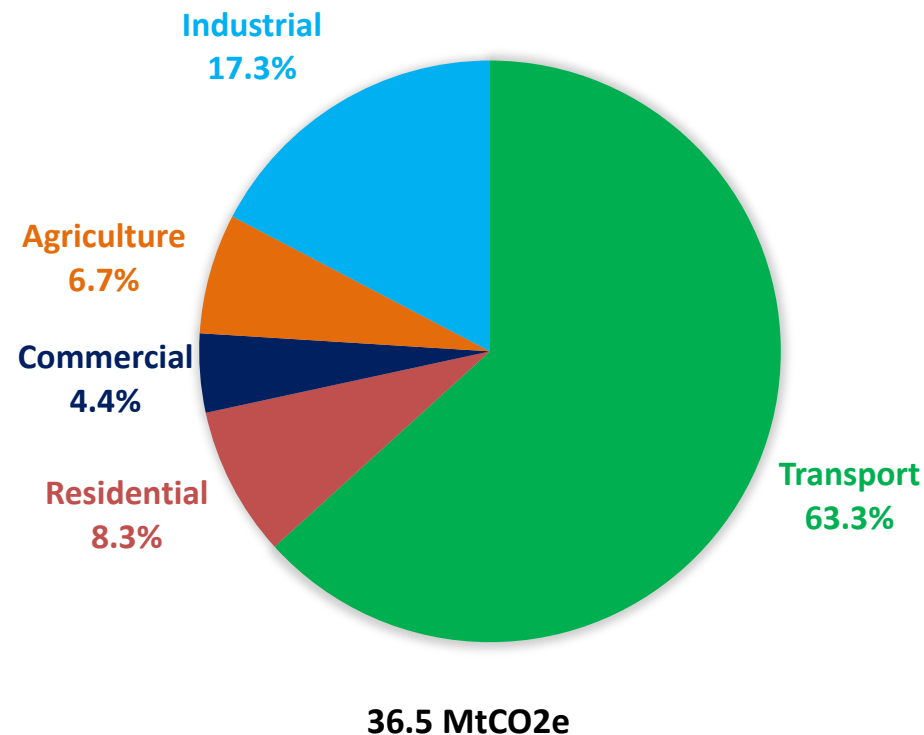
- Fossil fuel consumption increases by 7.2 times in 2050.
- Transport sector has the largest share in total fossil fuel consumption

# Sectoral GHG Emissions in Base Case

2010

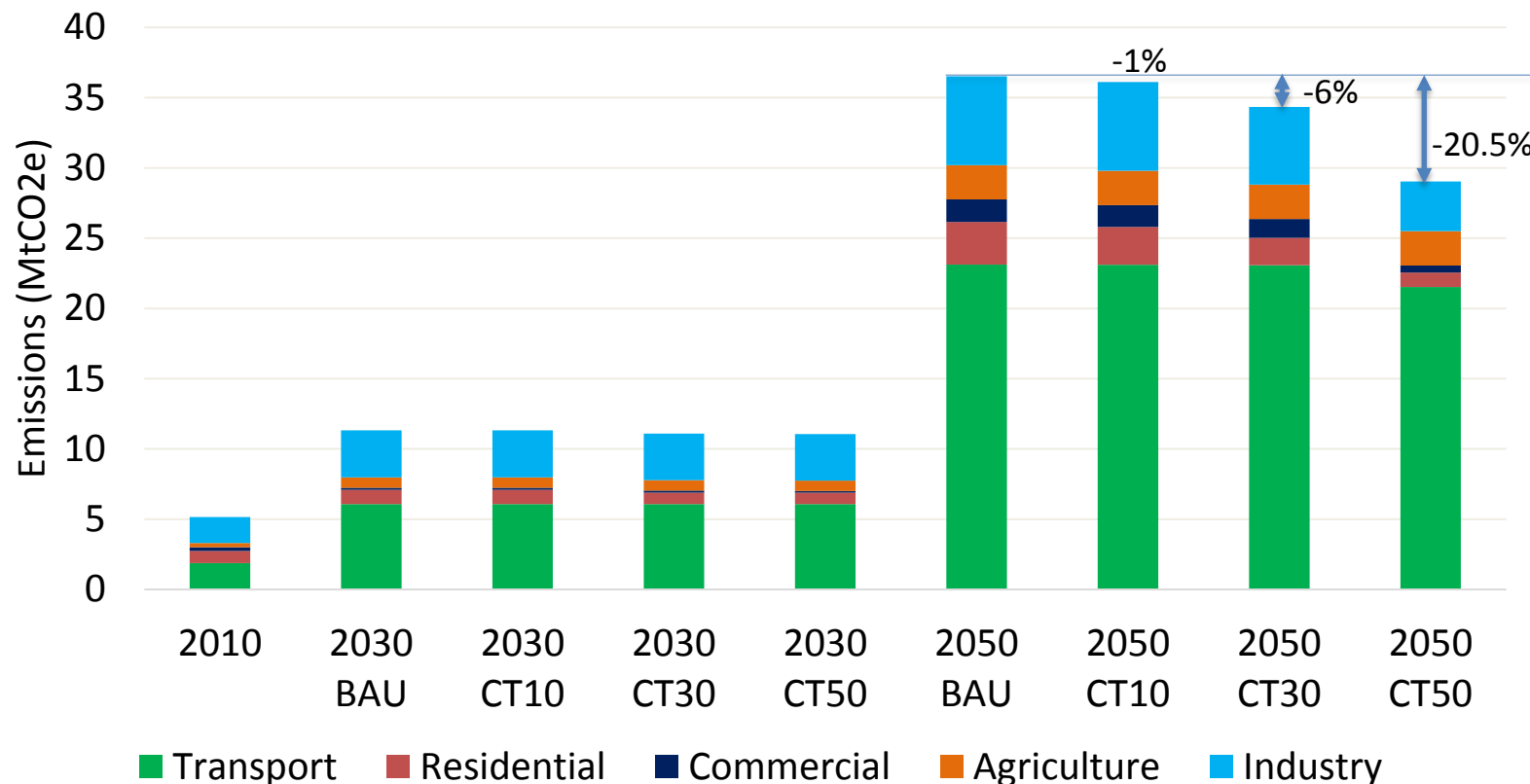


2050



- GHG emissions will increase by 6 fold.
- Transport Sector would be the largest emitter followed by industrial, residential, agriculture and commercial and sectors during 2010-2050.
- Share of the transport in GHG emission increases from 36.4% in 2010 to 63.3% in 2050.

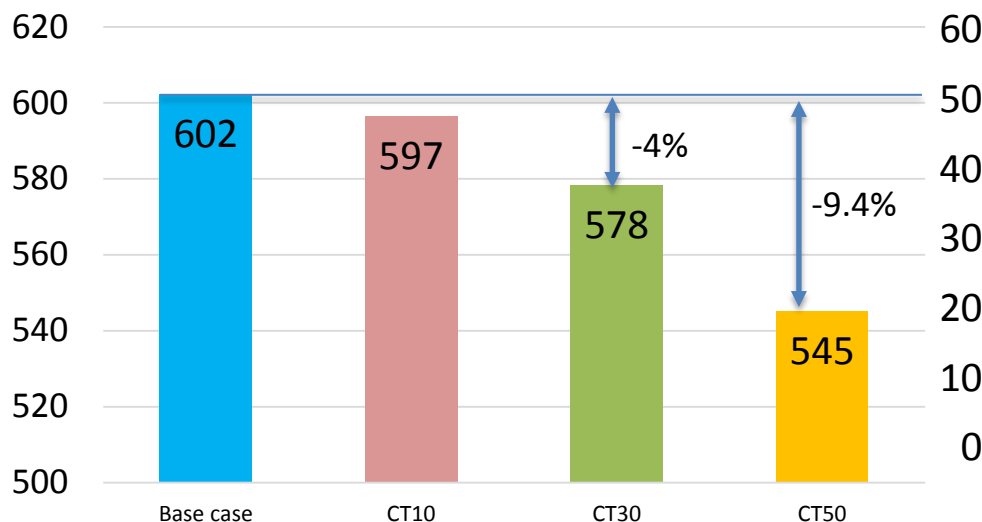
## Sectoral GHG Emissions in Base Case and CT Cases



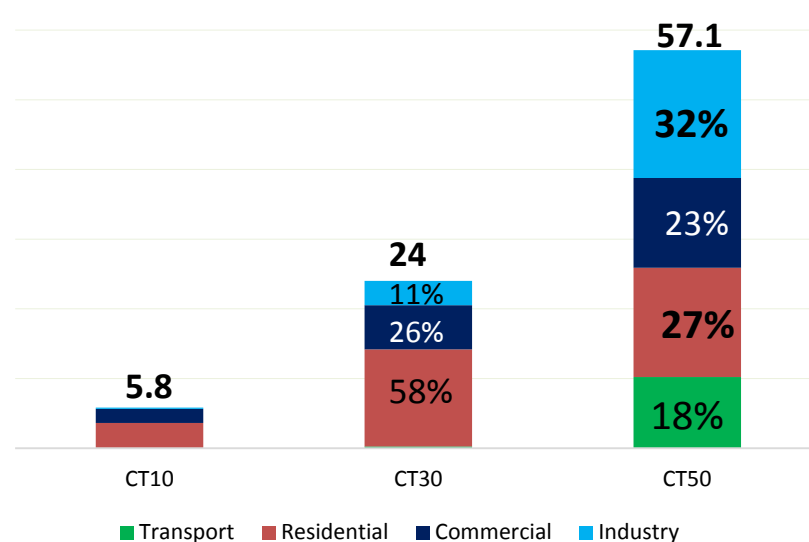
- GHG emissions in 2050 would increase by 6.1, 6.0, 5.6 and 4.6 times in base case, CT10, CT30 and CT50 from the level of 2010.
- In 2050, GHG emissions decrease by 1%, 6% and 20.5% in CT10, CT30 and CT50. <sup>13</sup>

# Cumulative GHG Emission in CT cases and Sectoral Shares in GHG Reduction

Cumulative GHG emissions (MtCO<sub>2</sub>e)

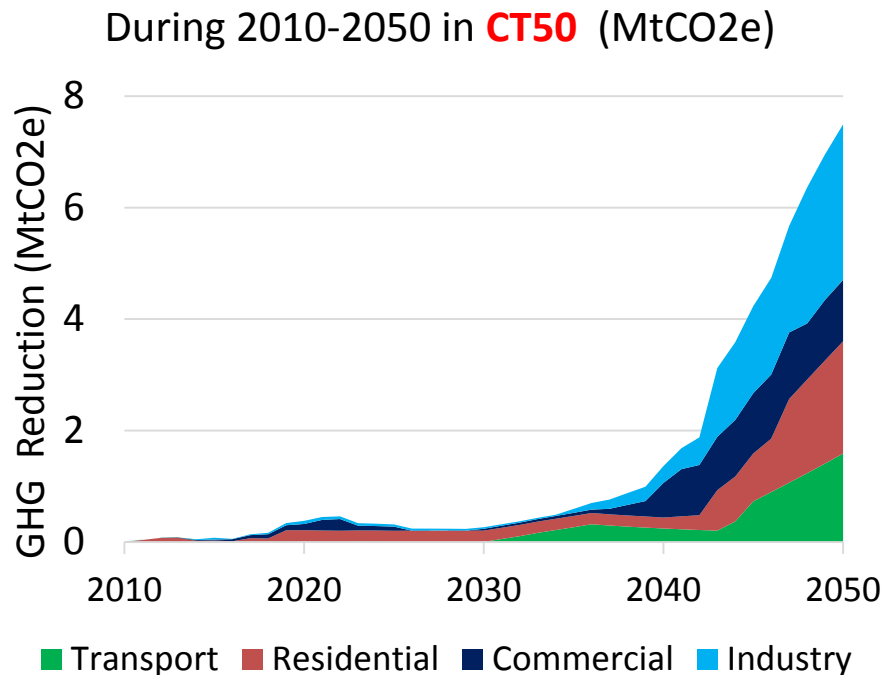


Cumulative GHG reduction (MtCO<sub>2</sub>e)

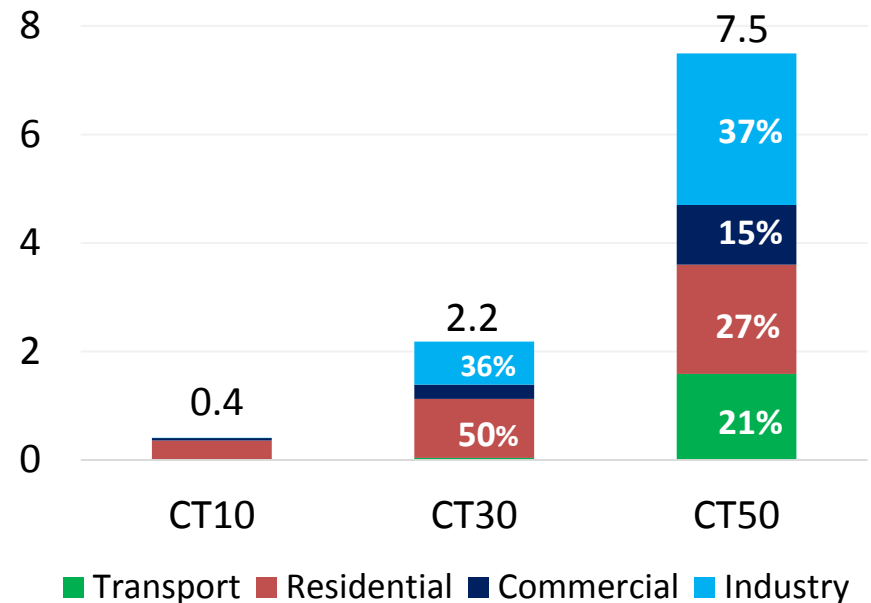


- Cumulative emission decreases by 1%, 4% and 9.4% in CT10, CT30 and CT50 cases.
- The share of transport, residential, commercial and industrial sector in cumulative reduction in CT30 is 5%, 58%, 26% and 11%.
- The share of transport, residential, commercial and industrial sector in cumulative reduction in CT50 is 18%, 27%, 23% and 32%.

# GHG Emission Reduction by Sector in CT cases in 2050



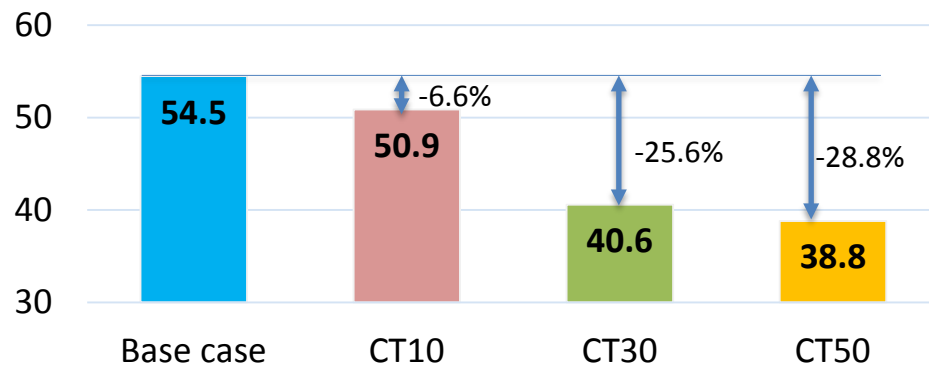
Sectoral GHG emission Reduction in 2050 (MtCO<sub>2</sub>e)



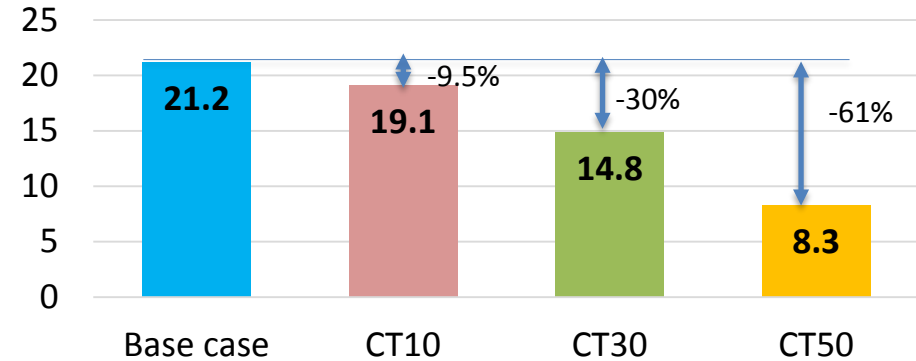
- GHG Emission reduction in 2050 is achieved mainly from residential sector in CT10 and CT30.
- In CT50, GHG emission reduction in 2050 from industrial, residential, transport and commercial are 37%, 27%, 21% and 15% respectively.

# Effect of Carbon Tax on Cumulative GHG Emission during 2010-2050 in Different Sector

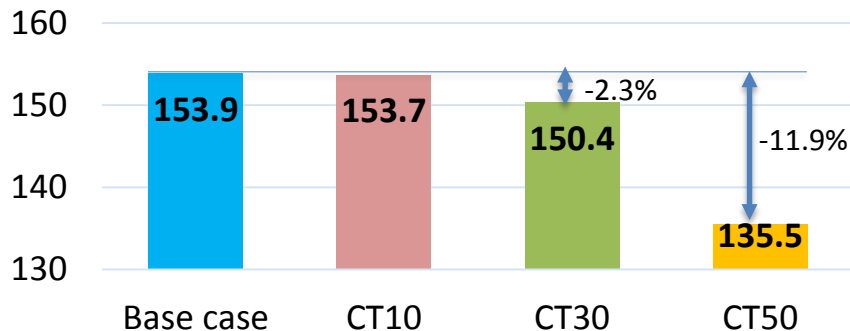
Cumulative GHG emission in **residential** sector (MtCO<sub>2</sub>e)



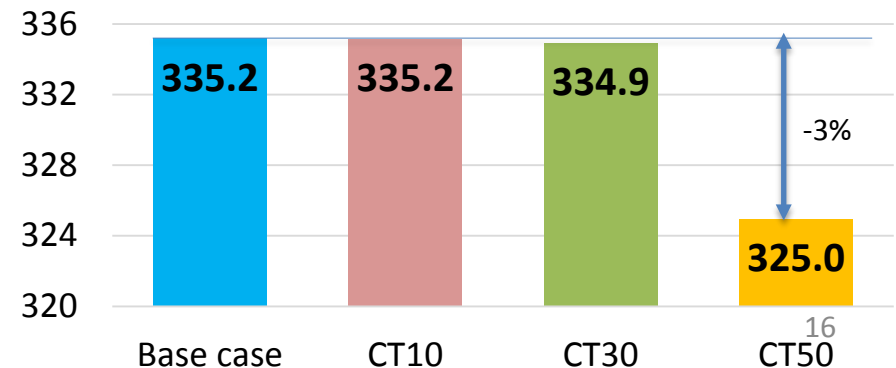
Cumulative GHG emissions in **commercial** sector (MtCO<sub>2</sub>e)



Cumulative GHG emissions in **industry** (MtCO<sub>2</sub>e)



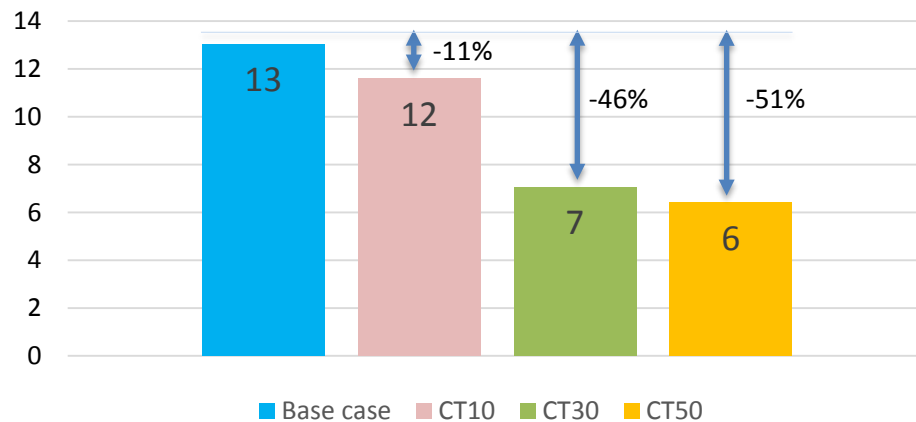
Cumulative GHG emission in **transport** sector (MtCO<sub>2</sub>e)



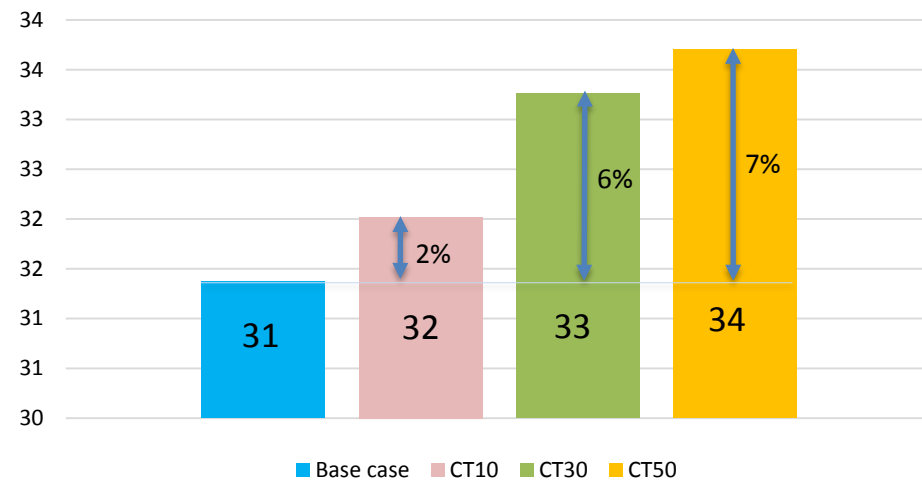


# Effect of Carbon Tax on Fuel Mix in Residential Sector

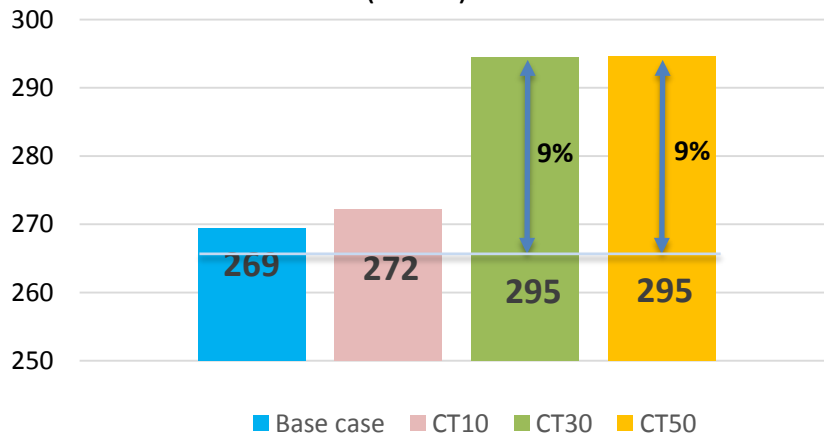
Cumulative **LPG** consumption during 2010-2050 (Mtoe)



Cumulative **electricity** consumption during 2010-2050 (Mtoe)



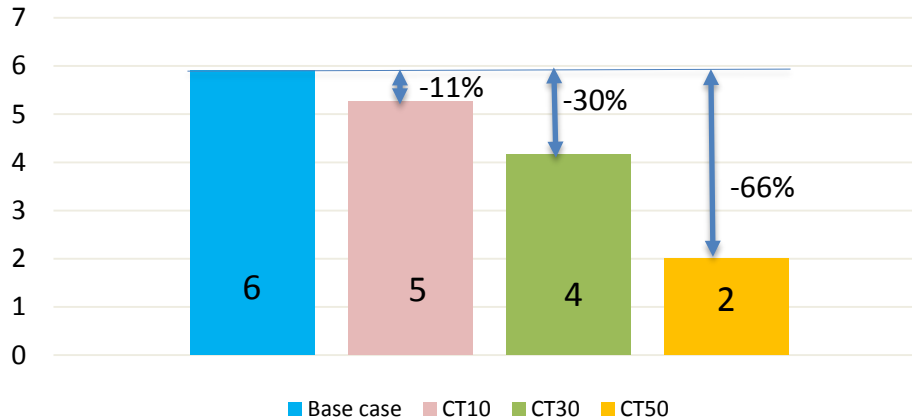
Cumulative **biomass** consumption during 2010-2050 (Mtoe)



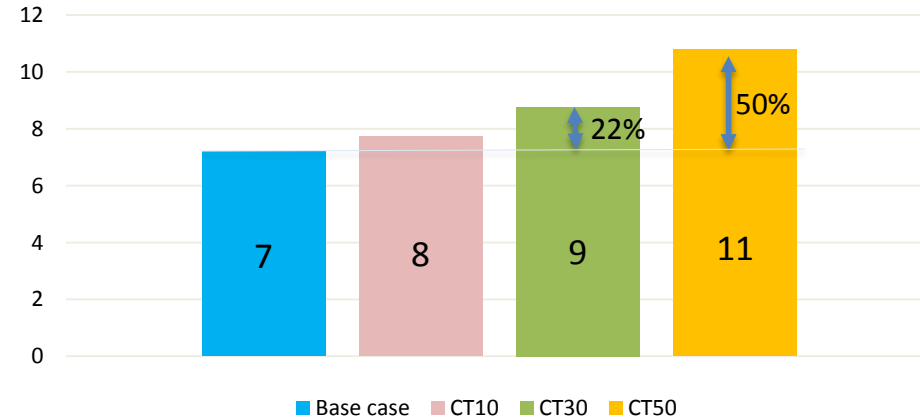
- Cumulative LPG use decreases by 11%, 46% and 51% in CT10, CT30 and CT50
- Cumulative electricity use increases by 2%, 6% and 7% in CT10, CT30 and CT50
- Cumulative biomass use increases by 1%, 9% and 9% in CT10, CT30 and CT50

# Effect of Carbon Tax on Fuel mix and Energy Efficiency in Commercial Sector

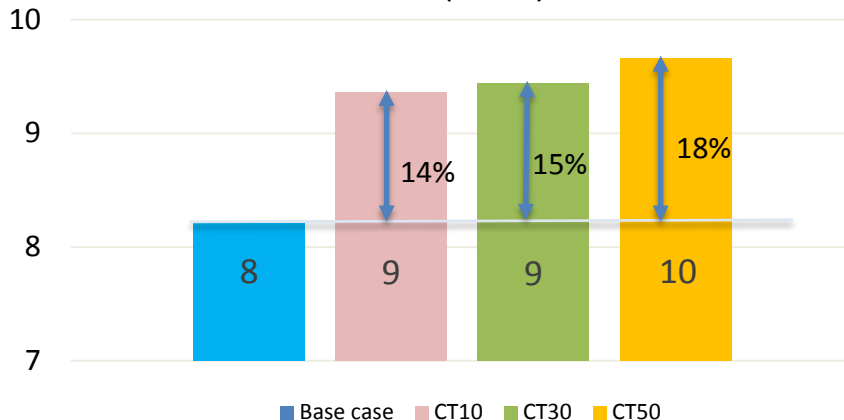
Cumulative **LPG** consumption during 2010-2050 (Mtoe)



Cumulative **electricity** consumption during 2010-2050 (Mtoe)

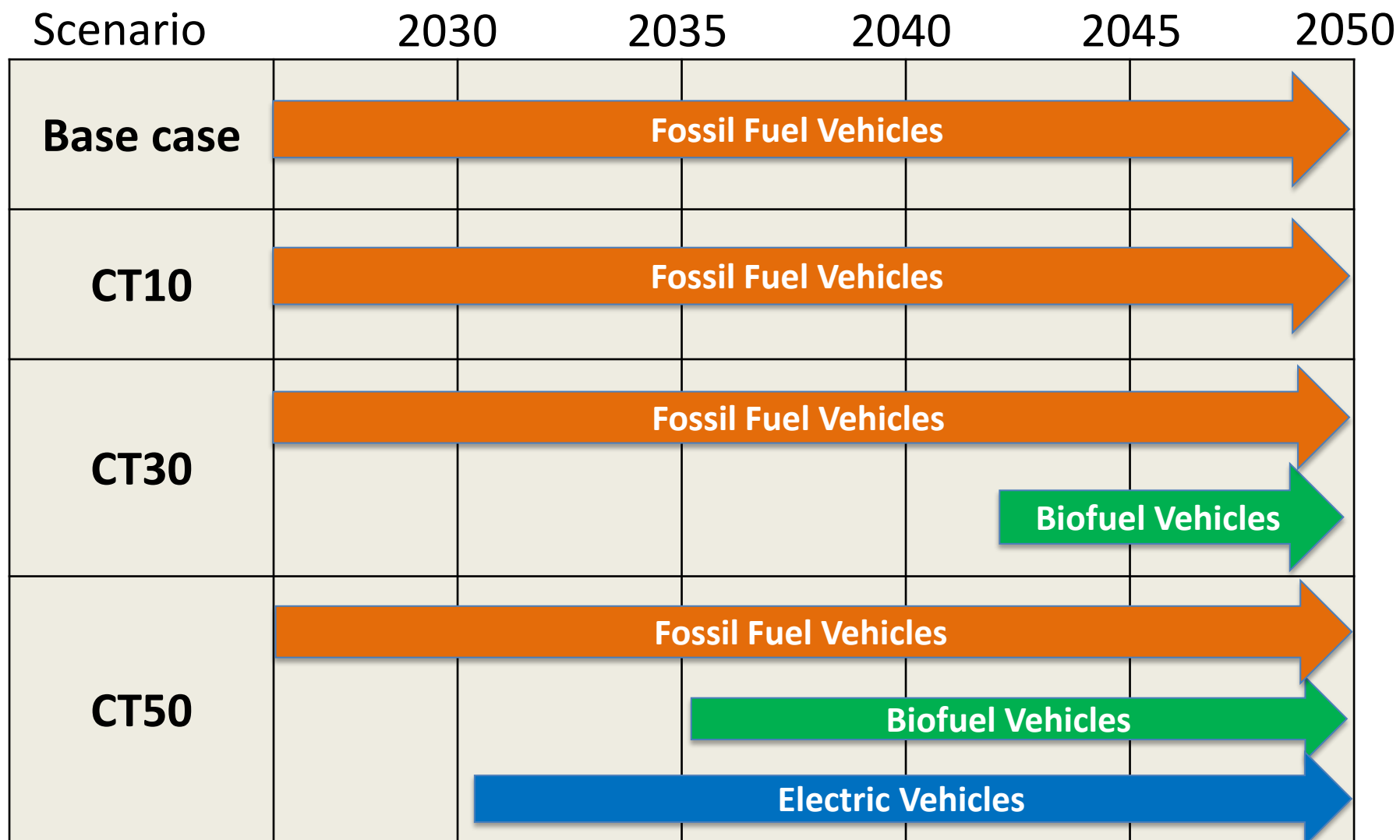


Cumulative **biomass** consumption during 2010-2050 (Mtoe)

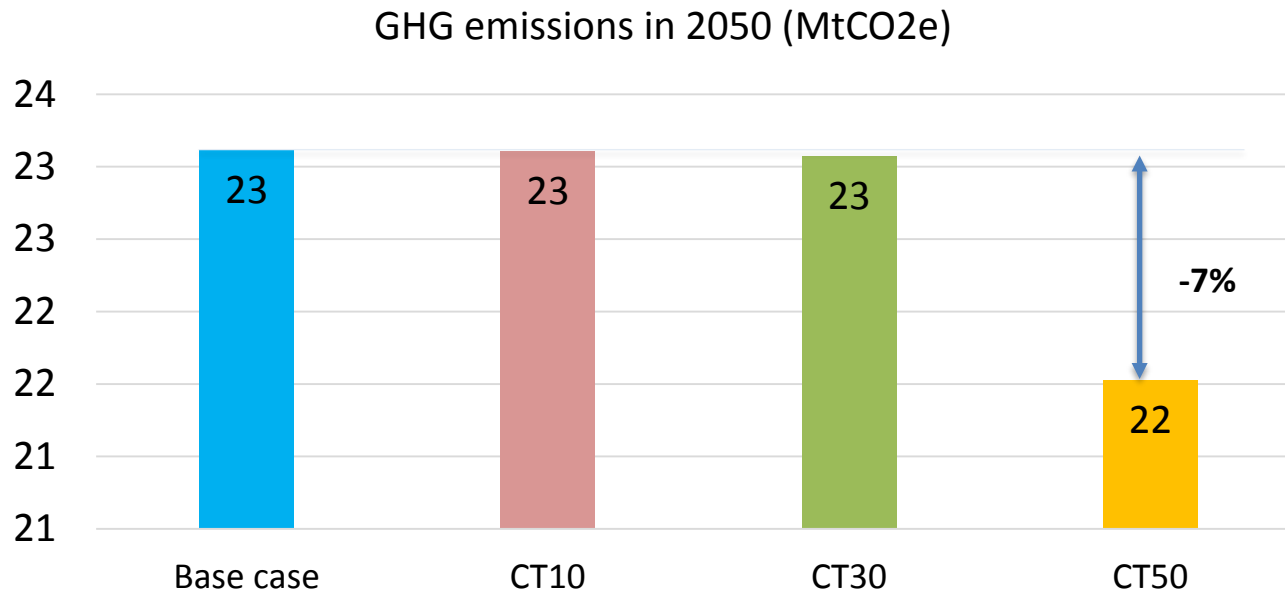


- Cumulative LPG use decreases by 11%, 30% and 66% in corresponding scenarios.
- Cumulative electricity use increases by 7%, 22% and 50% in CT10, CT30 and CT50.
- Cumulative biomass use increases by 14%, 15% and 18% in CT10, CT30 and CT50
- Share of LPG in cooking and water heating decreases in CT cases.
- Efficient space cooling devices (efficient fan) cost effective after 2040 in all carbon tax scenarios.

# Deployment of Low Carbon Transport Options



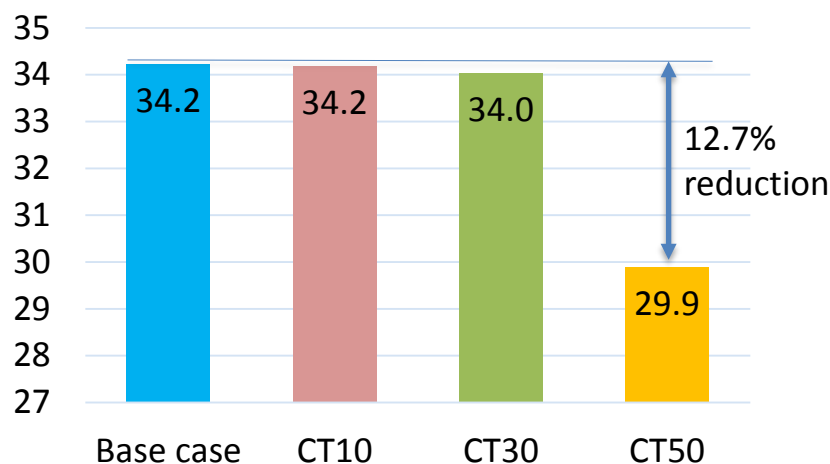
## Effect of Carbon Tax on GHG Emission in **Transport** Sector



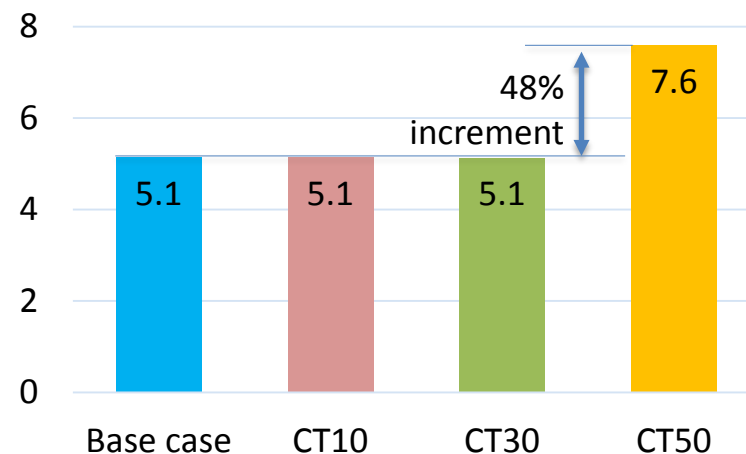
- In CT50, GHG emission reduction compared to base case in transport sector is 0.03%, 0.2% and 7% in CT10, CT30 and CT50 cases.
- CT10 and CT30 are not effective to promote electric vehicles in transport sector

## Effect of Carbon Tax on Fuel Use in the **Industry** Sector

### Coal consumption (Mtoe)



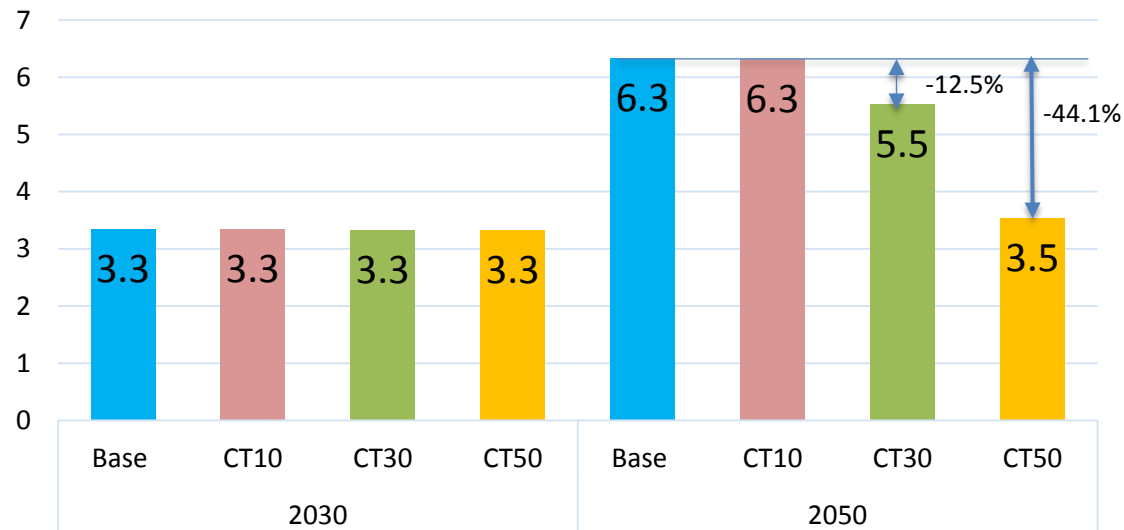
### Oil consumption (Mtoe)



- Cumulative coal consumption decreases by 0.6% and petroleum consumption increases by 0.3% in CT30.
- Cumulative coal consumption decreases by 12.7% but petroleum consumption increases by 48% in CT50.
- Diesel will replace coal boiler in CT50 after 2042.

# Effect of Carbon Tax on GHG Emissions in the Industry Sector

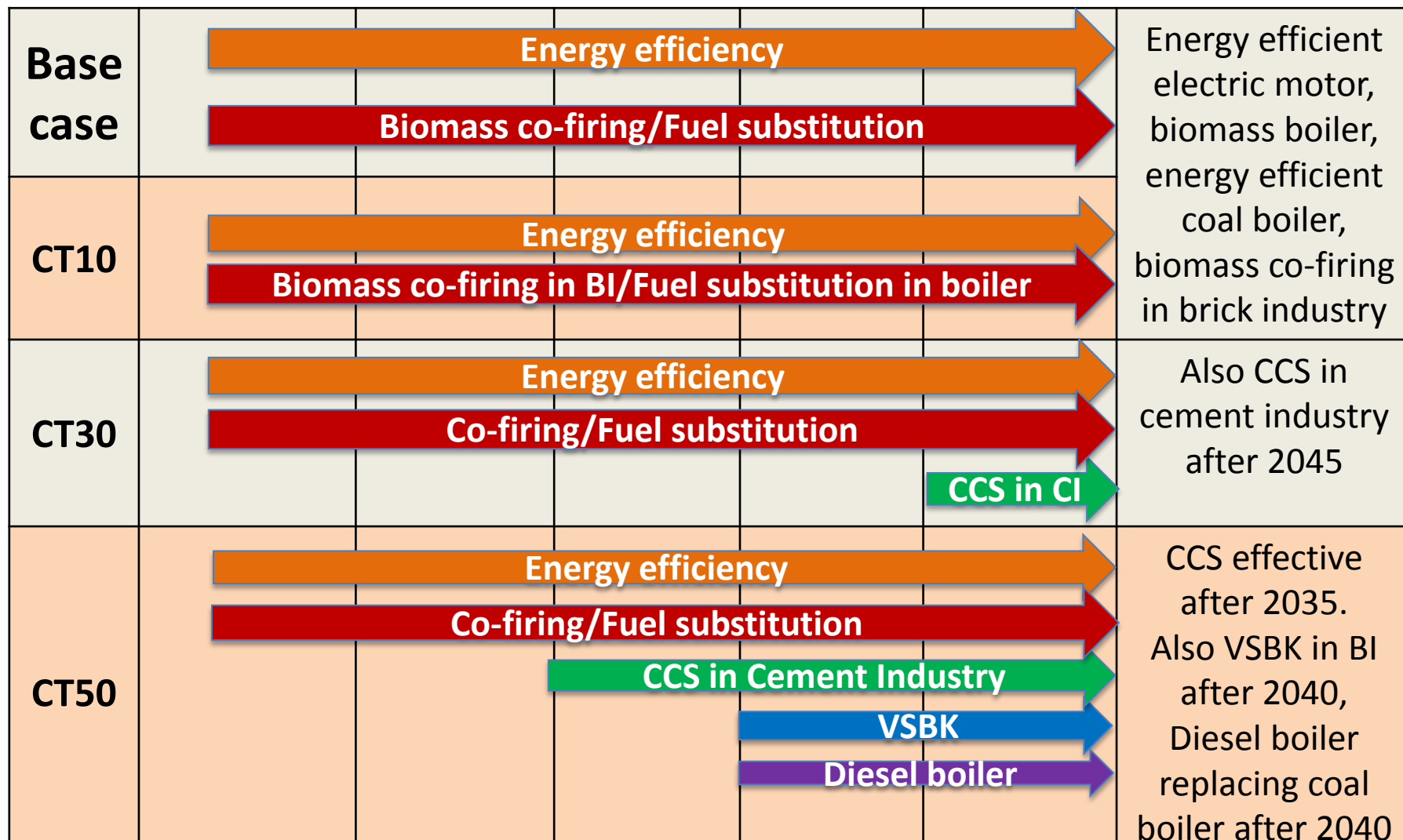
## GHG Emissions (MtCO<sub>2</sub>e)



- GHG emissions in 2050 from industrial sector decreases by 0.1%, 12.5% and 44.1% in CT10, CT30 and CT50.
- Reduction in GHG emissions due to substitution of coal by other fuels and energy efficiency in CT cases.

# Deployment of Low Carbon Options in Industry

2010 ..... 2030      2035      2040      2045      2050



# Conclusion

- Transport sector is the major emitter of GHG emissions during 2010-2050
- However, highest GHG emission reduction occurs in residential Sector in CT10 and CT30; in CT50, highest GHG reduction takes place in the industry sector.
- Commercial sector accounts for the second highest level of GHG mitigation in CT10 and CT30, while residential sector accounts for the second highest level of mitigation in CT50.
- Reduction in GHG emission occurs mainly through the substitution of LPG with electricity in the residential sector and substitution of coal by oil and biomass in the industrial sector.
- CCS becomes cost effective from 2045 in CT30 and from 2035 in CT50.
- Biofuels in transport are cost effective after 2040 in CT30 and after 2035 in CT50.



Thank you