Evaluation of Reduction of CO_2 Emission and Environmental Benefits under various scenarios A case study of Jinan, China

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2019.11.08

OUTLINE

1. CONTEXT
2. METHODOLOGY
3. RESULT AND DISCUSSION
4. CONCLUSIONS

CONTEXT

- **Air pollution is becoming a serious issue.**
- **Carbon Reduction is a big challenge.**

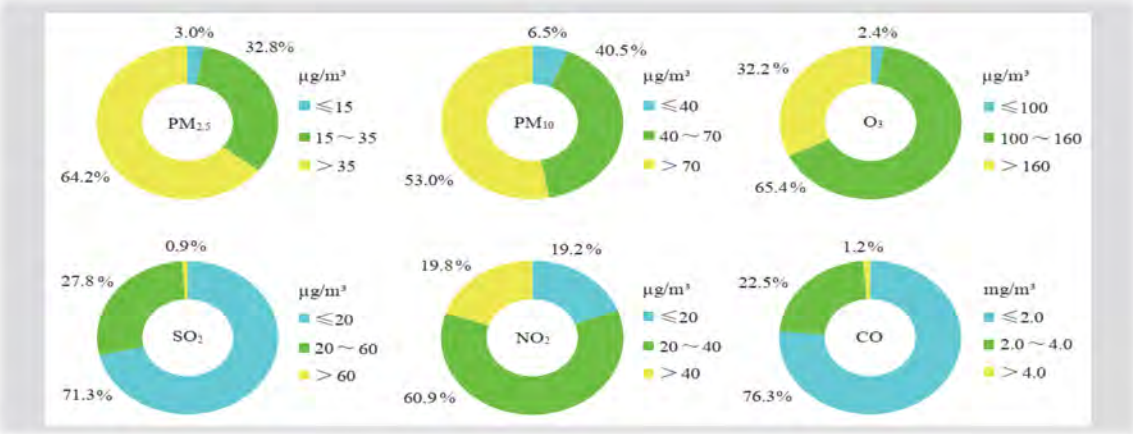


Fig. 1 Air quality of 338 cities in China in 2017

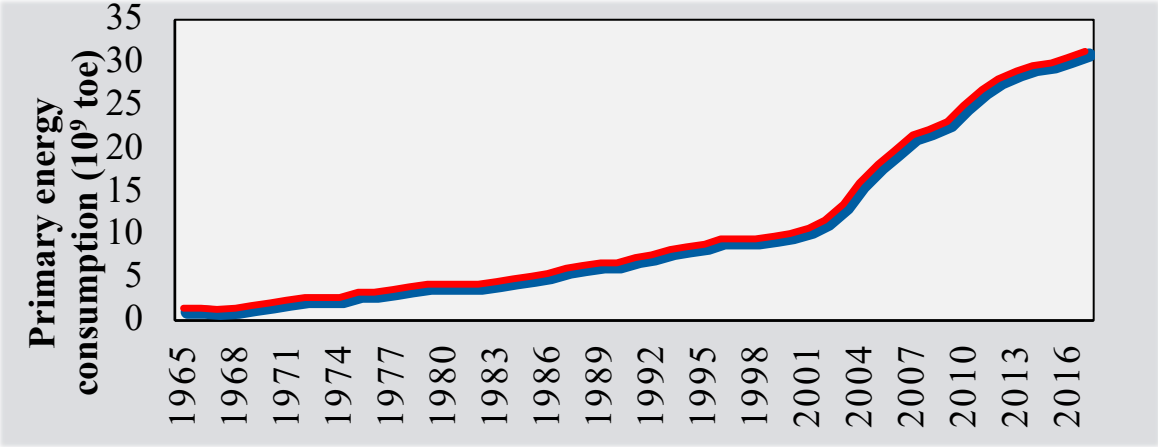


Fig.2 China's primary energy consumption from 1965 to 2017

CONTEXT

- **Air pollution is also a serious issue in Jinan.**

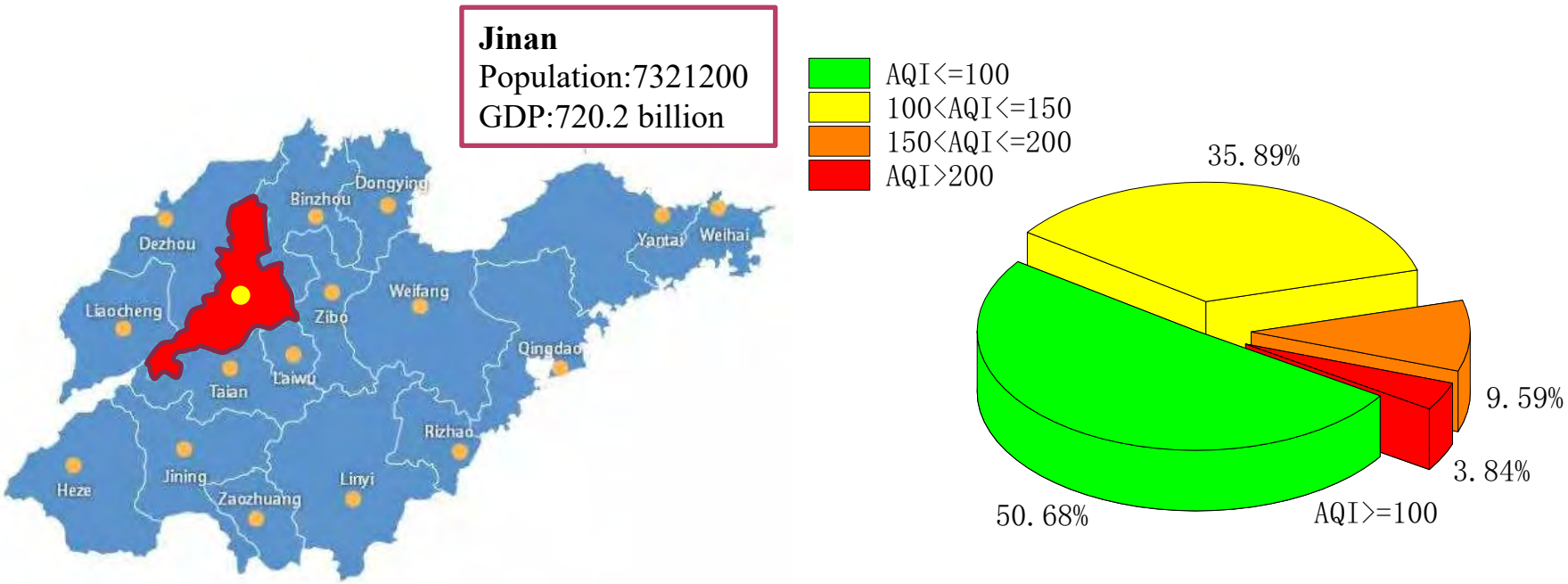


Fig. 3 Location and air quality of Jinan in 2017

CONTEXT

Try to Answer :

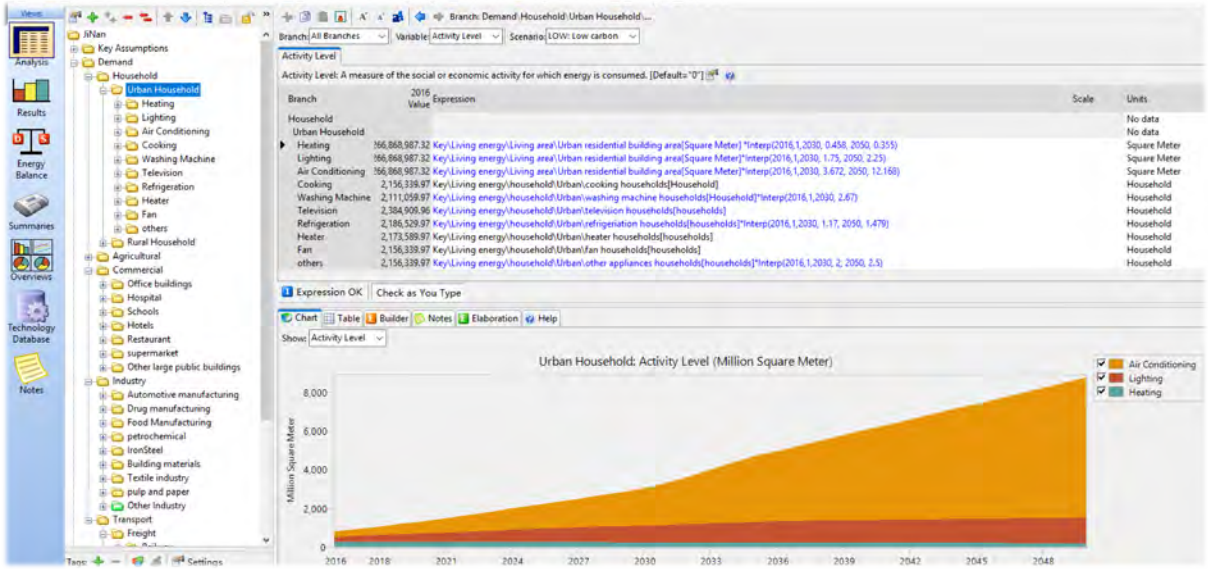
- Energy demands of Jinan from 2016 to 2050 under PC,LC and ELC scenarios?
- Environmental benefits of Jinan from 2016 to 2050 under PC,LC and ELC scenarios?

METHODOLOGY

✓ An Integrated Model Based-on LEAP & LCA

LEAP

LCA



METHODOLOGY

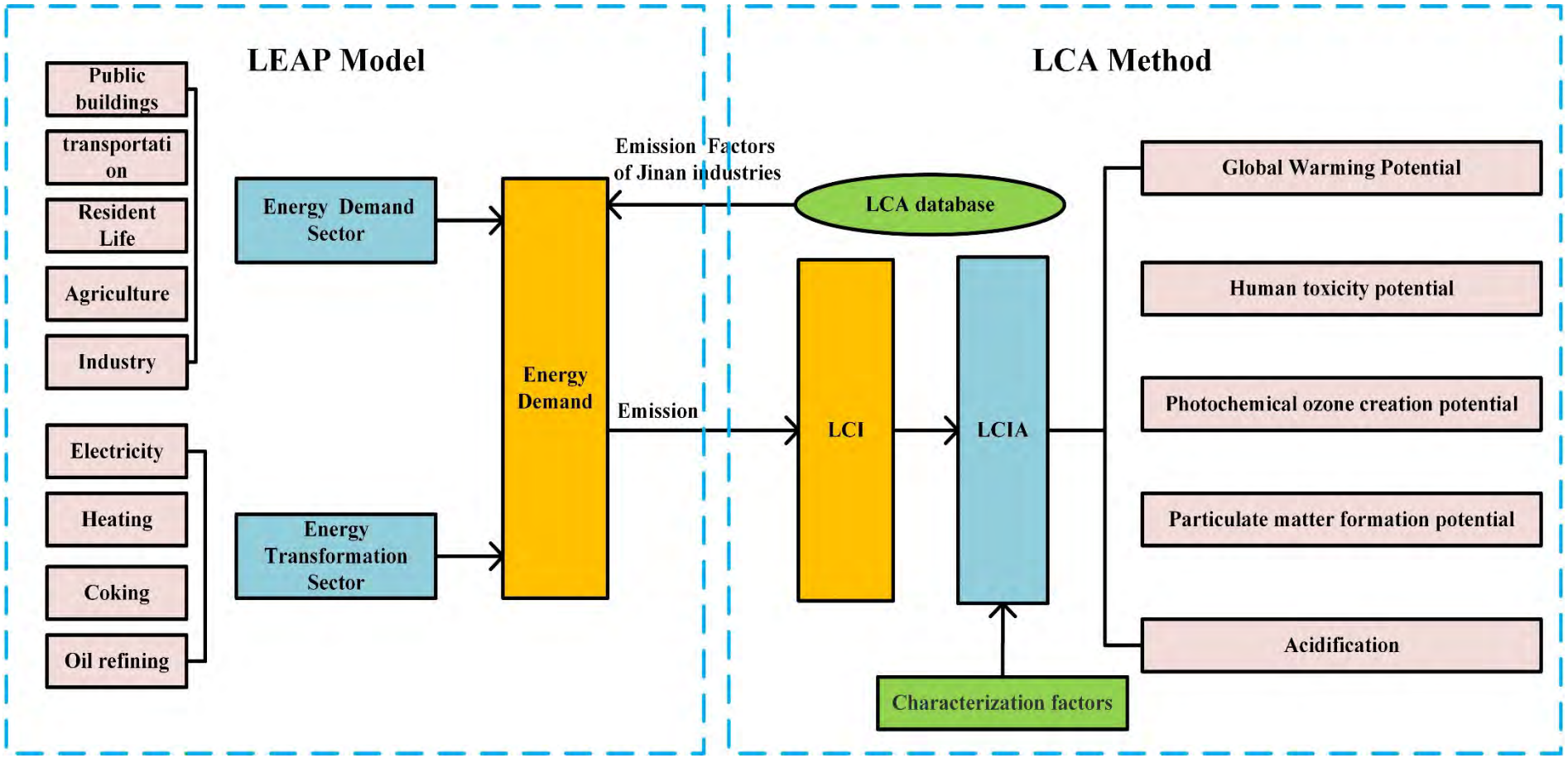


Fig.4. The Integrated LEAP & LCA Model Framework

METHODOLOGY

- The data of social , economic , sector in model from the status of Jinan and its development plans

Table.1 social and economic indicators

	Unit	2016	2020	2025	2030	2035	2050
Population	Million	8.61	10.35	12.00	12.73	13.50	13.37
Urbanization rate	%	68.13	72.00	80.00	85.00	90.00	90.00
Households	Million	3.08	3.74	4.41	4.73	5.10	5.18
Urban	Million	2.16	2.76	3.60	4.08	4.64	4.72
Rural	Million	0.93	0.98	0.81	0.66	0.46	0.46
Per capita GDP	Thousand yuan	84.09	96.58	110.47	134.20	154.68	261.71
GDP	billion	723.89	1000	1325.65	1708.08	2088.15	3497.93
Primary industry	%	5.10	4.01	3.41	2.90	2.66	2.03
The secondary industry	%	37.60	36.97	35.54	34.10	32.81	29.07
The tertiary industry	%	57.30	59.02	61.04	63.00	64.53	68.90

METHODOLOGY

Four scenarios:

- Business-as-usual scenario(BAU)
- Low-carbon policy scenario(LC)
- Pollution control policy scenario(PC)
- Enhancing low carbon policy scenario (ELC)

RESULTES AND DISCUSSION

Energy demand

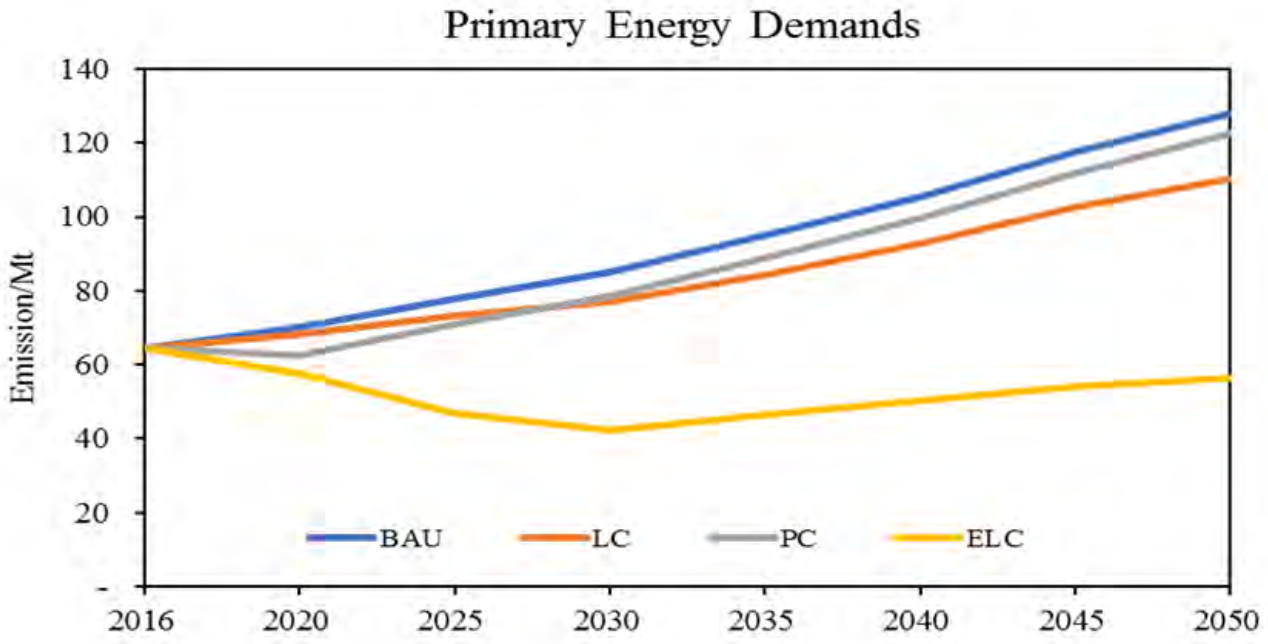


Fig.5.Energy demands of all scenarios in Jinan

In 2050, primary energy demands in PC, LC and ELC scenarios will decline by 4.1%, 13.6% and 55.8% compared to BAU scenario. From 2016 to 2030, the PC policies work more powerfully than the LC policies in terms of energy demand.

RESULT AND DISCUSSION

Energy demand

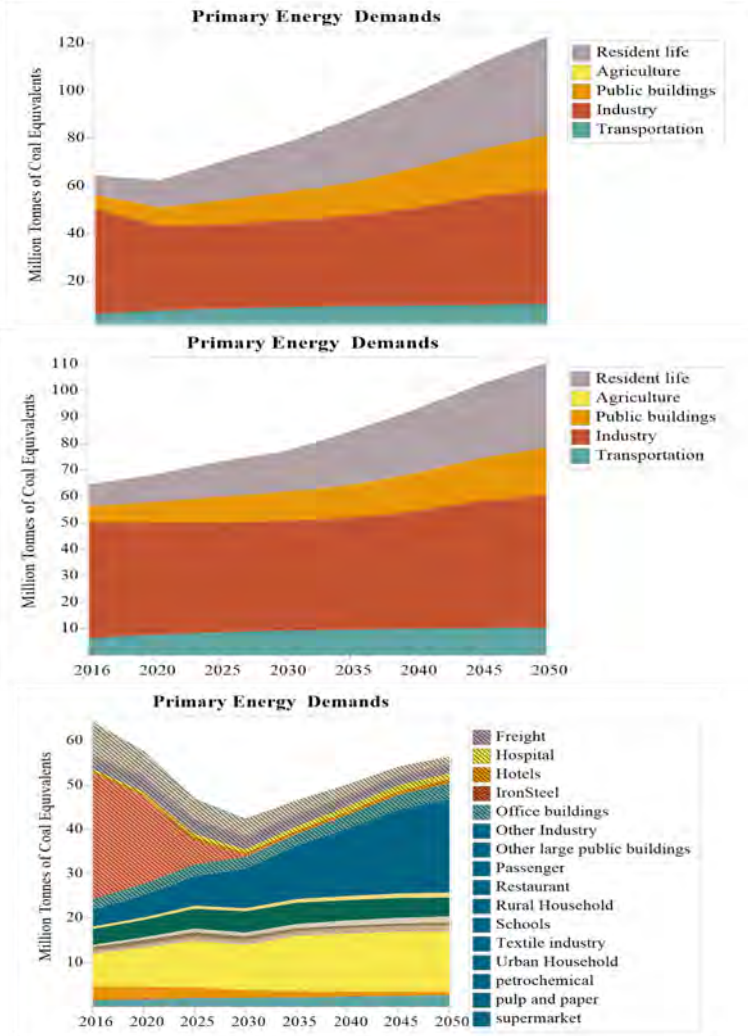


Fig.6. Energy demands by sectors of PC,LC and ELC in Jinan

- From 2016 to 2030, pollutant control policy will be more effective than LC. Because of the sustainable promotion of energy-saving buildings, primary energy demand in LC scenario will be less than those in PC scenario after 2030.

- In ELC, the primary energy demand of industry will fall by 45% compared with 2016.The steel industry is largest energy demand sector in 2016, which was 28.53 Mtce. However, its proportion will drop from 44.41% in 2016 to 0.85% in 2030 and even to 0.1% in 2050.

RESULT AND DISCUSSION

Pollutants and CO_2 emission

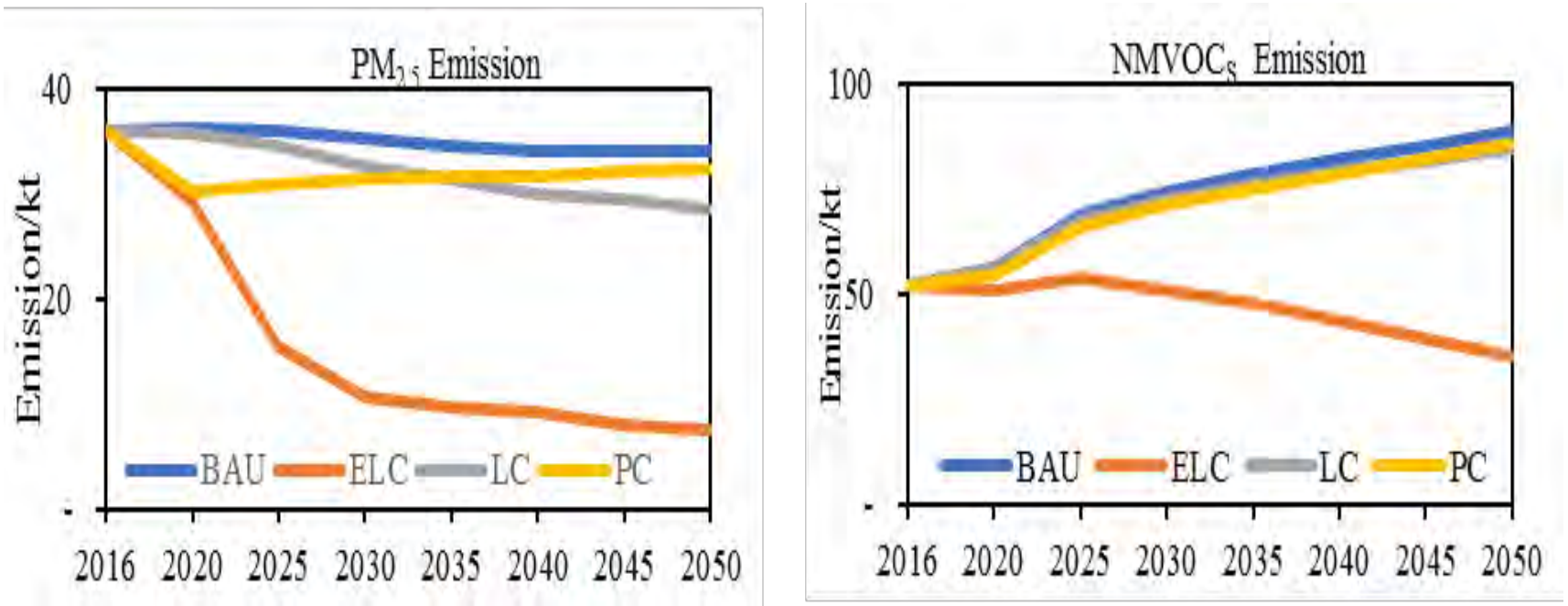


Fig.7. $PM_{2.5}$ and $NMVOC_S$ emissions of all scenarios in Jinan

In 2050, $PM_{2.5}$ emission will be 4.82%,16.23% and 78.09% lower in PC, LC and ELC scenarios than that in BAU scenario. $NMVOC_S$ emission will be 3.45%,4.80% and 60.13% lower in PC, LC and ELC scenarios than those in BAU scenario.

RESULT AND DISCUSSION

Pollutants and CO_2 emission

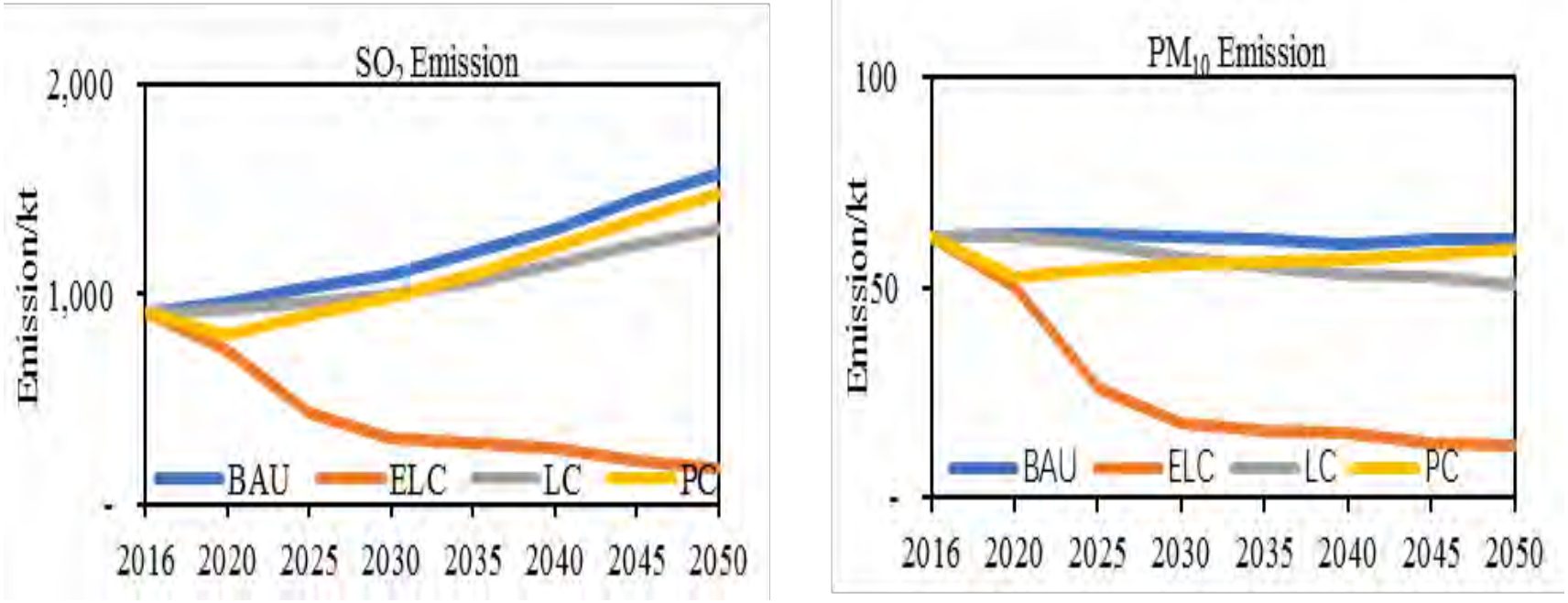


Fig.8. PM_{10} and SO_2 emissions of all scenarios in Jinan

In 2050, PM_{10} emission will be 4.15%,17.38% and 79.67% lower in PC, LC and ELC scenarios than tthose in BAU scenario. SO_2 emission will be 5.82%,16.33% and 88.87% lower in PC, LC and ELC scenarios than those in BAU scenario.

RESULT AND DISCUSSION

Pollutants and CO_2 emission

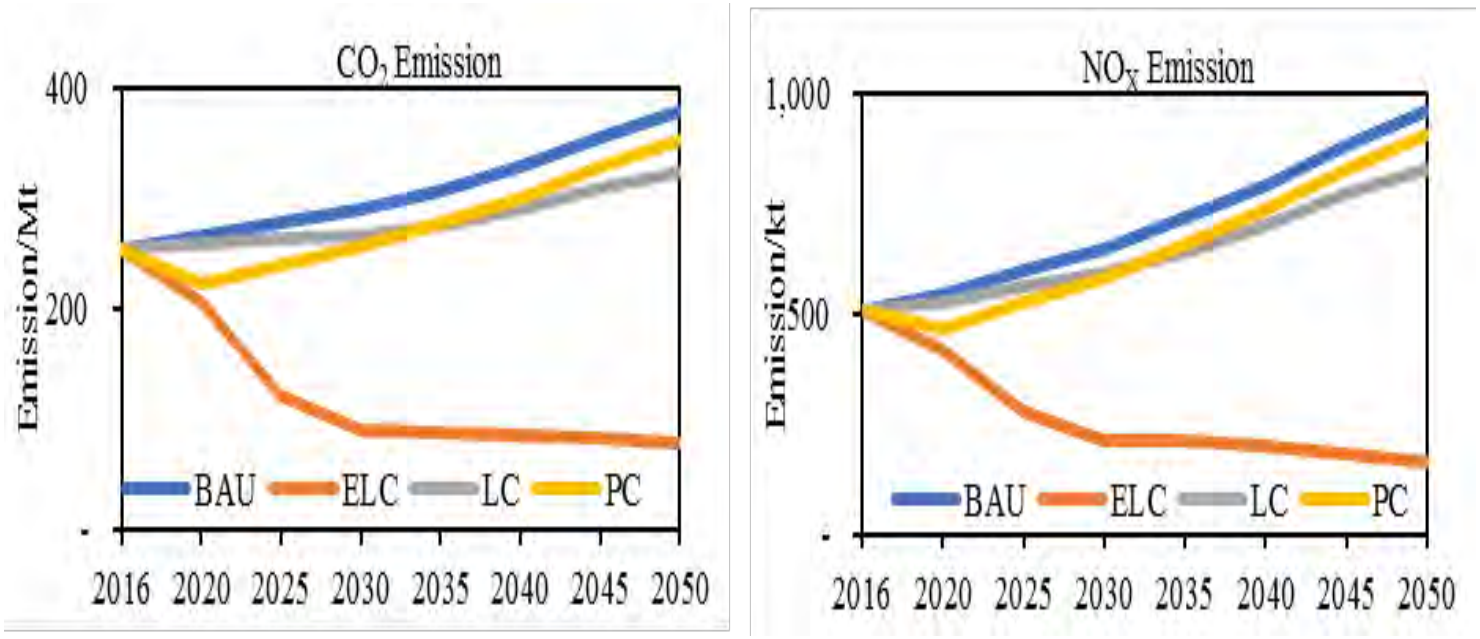


Fig.9. CO_2 and NO_X emissions of all scenarios in Jinan

In 2050, CO_2 emission will be 6.63%,14.63% and 79.17% lower in PC, LC and ELC scenarios than that in BAU scenario. NO_X emission will be 5.71%,13.89% and 82.51% lower in PC, LC and ELC scenarios than that in BAU scenario.

RESULT AND DISCUSSION

Pollutants and CO_2 emission

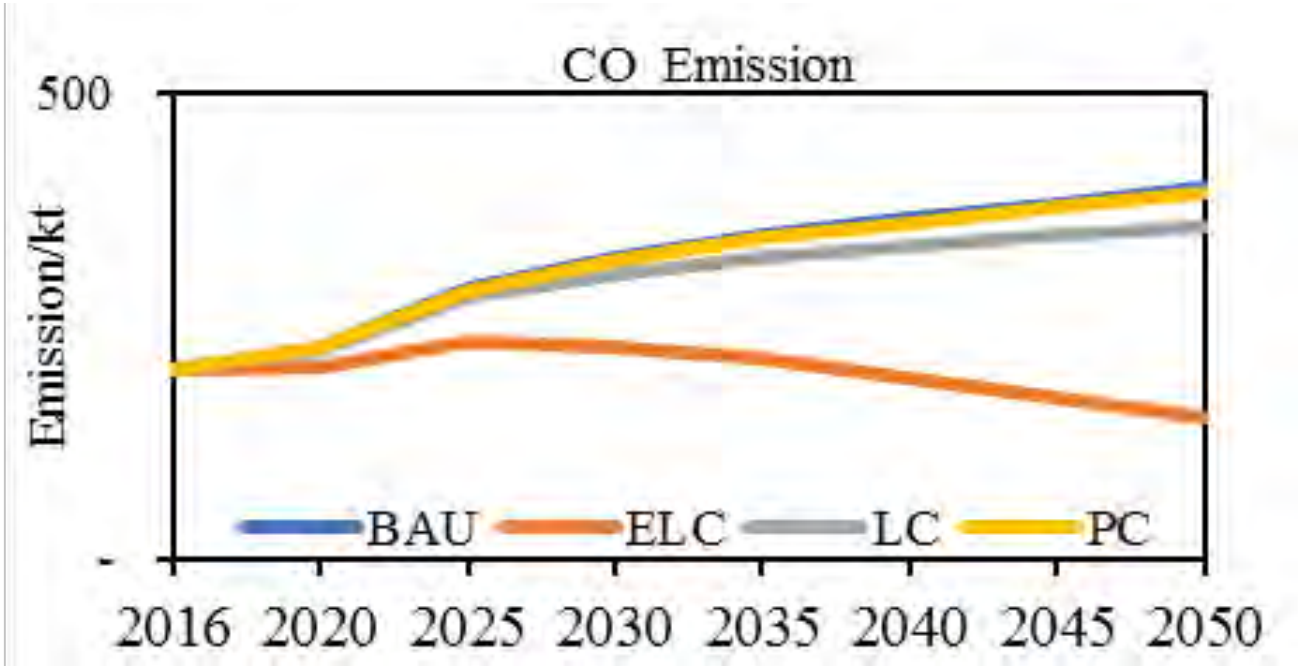


Fig.10. CO emission of all scenarios in Jinan

In 2050, CO emission will be 1.03%,10.54% and 61.88% lower in PC, LC and ELC scenarios than that in BAU scenario.

RESULT AND DISCUSSION

Pollutants and CO_2 emission

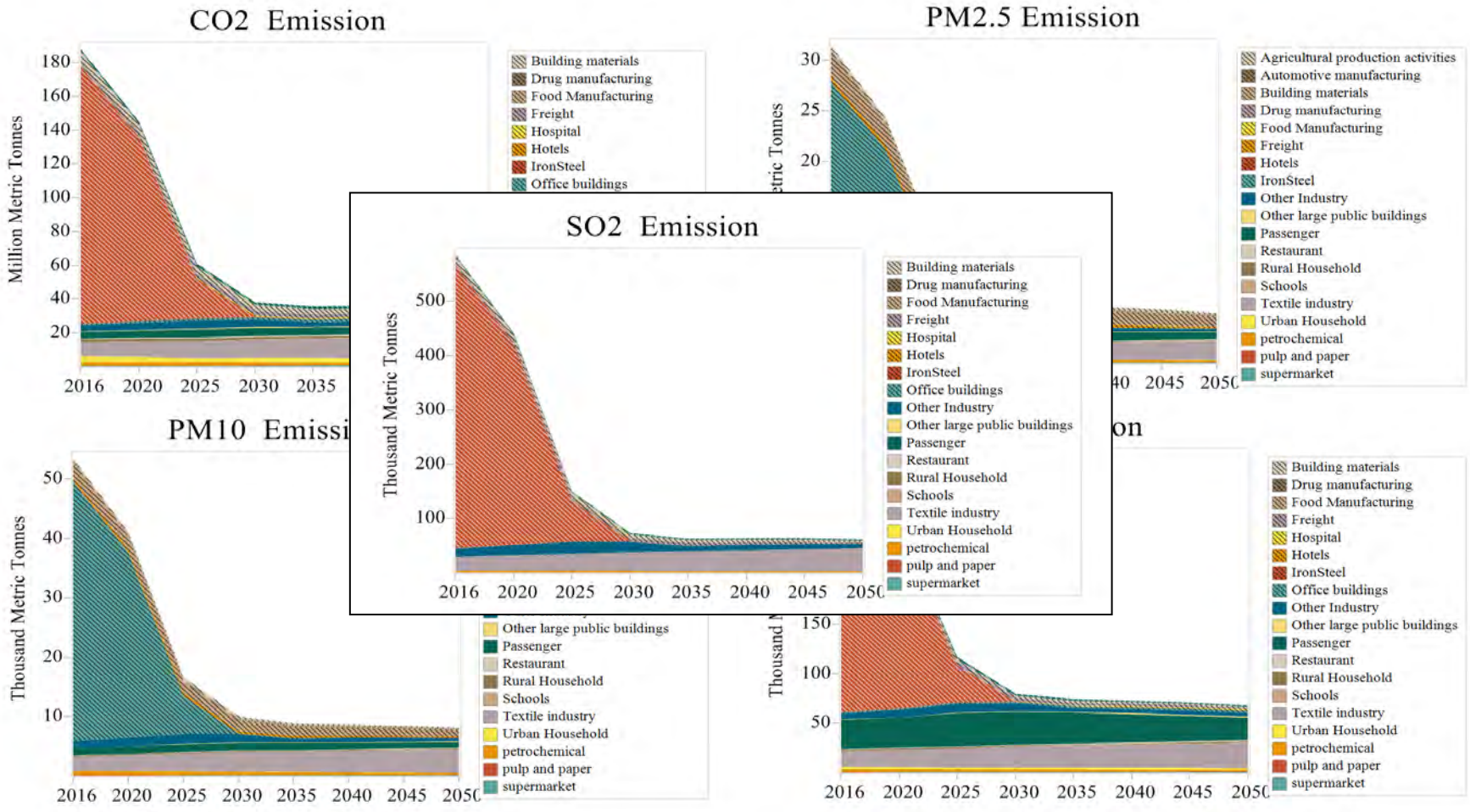


Fig.11. CO_2 ,PM_{10} ,$PM_{2.5}$ and NO_X emission from sector of ELC in Jinan

RESULT AND DISCUSSION

Pollutants and CO_2 emission

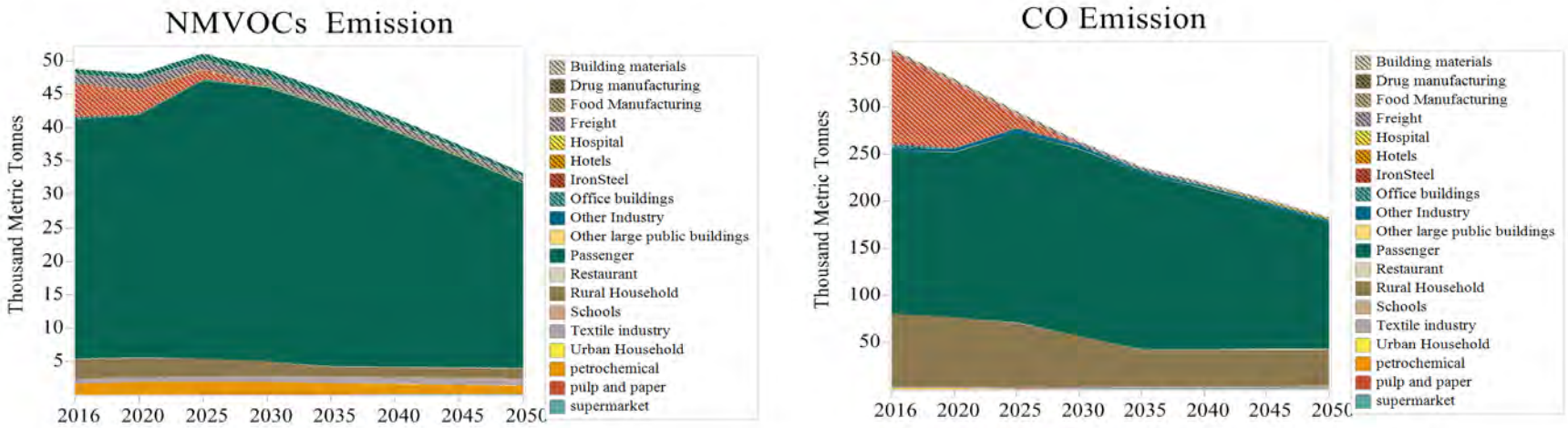
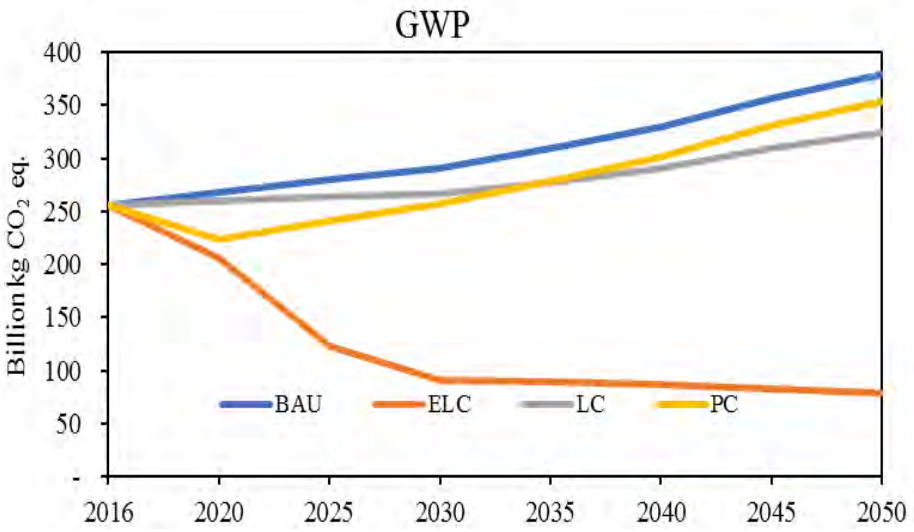


Fig.12. CO and $NMVOC_S$ emission from sector of ELC in Jinan

The iron and steel industry is the major contributing sector of CO_2, PM_{10}, $PM_{2.5}$, NO_X and SO_2 emission before 2030, and transportation is the major contributing sector of CO and $NMVOC_S$ emission during 2016-2050.

RESULT AND DISCUSSION

Environmental benefits



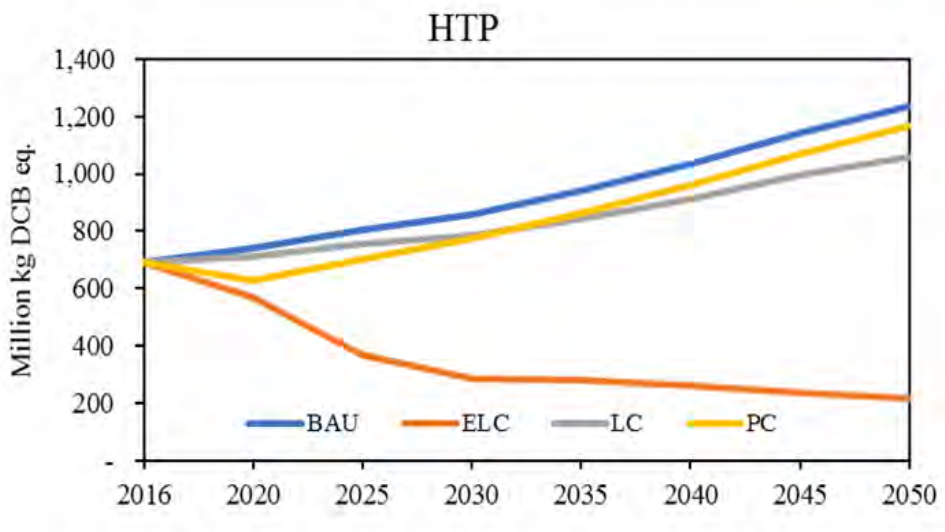


Fig.13. GWP and HTP of all scenarios in Jinan

In 2050, GWP will be 6.62%,14.60% and 79.10%lower in PC, LC and ELC scenarios than that in BAU scenario. HTP will be 5.61%,14.05% and 82.20% lower in PC, LC and ELC scenarios than that in BAU scenario.

RESULT AND DISCUSSION

Environmental benefits

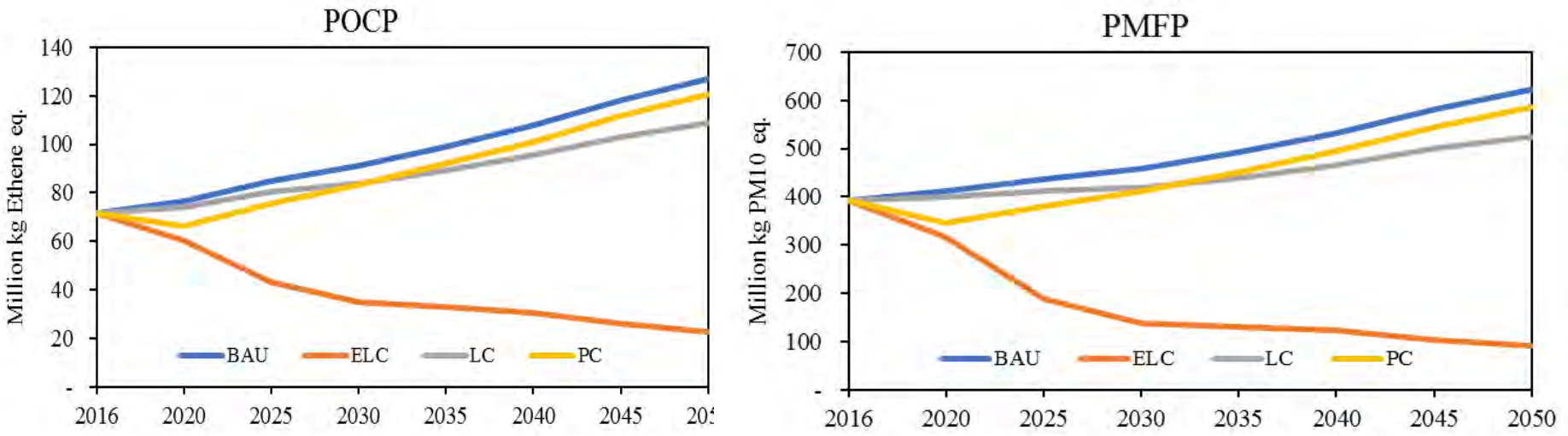


Fig.14. POCP and PMFP of all scenarios in Jinan

In 2050, POCP will be 5.14%,14.09% and 82.14%lower in PC, LC and ELC scenarios than that in BAU scenario. PMFP will be 5.56%,15.60% and 85.21% lower in PC, LC and ELC scenarios than that in BAU scenario.

RESULT AND DISCUSSION

Environmental benefits

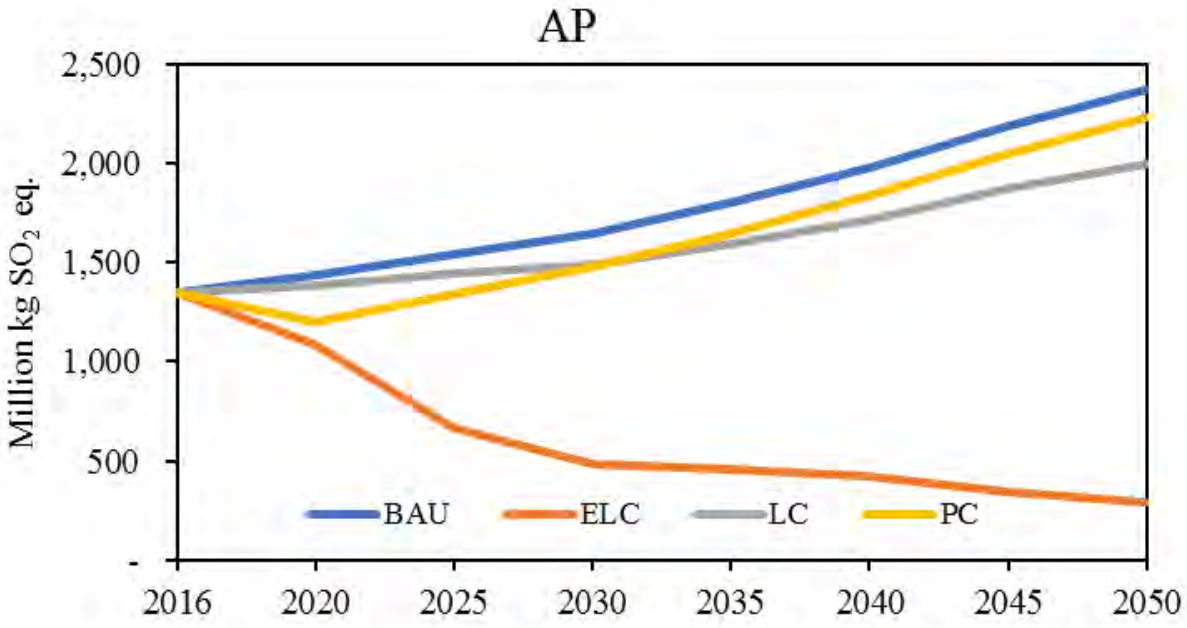


Fig.15. AP of all scenarios in Jinan

In 2050, AP will be 5.80%,15.84% and 87.58%lower in PC, LC and ELC scenarios than that in BAU scenario.

RESULT AND DISCUSSION

Environmental benefits

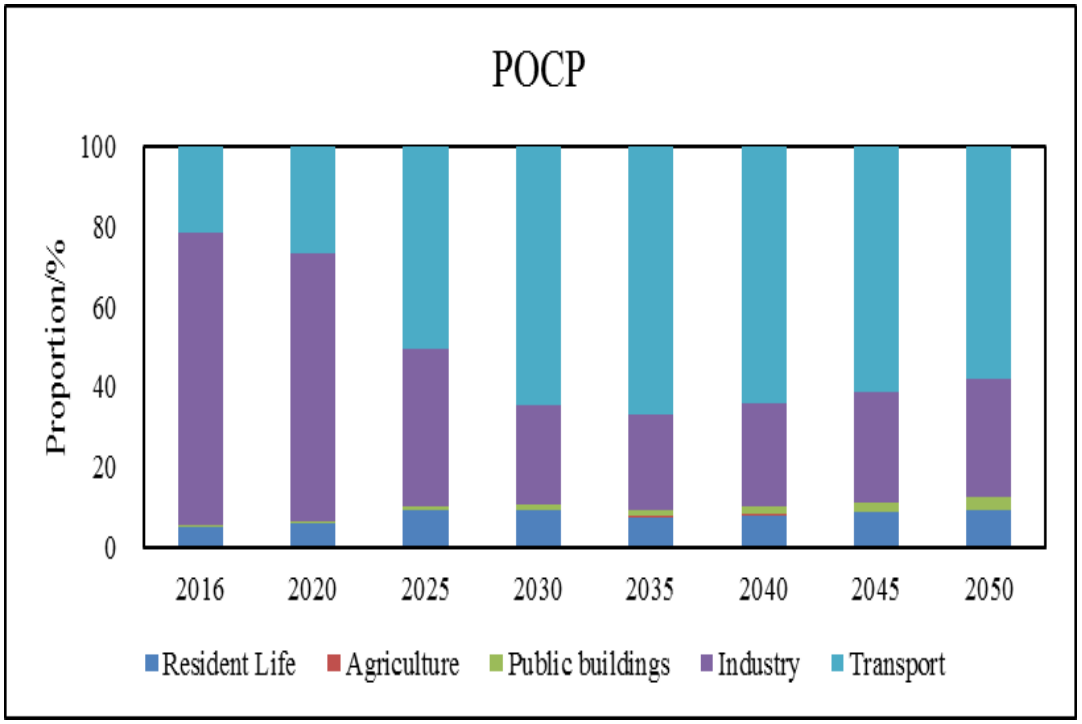


Fig.16. POCP in sectors of ELC in Jinan

The share of transportation to POCP increases from 21.34% in 2016 to 50.70% in 2025, and will become the greatest contributor.

RESULT AND DISCUSSION

Environmental benefits

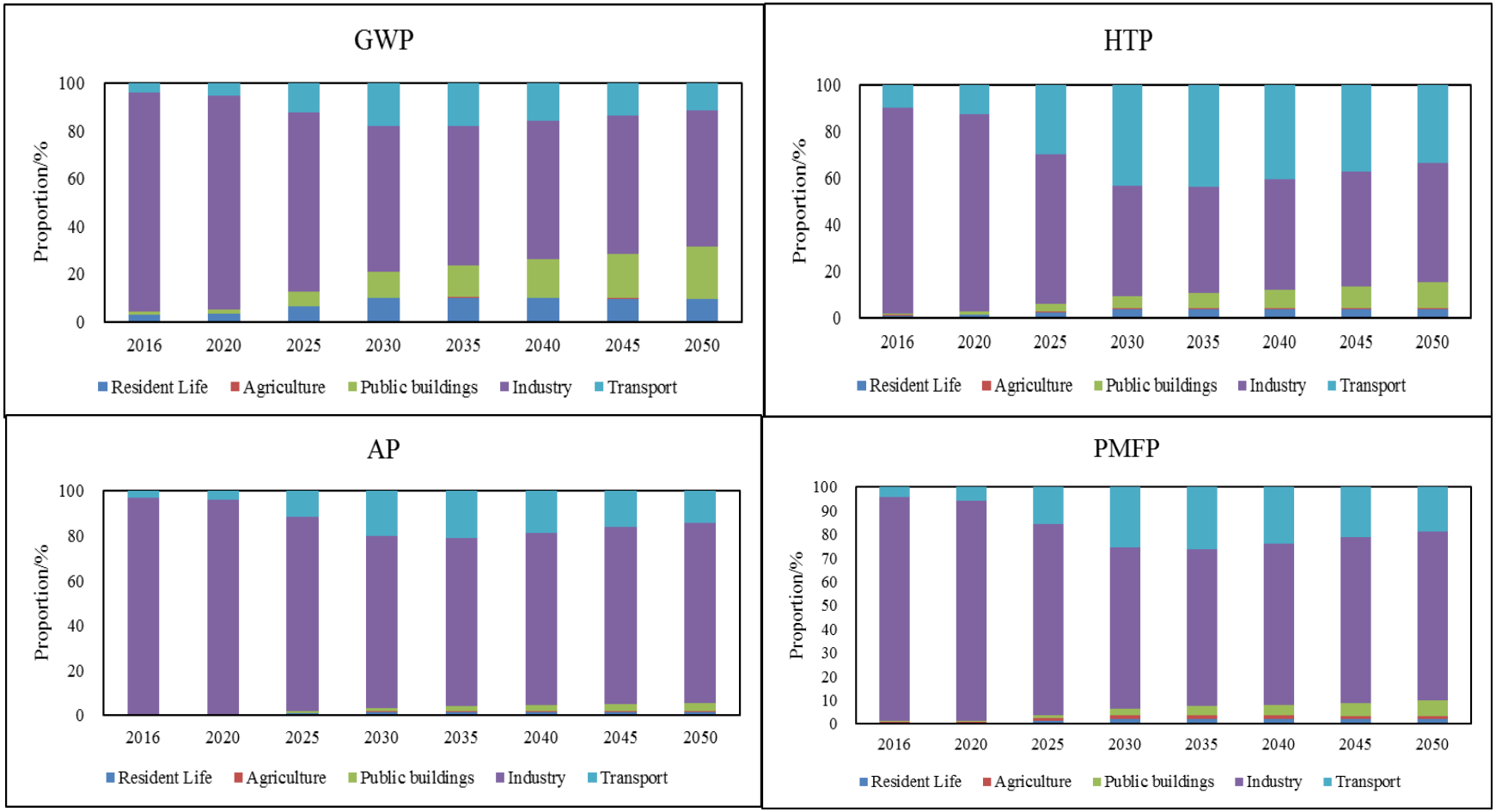


Fig.17. GWP,HTP,PMFP and AP in sectors of ELC in Jinan

CONCLUSIONES

- ✓ **In 2050, primary energy demands under PC, LC and ELC scenarios will decline by 4.1%, 13.6% and 55.8% compared to BAU scenario.**

- ✓ **In 2050, under PC, LC and ELC ,GWP will be 6.62%,14.60% and 79.10% lower scenarios than that in BAU scenario.**

- ✓ **In terms of energy demand, from 2016 to 2030, the PC policies work more powerfully than the LC policies, while from 2030 to 2050 the LC policies will affect more powerfully.**

- ✓ **under ELC scenario, energy demand will decrease significantly, it will be 55.8% lower than that in BAU scenario in 2050. CO_2, PM_{10}, $PM_{2.5}$, NO_X and SO_2 will reduce by 79.17%,79.67%, 78.09 %, 82.51% and 88.87%, respectively.**

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ACKNOWLEDGMENTS

- **This work was financial supported by National Joint Research Center for Tacking key Problems In Air Pollution Control and Chinese Academy of Environmental Planning [grant numbers DQGG0302].**

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Thank You For Your Attention !

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