Supplementary Material

**Supplementary Table A.** BUA, ESO, and ETD scenario settings of several sectors

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|  | BUA | ESO | ETD |
| Agriculture, Forestry, Animal Husbandry and fishery  | In 2015 ,2020, 2030 and 2040, energy consumption per unit added value will decrease by 1.5%, 1.00%, 0.75% and 0.50% annually, respectively. | From 2015 to 2020, 10% of raw coal and diesel will be replaced by natural gas and electricity, and the added value of replacement will be increased by 10% every 10 years thereafter. | In 2015, 2020, 2030 and 2040, the average annual reduction rate of energy consumption per unit added value is set at 1.5%, 3.5%, 3.5% and 2% respectively. From 2015 to 2020, 10% of raw coal and diesel will be replaced by natural gas and electricity, and 20% will be added every 10 years thereafter.  |
| Industry | In 2015, 2020, 2030 and 2040, industrial energy consumption per unit of added value will decrease by 2%, 2.5%, 1.5% and 0.5% annually. | From 2015 to 2020, 10% of raw coal and coke will be replaced by natural gas and electricity, and the added value of replacement will be increased by 15% every 10 years thereafter. | In 2015, 2020, 2030, 2040, the average annual decrease rate of industrial unit added value energy consumption is 2.8%, 3.0%, 3.5% and 3%. Set natural gas and electricity to replace 20% of raw coal and coke, and add 20% to the added value of replacement every 10 years.  |
| Construction | In 2015,2020,2030.2040, industrial unit added value energy consumption will decrease by 2.0%, 2.5%, 1.0% and 0.5% annually. | From 2015 to 2020, natural gas and electricity will replace 5% of diesel and gasoline. From 2020 to 2030, 15% of the substitute added value of natural gas and electricity will be replaced by diesel and gasoline, and 15% will be added every 10 years thereafter.  | In 2015, 2020, 2030, 2040, the average annual decline rate of industrial unit added value energy consumption is 2.8%, 3.0%, 3.5% and 2.5%. From 2015 to 2020, electricity will replace 5% of diesel and gasoline. From 2020 to 2030, 5% of diesel and gasoline will be replaced by electricity, and 15% will be added every 10 years thereafter. |
| Transport | From 2015 to 2020, energy consumption per unit added value will decrease by 1.0% annually. From 2020 to 2030, energy consumption per unit of added value will be reduced by 0.5 percent annually. From 2030 to 2040, energy consumption per unit of added value will decrease by 0.5 percent annually; From 2040 to 2050, energy consumption per unit added value will decrease by 0.5% annually. | From 2015 to 2020, 10% of the replacement value of gasoline and diesel will be replaced by renewable energy, and 10% will be added every 10 years thereafter. | From 2015 to 2020, set the average annual reduction rate of energy consumption per unit of added value at 2.25%; From 2020 to 2030, energy consumption per unit of added value will decrease by 3.50% annually. From 2030 to 2040, energy consumption per unit added value will decrease by 2.5% annually; From 2040 to 2050, energy consumption per unit added value will decrease by 1.8% annually; From 2015 to 2020, 20% of the substitute added value of gasoline and diesel will be replaced by renewable energy, and 20% will be added every 10 years thereafter. |
| Commercial | From 2015 to 2020, the energy consumption per unit of added value will decrease by 0.5% annually. From 2020 to 2030, energy consumption per unit of added value will decrease by 1.0% annually. From 2030 to 2040, energy consumption per unit of added value will decrease by 0.5% annually. From 2040 to 2050, energy consumption per unit of added value will decrease by 0.5% annually. | From 2015 to 2020, 10% of raw coal will be replaced by natural gas and electricity, and 10% will be added every 10 years thereafter. | From 2015 to 2020, the average annual reduction rate of energy consumption per unit of added value will be 2.3%. From 2020 to 2030, energy consumption per unit of added value will be reduced by an average annual rate of 3.0 percent. From 2030 to 2040, energy consumption per unit added value will decrease by 2.5% annually. From 2040 to 2050, energy consumption per unit added value will decrease by 1.50% annually. From 2015 to 2020, 20% of raw coal will be replaced by natural gas and electricity, and the added value of replacement will be increased by 15% every 10 years thereafter. |
| Service | From 2015 to 2020, the energy consumption per unit added value will decrease by 1.25% annually. From 2020 to 2030, energy consumption per unit of added value will be reduced by 1.5% annually. From 2030 to 2040, energy consumption per unit added value will decrease by 1.0% annually. From 2040 to 2050, energy consumption per unit added value will decrease by 0.5% annually. | From 2015 to 2020, 10% of raw coal and gasoline will be replaced by natural gas and electricity, and the added value of replacement will be increased by 15% every 10 years thereafter. | From 2015 to 2020, set the average annual reduction rate of energy consumption per unit of added value at 2.3%. From 2020 to 2030, set the average annual reduction rate of energy consumption per unit of added value at 3.0%. From 2030 to 2040, set the average annual reduction rate of energy consumption per unit of added value at 2.5%. From 2040 to 2050, set the average annual reduction rate of energy consumption per unit added value at 1.65%. And 15%, 30%, 50% and 70% of raw coal and gasoline will be replaced by natural gas and electricity respectively. |
| Urban and rural | From 2015 to 2020, the per capita energy intensity of urban residents will increase at an average annual rate of 0.5%, from 2020 to 2030 by 1.5% and from rural areas by 1.0%, and from 2030 to 2040 by 1.2%. The per capita energy intensity of rural residents will increase by 0.9% annually. From 2040 to 2050, the per capita energy intensity of urban residents will increase by 1% annually, and that of rural residents by 0.75% annually. | From 2015 to 2020, we will set up urban living departments, with natural gas and electricity replacing 20% of raw coal, and adding 20% of the added value substituted for coal every 10 years thereafter. From 2015 to 2020, 10% of raw coal will be replaced by natural gas and electricity in rural areas, and 20% of raw coal will be replaced by natural gas and electricity in rural areas from 2020 to 2030, and the added value of substitution will be increased by 20% every 10 years thereafter. | From 2015 to 2020, the per capita energy intensity of urban residents will increase by 1.5% annually, natural gas and electricity will replace 20% of raw coal, and rural residents will increase by 1.0% annually, natural gas and electricity will replace 10% of raw coal. From 2020 to 2030, the above settings are 2.5%, 40%, 2.0% and 20% respectively. From 2030 to 2040, they are 2%, 60%, 1.5%, 40%; From 2040-2050, they are 1.5%, 80%, 1.0% and 60% respectively. |
| Power generation | The power generation structure will remain unchanged and similar to the base year. Thermal power will still dominate, accounting for 96.80% of the total power generation by 2050, while renewable energy will still not reach 10%. | Coal-fired power generation continues to decline, with its share falling to 65% by 2030 and 50% by 2050. By 2020, the share of gas-fired power generation will reach 20%, followed by 28% in 2030, 31.5% in 2040 and 37% in 2050. Transmission and distribution loss maintained stable. | From 2015 to 2020, we will increase the conversion efficiency of power generation by 10%, further expand cogeneration of heat and power, and increase the proportion of gas-fired power generation. By 2030 and 2050, the proportion of coal-fired power generation will fall to 55% and 35%, while the proportion of gas-fired power generation will rise to 35% and 48%. By 2050, solar power will reach 8% and biomass 7% respectively. |