Results and key findings
SDG 7 Roadmap for Kazakhstan

NEXSTEP
National Expert SDG Tool for Energy Planning

Virtual Workshop on
Stakeholder Consultation and Capacity Building on the National Expert SDG Tool
for Energy Planning (NEXSTEP) for the SDG 7 Roadmap for Kazakhstan

Anis Zaman
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(on behalf of ESCAP)

9th November 2023

ESCAP
Economic and Social Commission
for Asia and the Pacific

Objective of this Presentation
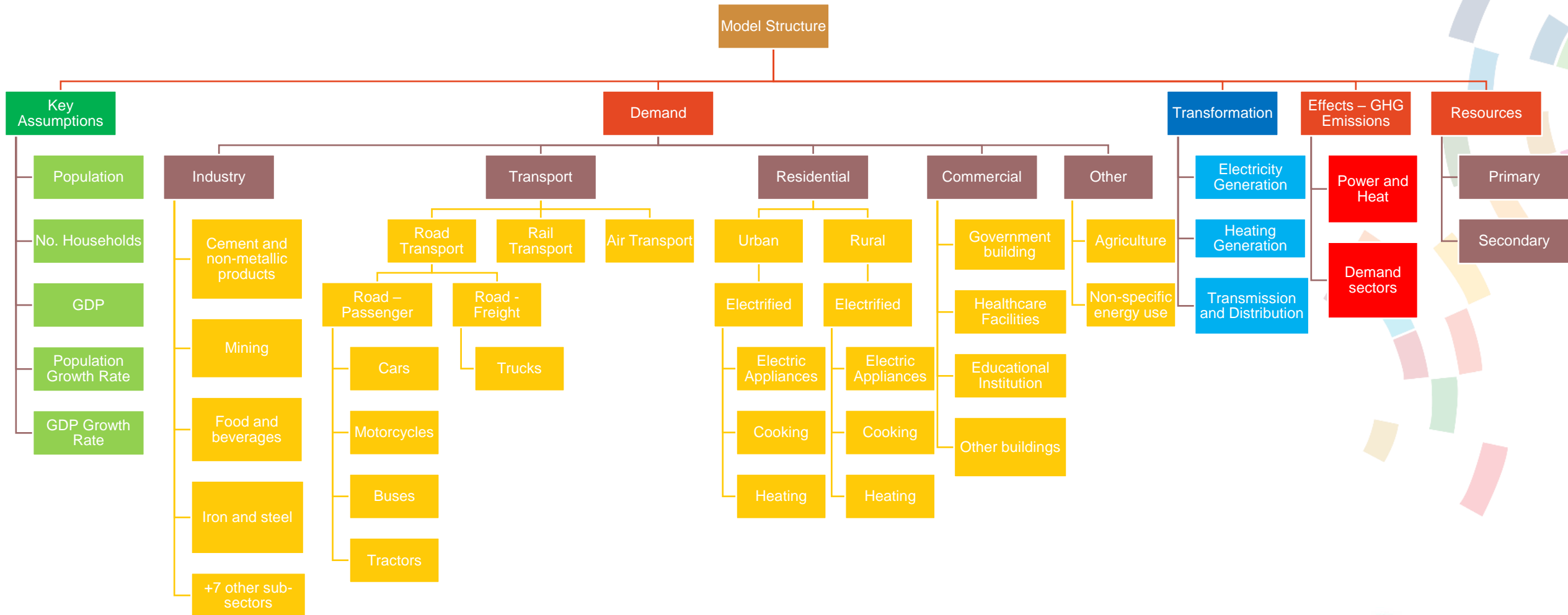
Provide:

- Brief introduction to the modelling methodology

- Current energy situation (2021)

- Highlights of energy transition pathways (scenarios)

Gauge stakeholder's feedback:

- Modelling data and assumptions used

- Proposed energy transition interventions

Scenario Development Process in LEAP

Data Collection – bottom-up approach

Residential
- Cooking distribution and intensity data
- Appliance ownership consumption intensity
- Heating distribution and intensity data

Industry
- Fuel consumption data (i.e. electricity, oil products)

Transport
- Vehicle statistics (i.e. number of vehicles by fuel type)
- Annual travelled mileage, passenger load factor, fuel economy

Commercial
- Floorspace data
- Electricity and fuel consumption intensity (kWh/m^2)

Power
- Existing capacity and generation
- Planned power capacity expansion

Data Sources

- Governmental reports/surveys
- Governmental databases
- International organisation databases
- Benchmarking
- Research papers etc.

Current situation of the energy sector

Base year 2021

Energy Situation in 2021

Kazakhstan's 2021 status for the SDG 7 indicators and GHG emissions

ACCESS TO MODERN ENERGY

100%

Population with access to electricity in **2021**

94%

Population with access to clean cooking in **2021**

RENEWABLE ENERGY

1.9% of TFEC

Excluding traditional biomass usage in residential cooking and heating

ENERGY EFFICIENCY

5.6 MJ/USD

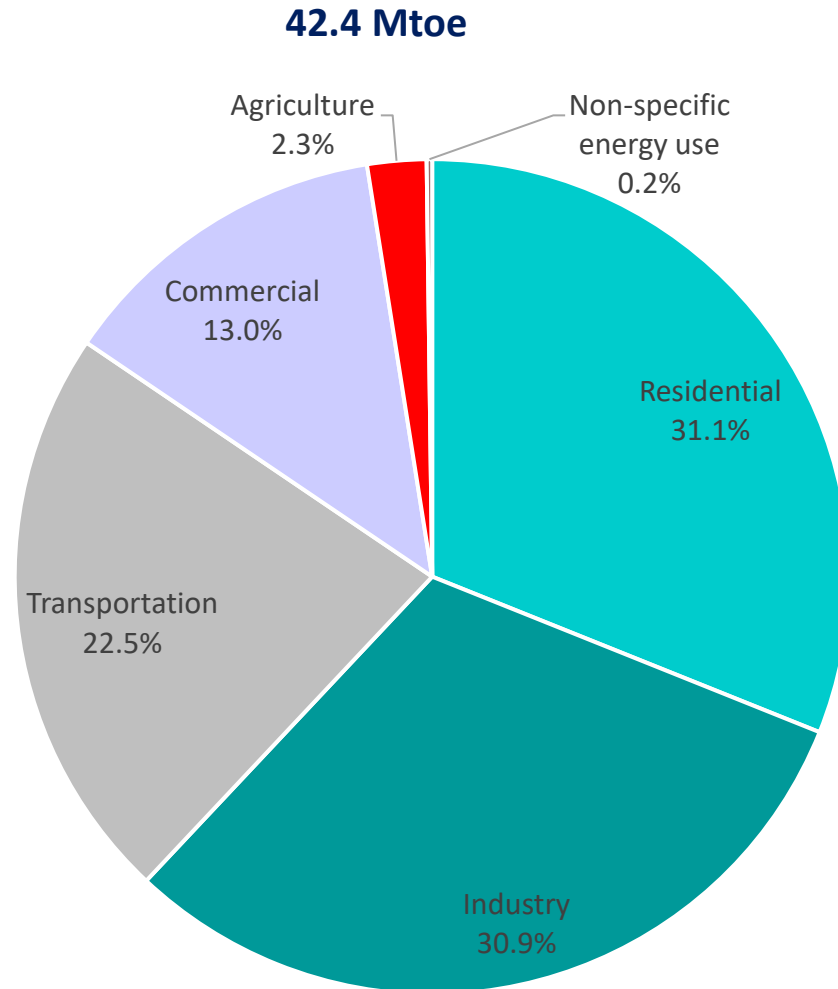Primary energy intensity measured in terms of primary energy and GDP (PPP, 2017)
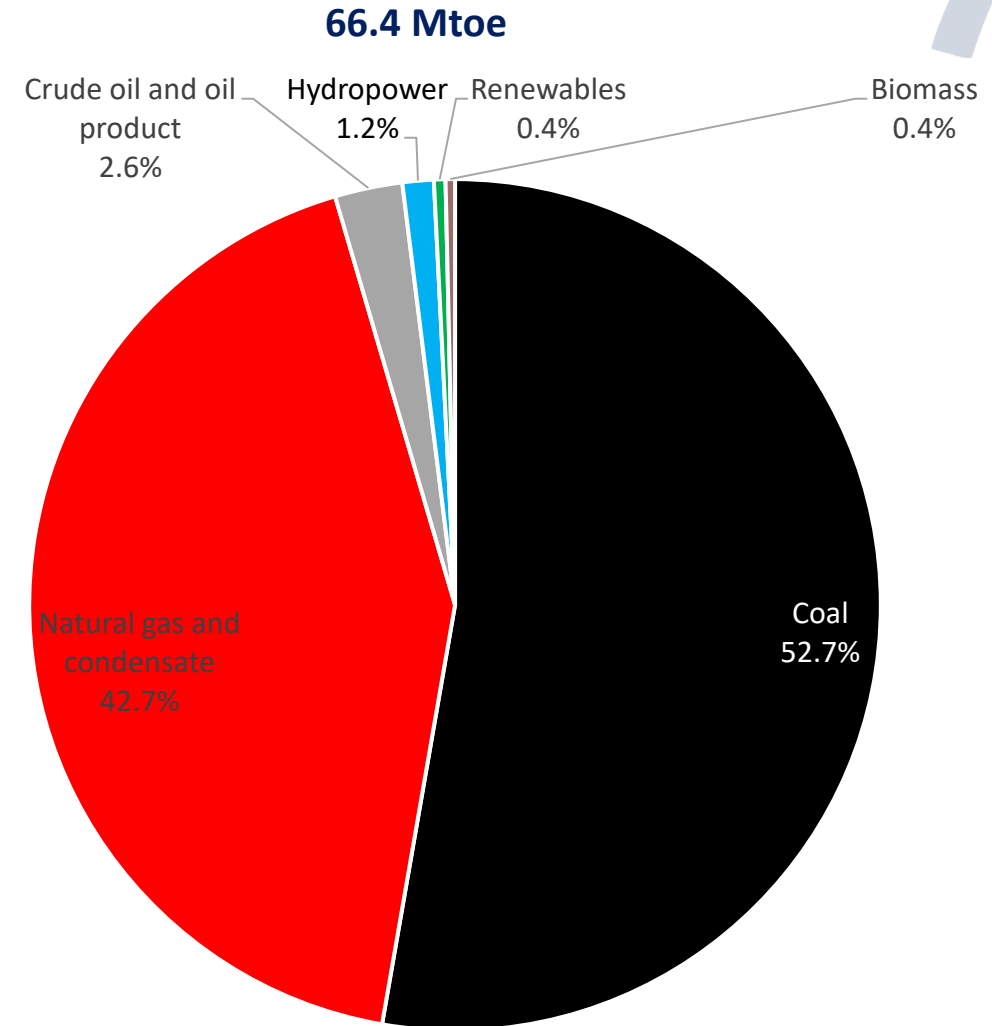
GHG EMISSIONS

213.7 MtCO2-eq

Considering the energy sector only

TFEC and TPES, 2021

Total final energy consumption (TFEC) in 2021 by Sector

42.4 Mtoe

- Agriculture 2.3%
- Non-specific energy use 0.2%
- Commercial 13.0%
- Residential 31.1%
- Transportation 22.5%
- Industry 30.9%

Total primary energy supply (TPES) in 2021 by Fuel

66.4 Mtoe

- Crude oil and oil product 2.6%
- Hydropower 1.2%
- Renewables 0.4%
- Biomass 0.4%
- Coal 52.7%
- Natural gas and condensate 42.7%
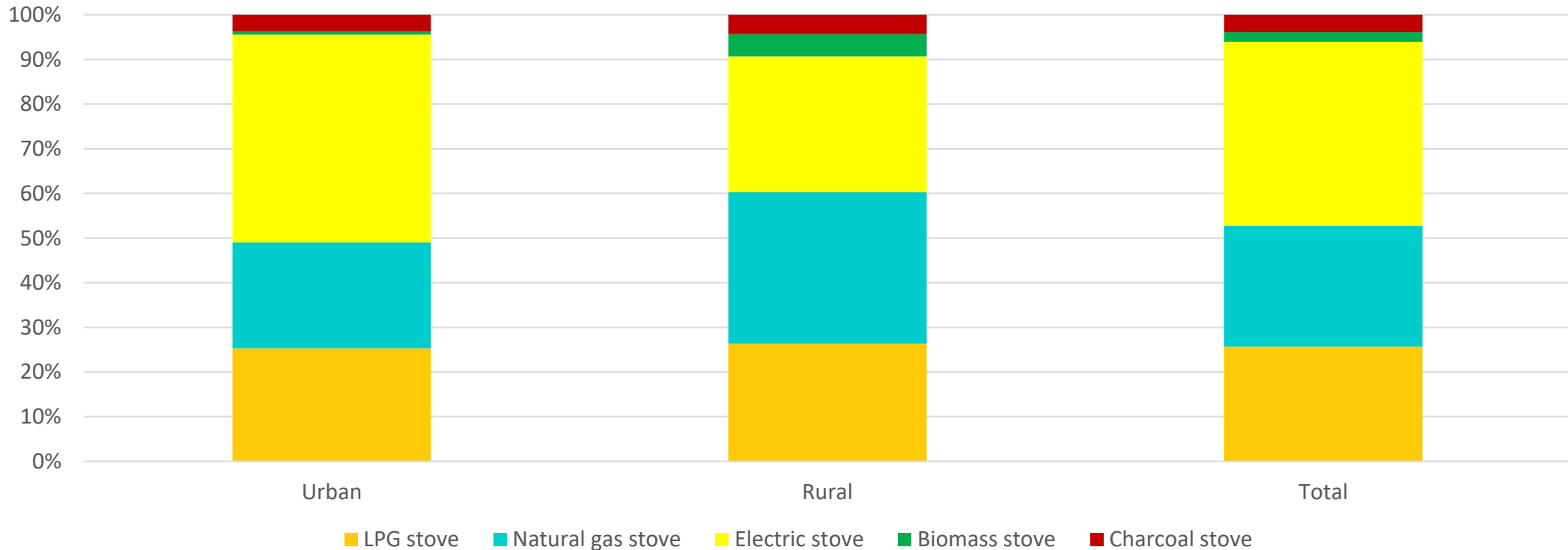
Energy Balance 2021

Fossil fuel *makes up a large portion of Kazakhstan's energy flows.*

Unit: Million Tonnes of Oil Equivalent (MTOE)
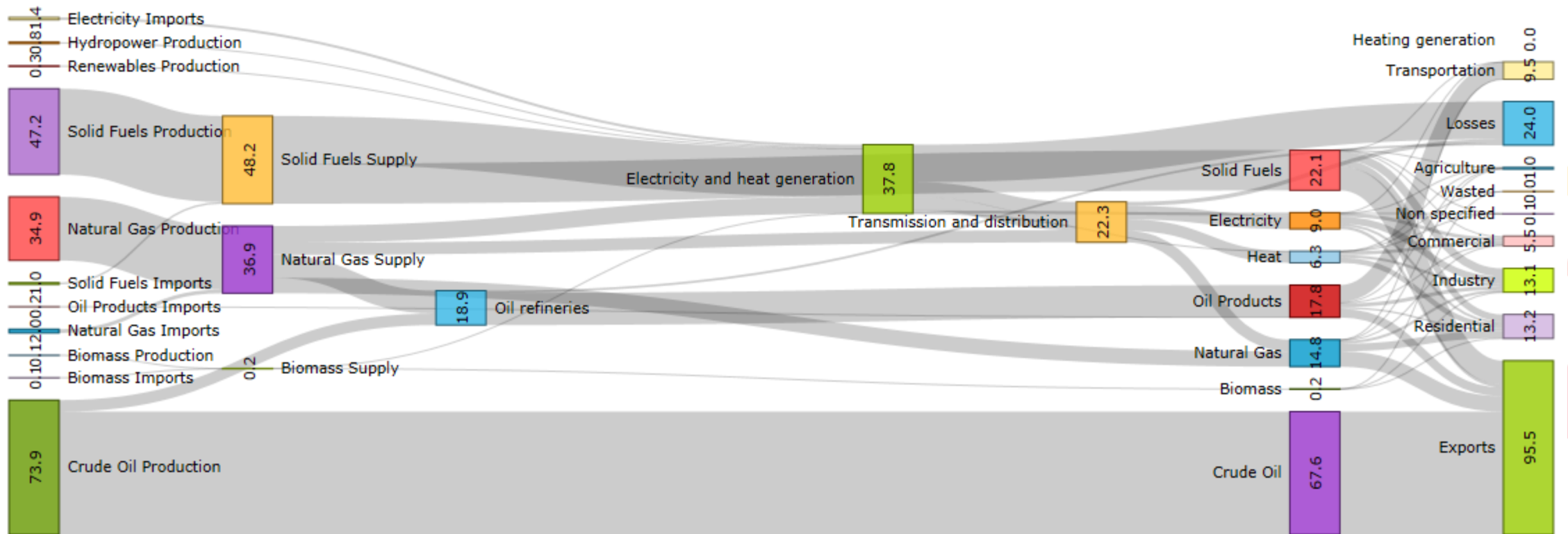
Access to modern energy in 2021
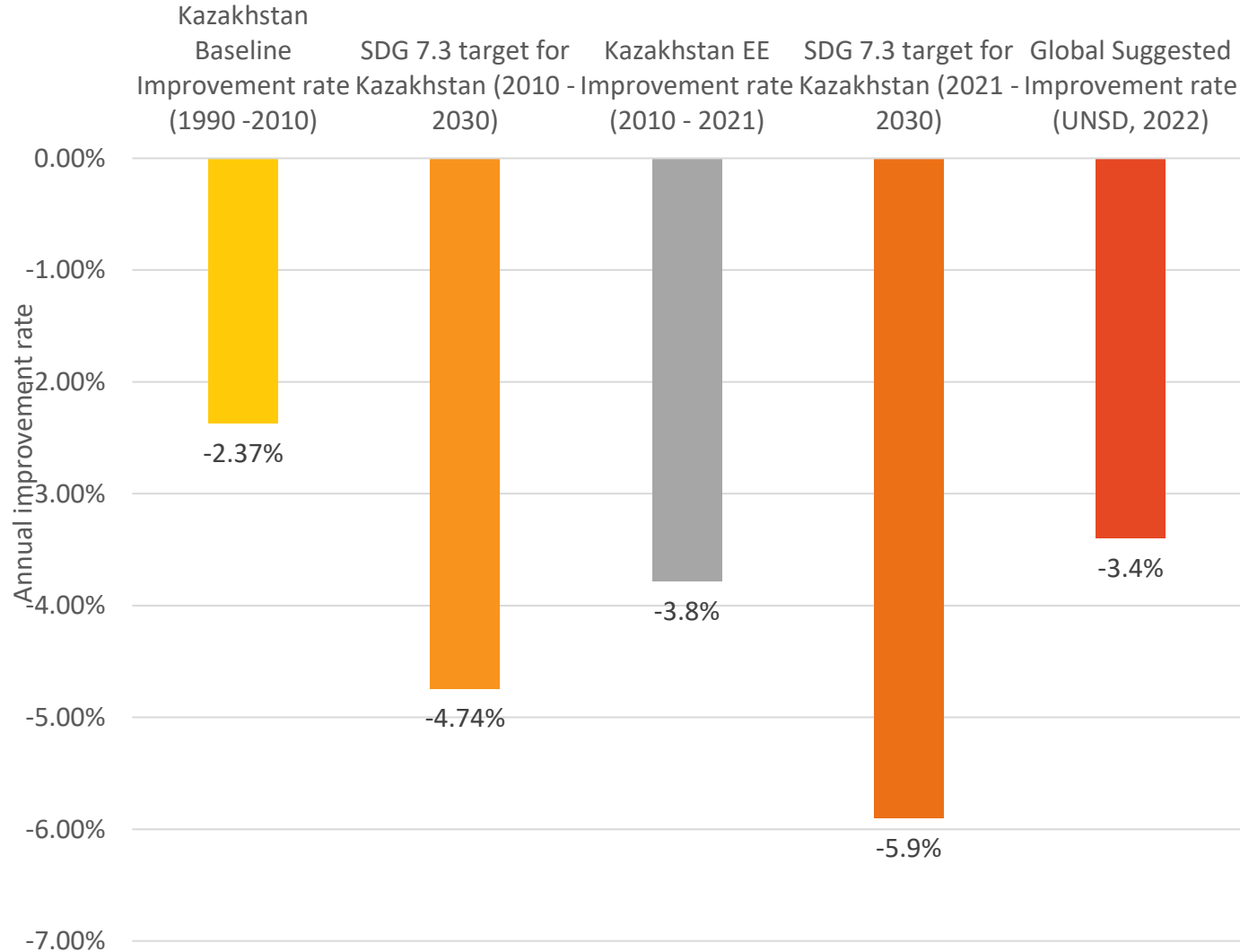
- The electrification rate in Kazakhstan **was already 100 per cent in 2021**
- The clean cooking access was **94 per cent in 2021**
- Around 305,662 households still relied on unclean and polluting kerosene and biomass stoves as their primary cooking technology
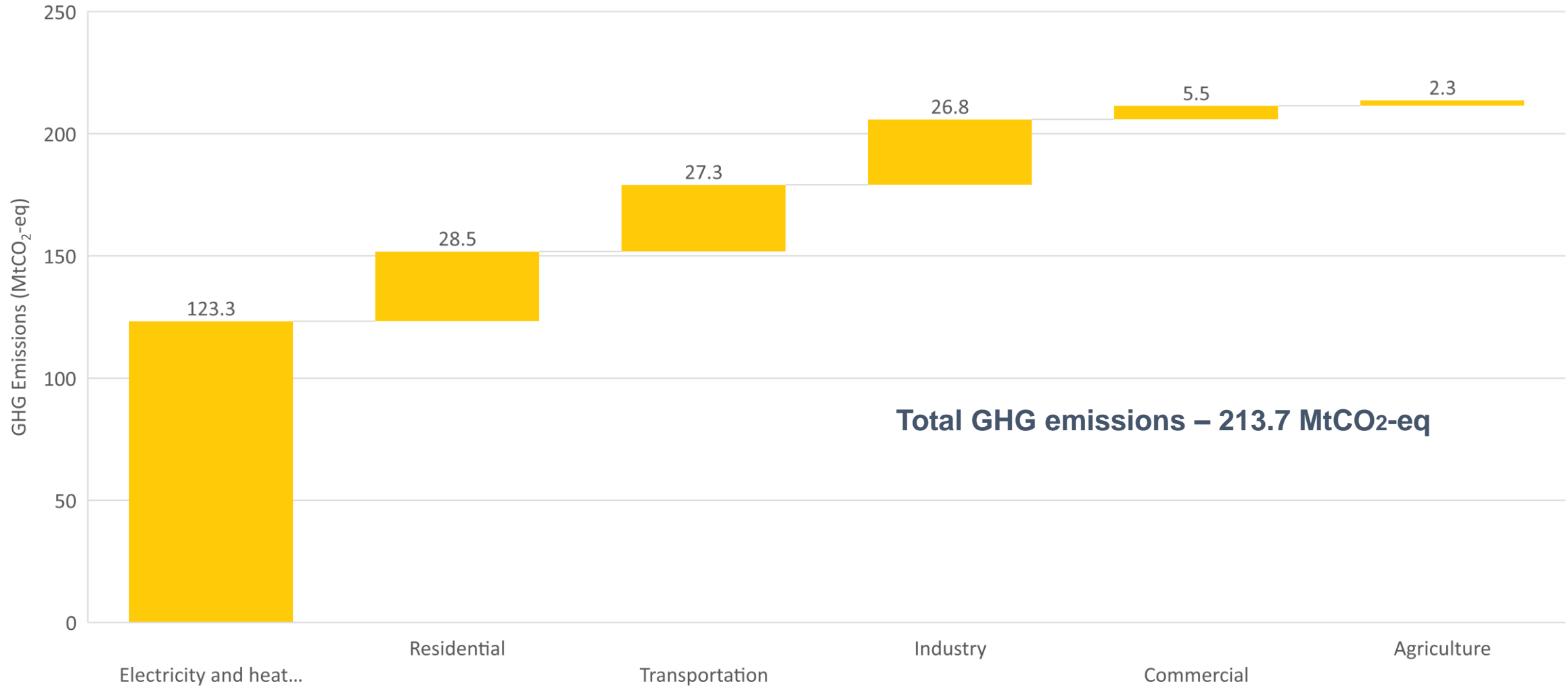

Legend: LPG stove, Natural gas stove, Electric stove, Biomass stove, Charcoal stove. Categories: Urban, Rural, Total.

Energy intensity target setting

Chart categories (left to right):
- Kazakhstan Baseline Improvement rate (1990 -2010): -2.37%
- SDG 7.3 target for Kazakhstan (2010 - 2030): -4.74%
- Kazakhstan EE Improvement rate (2010 - 2021): -3.8%
- SDG 7.3 target for Kazakhstan (2021 - 2030): -5.9%
- Global Suggested Improvement rate (UNSD, 2022): -3.4%

Y-axis: Annual improvement rate (0.00% to -7.00%)

- Energy intensity (MJ/US$) is an indication of how much energy is supplied (TPES in MJ) to produce one unit of economic output (GDP in US$ adjusted to power purchasing parity in 2017)

- The annual improvement rate is the compound annual growth rate (CAGR) of energy intensity between two different years

- A doubling of the 1990-2010 improvement rate to achieve the SDG 7.3 target requires a CAGR of 4.7 per cent between 2010 and 2030 reaching an energy intensity of 3.3 MJ/US$.

- To reach 3.3 MJ/US$ in 2030, the CAGR between 2021 and 2030 must be around 5.9 per cent which is a challenge.

- NEXSTEP analysis suggests to align with the global target of 3.4 per cent, reaching 4.1 MJ/US$.

GHG emissions in 2021

GHG Emissions (MtCO$_2$-eq)

Total GHG emissions – 213.7 MtCO$_2$-eq

- 123.3 — Electricity and heat…
- 28.5 — Residential
- 27.3 — Transportation
- 26.8 — Industry
- 5.5 — Commercial
- 2.3 — Agriculture

Scenarios development 2030

Assumptions, growth factors and constraints

Scenarios

The baseline – Business As Usual (BAU) Scenario

Assessing the gap – Current Policy Scenario (CPS)

Meeting the SDG and NDC targets – Sustainable Development Goal (SDG) Scenario

Beyond 2030 - Sustainable Heating Scenario and Towards Net Zero Scenarios

Key Growth Projections and Assumptions

Parameters	Business as usual scenario	Current policy scenario	Sustainable Development Goal scenario
Economic growth	3.2 per cent between 2021 and 2022,4.1 per cent between 2022 and 2023, 4.3 percent per annum from 2023		
Population growth	1.6 per cent per annum		
Urbanization rate	67 per cent in 2021, growing to 68 per cent in 2030		
Commercial floor space	Assumed annual energy consumption increasing at the same growth as GDP		
Industrial activity	Assumed annual energy consumption increasing at the same growth as GDP		
Transport activity	Passenger transport activities and freight transport activities are assumed growing at a rate like the growth in GDP per capita		
Residential activity	The appliance ownership for electrical appliances is projected to grow at a rate like the growth in GDP per capita.		
Access to electricity	The 100 per cent access to electricity has been achieved.		
Access to clean cooking fuels	Projected based on the historical penetration rate between the 2000-2020 period.		100 per cent clean cooking access rate
Energy efficiency	Additional energy efficiency measures not applied	Improvement based on current policies	Global improvement in energy intensity adopted
Power plant	Considers 2021 RE share in power generation and grid emissions	Considers capacity expansion provided by national consultant	

SDG scenario

Achieving SDG 7 Targets in 2030

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9th November 2023

SDG and NDC Targets

SDG 7 Targets

7.1.1   Access to Electricity – *100% by 2030*

7.1.2   Access to Clean Cooking Fuel – *100% by 2030*

7.1.3   Renewable Energy in TFEC – *no set target*

7.1.4   Energy efficiency – *doubling the rate of improvement in energy efficiency*

a mitigation target of Kazakhstan's NDC that will be a 15 per cent reduction in total national greenhouse gas (GHG) emissions by 2030, compared to the 1990 emissions. Kazakhstan could achieve a 25 per cent emission reduction with additional international investments and green climate funds, along with access to the transfer of low-carbon technologies (conditional target).
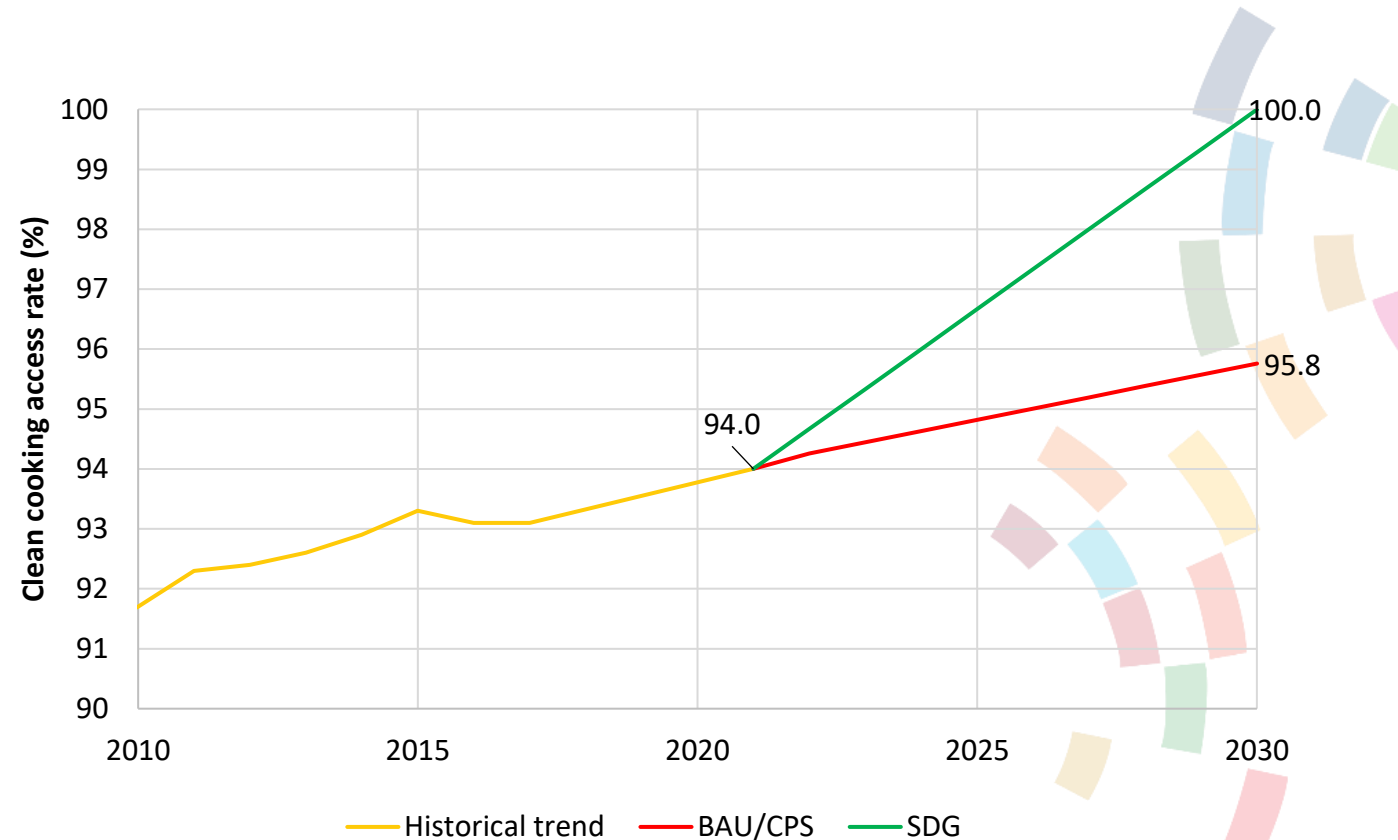
Access to modern energy in 2030

Access to Electricity

- Universal access to electricity is already achieved
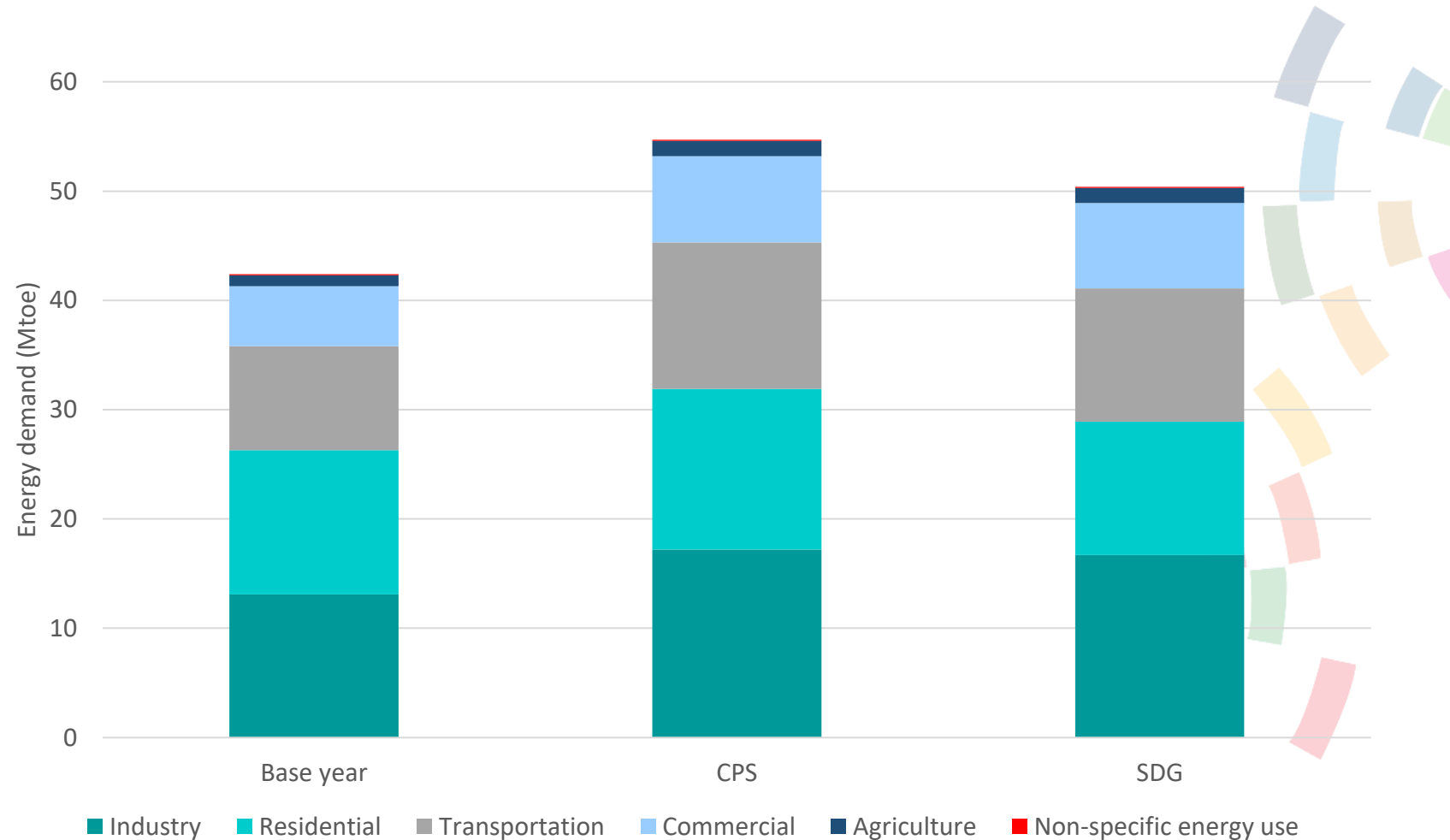
Access to Clean Cooking

- Universal clean cooking is unlikely to be achieved under the current policy settings
- The gap is projected to be **4.2 per cent in 2030**
- NEXSTEP suggests **electric cook stoves** as the most appropriate clean cooking solution **to close the 4.2 per cent gap**.
- Benefits include:
  - cost effective
  - zero GHG emissions & indoor air pollution
  - minimal monitoring and follow up
- Natural gas and LPG cook stoves will still play a role in Kazakhstan households since natural gas, particularly, can also provide the required energy for heating.

Chart: Clean cooking access rate (%), 2010–2030. Historical trend (yellow), BAU/CPS (red), SDG (green). Values shown: 94.0 (2021), 100.0 (SDG, 2030), 95.8 (BAU/CPS, 2030).

Technology	Annualized cost
Electric cooking stove	US$ 68
Improved cooking stove (ICS)	US$ 88
LPG stove	US$ 100
Natural gas stove	US$ 116

Energy Demand in 2030

- By 2030, in all scenarios, the industrial sector consumption will be by far still the largest followed by the residential and transport sector.

- Some adoption of energy efficiency measures in SDG scenario might reduce around 4.3 Mtoe compared to the CP scenario.
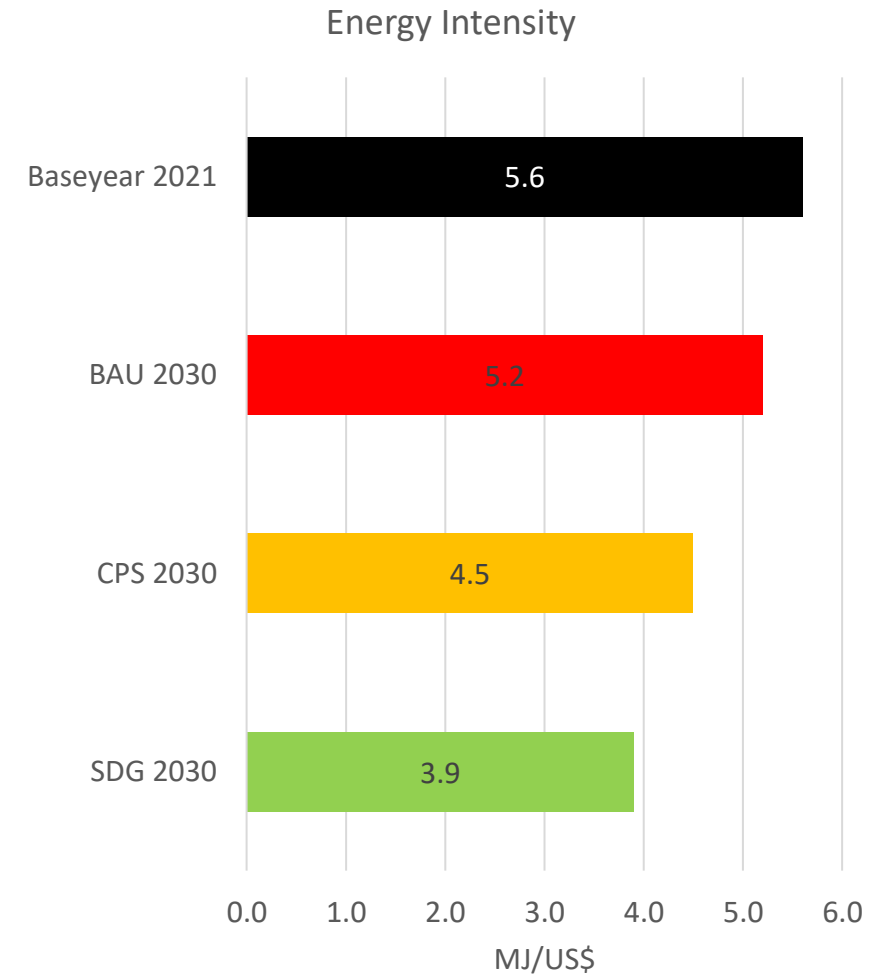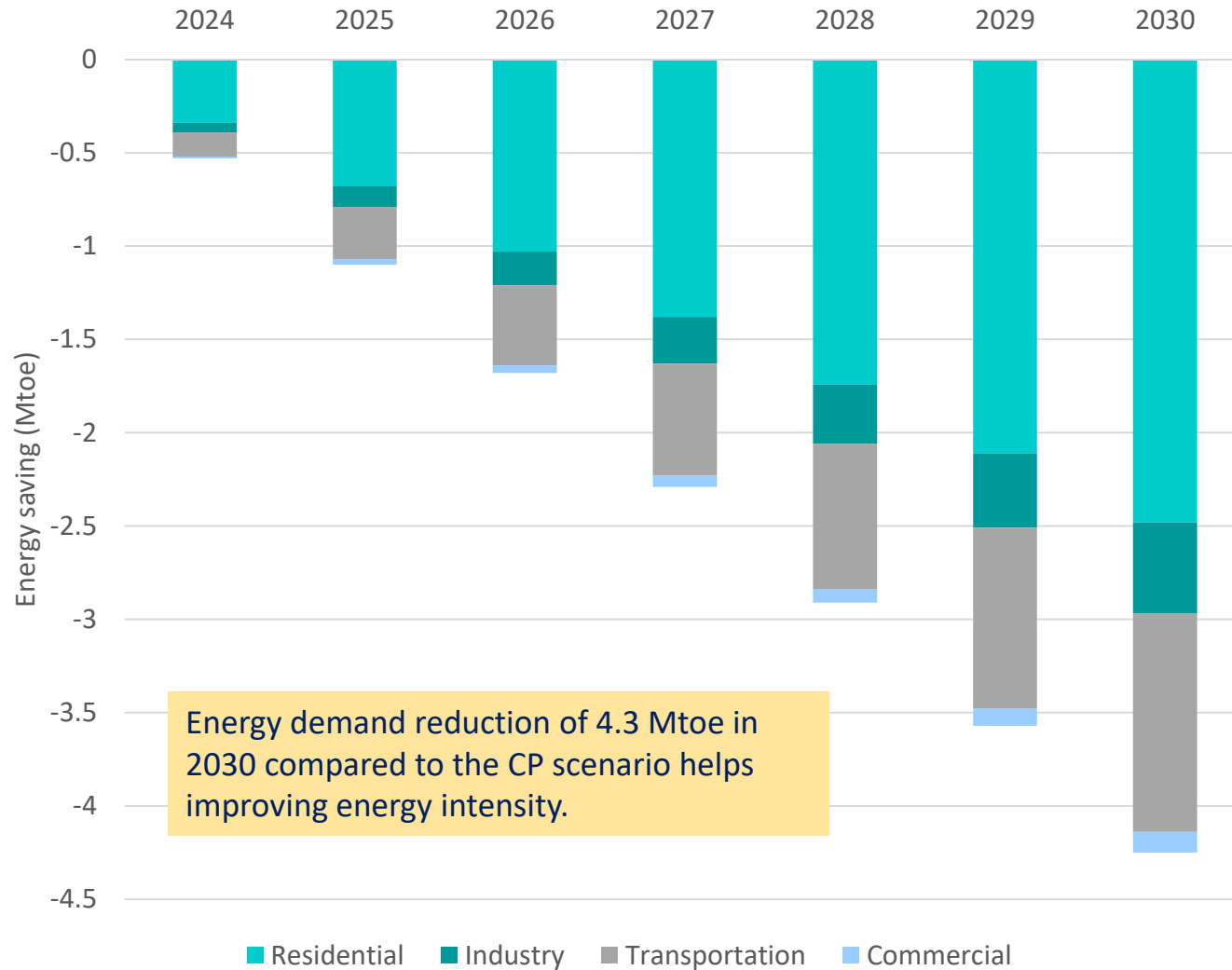
Energy saving in CPS in 2030

Sector	Measure	Energy demand reduction in 2030 (Mtoe)
Residential	The development of energy-efficient construction, for which the requirements for energy efficiency of building materials, products and structures will be revised and measures will be developed to stimulate the construction of high-class energy efficiency facilities will simultaneously raising the awareness of the citizens.	0.56
Transportation	Updating the public vehicle fleet and increasing its number in the most densely populated cities of Kazakhstan while implementing eco-driving and operational transport monitoring system	0.37
Industry	Financing measure for modernizing technological processes and equipment and introducing energy-saving measures in all industries, which will reduce physical wear and tear by at least 10 per cent and increase the efficiency of existing equipment	1.91
Commercial	Increase in the share of purchased energy-efficient equipment will be ensured by monitoring public procurement of goods, works and services for compliance with energy efficiency requirements, as well as establishing administrative liability for their violation	0.11
Total		2.95

Energy saving in SDG scenario 2030

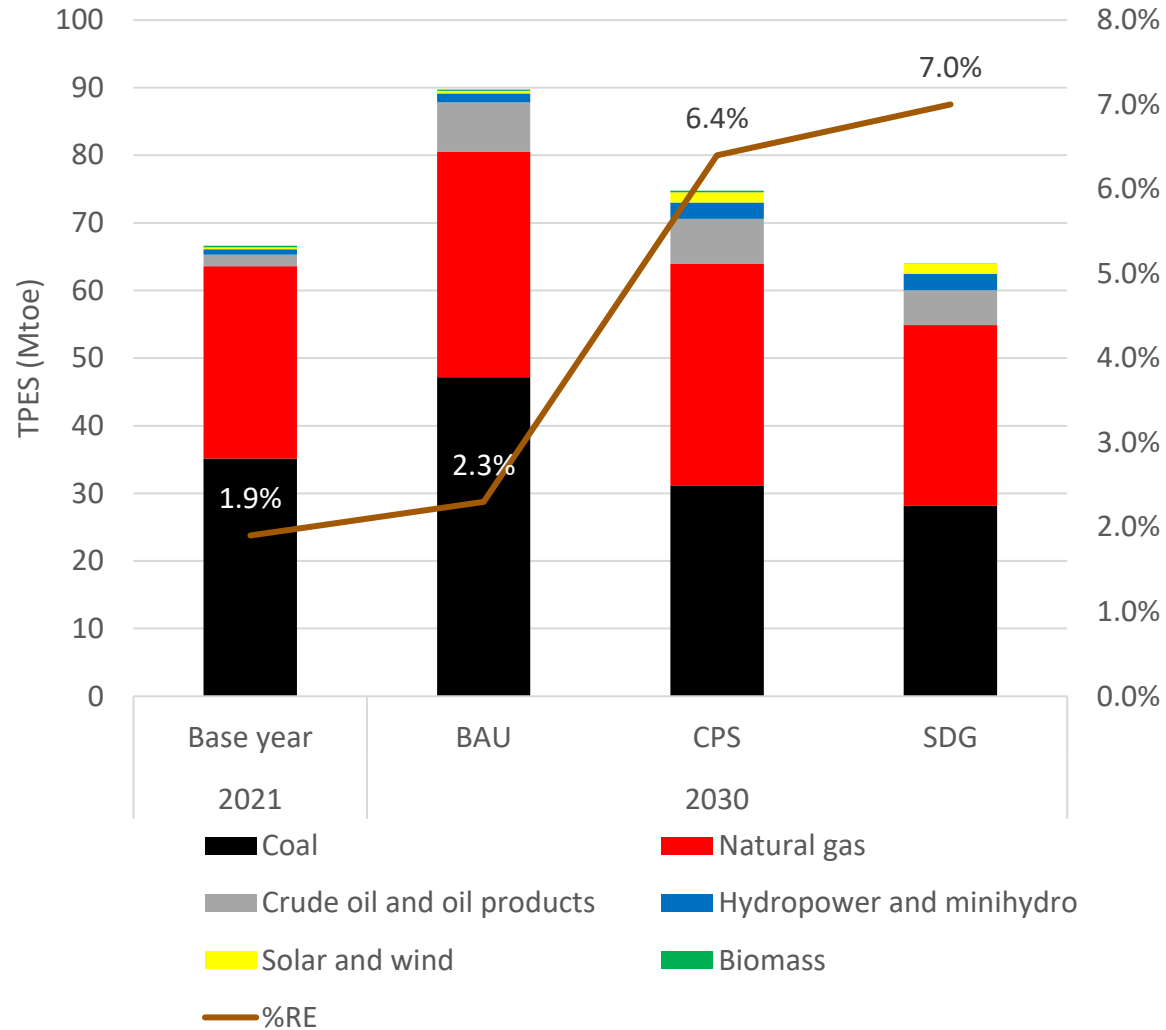| Sector	Measure	Energy demand reduction in 2030 (Mtoe)
Residential Cooking	Phasing out inefficient biomass and charcoal cookstoves by electric cookstoves	0.12
Residential Heating	Deep thermal retrofitting in urban areas and insulation improvement in rural areas while simultaneously phasing out the coal stove in urban area with district heating and natural gas heater. Introduction of improved coal boiler in rural areas to reduce coal and fuelwood heating.	2.16
Residential MEPS	Increase the adoption of energy-efficient lighting, refrigeration, and television	0.2
Total		2.48

Sector	Measure	Energy demand reduction in 2030 (Mtoe)
Commercial	External insulation of commercial buildings to achieving at least 20 per cent energy saving in heating	0.11
Industry	Improvement of 15 per cent efficiency of electricity and 20 per cent of thermal demand	0.49
Transport – Passenger transport	Electric cars penetration by 15 percent and electric buses penetration by 5 percent in 2030	0.81
Transport – Freight Transport	10 per cent of electric trucks penetration in 2030	0.36
Total		1.77

Energy Intensity (MJ/USD) in 2030

Energy demand reduction of 4.3 Mtoe in 2030 compared to the CP scenario helps improving energy intensity.

Energy Intensity

Scenario	MJ/US$
Baseyear 2021	5.6
BAU 2030	5.2
CPS 2030	4.5
SDG 2030	3.9

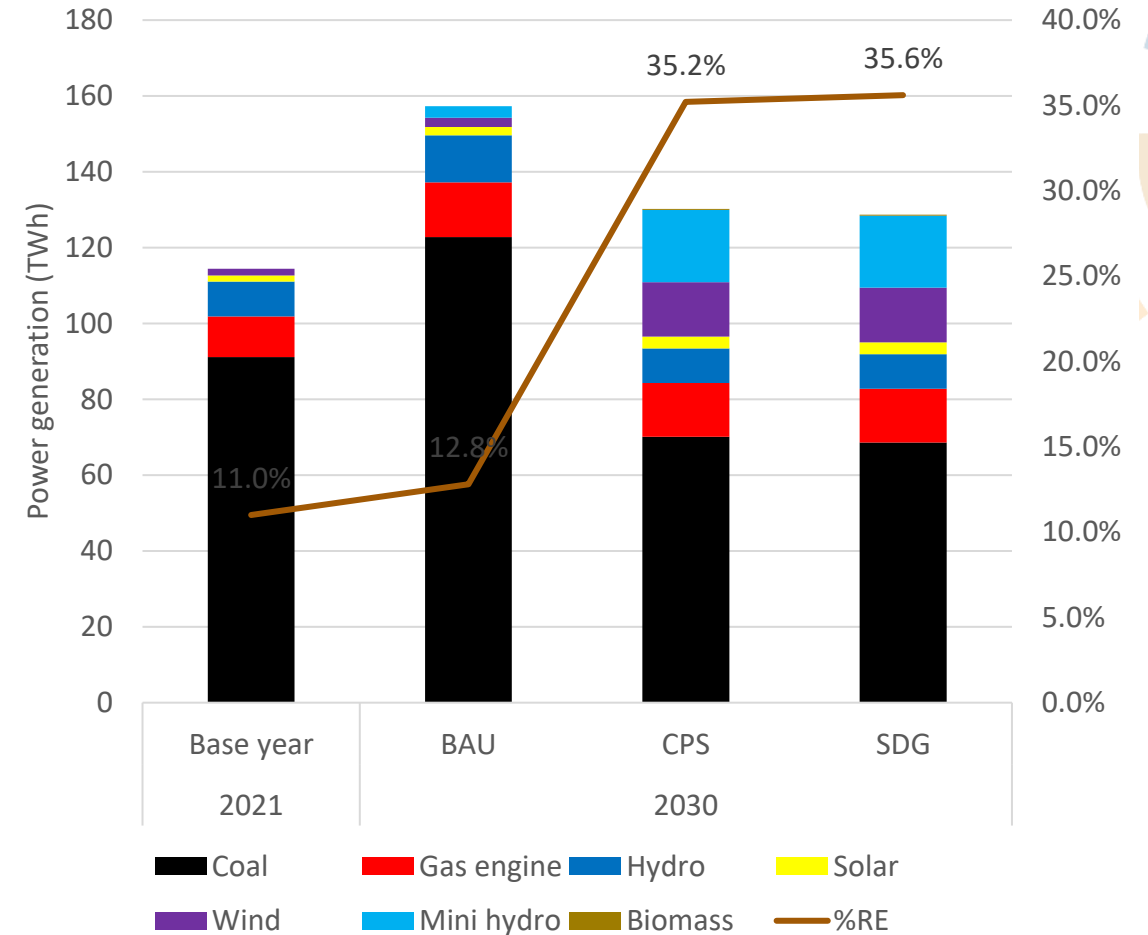Legend: Residential · Industry · Transportation · Commercial

Renewable Energy

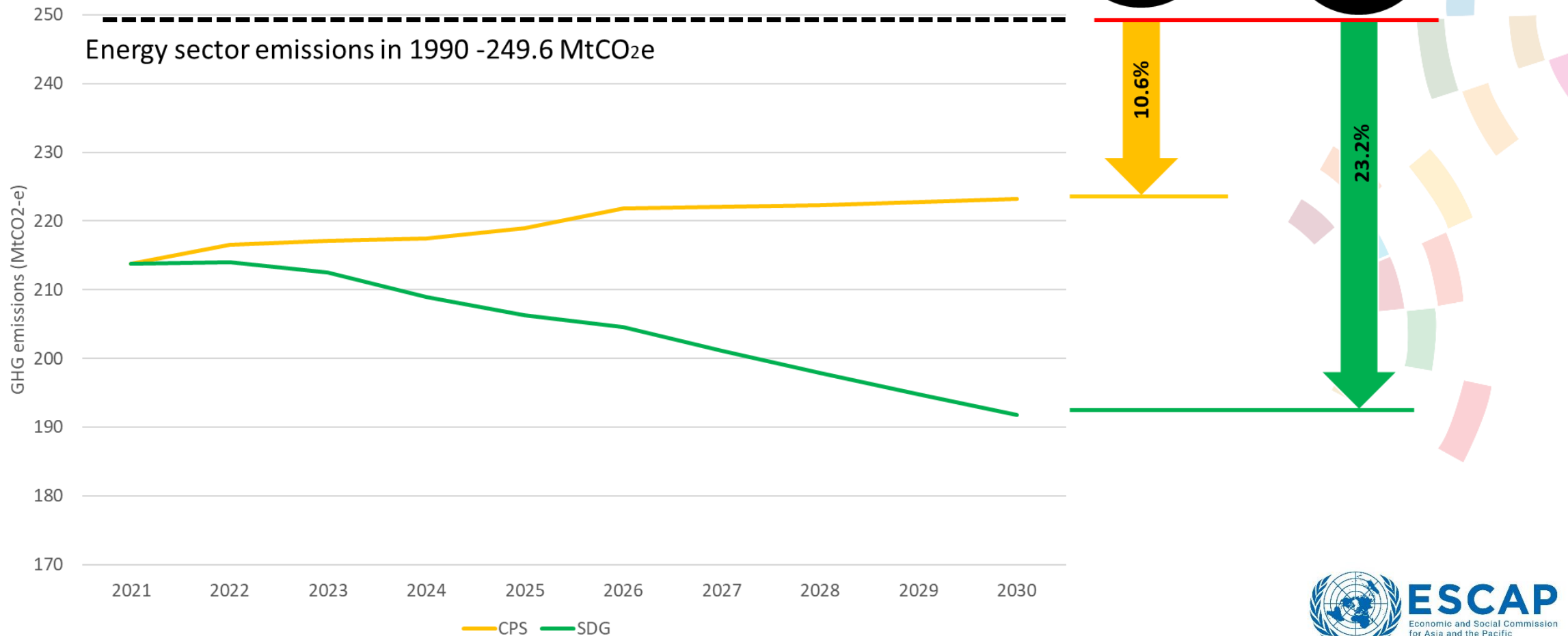## Renewable share in TFEC

Renewable share in power generation

Emissions in 2030

- An unconditional mitigation target of Kazakhstan's NDC that will be a 15 per cent reduction in total national greenhouse gas (GHG) emissions by 2030 compared to 1990 level. The conditional one will be 25 per cent.
- The SDG scenario will help Kazakhstan achieve the unconditional NDC target.

Energy sector emissions in 1990 -249.6 MtCO$_2$e

GHG emissions (MtCO2-e)

26.4 MtCO2-e

57.9 MtCO2-e

10.6%

23.2%

CPS   SDG

Progress towards SDG 7 Targets for 2030

Energy system trajectories

Baseyear

Access to electricity 100% in 2021

Access to clean cooking 94% in 2021

Energy Efficiency 5.6 MJ/USD in 2021

Renewable Energy share in TFEC **1.9%** in 2021

Emissions 213.7 MtCO2e in 2021

Kazakhstan's baseline situation

Current Policy Scenario

Access to electricity 100% by 2030

Access to clean cooking 95.8% in 2030

Energy Efficiency 4.5 MJ/USD by 2030

Renewable Energy share in TFEC **6.4%** by 2030

Emissions 223.2 MtCO2e in 2030

Kazakhstan's energy future based on current policy

Sustainable Development Goal 7

Access to electricity 100% by 2030

Access to clean cooking 100% by 2030

Energy Efficiency 3.9 MJ/USD by 2030

Renewable Energy share in TFEC **7%** by 2030

Emissions 191.8 MtCO2e in 2030

Kazakhstan's sustainable energy transition

Scenario Development

Access to modern energy

Energy efficiency

Renewable energy share in TFEC & GHG emissions

Energy transition beyond 2030

Muhammad Saladin Islami

Consultant to ESCAP

Sustainable Heating Scenario by 2030

Building on the SDG scenario, the sustainable heating scenario further explores how the country can transition its heating demand and supply side towards cleaner technologies to achieve conditional NDC target

Demand Side

- Phasing out of the remaining inefficient heating technology in the residential sector using electrical heaters and natural gas boilers
- Deep retrofitting in the commercial sector
- average natural gas boiler efficiency can also be improved from 75 per cent to 84 per cent

Supply Side

- Addition of 2.5 GW heat pump (22.3% RE in heat generation)
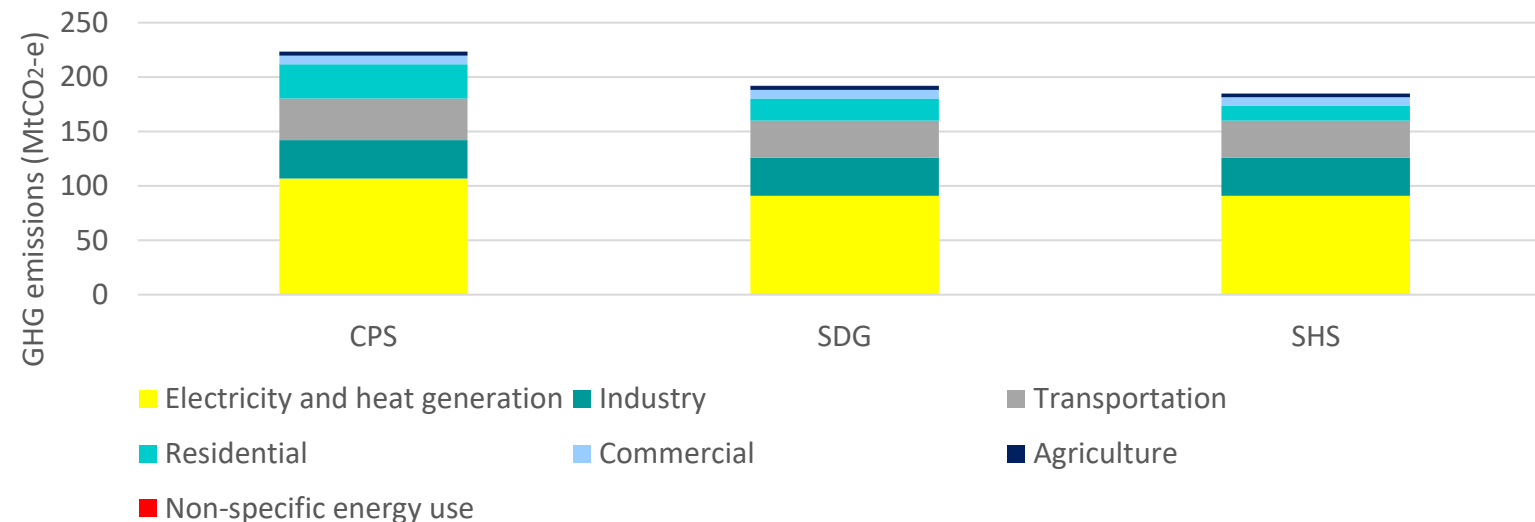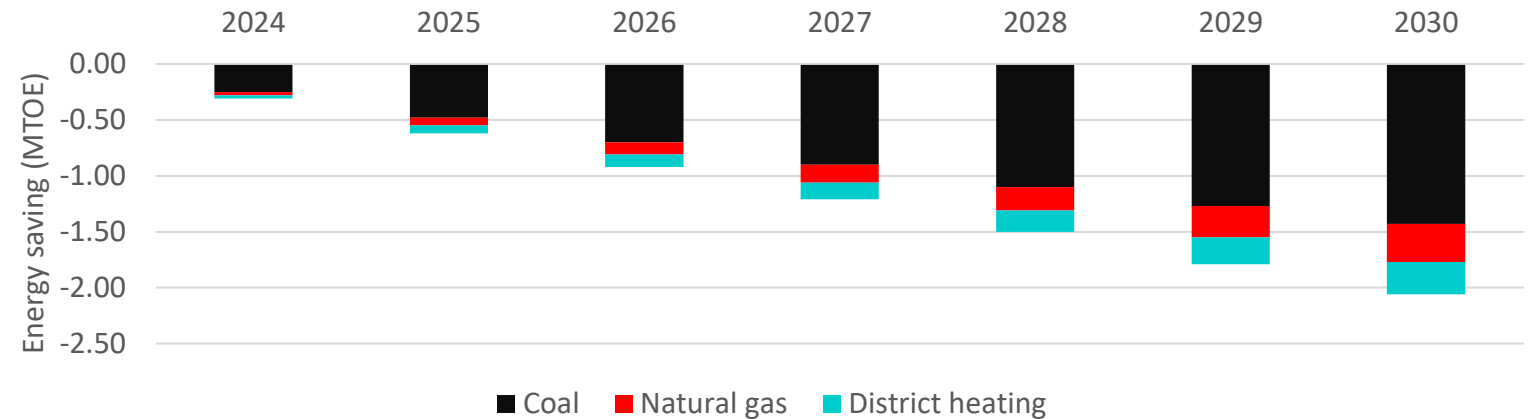
Towards Net Zero by 2050

Additional **demand and GHG emission reduction** can be realized through the following:

2031 - 2050

- Adoption of 100 per cent electric cook stoves by 2050
- Adoption of 100 percent electric vehicles for road transport by 2050
- Fuel switching to electricity in the industry sector
- Decarbonise power sector using renewable system with BESS
- Decarbonise heating sector with heat pump
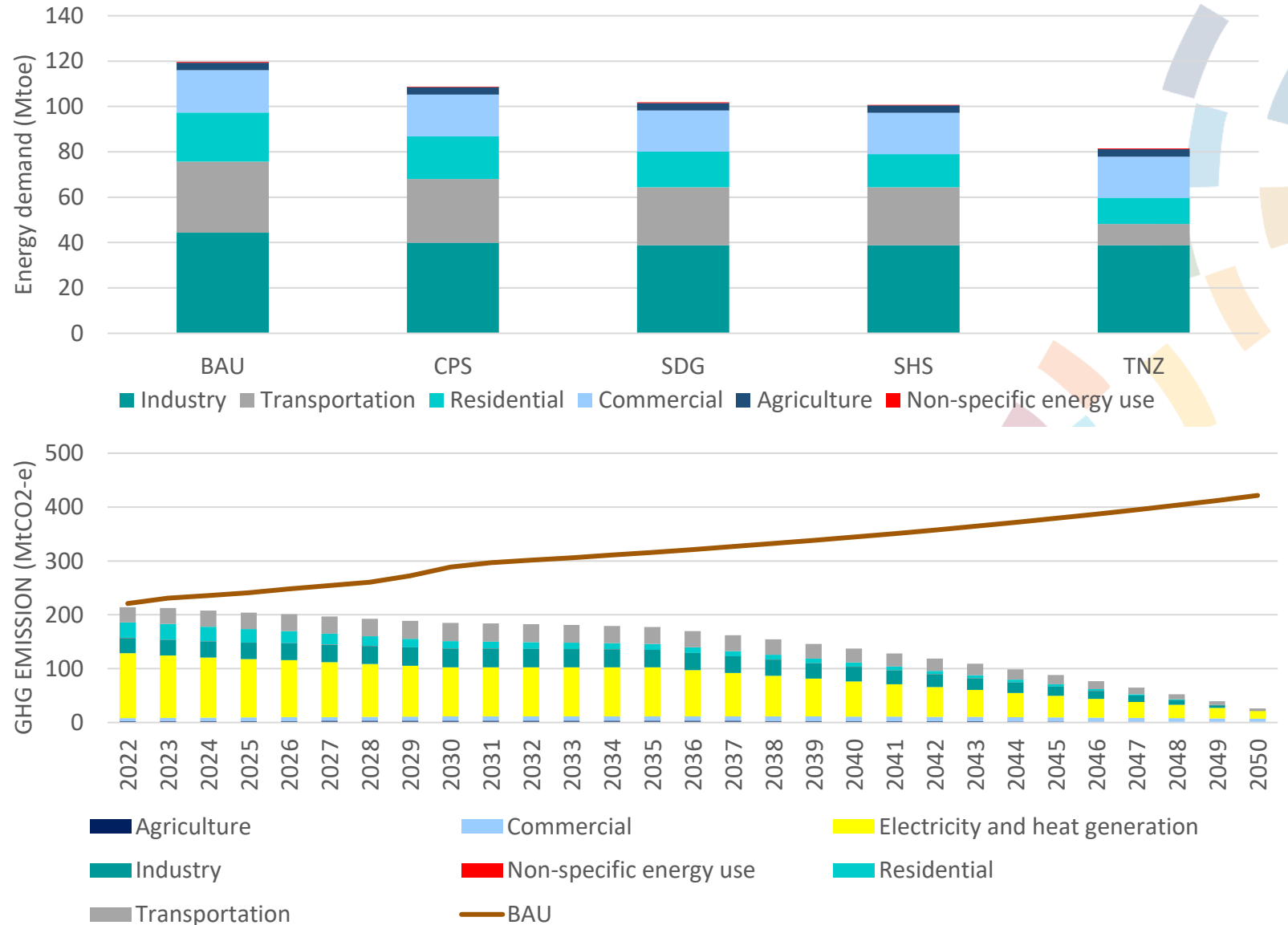
Policy recommendations/Conclusion

1. **Access to clean cooking technologies** should be the number 1 priority.

2. **Elimination of polluting heating technologies** should be pursued to reduce impacts from indoor air pollution.

3. **Energy efficiency implementation shall put focus on the whole economy,** to reduce energy-related /emissions.

4. **Transport electrification** is key to energy demand reduction and GHG emission reduction.

5. **Decarbonisation of the power and heating supply** provides the highest potential in GHG emission reduction as well as improves energy security

Thank you