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PI “Center for Energy Research”

Climate mitigation and energy options:

Preliminary model results for Kazakhstan

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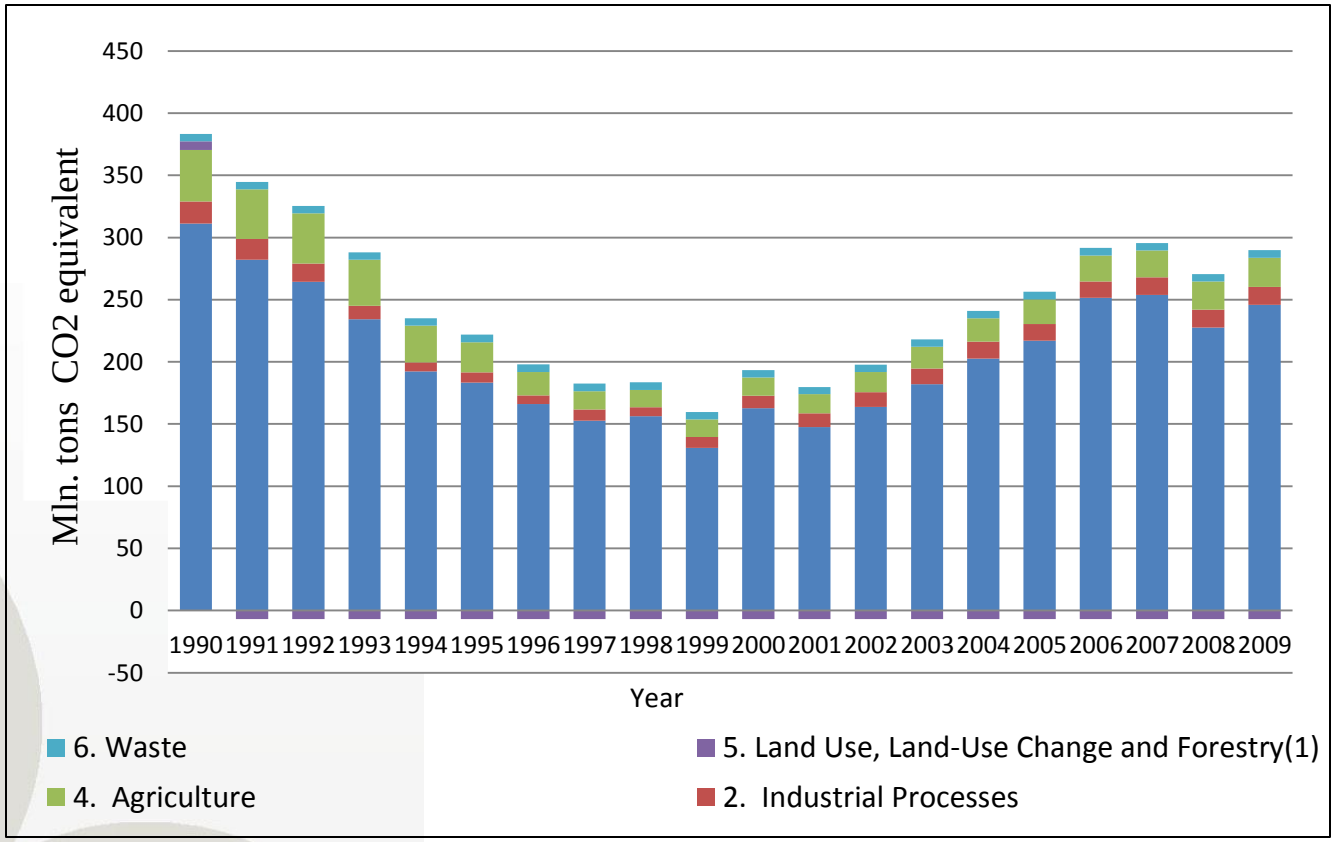
GHG emissions of Kazakhstan



Main sources of emissions:

- 88% Energy sector
- 5.5% Industrial processes
- 4.6% Agriculture
- 1.9% Waste

Dynamics of total national emissions in the Kazakhstan, 1990-2008 by sources, (Source: National Inventories, KazNIIEK, 2010)

Kazakhstan – is the largest emitter in CA, takes third place in CIS after Russia and Ukraine (CO2 emissions per capita – 13.6 tonnes/capita)

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Impacts of climate change in Kazakhstan

- Average annual temperature of air increased in average by 0.31°C every ten years
- Glaciers melting (by 0.8% per year by area)
- Increase of mudflows and droughts
- Displacement of wetting boundaries

Declared decisions under Kyoto and post-Kyoto

- Kazakhstan ratified Kyoto protocol in March 2009
- Commitments for Post-Kyoto protocol are to reduce GHG emissions:
  - by 15% by 2020
  - by 25% by 2050 from the levels of the base year 1990

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The TIMES-Kazakhstan modeling tool to evaluate different mitigation options

Objectives

- Develop model of the energy technologies system of Kazakhstan
- Assist policy-makers in decision making in developing low carbon economy
- Predict energy production, consumption, energy prices, emissions, technology investments, total system cost on a long-term horizon for different scenarios
- Capacity building in energy systems modeling
- Use a methodology available in many other countries

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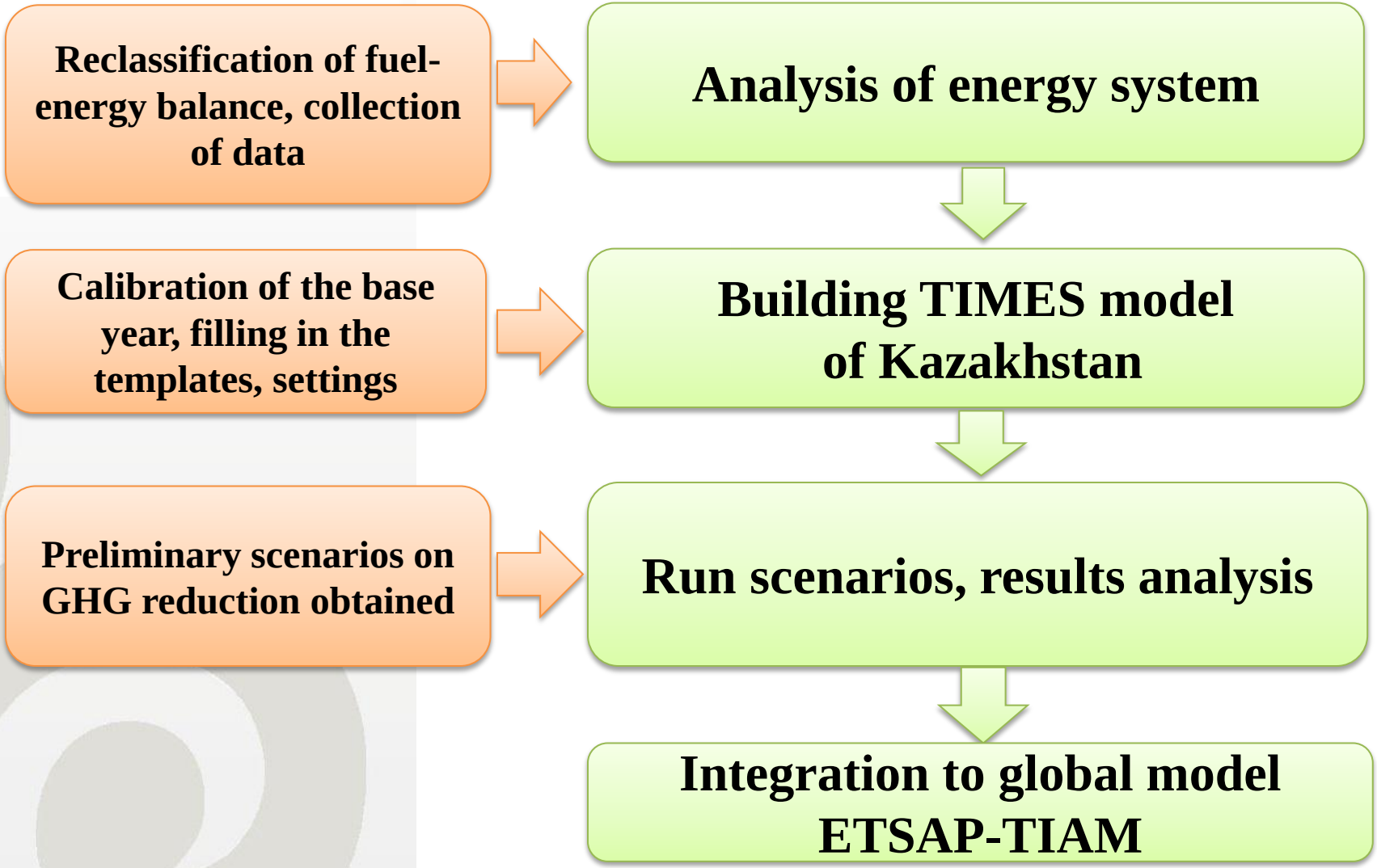
Implementation stages



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Reclassified fuel-energy balance of Kazakhstan for 2010, Mtoe

	Coal	Crude Oil	Oil Prod.	Gas	Biomass & Waste	Elect-ricity	Heat	Total
-- Primary production	**53.66**	**79.92**	**0.00**	**25.11**	**1.34**	**0.72**	**0.00**	**160.75**
-- Imports	0.63	5.98	1.64	2.92	0.00	0.25	0.00	11.42
-- Exports	-15.23	-68.70	-9.58	-5.17	0.00	-0.15	0.00	-98.83
-- Withdrawal from stock	-0.95	-0.97	-0.25	-0.01	0.00	0.00	0.00	-2.19
Total primary energy supply	**38.11**	**16.22**	**-8.19**	**22.85**	**1.34**	**0.82**	**0.00**	**71.14**
-- Energy transformations	-26.68	-15.50	19.62	-8.30	-0.27	6.39	9.61	-15.14
-- --Plants	-24.40	0.00	-0.43	-4.15	0.00	6.39	9.61	-12.98
-- --Oil refineries	0.00	-15.50	15.90	0.00	0.00	0.00	0.00	0.39
-- --Coal transformation	-2.28	0.00	0.00	0.00	0.00	0.00	0.00	-2.28
-- --Other transf + stat. difference	0.00	0.00	4.16	-4.16	-0.27	0.00	0.00	-0.27
-- Energy industry own use	**-1.02**	**0.00**	**-2.37**	**-10.43**	**0.00**	**-1.76**	**-2.17**	**-17.75**
-- Losses	**-0.99**	**-0.72**	**-0.23**	**-0.88**	**0.00**	**-0.57**	**-1.06**	**-4.44**
-- Final consumption	**9.42**	**0.00**	**8.83**	**3.24**	**1.07**	**4.88**	**6.38**	**33.82**
-- -- Industry	4.08	0.00	1.81	0.83	0.00	3.14	2.35	12.20
-- -- Transport	0.01	0.00	5.89	0.72	0.00	0.11	0.02	6.74
-- -- Residential	3.73	0.00	0.24	1.04	0.99	0.97	2.71	9.68
-- -- Commercial, public services	1.24	0.00	0.15	0.60	0.06	0.61	1.10	3.76
-- -- Agriculture, forestry & fish.	0.21	0.00	0.47	0.02	0.01	0.05	0.21	0.97
-- -- Non-energy use	0.14	0.00	0.28	0.03	0.00	0.00	0.00	0.46

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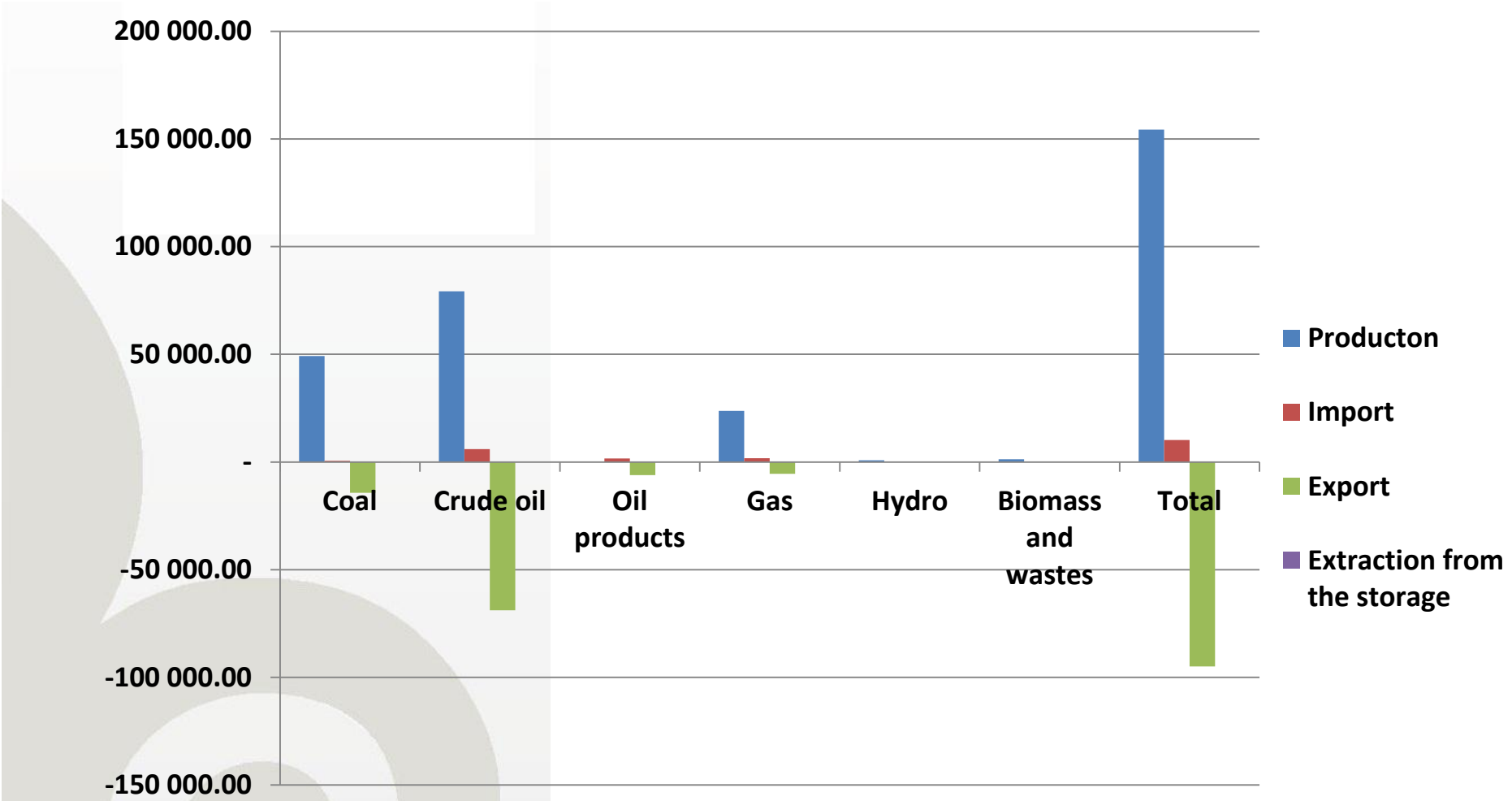
Total primary energy supply in 2009, ktoe



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Efficiency of some power plants of Kazakhstan

	Name of the plants	Type of fuel	Installed capacity, MW	Efficiency, %
1	LTD «Astana Power»	Coal	360	18
2	TOO «Corporation Kazakhmys» GRES	Coal	608	20
3	JSC “Aktobe CHP”	Gas	103	16
4	JSC «Ust-Kamenogorskaya CHP»	Coal	241,5	21
5	Ekibastyz GRES-2	Coal	1000	27
6	LTD “МАЭК”	Gas	1342	24
7	JSC “Zhayukteploenergy”	Gas	58,5	15
8	JSC «3-Energycenter CHP»	Gas	160	25
9	GCC «Kzyl-Orda CHP»	Gas	113	26

GRES – Governmental regional electrical power station
GCC –Governmental communal company

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TIMES MODEL GENERATOR

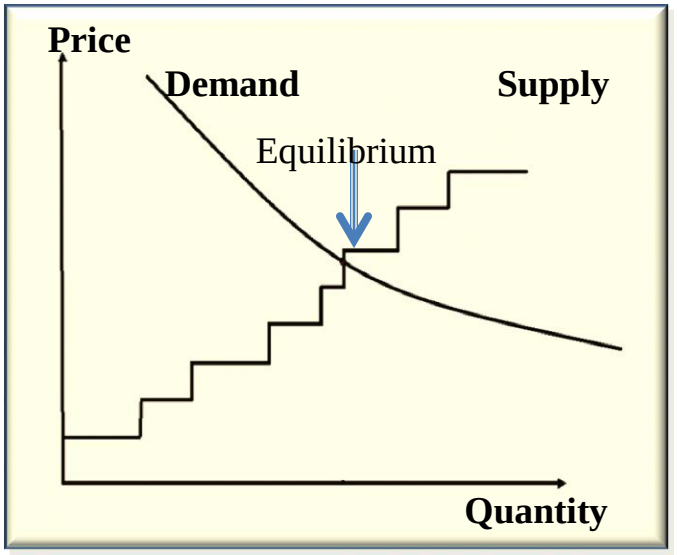
- TIMES is the technical and economical tool of modeling, that predicts possible future development in consistent with different measurements of TIMES.
- It allows us to organize information of the system
- Reduces complex systems in an manageable form
- Developed by energy technology systems analysis program in accordance with International Energy Agency IEA-ETSAP
- 4 types of input data: the demand for energy services, primary potential energy, policies, description of group technologies

Energy system structure

Energy flows and prices

Forecast growth of demand for energy services/goods

Technological and political limitations



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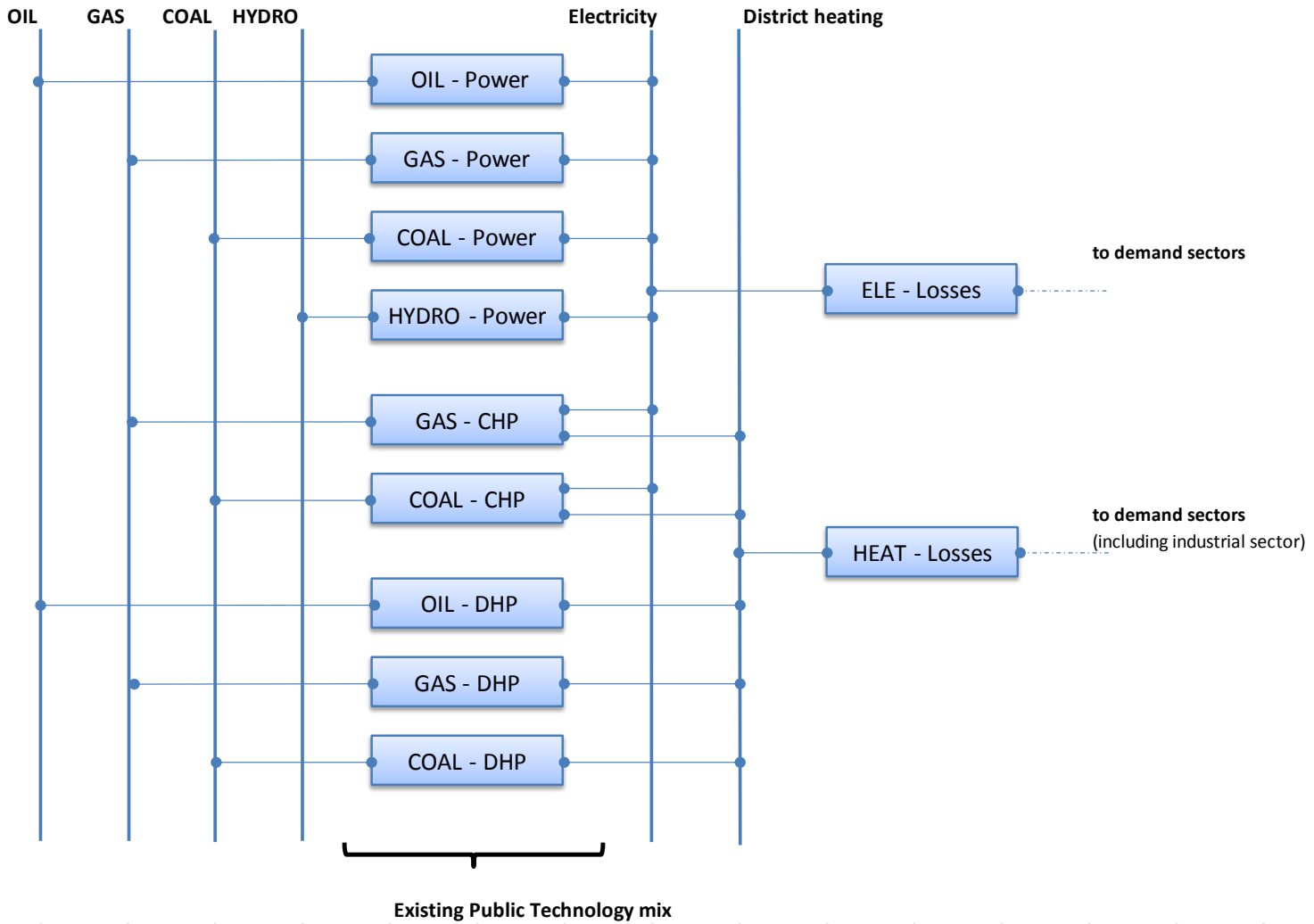
Representation of public heat and electricity in the model



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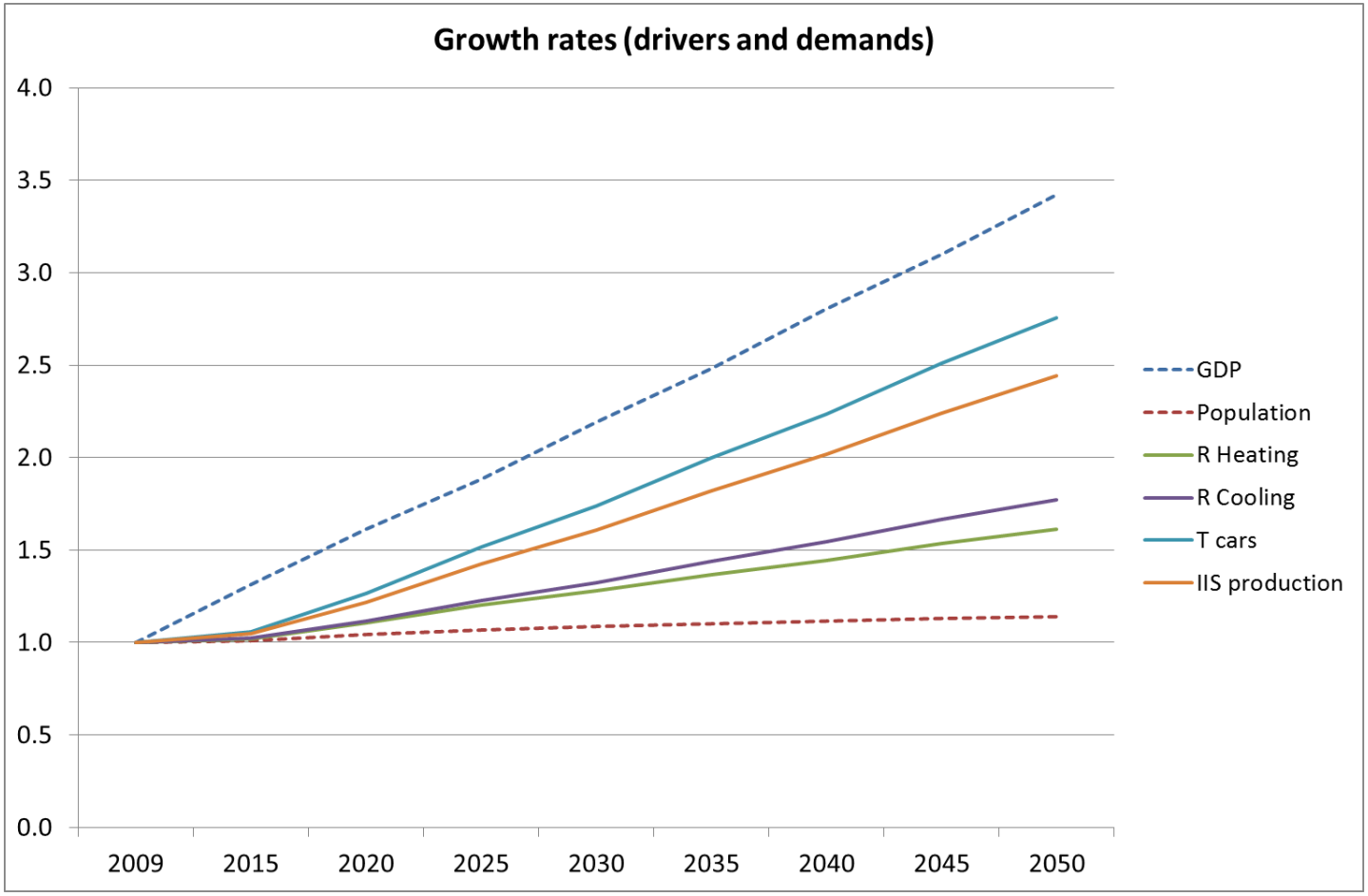
From a static balance to a dynamic model



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3 scenarios built:

Scenarios	Annual growth of GDP, %
Business as usual (BAU) Scenarios without any constraints to GHG emissions, at a minimum cost of the energy system.	2011-2020: 4.2% 2021-2030: 3.2% 2031-2040: 2.5% 2041-2050: 2%
CO_2 -15% Scenario considers the implementation of voluntary commitments, taken by Republic of Kazakhstan within the Copenhagen agreement: reduction of GHG emissions to 15 % by 2020 (233 mln tons of CO_2 equivalent) and 25 % by 2050 (206 mln. tons of CO_2 equivalent), in relation to the level of the base year 1992.	
CO_2 -20% Scenario with strong constraints of GHG emissions: 20 % by 2020 (219 mln. ton of CO_2 equivalent) and 50 % by 2050 (137 mln. tons of CO_2 equivalent) in relation to the base year 1992.	

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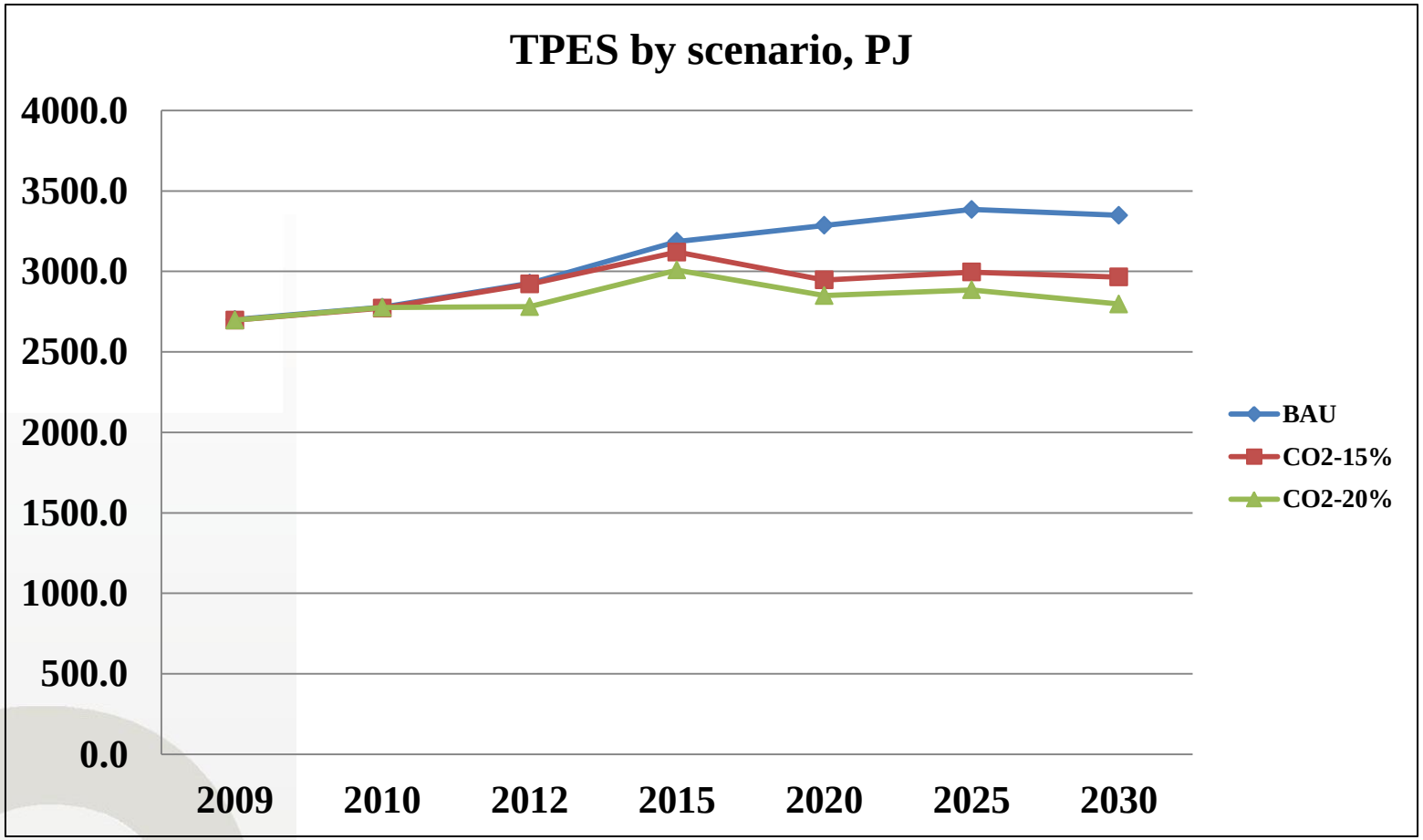
Preliminary results: Total primary energy supply, PJ



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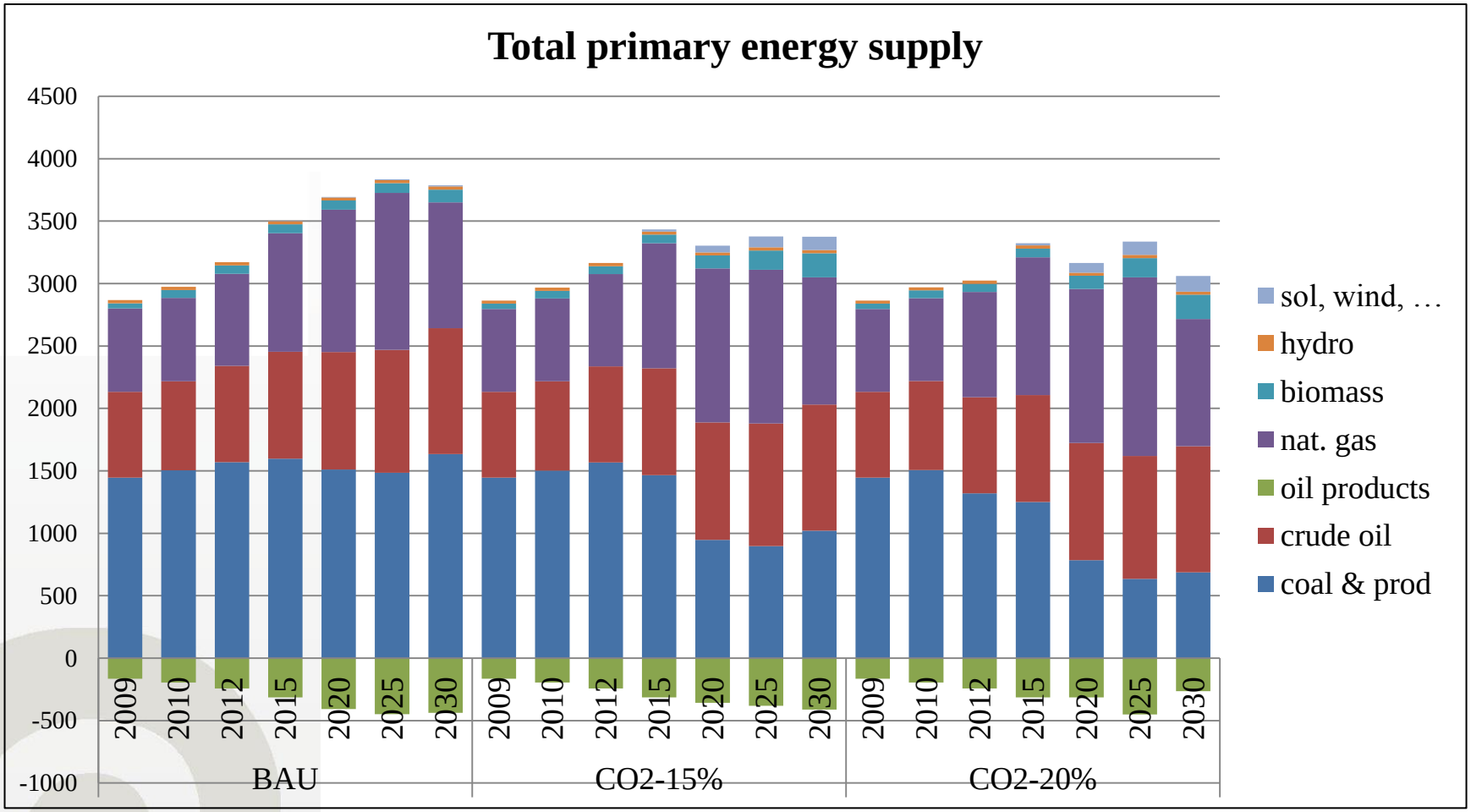
Preliminary results: Total primary energy supply by commodity, PJ



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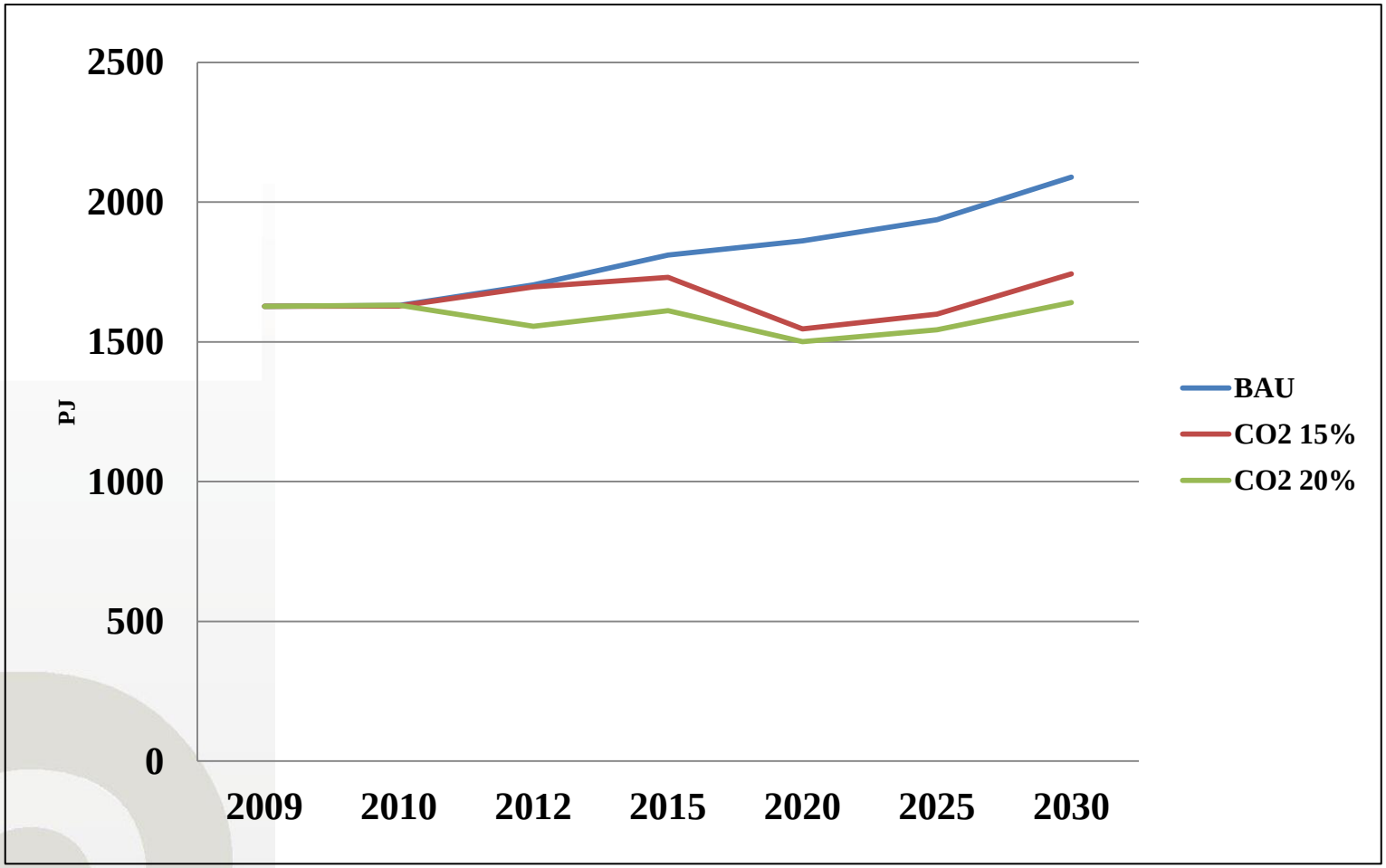
Preliminary results:
Total final consumption of fuel resources, PJ



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- BAU the fastest growing consumption sector is the transport consumption that increases to 1.5 times and industry to1.3 times

- CO2-15% the residential sector contributes mostly to CO2 reduction in the consumption side: 127 PJ decrease over 2009-2030. In 2030, for space heating: heat pumps (41%) and NGA burners (32%) as well as more efficient coal burners (9%), heat exchangers (10%) will be used. For water heating NGA and Solar water heaters will take place.

- In CO2-20% the decrease in the residential sector accounts for 155PJ over 2009-2030. In 2030, for space heating next technologies will be used 49% - heat pumps, 30 % - gas boilers, 11 % heat exchangers.

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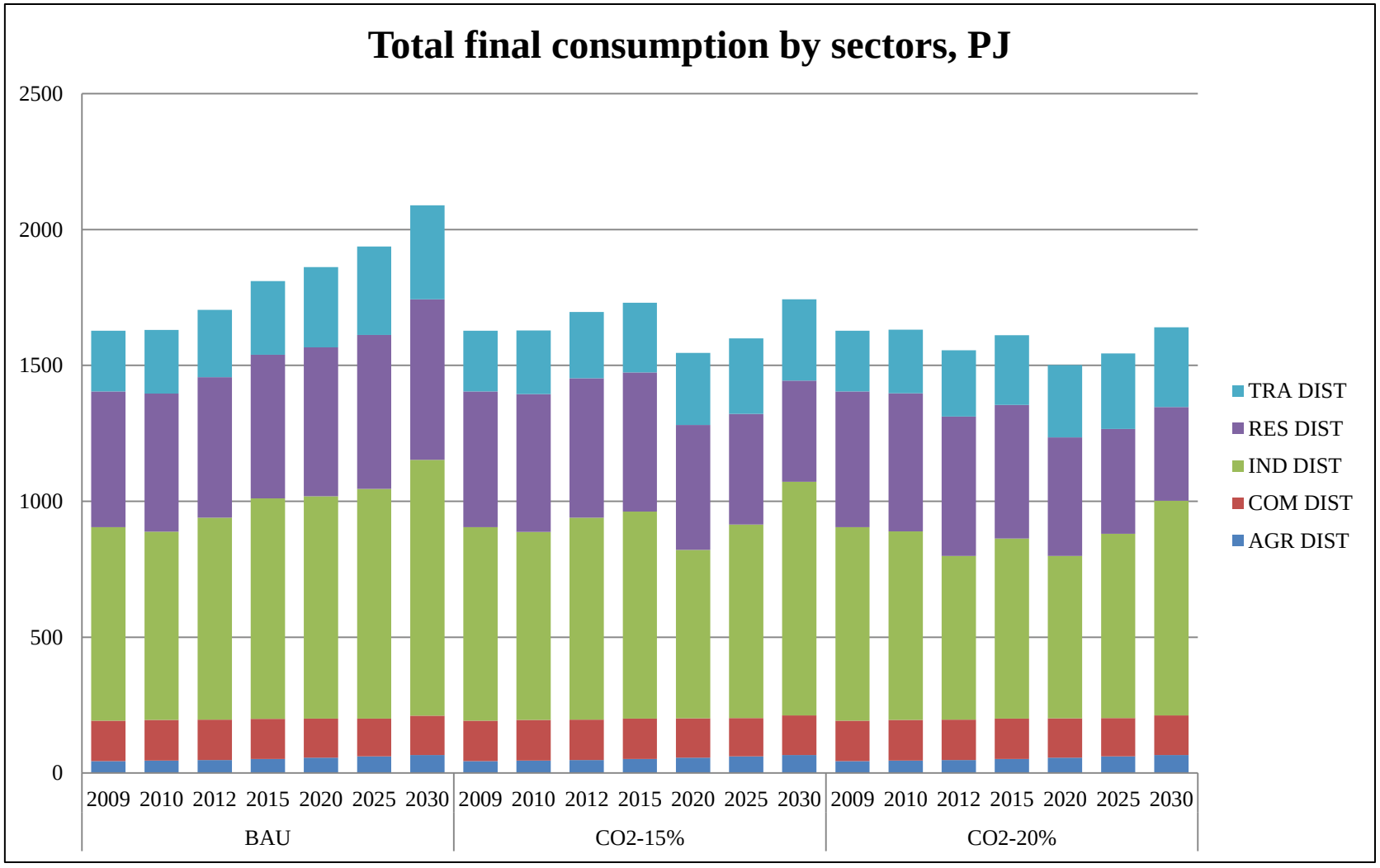
Preliminary results: Total final consumption by sector, PJ



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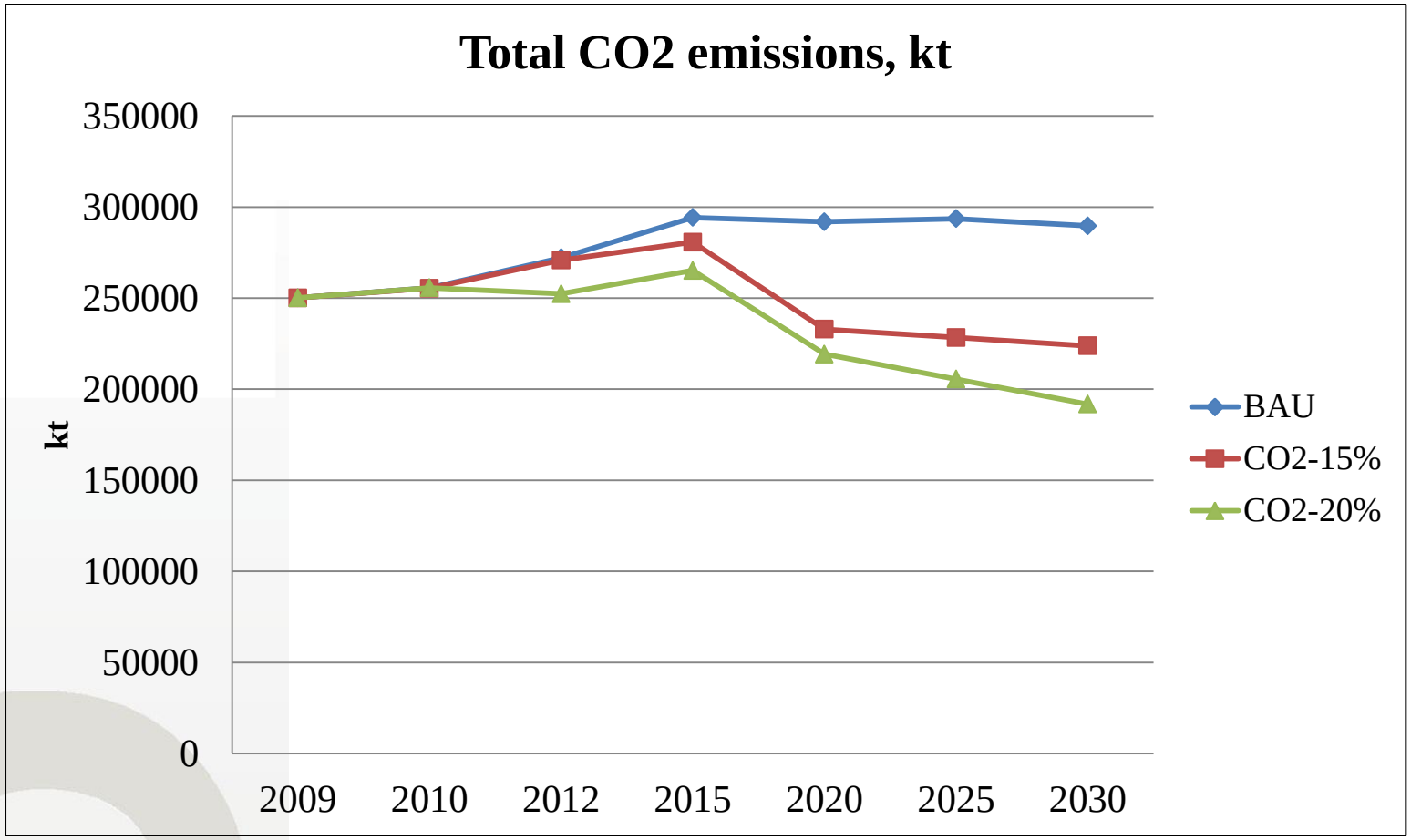
Preliminary results: CO_2 emissions scenarios, thousand. tons of CO_2 equivalent



BAU scenario the GHG emissions increase to 16% by 2030 with regards to 2009

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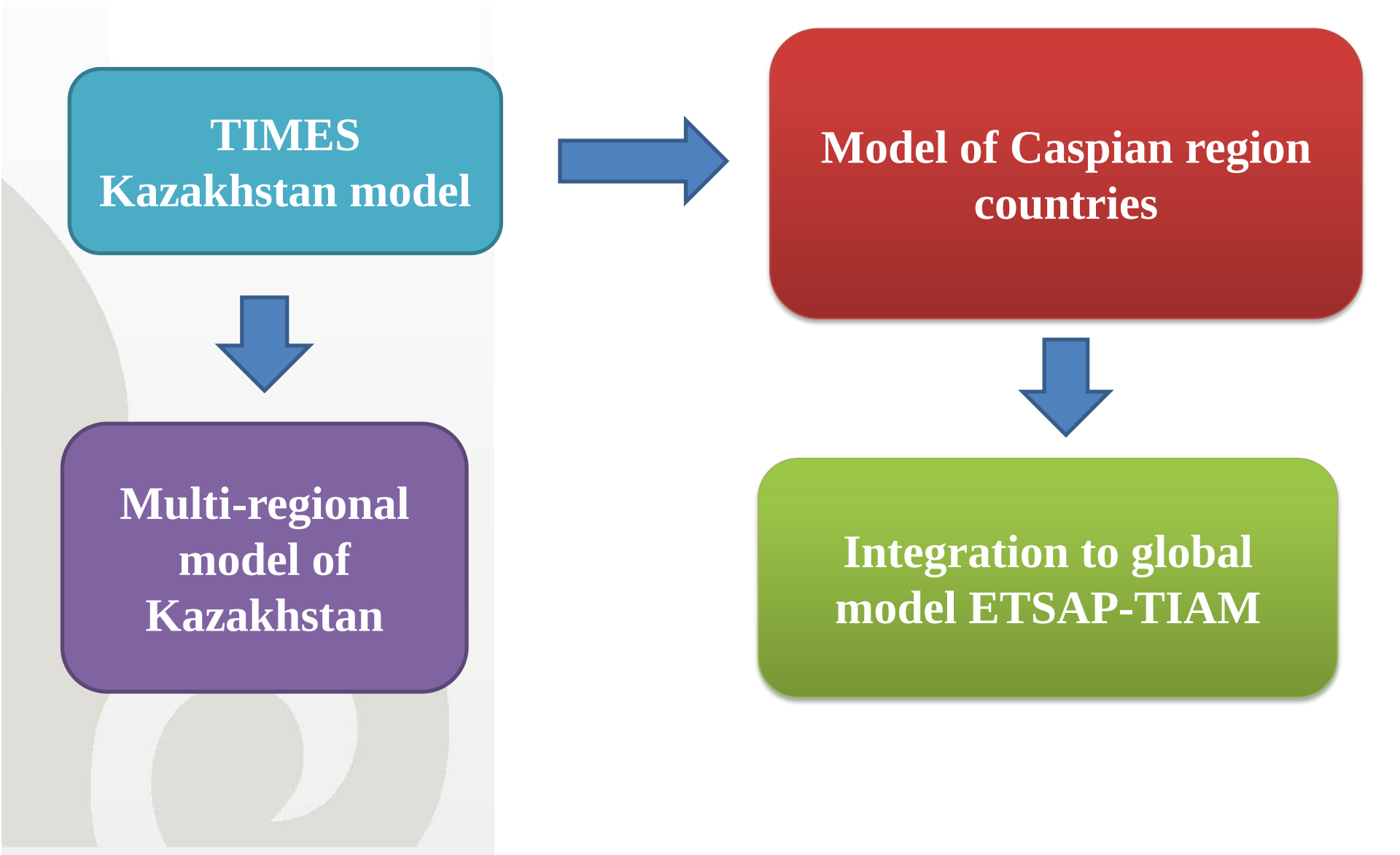
Future plans of the modeling group at NU



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Thank you for attention!

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