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Sustainable Energy Connectivity in Central Asia

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"From Coals to Goals"

Challenges towards carbon neutrality in Kazakhstan

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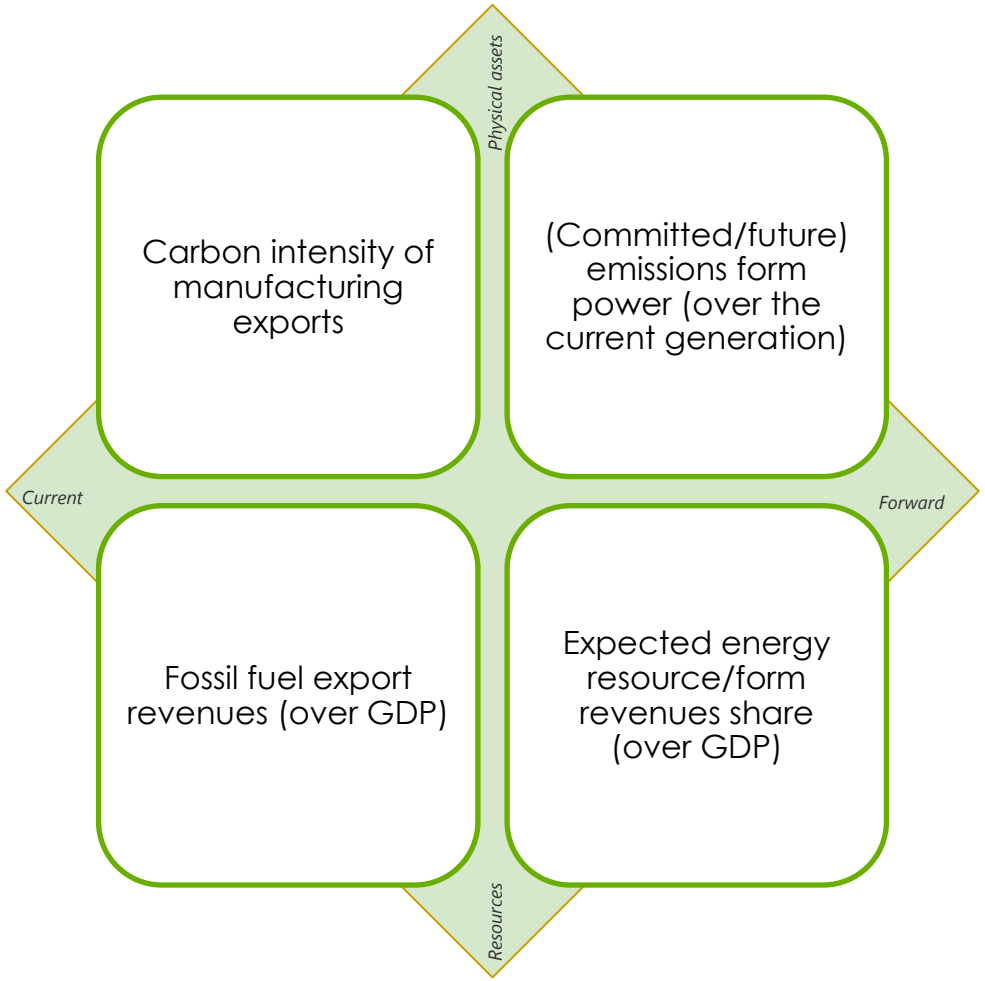
Stantec | intec | ACTED | European University Institute | Robert Schuman Centre for Advanced Studies | FSR Energy | Florence School of Regulation

“Exposure” to world low-carbon transition: “high”



Author's elaboration, adjusted from World Bank. doi:10.1596/978-1-4648-1340-5

“High” exposure

Pillars to tackle the risk:

→ “Rational” management of the existing resources/assets (and a strategic vision for new assets!)

→ “Structural” changes of the economy and technology transition

→ Well-designed energy (and climate) policies

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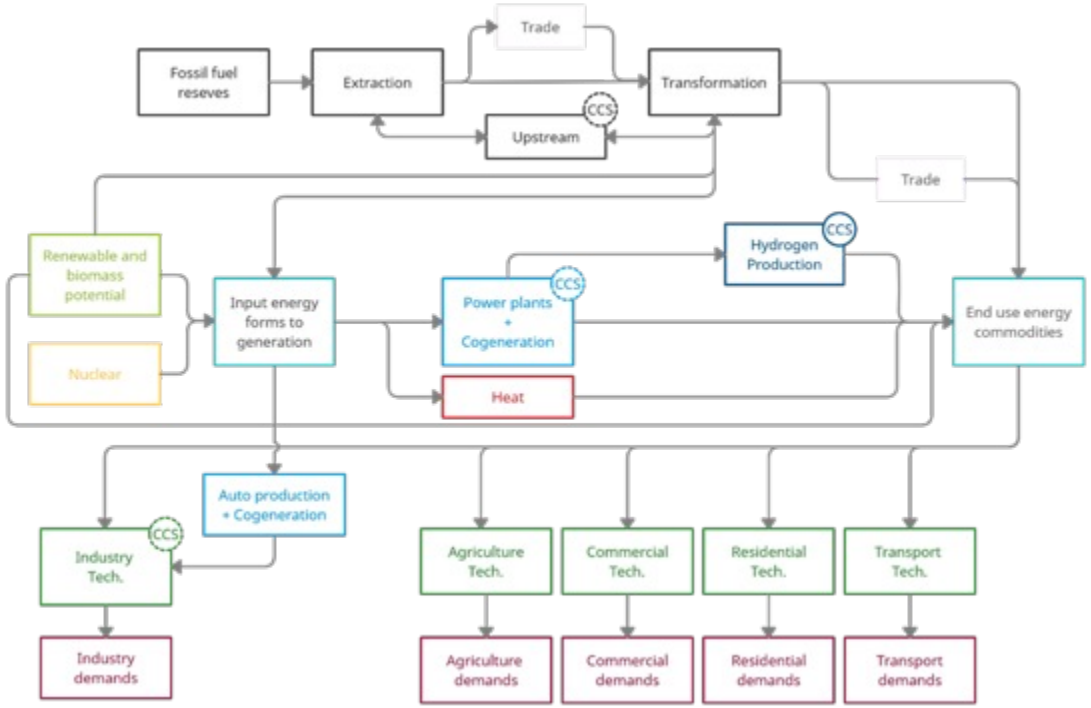
Analytical approach

KEY Message: No unique way to "interpret" the challenge and to develop analyses
KEY Message: No simplistic / binary (YES/NO) response to complex problems
KEY Message: Decision making needs "knowledge" more than / before "answers"

Integrated analysis: based on a holistic approach which addresses simultaneously as many perspectives or dimensions of the energy and climate dynamics as possible, and takes into account the cross-cutting nature and interactions between those dimensions.



Multiple explorations: learning by exploring / learning by comparing.
Energy scenarios serve as points of comparison to evaluate sensitivities and multiple outcomes.

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Approach: design of a large strategic exercise

5 - different CO2 prices (to mimic different emission reduction ambitions, from "no" to "decarbonisation")	--->	Very Low / Low / Medium / High / Very High (EU decarbonisation)
3 - different assumptions on CCS (uncertainty covering the storage potential and the rate of capture)	--->	No / Medium / Large
2 - different assumptions for nuclear	--->	No / Yes (up to 12 GW in 2060)
2 - different assumption for IGCC (CAPEX and subsidy)	--->	Default values / -25% CAPEX and subsidy covering the variable costs (excluding fuel)
2 - different cost of renewable techs and H2 techs (uncertainty for CAPEX)	--->	Default / High (+33% CAPEX)
2 - different contribution of other offset options (DAC and natural)	--->	Default / Low (-40% CAPEX)

240 Total number of cases

Combinatorial method to explore scenarios (by permutating and combining influencing factors)

CO2-1	1	6	11	16	21	26	31	36	41	46	51	56	61	66	71	76	81	86	91	96	101	106	111	116
CO2-2	2	7	12	17	22	27	32	37	42	47	52	57	62	67	72	77	82	87	92	97	102	107	112	117
CO2-3	3	8	13	18	23	28	33	38	43	48	53	58	63	68	73	78	83	88	93	98	103	108	113	118
CO2-4	4	9	14	19	24	29	34	39	44	49	54	59	64	69	74	79	84	89	94	99	104	109	114	119
CO2-5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120

CO2-1	121	126	131	136	141	146	151	156	161	166	171	176	181	186	191	196	201	206	211	216	221	226	231	236
CO2-2	122	127	132	137	142	147	152	157	162	167	172	177	182	187	192	197	202	207	212	217	222	227	232	237
CO2-3	123	128	133	138	143	148	153	158	163	168	173	178	183	188	193	198	203	208	213	218	223	228	233	238
CO2-4	124	129	134	139	144	149	154	159	164	169	174	179	184	189	194	199	204	209	214	219	224	229	234	239
CO2-5	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225	230	235	240

Example (12): Low CO2 price; Large CCS potential, no nuclear, no support for IGCC, default costs for RES and H2, default costs for CO2 offset technologies

Example (46): Very low CO2 price; NO CCS potential, YES nuclear, YES support for IGCC, default costs for RES and H2, default costs for CO2 offset technologies

Example (240): Very high CO2 price; Large CCS potential, YES nuclear, YES support for IGCC, High costs for RES and H2, Low costs for CO2 offset technologies

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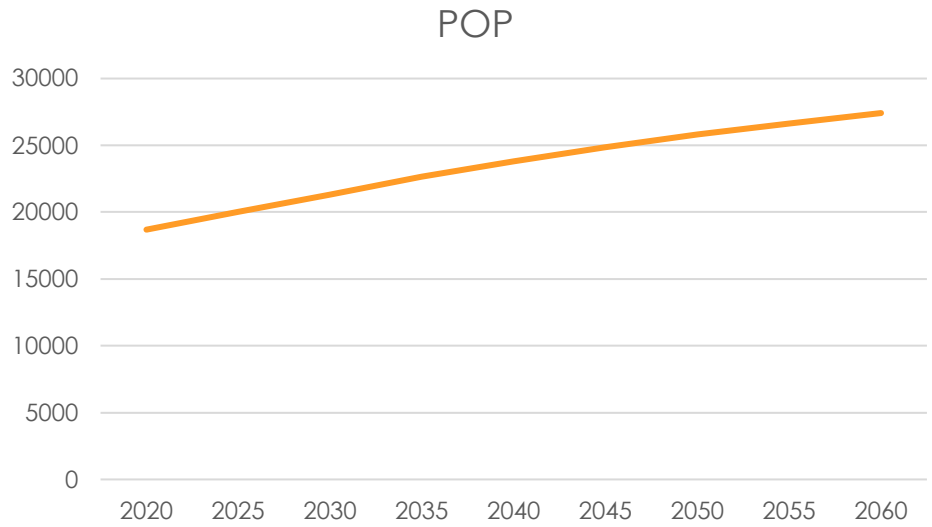
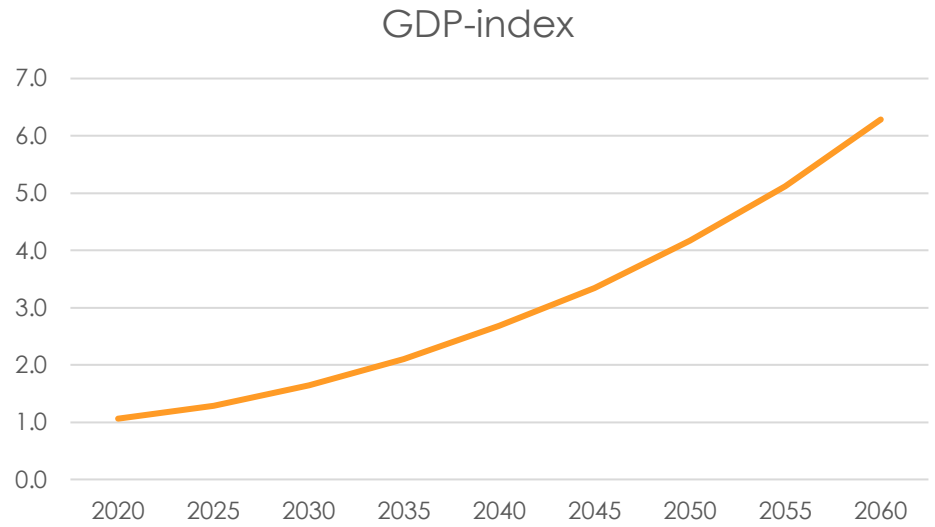
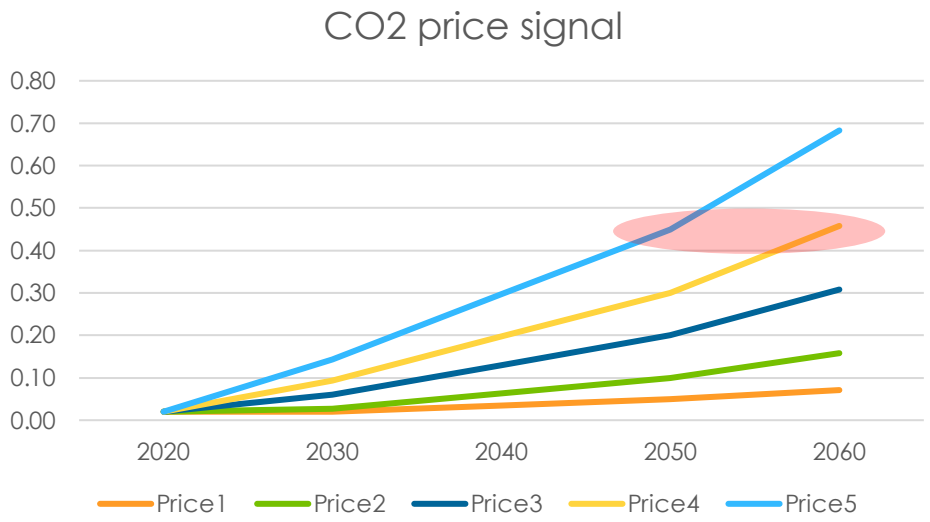
Approach: key drivers







~450 $/t similar to the EU value (to reach the EU 2050 climate neutrality in the FF55 package analysis)

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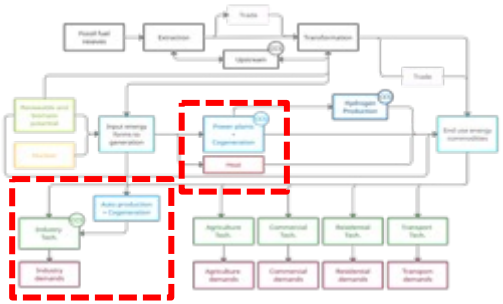
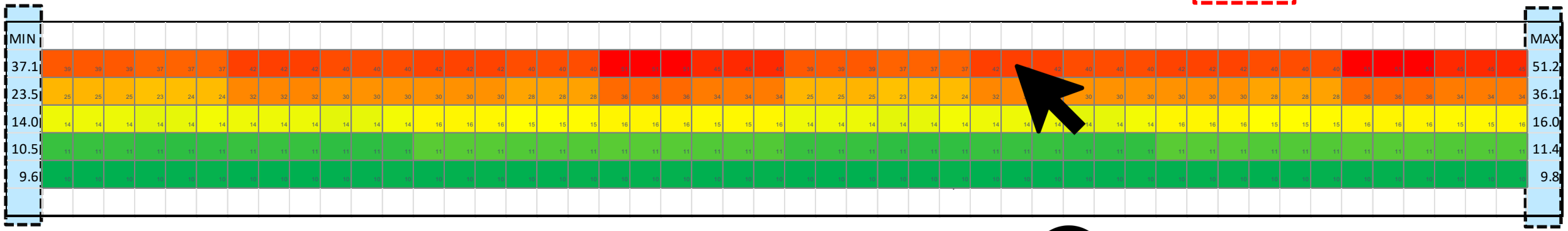
Findings (spreadsheet-based navigator)

KPI: Coal usage (in generation and industry) in the time horizon (2020-2060).
Expressed in terms of equivalent n. of years of 2020 consumption





Dark red cells: high number of years
Orange/Yellow cells: intermediate
Dark green cells: low number of years

A tooltip displays the description of the case when users point the corresponding cell.

Two click away from case specific results:
- Generation capacity
- Electricity generation
- Total emissions
- Final consumption
- System Costs (relative)

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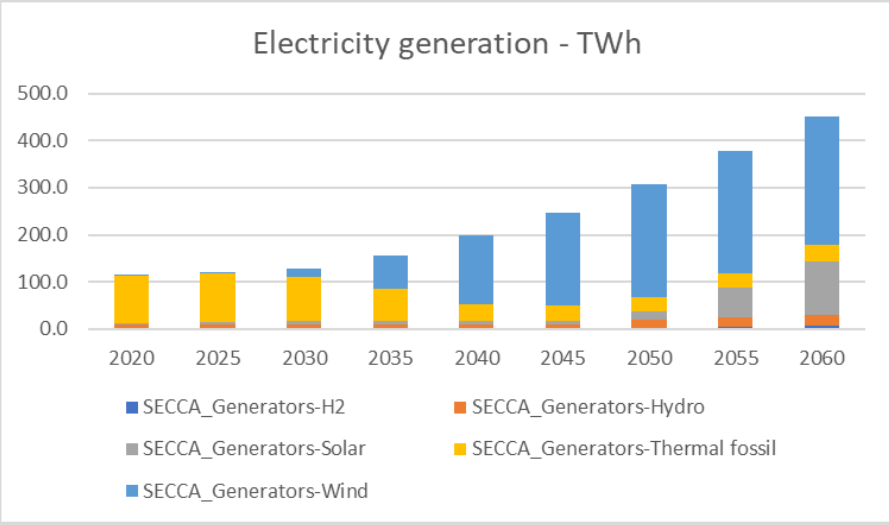
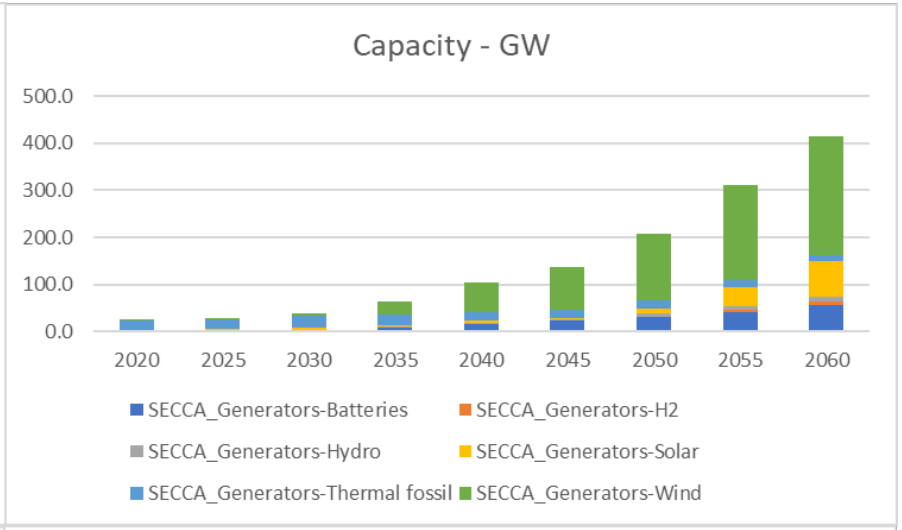
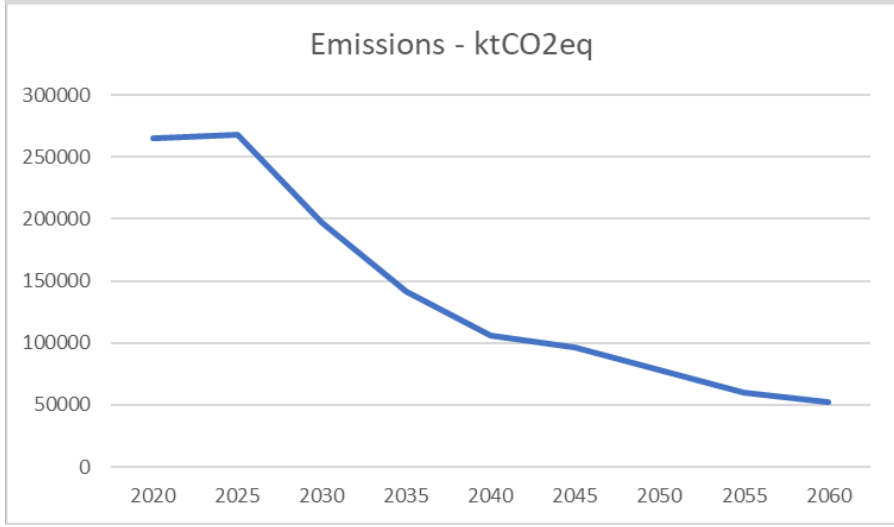
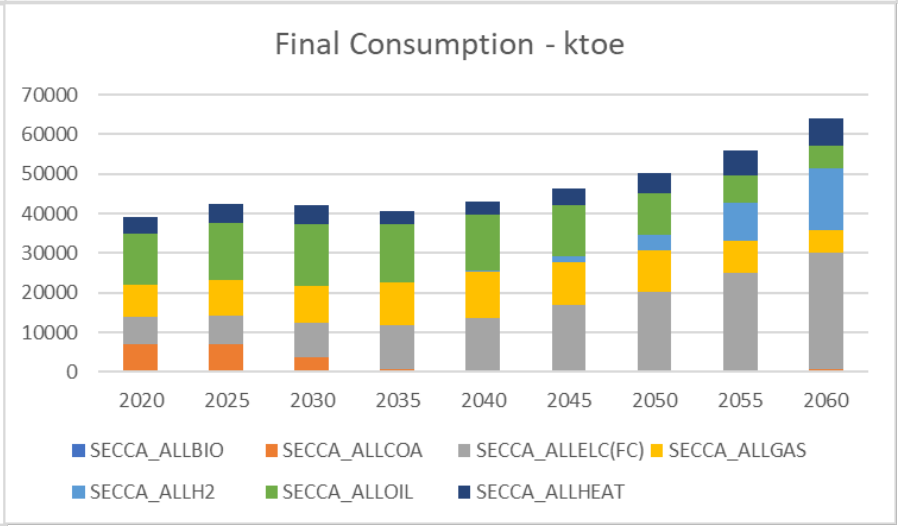
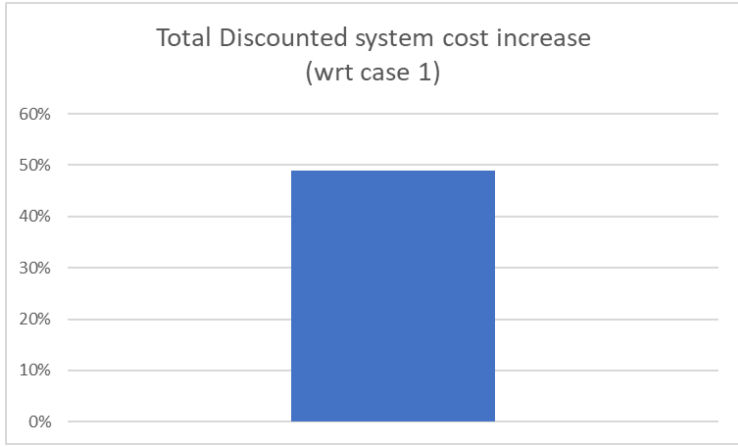
Findings (navigator) – Case X











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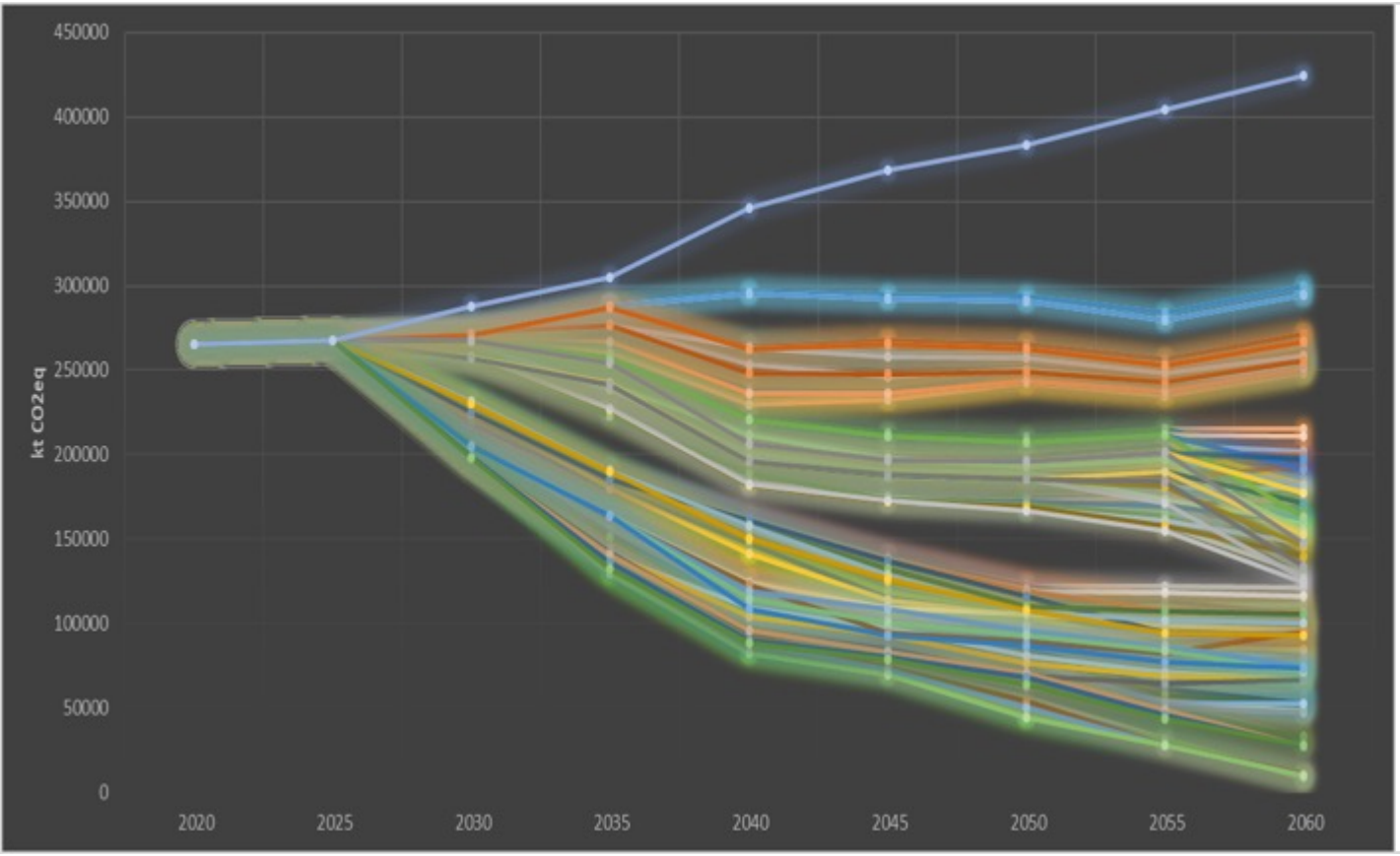
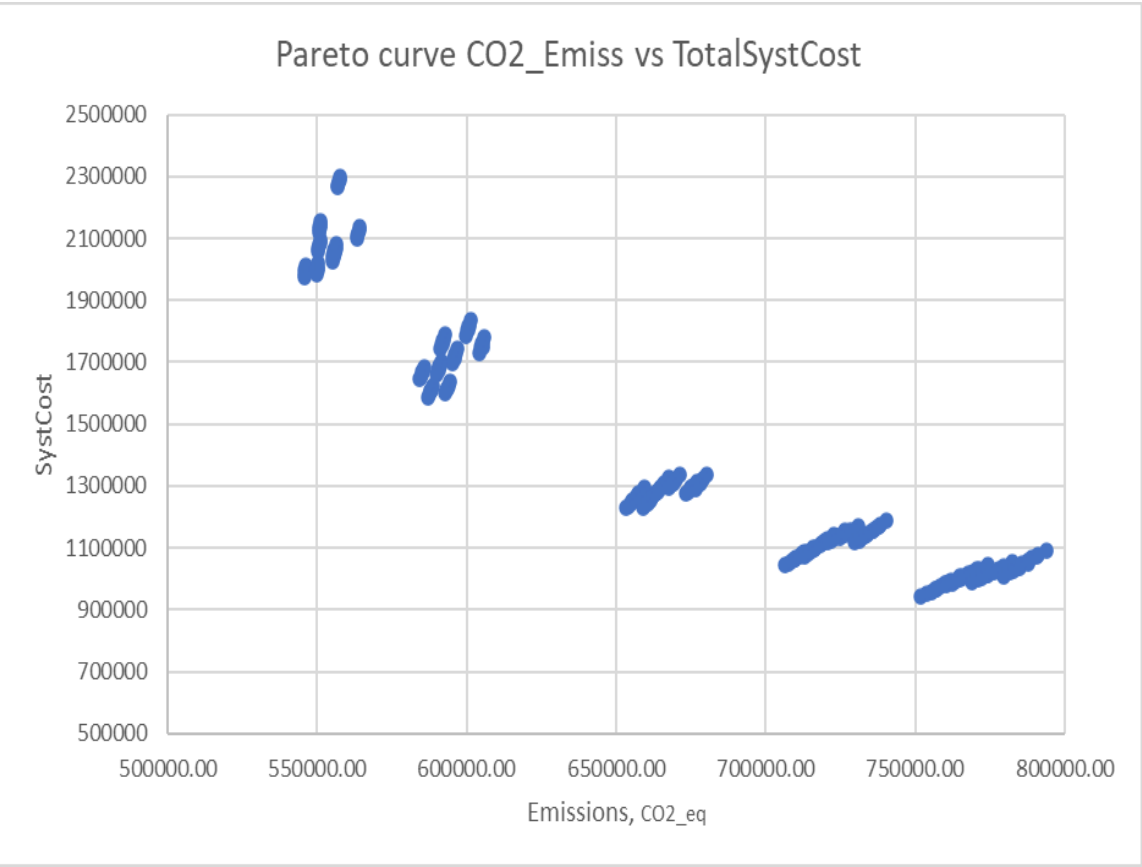
Findings (navigator) – Spectrum of emissions and tradeoffs





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Strategic insights

Under the undertaken exploration:

- Cumulative coal usage over the period (2020-2060) ranges between (around) 10 years and 51 years of 2020 equivalent consumption.

- None of the identified influencing factors makes a long-term utilisation of coal compatible with deep mitigation (nearly zero) trajectories.

- Even for mild mitigation targets (eg around -50% wrt to 2020), the annual (average) consumption of coal over the next 40 years is projected to be around 1/3 of today's values.

    - There is high risk of "stranded" assets (if new coal-based plants/facilities are built in the next years).

    - High risk of loss of competitiveness (to be further investigated)

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Typical outputs

Greenhouse gas emissions trajectory: per sector (transport, industry, residential, commercial, agriculture, electricity generation, upstream/midstream oil and gas), per fuel (diesel oil, natural gas, lignite etc.), and calculation of key indicators (carbon intensity per unit energy, energy intensity etc.).

Technology mix and evolution over time. Installed capacities per technology type and fuel type in the power sector, capacities of technologies in the demand sectors (industry, residential/commercial buildings, transportation). **Changes in technology utilization over time.**

Investment costs. Over the year of the time horizon, by technology type and sector (ex-post analysis of breakdown between public/private investments)

Final energy consumption and primary energy supply . Per energy commodity (electricity, lignite, natural gas, diesel oil, gasoline, HFO etc.) and per sector (transport, industry, residential, commercial, agriculture).

Grid electricity demand and imports/exports: per year, broken down per sector (transport, buildings, industry, agriculture) including the additional demand from electrification of transport, electrification of heating and cooling services, and electrification of industry.

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Stakeholder dialogue - SECCA

Model-based analyses (virtual)

"**Insights and knowledge from tools**" VS "**What do decision makers would like to know**"

Decisions (real)

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Summary

Scope of the work: Explore the role of coal in the energy system of Kazakhstan against the emission reduction ambitions.

Provide a test-bed for the development of additional/alternative assessments.

Approach: Analysis organised in a model-based "large strategic exercise" with 240 cases to investigate the "combined" impact of the following influencing factors: CO2 prices, CCS potential, development of nuclear energy, support of coal-fired stations, costs of RES and H2, contribution of emission offset options.

Findings: the role of coal differ "case by case" depending on the specific combination of factors. *Even under the most favourable conditions, the coal consumption in the medium-long term is hardly compatible with medium-deep emissions mitigation ambitions.*

Material: full spreadsheet-based dashboard (to navigate the 240 cases and the "key" outputs of each case).

Model files: hosted in a cloud-based platform for collaborative development and version control. Access can be granted to local experts and Institutions for further development (and use) in the framework of the SECCA project ("co-development"), and/or for independent utilisations.

Next steps: ideas, proposals and discussion

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Q&A

Thank you for your attention!

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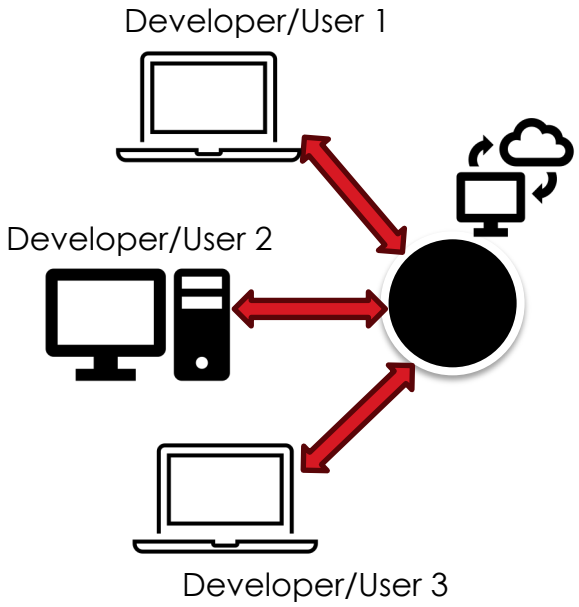
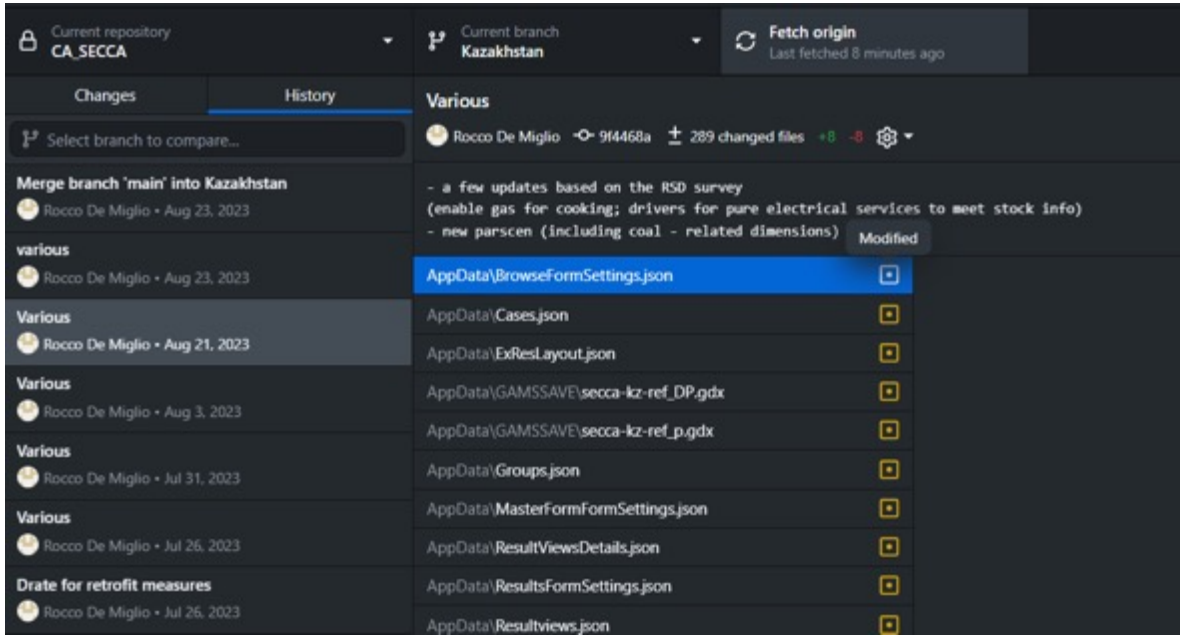
Collaboration and co-development

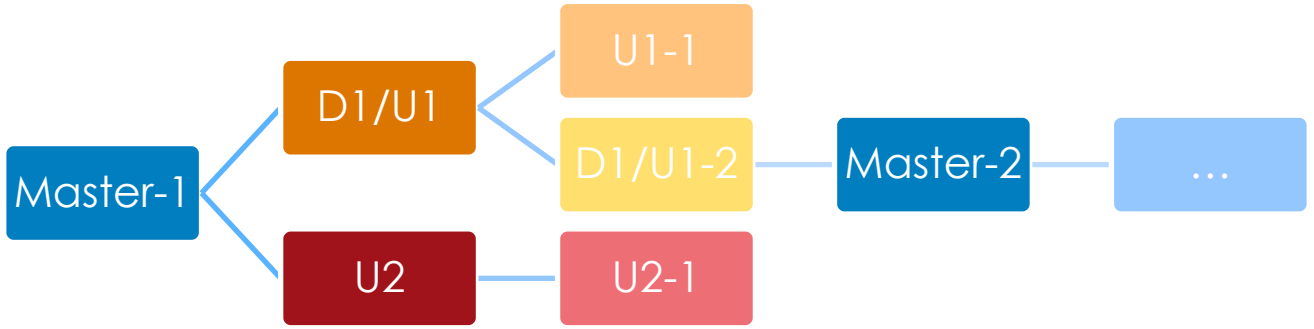




For hosting the model files and collaborating with the team.

Access can be granted to local Organisations (with previous modelling experience):
ERI
Zhasyl Damy
Astana IT
Nazarbayev University
…

A workflow example



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