"Workstream 1" on Scenarios

Progress Report by the Modeling Team

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Agenda

- Progress report after October 2013
- Complementary: Sensitivity analysis
- Driving factors as an input to High Road Scenario
- Gas Price modeling and recent price developments
- Report on the "convergence" meeting
- --- afternoon
- Proposal for modeling support of the High Road scenario

Scenario modeling group to the Workstream 1 of GAC

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Independent Expert

Scenario modeling group to the Workstream 1 of GAC

- Technical group has been established
  - Composed of top experts with proven track record
  - Can operatively generate traceable E3 modeling answers to policy-relevant questions in the context of the scenario field
- New format of discussion suggested and demonstrated: from debating about singular resulting trajectories or even figures to constructive alternative ways to achieve a certain state
- Regular participation of the group in the key meetings and start of methodological cooperation with the EC teams involved in modeling
  - Announcement of Methodology in May 2013 (Brussels)
  - Presentation to GAC meeting in June 2013 (Brussels)
  - Joint Modeling workshop with EC and ENTSOG in October (Vienna)
  - Scenario workshop in October 2013 (Brussels)
  - Presentation to GAC meeting in November 2013 (Moscow)
  - Joint Modeling workshop with EC and ENTSOG in January 2014 (Brussels)

Technical Group: Goals

- Motto
  - To design, maintain and promote the Modeling Framework for Generating Strategic Scenarios
- Goal
  - To broaden the vision of experts and policymakers in analyzing scenarios of achieving certain targets
  - To help reveal invisible or non-trivial outcomes
- Purpose
  - Analysis of the consequences of certain energy policy targets
    - e.g. "what is the cost of compliance of '20-20-20' from the perspective of energy industry and end users?
  - Generation of messages as decision support aid
    - e.g. "Russia shall support any EU initiatives targeted at CO_2 reduction or RES promotion for they remove the competition from coal and position gas as transitional fuel"
  - Preparation of a basis for Strategic Early Warning System

Technical Group: Approach

- Means
  - Tools: MESSAGE model for modeling supply, ECHO model for modeling demand side
  - Connection point to real world: Baseline (Reference) scenario, which is based on the common exogenous assumptions sources (Eurostat, IEA/OECD, Enerdata, DG Energy scenarios)
  - Exercise: Calibration of Reference scenario, simulation REF alternatives on the basis of Case Studies
- Method
  - Empirical sensing of the states and trajectories in the scenario field

Discussion on 23 October: Lessons Learned

- Most of the points raised at the workshop have been dealt with in the model since October 23

- Methodology and scenario data:
  - Publish price import tables and building renovation assumptions
    Done (REF)
  - Think about segregation of CO_2 sources: from fuel use and from end use
    Will be worked out in 2014

- Gas price modeling:
  - Implement a price mechanism based on the cost of the resource
    Will be worked out in 2014. Sought construction: cost of resource, cost of extraction, cost of transport, export taxes, exporters' profit margin
  - Implement pricing at the border
    The focus in 2014 will be on the above principle

- Infrastructural:
  - Include the Southern corridor (TAP, TANAP, etc.) explicitly in the model

    Done

  - Increase USA LNG exporting capacity

    Done

  - Gas in transportation sector

    Will be done in 2014

- Empirical:
  - Calibration of the model in 2010 resulted in high values (e.g. gas demand in EU) in 2015

    Adjusted by tightening the trends in 2015

Planned Developments 2014

- Modeling:
  - Under consideration: expansion of the demand regions to better capture regional specifics
  - Modeling of supply regions in Russia
    - Cost-based pricing
    - Additional objective: maximize revenue from sales
  - Deepening the end use modeling
  - CO_2 segregation per sectors
  - Buildings insulation

- Conceptual
  - Principles of Incorporating ECHO in MESSAGE
  - Distributable materials: paper and tables
  - Concept and methodology to design the High-Road scenario

Scenarios per Driving Factors

Socio-Economical

- 5 LOW scenarios: variations of REF with lower GDP growth rates
- 3 HIGH scenarios: variations of REF with higher GDP growth rates

Energy Import Prices

- 14 scenarios of Russian import gas prices
- 6 scenarios of USA LNG prices
- One Price scenario: All import sources deliver at one price
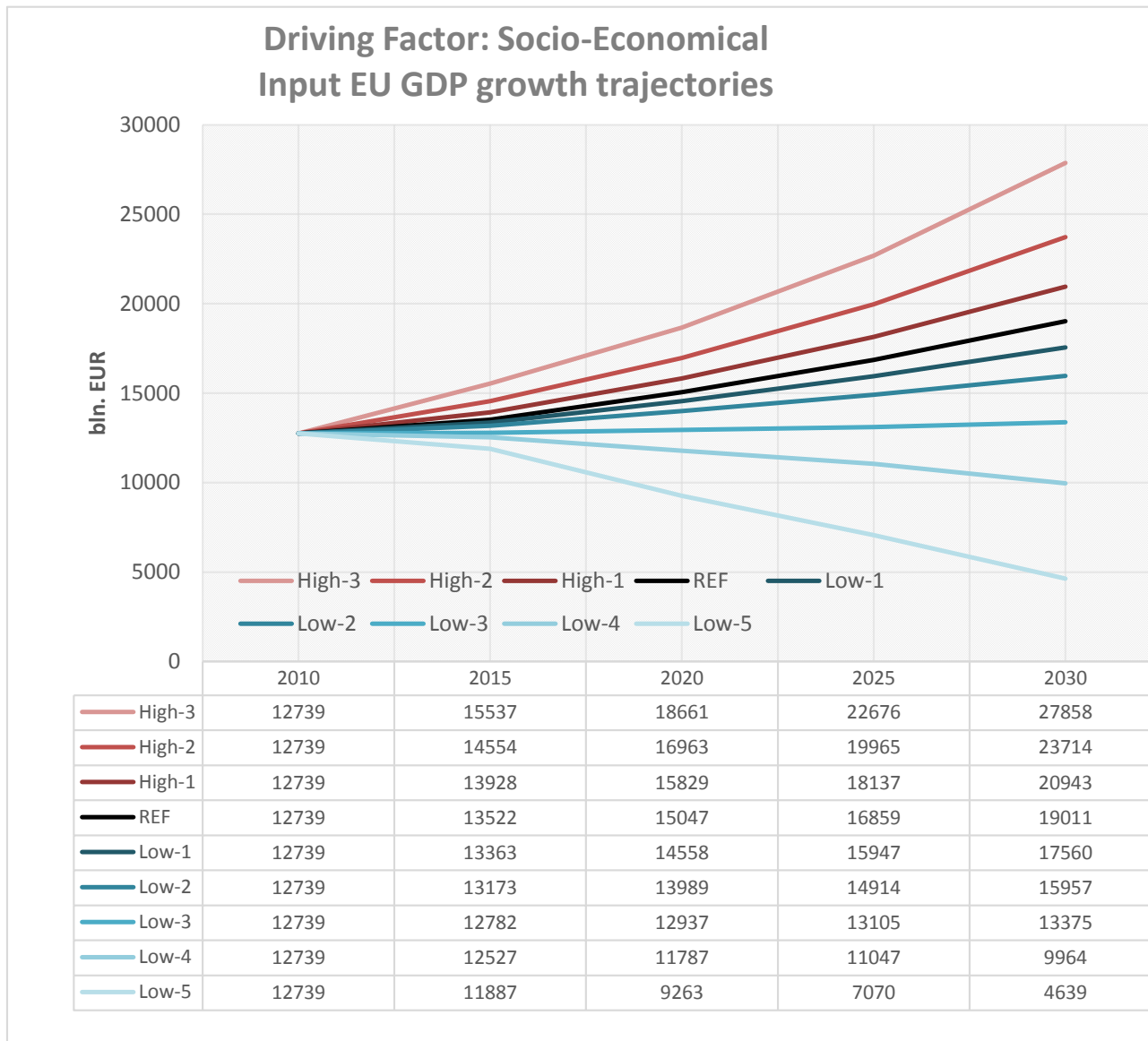
Geopolitical

- SGS: production of shale gas in the EU
- ESS: limiting singular exporter's share to 25% of the market
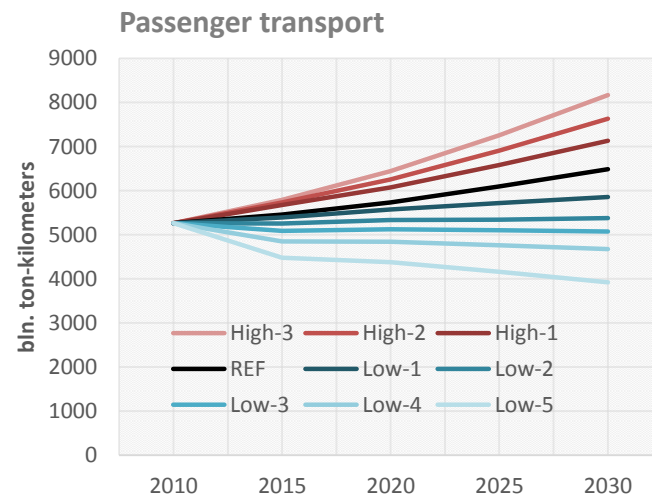- Norway Gas: No limitation on export capacities. Next resource grade costs the same

Energy Policies

- CO2R: the 20% CO2 reduction target shifts to 2030
- CO2C: the CO2 reduction target is fixed on 2010 level

Socio-Economical Factor: Input Scenarios of EU GDP

Driving Factor: Socio-Economical
Input EU GDP growth trajectories

	2010	2015	2020	2025	2030
High-3	12739	15537	18661	22676	27858
High-2	12739	14554	16963	19965	23714
High-1	12739	13928	15829	18137	20943
REF	12739	13522	15047	16859	19011
Low-1	12739	13363	14558	15947	17560
Low-2	12739	13173	13989	14914	15957
Low-3	12739	12782	12937	13105	13375
Low-4	12739	12527	11787	11047	9964
Low-5	12739	11887	9263	7070	4639

Socio-Economical Factor: Intermediate Results (ECHO)
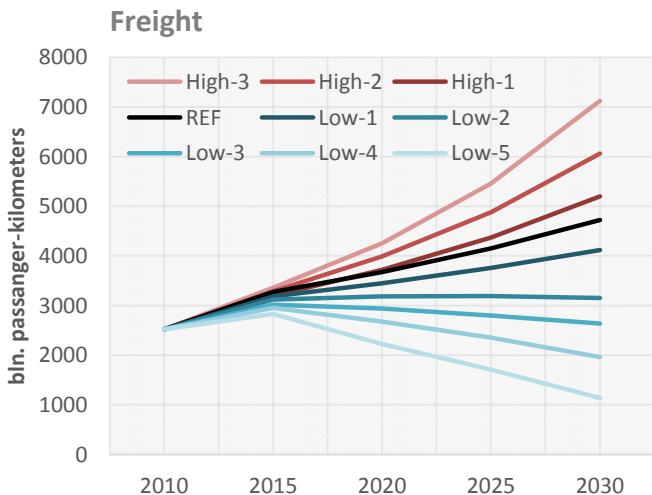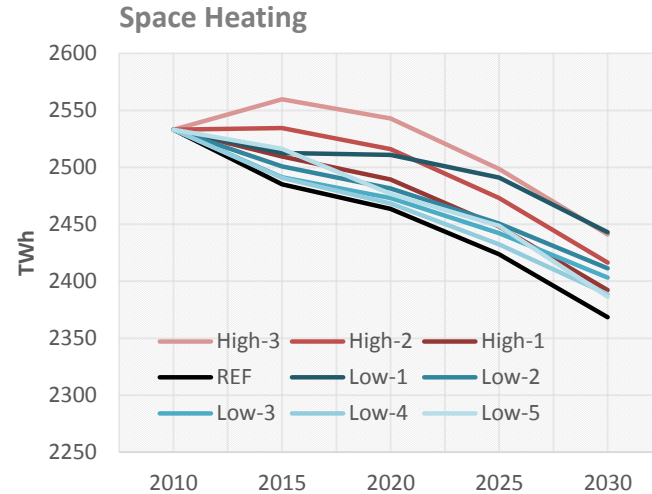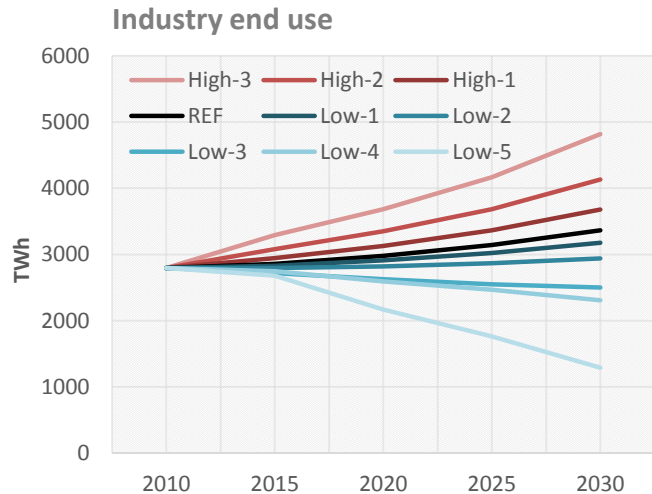
Socio-Economical Factor: Resulting TPES gas

Driving factor: socio-economical.
Resulting TPES, gas, EU

млрд. м3 в год

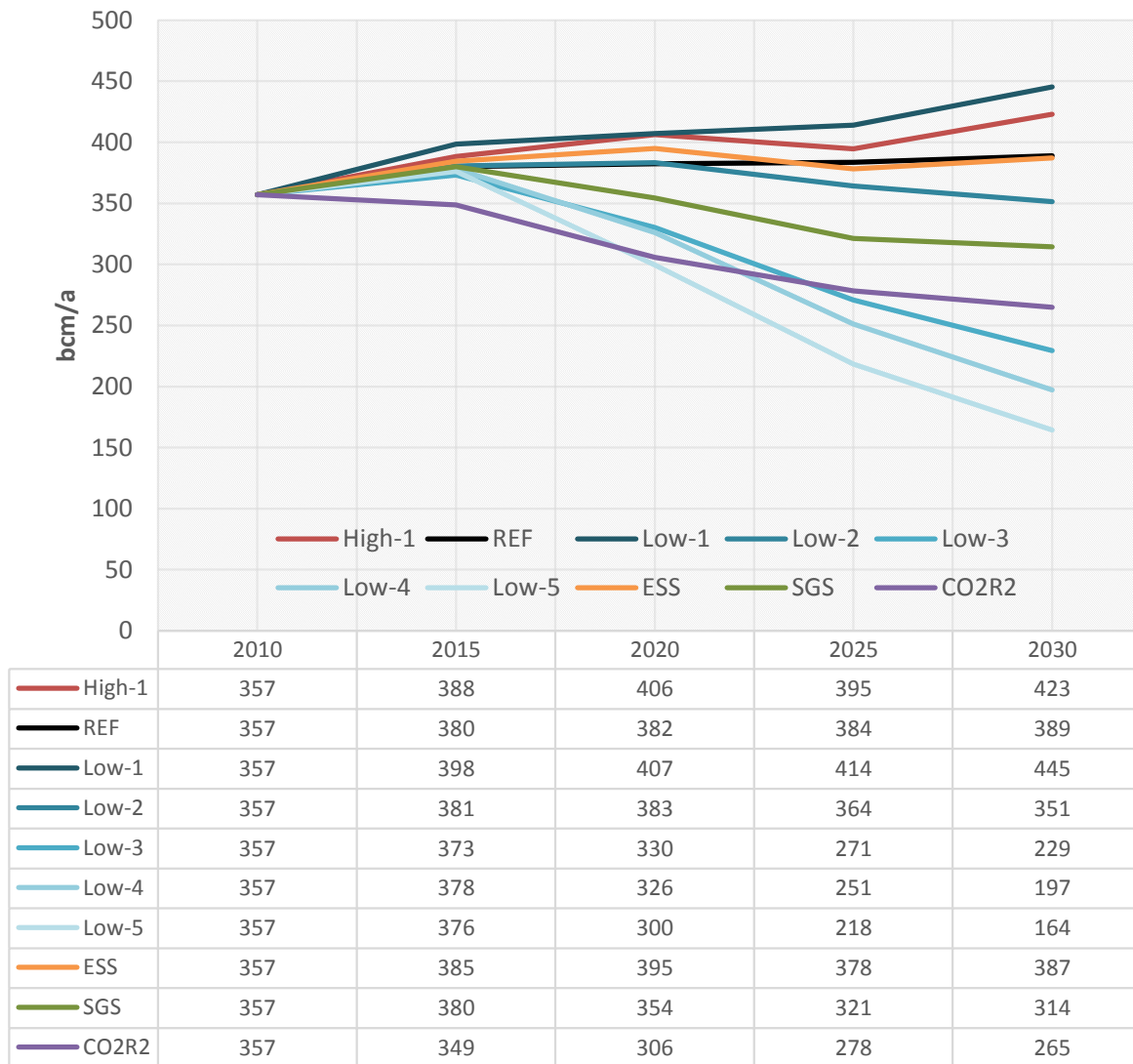|	2010	2015	2020	2025	2030
High-1	534	552	558	536	554
REF	534	544	534	525	520
Low-1	534	562	559	555	576
Low-2	534	545	535	505	482
Low-3	534	537	471	382	310
Low-4	534	542	463	354	265
Low-5	534	539	425	300	216
ESS	534	548	545	519	518
SGS	534	544	535	529	521
CO2R2	534	510	446	404	387

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Socio-Economical Factor: Resulting Gas Production

Driving factor: socio-economical.
Resulting indigenous gas production in the EU.

млрд. м3 в год

	2010	2015	2020	2025	2030
High-1	177	164	152	141	131
REF	177	164	152	141	131
Low-1	177	164	152	141	131
Low-2	177	164	152	141	131
Low-3	177	163	140	111	81
Low-4	177	163	137	103	68
Low-5	177	163	125	82	51
ESS	177	164	150	141	131
SGS	177	164	181	207	207
CO2R2	177	161	141	126	122

Socio-Economical Factor: Resulting Gas Imports

Driving Factor: socio-economical.
Resulting import of gas to the EU.

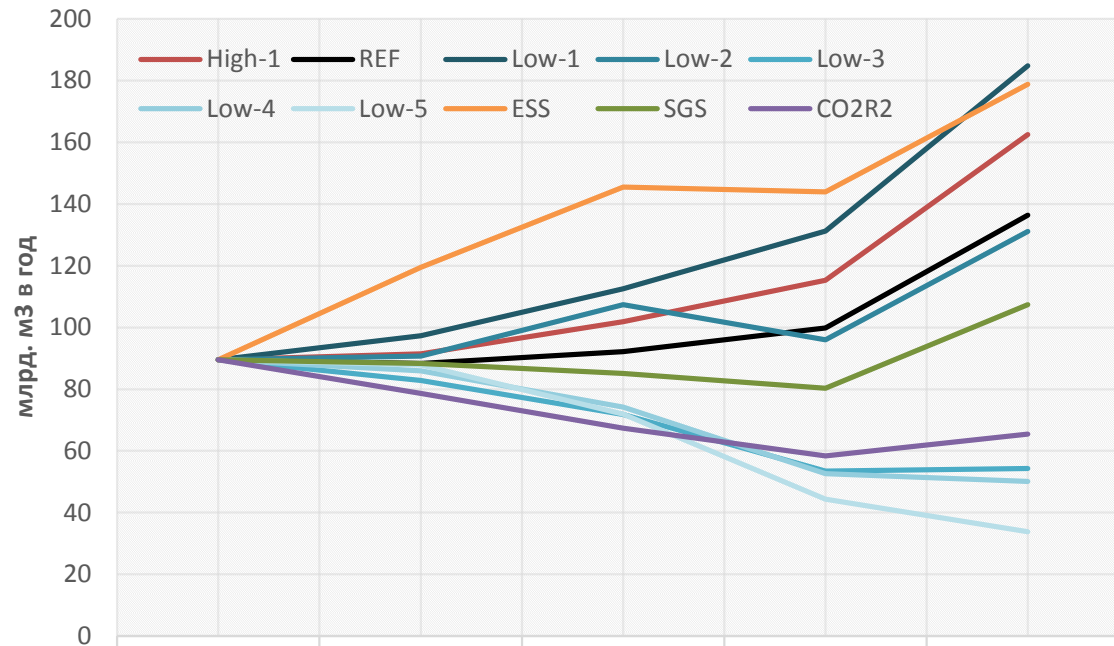|	2010	2015	2020	2025	2030
High-1	357	388	406	395	423
REF	357	380	382	384	389
Low-1	357	398	407	414	445
Low-2	357	381	383	364	351
Low-3	357	373	330	271	229
Low-4	357	378	326	251	197
Low-5	357	376	300	218	164
ESS	357	385	395	378	387
SGS	357	380	354	321	314
CO2R2	357	349	306	278	265

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Socio-Economical Factor: Resulting Gas Imports from Russia

**Driving factor: socio-economical.
Resulting import of Russian gas to the EU.**

	2010	2015	2020	2025	2030
High-1	120	132	148	173	183
REF	120	127	135	179	182
Low-1	120	137	138	173	179
Low-2	120	125	134	161	157
Low-3	120	128	124	127	122
Low-4	120	128	123	119	100
Low-5	120	123	112	103	89
ESS	120	107	99	95	97
SGS	120	127	132	133	143
CO2R2	120	128	123	132	135
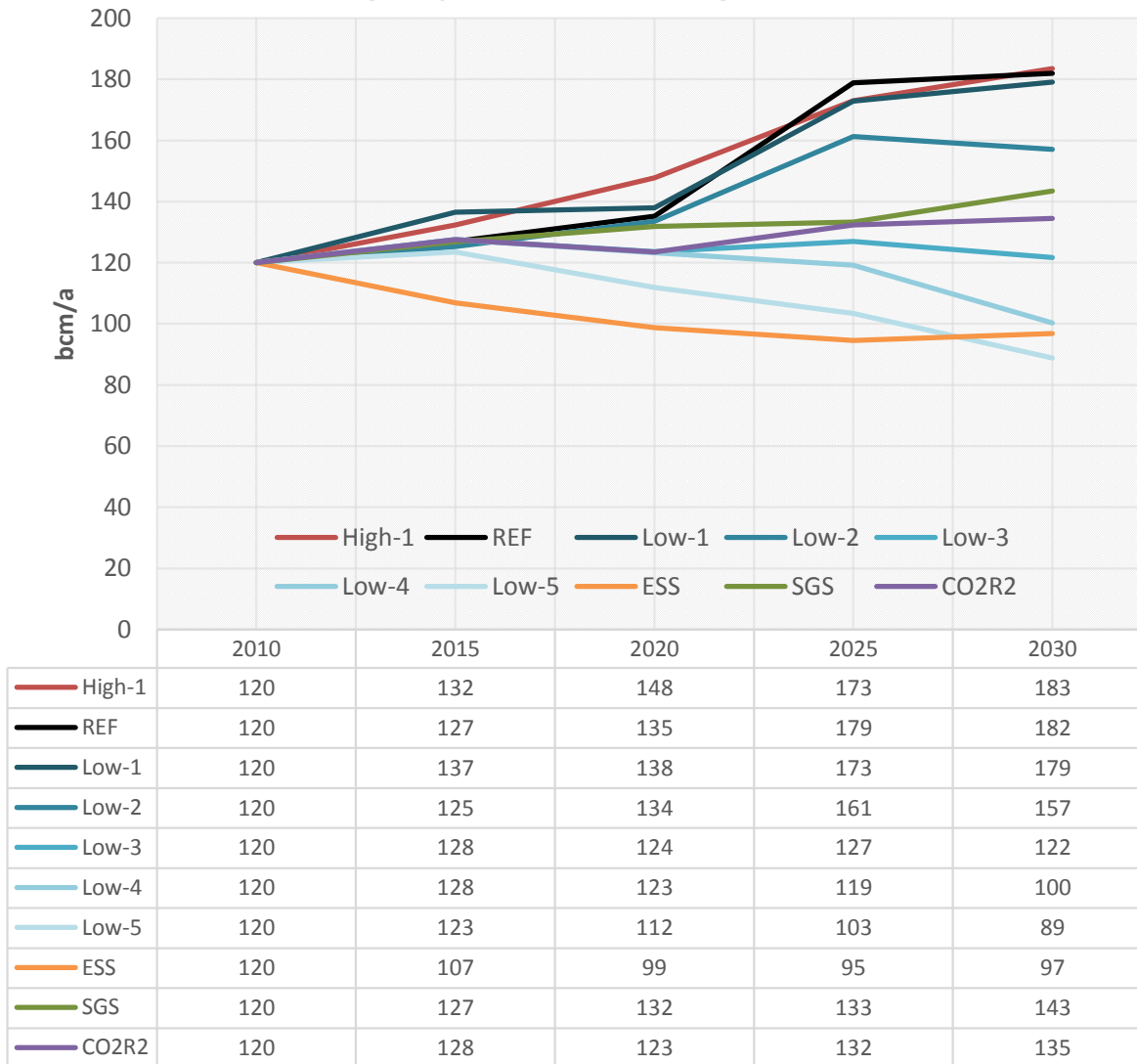
Socio-Economical Factor: Resulting LNG Imports

**Driving factor: socio-economical.
Resulting gas import of LNG to the EU.**

млрд. м3 в год

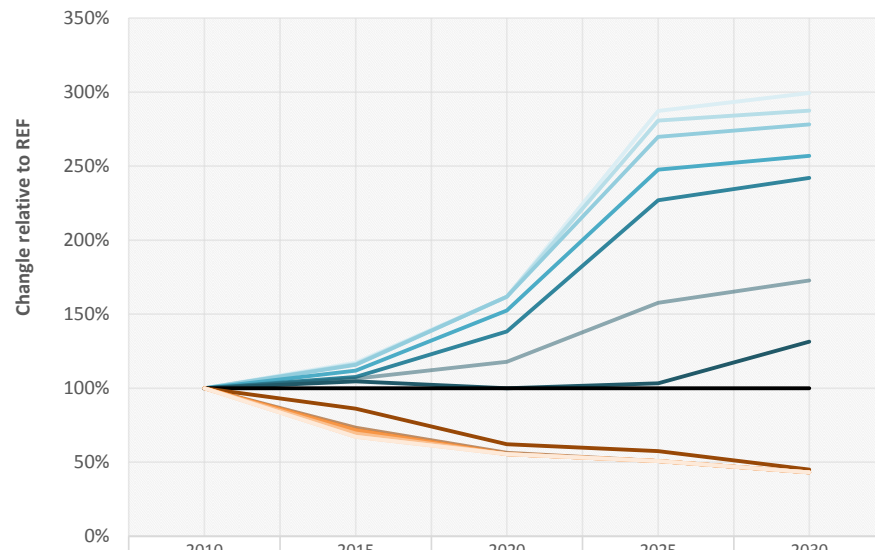|	2010	2015	2020	2025	2030
High-1	90	91	102	115	163
REF	90	88	92	100	136
Low-1	90	97	113	131	185
Low-2	90	91	107	96	131
Low-3	90	83	72	53	54
Low-4	90	86	74	53	50
Low-5	90	88	72	44	34
ESS	90	119	146	144	179
SGS	90	88	85	80	107
CO2R2	90	79	67	58	65

Import Prices Factor: Input Scenarios of Russian Gas Price

Driving factor: import prices (Russia) — Input scenarios

$/GJ
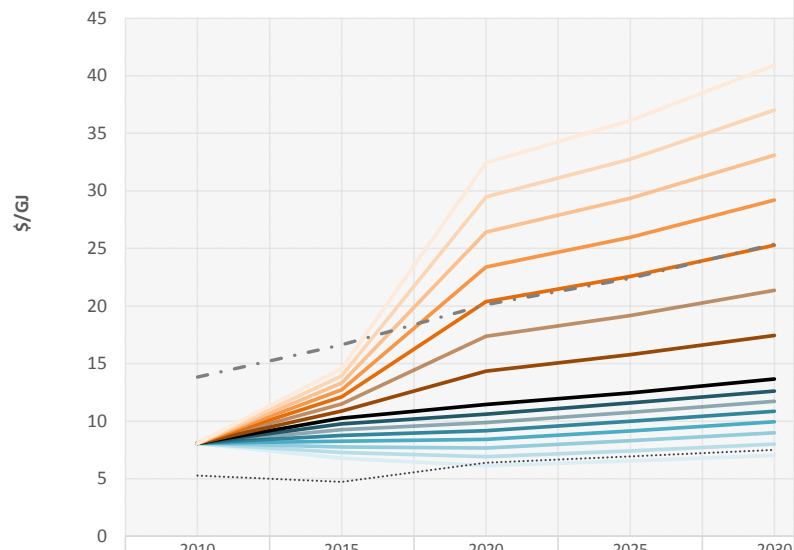
	2010	2015	2020	2025	2030
LP-1	8,1	6,8	6,1	6,6	7,0
LP-2	8,1	7,3	6,9	7,4	8,0
LP-3	8,1	7,8	7,7	8,3	9,0
LP-4	8,1	8,3	8,4	9,2	9,9
LP-5	8,1	8,8	9,2	10,0	10,9
LP-6	8,1	9,3	9,9	10,8	11,7
LP-7	8,1	9,8	10,6	11,6	12,6
REF	8,1	10,3	11,4	12,4	13,7
HP-1	8,1	10,9	14,3	15,8	17,4
HP-2	8,1	11,5	17,4	19,2	21,4
HP-3	8,1	12,1	20,4	22,6	25,3
HP-4	8,1	12,7	23,4	26,0	29,2
HP-5	8,1	13,3	26,4	29,4	33,1
HP-6	8,1	13,9	29,5	32,8	37,0
HP-7	8,1	14,6	32,4	36,1	40,9
Oil	13,8	16,6	20,1	22,4	25,4
Coal	5,3	4,7	6,4	6,9	7,5

Driving factor: import prices (Russia) — Resulting Export of Russian Gas to the EU

Change relative to REF

	2010	2015	2020	2025	2030
LP-1	100%	117%	162%	287%	299%
LP-2	100%	116%	162%	281%	288%
LP-3	100%	116%	162%	270%	278%
LP-4	100%	112%	153%	248%	257%
LP-5	100%	107%	138%	227%	242%
LP-6	100%	106%	118%	158%	173%
LP-7	100%	105%	100%	103%	131%
REF	100%	100%	100%	100%	100%
HP-1	100%	86%	62%	58%	45%
HP-2	100%	73%	56%	51%	43%
HP-3	100%	72%	55%	51%	43%
HP-4	100%	72%	55%	51%	43%
HP-5	100%	69%	55%	51%	43%
HP-6	100%	67%	55%	51%	43%
HP-7	100%	67%	55%	51%	43%

Import Prices Factor: Input Scenarios of US LNG Price

Driving factor: import prices (LNG + all piped)
Input price scenarios
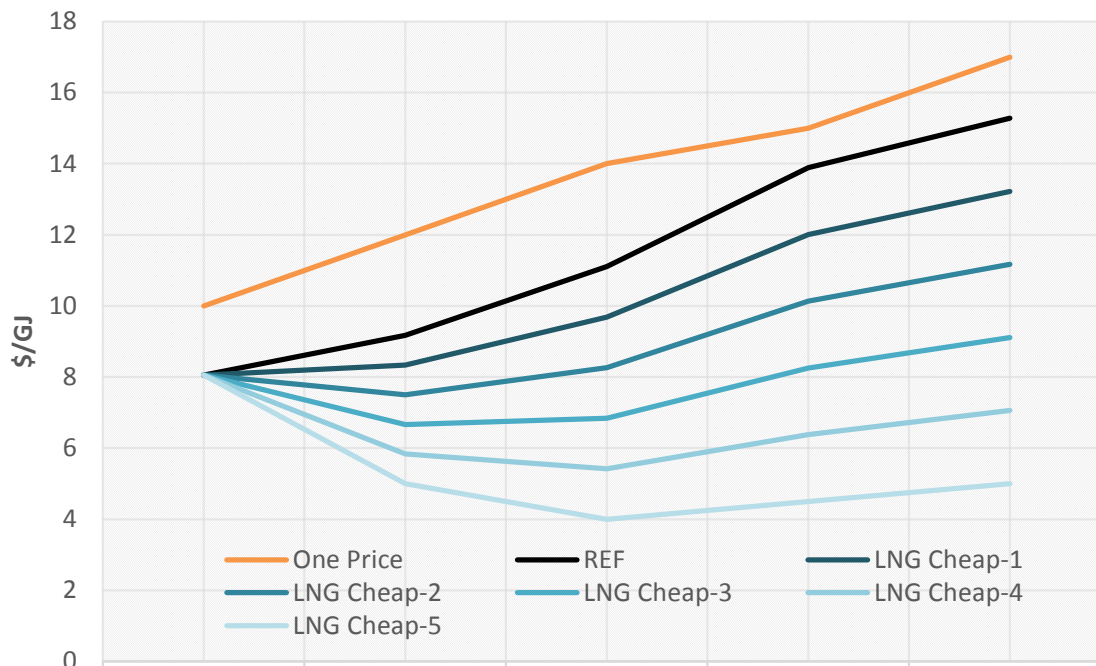
	2010	2015	2020	2025	2030
One Price	10	12	14	15	17
REF	8,1	9,2	11,1	13,9	15,3
LNG Cheap-1	8,1	8,3	9,7	12,0	13,2
LNG Cheap-2	8,1	7,5	8,3	10,1	11,2
LNG Cheap-3	8,1	6,7	6,8	8,3	9,1
LNG Cheap-4	8,1	5,8	5,4	6,4	7,1
LNG Cheap-5	8,1	5,0	4,0	4,5	5,0

Driving factor: import prices (LNG + all piped)
Resulting gas consumption in the EU
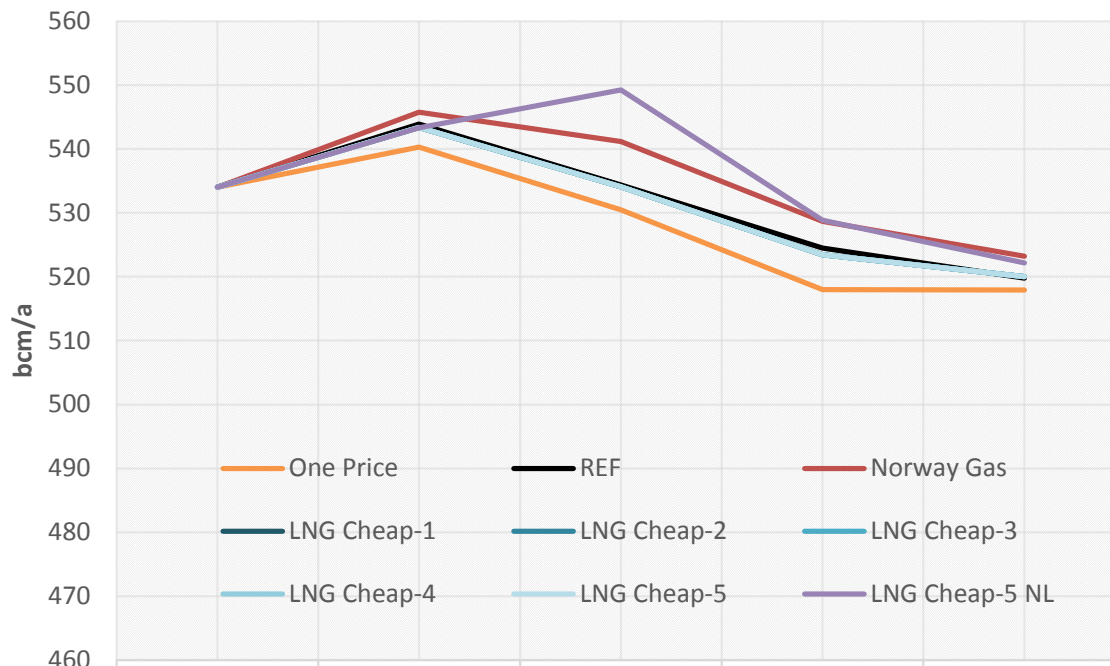
	2010	2015	2020	2025	2030
One Price	534	540	530	518	518
REF	534	544	534	525	520
Norway Gas	534	546	541	529	523
LNG Cheap-1	534	543	534	523	520
LNG Cheap-2	534	543	534	523	520
LNG Cheap-3	534	543	534	523	520
LNG Cheap-4	534	543	534	523	520
LNG Cheap-5	534	543	534	523	520
LNG Cheap-5 NL	534	543	549	529	522

Driving factor: import prices (LNG + all piped)
Resulting Import of Russian gas to EU

	2010	2015	2020	2025	2030
One Price	120	136	154	174	177
REF	120	127	135	179	182
Norway Gas	120	122	134	153	153
LNG Cheap-1	120	122	131	162	177
LNG Cheap-2	120	122	131	162	177
LNG Cheap-3	120	122	131	162	177
LNG Cheap-4	120	122	131	162	177
LNG Cheap-5	120	122	131	162	177
LNG Cheap-5 NL	120	122	99	98	100

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Import Prices Factor: Resulting LNG Import to the EU

Driving factor: import prices (LNG + all piped)
Resulting import of LNG to the EU

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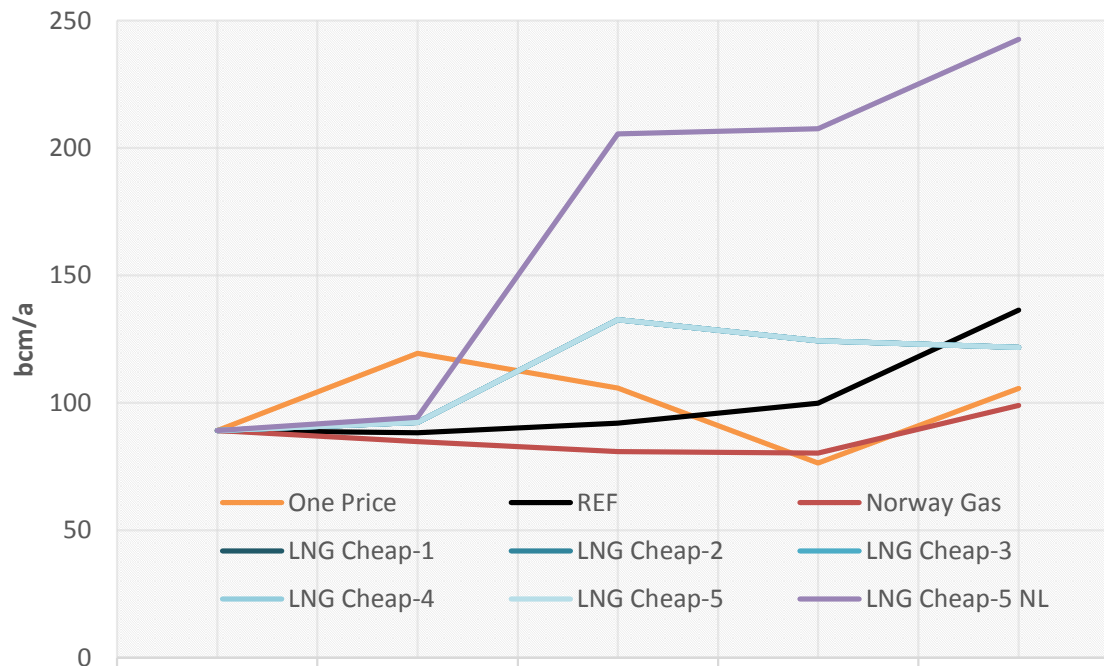
	2010	2015	2020	2025	2030
One Price	89	120	106	76	106
REF	89	88	92	100	136
Norway Gas	89	85	81	80	99
LNG Cheap-1	89	92	133	124	122
LNG Cheap-2	89	92	133	124	122
LNG Cheap-3	89	92	133	124	122
LNG Cheap-4	89	92	133	124	122
LNG Cheap-5	89	92	133	124	122
LNG Cheap-5 NL	89	94	206	208	243