REKK Regional Centre for Energy Policy Research

SEERMAP – Scenario definition

Grantors:

Ministerium für ein lebenswertes Österreich

European Climate Foundation

Consortium members:

Electricity Coordinating Center

OGR

Technische Universität Wien

ERRA Energy Regulators Regional Association

Outline

- Introduction
- Scenario settings:
  - Carbon constraints
  - Capacity development
  - Network assumptions
- Gas market modelling
- Sensitivity runs

Goals of the project

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Modelling

- Analyse the impact of the transition to a low carbon and energy secure pathway the electricity sector until 2050 in line with EU 2050 Roadmap (*Long Term Electricity Roadmap for the SEE region*) that highlights the potential synergies beyond the limited confines of national assessments
- Application of state of the art energy sector models of the participating consortia partners (electricity and gas sector market models of REKK, Green-X of Technical University of Vienna and the regional electricity network model of EKC)

Dialogue and capacity building

- Effectively distribute the findings of this roadmap to the high level decision-makers in the energy administration of the countries
- Build up capacities – in the form of training courses - amongst policy makers, TSO members, energy regulators and local think tanks in the field of renewable energy deployment and transmission network planning issues
- Build up a network of regional think tanks capable of contributing to the debate on the long term decarbonisation pathways in the SEE region
- Trigger discussions on electricity scenarios at a national level

Tools

- Scenario assessment based on the interlinkage of energy models of various energy sub-sectors:
  - EEMM – on electricity wholesale markets
  - GREEN-X on RES deployment
  - EKC electricity network model
  - EGMM on natural gas markets
- Based on the energy model assessment a macroeconomic impact assessment will also be carried out for the scenarios

Main building blocks of long term scenarios in the electricity sector

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- Scenario specific factors:
  - RES deployment
  - Carbon targets and pricing schemes to be applied in the region
  - Investment in new fossil power plants
- Same in all scenarios:
  - Long term electricity demand
  - Retirement of old fossil plants - due to IED requirements
  - Nuclear development assumptions
  - Network development
  - Technology cost reductions (nuclear, CCS, storage)
  - Energy carrier costs/prices

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Scenario settings (1)

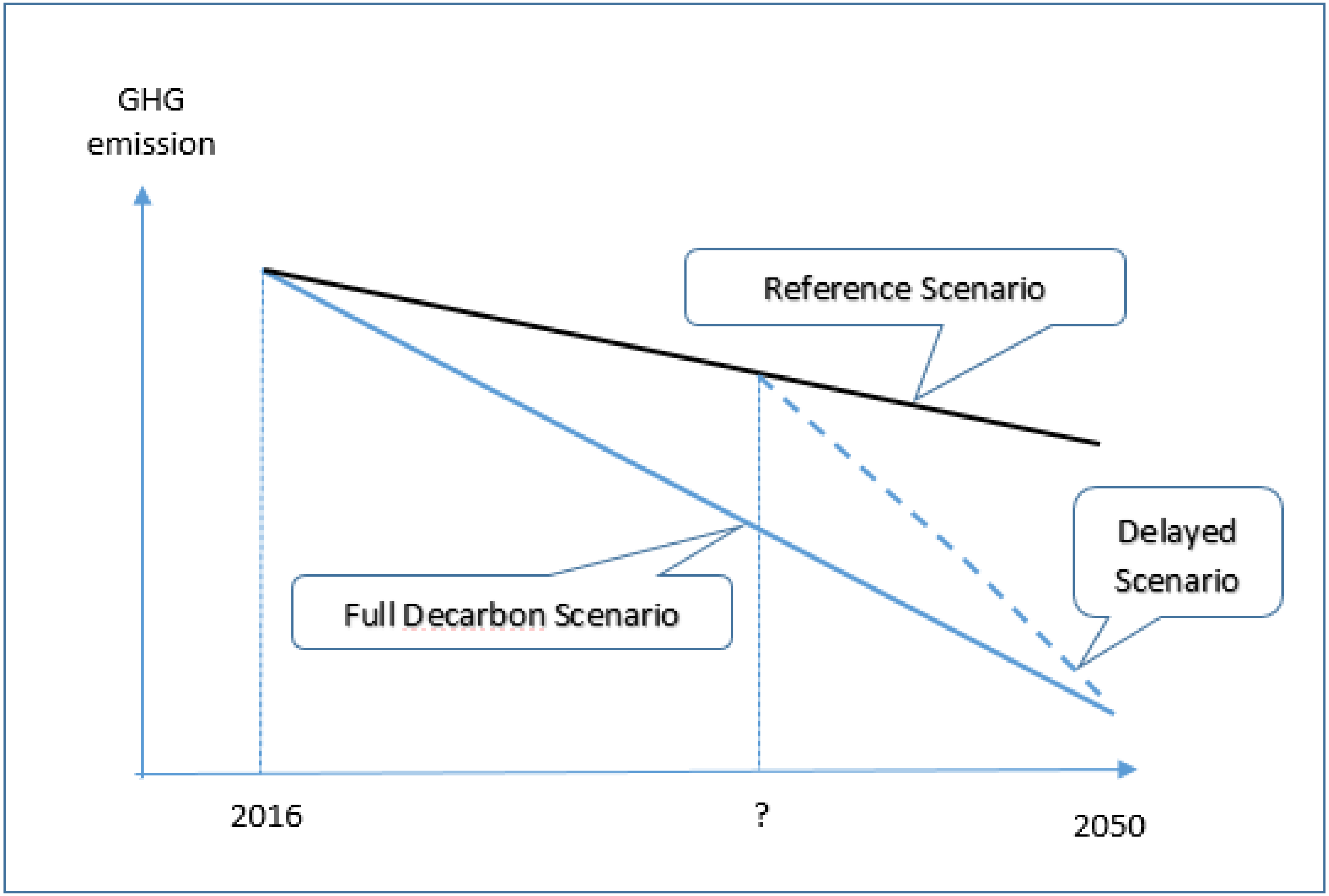
- Scenario specific factors that are derived from policy decisions of SEE countries:
  - Carbon targets and carbon pricing
  - Investment in new fossil plants
  - RES deployment
- While other factors treated exogenously – sensitivity assessment will be applied on the most influential ones (on demand, gas access/price, carbon price)

Scenario Settings (2)

Three core scenarios:

- **Reference** – reflecting present trends and projections of SEE and EU concerning climate commitments
- **Full decarbonisation scenario** – reaching the long term GHG goals of 93-99% of decarbonisation of the electricity sector
- **Delayed decarbonisation scenario** – where a first period (length to be agreed) will reflect the present trends/decisions (on coal/RES investments) and than turns to the decarbonisation targets in a second period

Scenario settings (3)



Carbon constraint

	GHG emission reduction target		CO2 price		
	SEE	EU3	data source	SEE	EU3
REF	no target	no target	from PRIMES (100€/tCO_2 by 2050)	from 2025/2030	from 2016
Delay	one common target which will be reached		from PRIMES (100€/tCO_2 by 2050)	from 2025/2030	from 2016
Full decarbon	one common target which will be reached		from PRIMES (100€/tCO_2 by 2050)	from 2025/2030	from 2016

SEE: AL, BIH, KO*, MK, ME, RS   EU3: BG, RO, EL

Carbon targets:

- No GHG target is assumed for REF in for 2050
- One common target for the Delay and Full Decarbon scenarios, weighted average of 99% of EU and 93% for the SEE

CO2 price:

- Timing of introduction in SEE? (2025/2030)

Capacity expansion

	New fossil plant		RES	
	SEE	EU3	SEE	EU3
REF	nat plan until 2030	nat plan until 2030	NREAP, or PRIMES ref	NREAP, or PRIMES ref
Delay	nat plan until 2030	nat plan until 2030	NREAP or PRIMES ref by 2030 after join to the EU gap filling	gap filling
Full decarbon	FID (2016 state)	FID (2016 state)	gap filling	

New fossil plants:

- National plans, expect Full Decarbon scenario – where only FID plants are built

RES expansion:

- RES is the endogenous variable (the „gap filler"): its level will guarantee compliance with the GHG target at a fixed carbon price environment

New planned fossil and nuclear PPs in the analysed SEE region by 2030

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Country	Unit name	Installed capacity [MW]	(Expected) year of commissioning	Fuel type	FID or planned	Type
AL	CCGT Vlora I. - 200	200	2020	natural gas	Planned	CCGT
AL	CCGT Vlora I. - 160	160	2025	natural gas	Planned	CCGT
BA	Ugljevik 3	600	2018	lignite	FID	thermal
BA	Tuzla 7	500	2019	lignite	Planned	thermal
BA	Kakanj 8	300	2021	lignite	Planned	thermal
BG	Kozlodui VII	1000	2027	nuclear	Planned	nuclear
BG	CHP Ovcha Kupel 2	12	2017	natural gas	FID	CCGT
BG	CHP Zemlyame 1	45	2016	natural gas	FID	CCGT
BG	CHP Zemlyame 2	45	2017	natural gas	FID	CCGT
BG	TPP MI2	500	2018	lignite	FID	thermal
GR	Piso Kampos Rhodes	115	2017	LFO	FID	CCGT
GR	Ptolemaida V, Kozani	600	2019	lignite	Planned	thermal
KO*	Kosova e Re Power	500	2025	lignite	Planned	thermal
ME	TPP Plevlja 2	225	2020	lignite	Planned	thermal
MK	Oslomej	120	2020	lignite	FID	thermal
MK	GAS -fired CCGT	30	2019	natural gas	Planned	CCGT
MK	GAS -fired CCGT	420	2028	natural gas	Planned	CCGT
MK	GAS -fired CCGT	150	2023	natural gas	Planned	CCGT
MK	Coal	120	2018	lignite	Planned	thermal
MK	Coal	200	2028	lignite	Planned	thermal
RS	CHP Pancevo	478	2019	natural gas	FID	CCGT
RS	Kolubara B	700	2021	lignite	Planned	thermal
RS	Kostolac B3	500	2026	lignite	Planned	thermal
RS	Nikola Tesla B3	350	2026	lignite	Planned	thermal

Retirement of fossil capacities by 2030

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Retirement of fossil capacity by 2030, MW				
	Natural gas	HFO	Coal and lignite	Total
AL	0	0	0	**0**
BA	0	0	730	**730**
BG	42	0	1 469	**1 511**
GR	810	300	600	**1 710**
KO*	0	0	1 353	**1 353**
ME	0	0	219	**219**
MK	0	210	822	**1 032**
RO	270	0	2 305	**2 575**
RS	0	0	339	**339**
Total	**1 122**	**510**	**7 837**	**9 468**
% in installed capacity in 2015	**14,0%**	**60,4%**	**33,2%**	**29,1%**

Source: EEMM modelling, REKK, National documents

New cross-border capacities

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- Initial data sources:
  - Under construction and approved categories are used in the model runs till 2030.
  - After 2030 ENTSO-E E-Highway network development is used.
- To be sent out to the participants in xls for update, especially regarding timing

Electricity demand

- Initial data source: PRIMES
- A single demand trajectory is to be used
- Cross-check with data developed in SLED project
- To be sent out to the participants in xls for update, especially regarding timing

Fossil fuel prices:

- Initial data sources:
  - PRIMES
  - IEA

Technology cost assumptions

- Technology development is exogenous to the region (minor influence on their cost reduction), so uniform cost reduction assumptions will be applied across the scenarios and countries:
- They include:
  - Nuclear technology
  - Carbon capture and storage
  - Energy storage technologies
- Their values will be revised compared to the EU Energy roadmap (2011)
  - CCS shows since than sluggish development
  - Energy storage technology shows more rapid development

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Gas market developments in SEE

- The main questions are if gas based electricity generation could play a ‚bridging fuel' type of role in the SEE countries? Could it replace old coal/lignite plant?
  - What would be the impact of such development?
    - On carbon emissions?
    - On infrastructure costs?
- Determining factors:
  - Availability of gas – gas infrastructure development in the region
  - gas price - Multi dimensional problem: interaction with coal plants, carbon price, RES costs and LNG price.
- With the application of EGMM we will explore this dimension in a dedicated sensitivity run.

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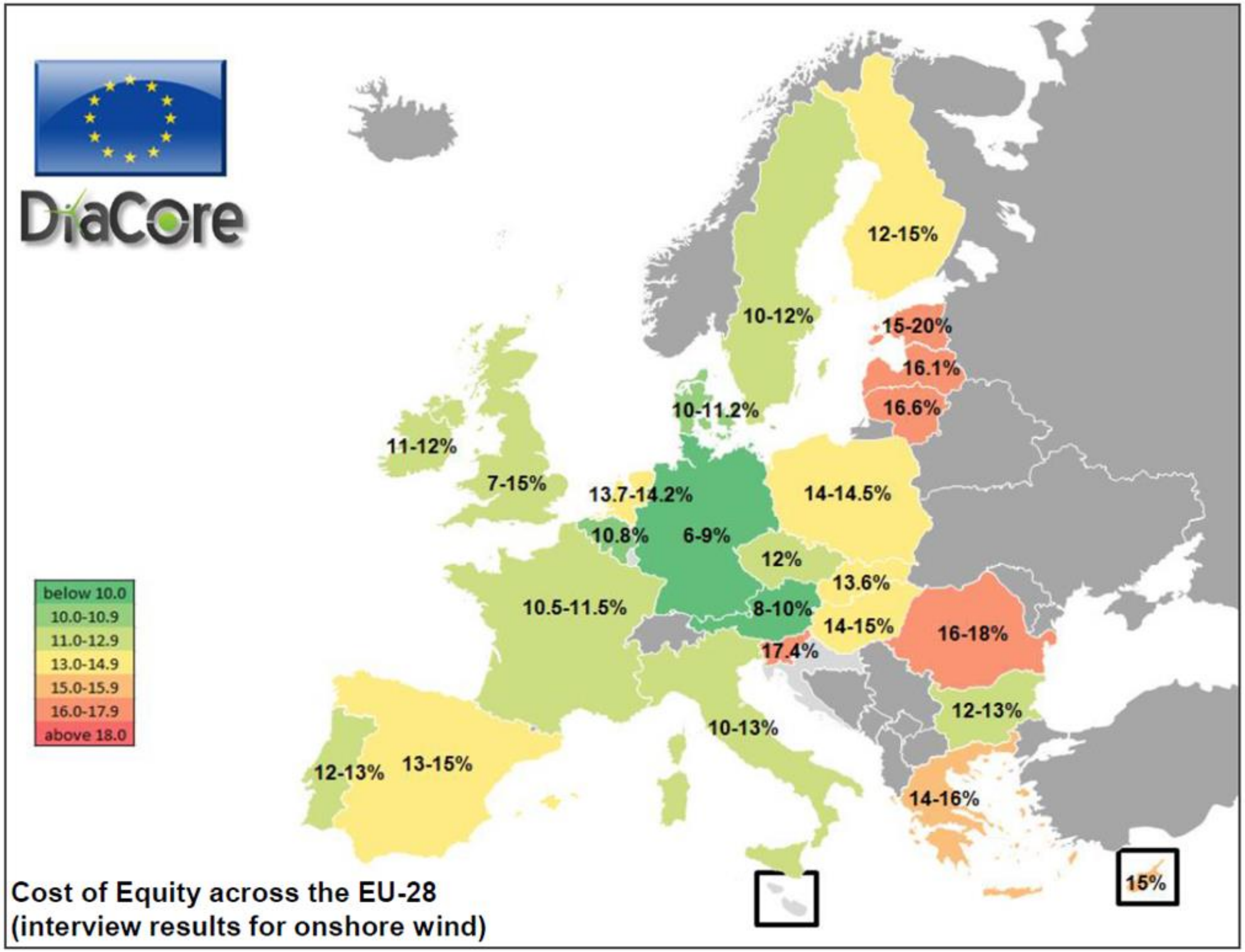
Sensitivity analysis

On the most important exogenous variables additional sensitivity runs will be carried out on:

- electricity demand
- carbon price
- gas availability and price
- cost of capital

Cost of equity



Source: Diacore project 2016

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Backup slides

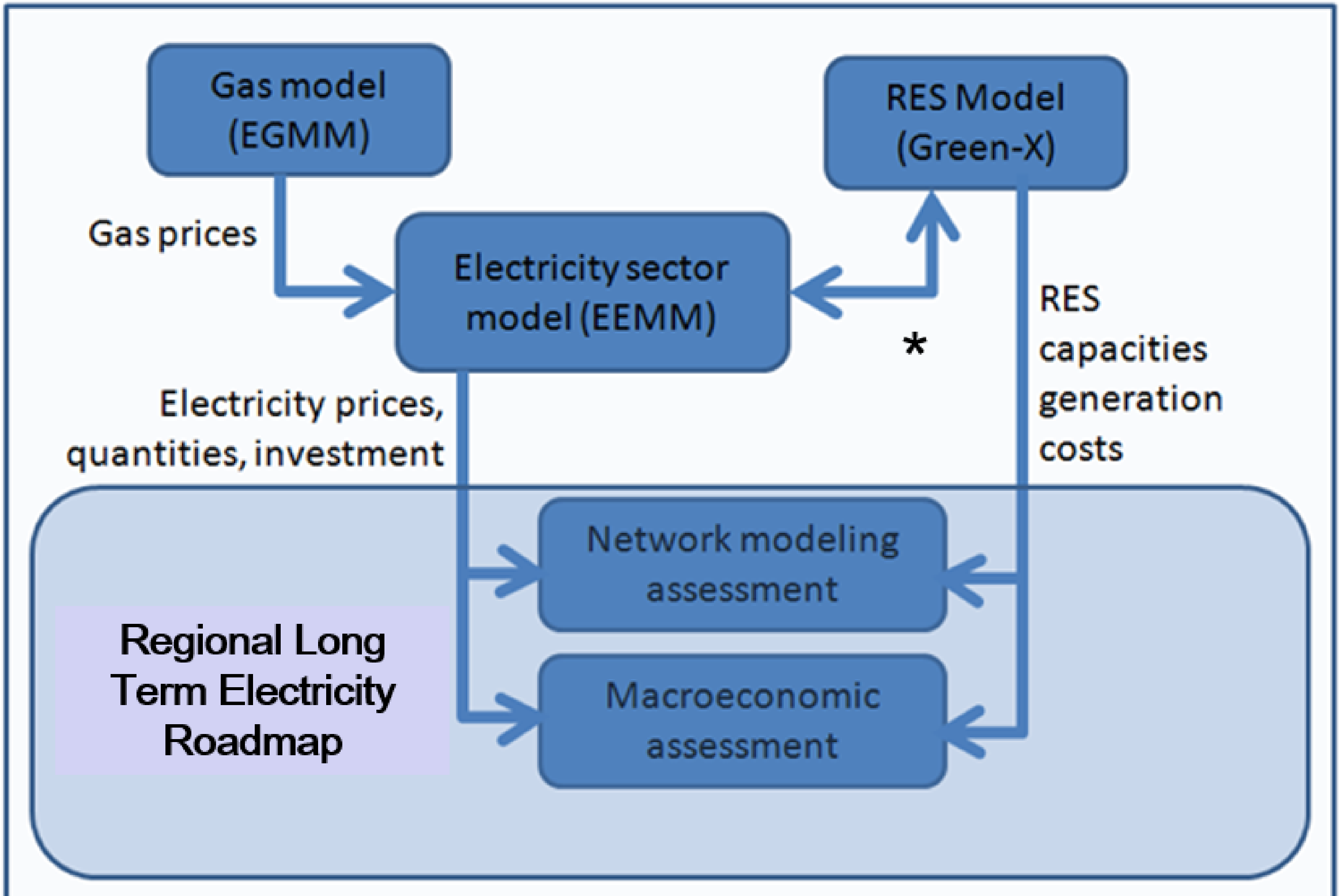
EU Climate Roadmap 2050

	2020	2030	2050
GHG reduction – power sector in mitigation scenarios		-54-68%	-93-99%
GHG reduction – power sector in Reference scenarios		33-39%	61-69%
Carbon value		50-60 €/t	100-370€/t
Low carbon technology (Nuke, CCS and RES)	60%	75-80%	nearly 100%
RES in power sector			50-55%

EU Energy Roadmap 2050

	2005	2030	2050
Carbon value		25-63 €/t	234-310€/t
Carbon Value in reference		32-40€/t	50-51€/t
RES in power sector		52-60%	59-86%
CCS		0.6-2.1%	6.9-31%
NUC		13-24%	2.5-26%

Modell Interlinkages



Electricity wholesale price, RES value, curtailment