

Development of scenarios (without, with, with additional), sensitivity analysis and EU practice

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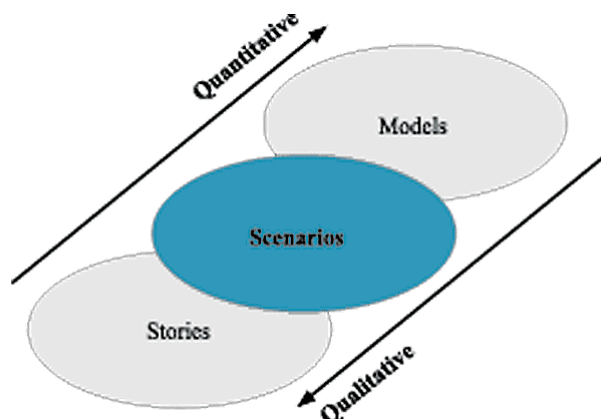
Outline of presentation

- Scenario definitions
- WEM, WAM and WOM scenarios
- Key assumptions in the scenarios
- Policies and Measures (PAMs)
- Sensitivity assessment
- Scenario assessment example of SLED

Scenario definition

- A plausible and often **simplified description** of how the future may develop, based on a coherent and internally consistent set of **assumptions about driving forces and key relationships**. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined with a narrative storyline. (Source: Climate Adapt project)
- Climate change modelling and scenario assumptions:
 - Very long time frame (20-50-100 years)
 - All economic sectors are impacted – key relationships are very complex
- Need for **simplification**, and focus on **key drivers**: limits of policies and limits on sectoral coverage

Storylines, Scenarios, Models



Source: IPCC, Emissions Scenarios 2000

WEM Scenario

- First task: to define a scenario which reflects a Business as Usual (BaU) development of our economy/society
- Terms: BaU, Reference scenario or Scenario With Existing Measures (WEM)
- By definition: includes all policies that are enacted and takes effect in the assessed period. (Base year)
- Example:
 - In electricity sector: includes impacts of the Large Combustion Plant Directive (e.g. Montenegro Pljevlja power plant)
 - Includes the 2020 renewable targets of the NREAPS (not only for EU member states, but EnC members)
 - Emission Trading Scheme (ETS) carbon value in the SEE region???

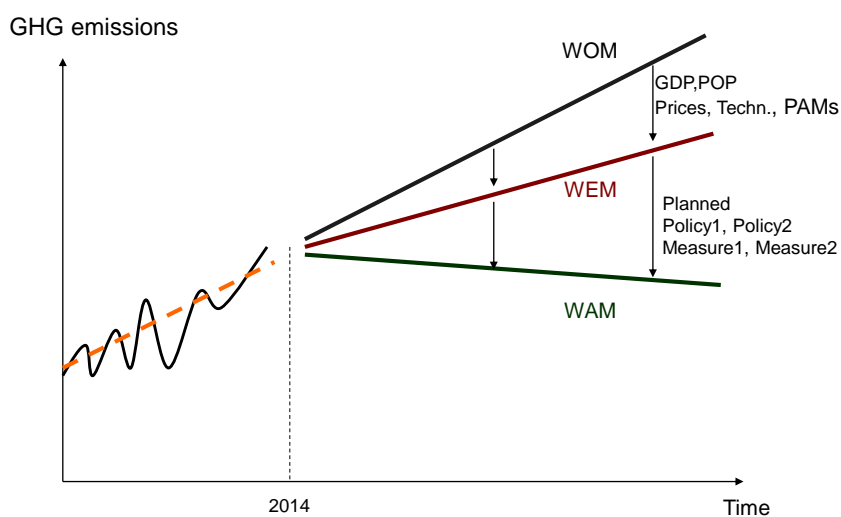
WAM Scenario

- With Additional Measures (WAM) scenario: goes beyond the WEM scenario, in that sense that the impacts of additional policies and measures (PAMs) that are included in WEM.
- The aim of WAM scenario(s):
 - Assess the impacts of extra policy measures
 - Cost effectiveness
 - Assess extra emission reduction of measure
 - Assess mitigation potential of the country/measure

WOM scenario

- Without Measures scenario (or frozen technology scenario) would follow a pathway, where there is no technology improvement would be assumed.
- It is not a realistic scenario, it rather serves computational, or comparative purposes. E.g. it measures the effects of the effects of existing policies.
- (usually it is not a compulsory scenario, neither for the UNFCCC nor for the EU Bi-annual reports)

WOM, WEM, WAM scenarios



Key Assumptions in the Scenarios



Minimum set of key assumptions:

- Assumption on economic development: GDP growth rates (or more detailed sectoral breakdown)
- Assumption on Population growth (UN forecasts)
- Prices of resources/fuels (as these are generally set at global level)
- Technological assumptions (e.g. availability of technologies – e.g. batteries, electric car, CCS etc.)
- Trade-off : the more details we put in the models, the more assumptions we have to use – which has to be also assessed (e.g. in sensitivity runs)

Consistency of Key Assumptions



- In order to satisfy the consistency conditions, we might consider using one source of 'narratives' describing the global tendencies of economic, technological developments
- One possible choice for these boundary conditions is the IPCC SRES scenario families: A1, A2, B1, B2 which would differ in economic development, trade level, cooperation, education level and technological development
 - But for national modelling national information sources would give reliable information
- They would provide a consistent set of (global) assumptions to a more focused regional, national or sectoral modelling

Policies and Measures

Based on the EU practice, PAM description should include:

- Assumption on the functioning of the ETS scheme
- Assumptions on the non-ETS sector
- On RES development (both electricity and heat)
- Energy efficiency improvements:
 - Impact of Energy Efficiency Directive (EED)
 - Energy Performance of Building Directive
- Transport sector (fuel efficiency, changes in transport demand)
- Additional national policies

...

PAM characterisation

Describing the PAMs include:

- Description of the PAM
- Costs of the policy or measure (investment and annual costs)
- Number of individuals/households or companies impacted
- Fiscal impacts (revenues or expenditures on the government side)
- GHG impacts
- Energy consumption impacts
- All these are generally time dependent - penetration of the effects might differ – this trend should be also characterised (e.g. penetration of new led lights)

Objectives of scenario assessment



Objective could also be various:

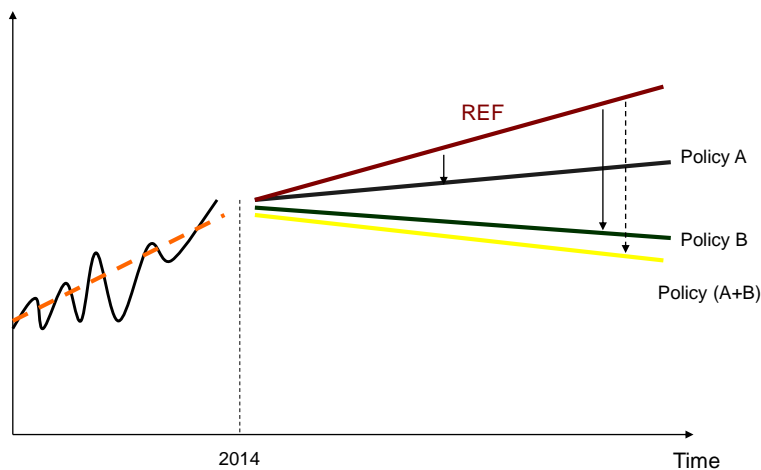
- Assess efficiency: Which policy mix would be the cheapest way to achieve certain GHG reduction target?
- Ranking of options according to costs and their abatement potentials (MAC curves)
- Assess the positive/negative interactions of the various policies (e.g. carbon taxation vs. RES policies) $PAM(A+B) \neq PAM(A) + PAM(b)$
- Share the targeted emission levels between sectors
- Share the targeted emission levels between GHGs



PAM (A+B)?



GHG emissions



Assessing scenarios

- Scenarios could be assessed individually or in a comparative way
- Individual assessment: what is the resulting GHG emission reduction, impacts on cost level, fiscal revenues or cost of the given policy mix described in the scenario etc..
- Comparative assessment, e.g. compared to the Reference scenario:
 - What is the additional emission reduction?
 - What is the impact on the fuel import?
 - Impact on operation and investments cost?

EU and UNFCCC practice on scenarios

- Scenario assessments are widely used in the Impact Assessments (IA) of legislative documents of the EU (Directives etc.)
- A wide range of IAs could be consulted at:
 - http://ec.europa.eu/smart-regulation/impact/ia_carried_out/cia_2014_en.htm#clima
- The IA on the 2030 framework for climate and energy (SWD 2014615) applies a multi-reference scenario assessment (see next slide)
- Also, national biannual reports of the UNFCCC:
 - http://unfccc.int/national_reports/biennial_reports_and_iar/submitted_biennial_reports/items/7550.php

Table 40: Overview table with the key results for the IA for the different scenario projections

	Ref.	GHG35/E E ⑥	GHG37 ⑥	GHG40 ⑥	GHG40	GHG40/EE	GHG40/ EE/RES30	GHG45/ EE/RES35
Main features scenarios								
Reference or enabling conditions	Ref.	Ref.	Ref.	Ref.	Enabling	Enabling	Enabling	Enabling
GHG reductions vs 1990	-32.4%	-35.4%	-37.0%	-40.4%	-40.6%	-40.3%	-40.7%	-45.1%
Renewables share ¹³⁹ - Overall	24.4%	25.5%	24.7%	25.5%	26.5%	26.4%	30.3%	35.4%
Renewables share ¹⁴⁰ - E-H&C	31.0%	32.6%	31.6%	32.9%	34.2%	34.1%	39.7%	47.3%
Energy savings ¹⁴¹	-21.0%	-24.4%	-22.9%	-24.4%	-25.1%	-29.3%	-30.1%	-33.7%
Other environmental impacts								
GHG emissions reduction in ETS Sectors vs 2005	-36%	-37%	-38%	-42%	-43%	-38%	-41%	-49%
GHG emissions reduction in non-ETS Sectors vs 2005	-20%	-26%	-28%	-31%	-30%	-35%	-33%	-34%
CO ₂ emission reductions vs 2005	-29%	-32%	-32%	-35%	-36%	-36%	-37%	-43%
<i>Power generation + District Heating</i>	-47%	-48%	-49%	-55%	-57%	-48%	-53%	-66%
<i>Industry</i>	-22%	-23%	-24%	-27%	-27%	-26%	-27%	-31%
<i>Residential, Services & Agriculture</i>	-31%	-36%	-38%	-41%	-39%	-49%	-47%	-49%
<i>Transport</i>	-12%	-15%	-12%	-12%	-14%	-20%	-19%	-19%
Non-CO ₂ emission reductions vs 2005	-19%	-28%	-38%	-43%	-40%	-38%	-33%	-35%
<i>Agriculture</i>	-4%	-13%	-25%	-28%	-28%	-25%	-19%	-22%
<i>Other non-CO₂ sectors</i>	-36%	-45%	-54%	-61%	-55%	-52%	-49%	-49%
Reduced pollution control & health damage costs (€bn/yr) ¹⁴²	n.a.	3.8 to 7.6	4.2 to 8.8	8.6 to 17.1	7.2 to 13.5	17.4 to 34.8	16.7 to 33.2	21.9 to 41.5

Source: EC Impact Assessment: SWD 2014/15

Sensitivity assessment

To check the uncertainties in the models, the main driving parameters and the main assumptions should also be checked.

The way to do that is to carry out a sensitivity assessment:

1. Select the important driving parameters and vary them in a reasonable range (e.g. GDP growth rates in a +- 0.5-2 % range compared to the reference values)
2. Select a resulting parameter to be checked: e.g. GHG emission levels/ fuel import
3. Compare the impacts of various parameters, and identify which are the most sensitive parameters (assumptions) in your model, and what could be the plausible range of errors in your assessment

Reduction potential of Carbon Values

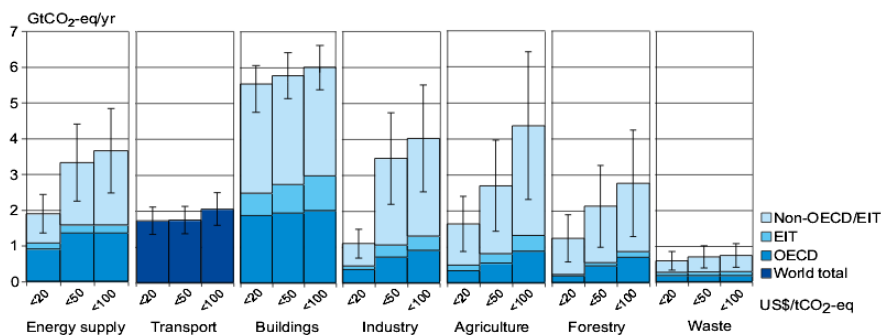


Figure TS27: Estimated sectoral economic potential for global mitigation for different regions as a function of carbon price in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments. A full explanation of the derivation of this figure is found in Section 11.3.

Barker T., I. Bashmakov, L. Bernstein, J. E. Bogner, P. R. Bosch, R. Dave, O. R. Davidson, B. S. Fisher, S. Gupta, K. Halsnæs, G. J. Heij, S. Kahn Ribeiro, S. Kobayashi, M. D. Levine, D. L. Martino, O. Masera, B. Metz, L. A. Meyer, G.-J. Nabuurs, A. Najam, N. Nakicenovic, H.-H. Rogner, J. Roy, J. Sathaye, R. Schock, P. Shukla, R. E. H. Sims, P. Smith, D. A. Tirpak, D. Urge-Vorsatz, D. Zhou, 2007: Technical Summary. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Example of a national scenario assessment

- SLED project – 4 SEE countries: Albania, Macedonia, Serbia and Montenegro) are assessed
- Electricity sector assessment
- 3 scenarios:
 - Reference scenarios
 - Currently Planned Policies scenario
 - Ambitious GHG policy scenario
- Example of Montenegro

Scenario definition 1

	Scenario assumptions	Reference GHG scenario
Taxation	Introduction of EU ETS	ETS to be introduced in 2025
	Introduction year of minimum excise duty	Year of introduction: 2020
Electricity supply	Environmental standards enforcement (Large Combustion Plant Directive)	Due to requirement of LCPD directive Pljevlja I closes in 2023.
	RES-E deployment	NREAPs : 826 MW Hydro, 151 MW wind, 10 MW PV and 29 MW Biomass by 2020. By 2030: 826MW Hydro, 190 MW wind, 32 PV and 39 MW Biomass
	Conventional capacity developments	Pljevlja II comes online in 2023 (254MW) Pljevlja I closes in 2023. Maoce TPP will not be built. FOR LCPD: Pljeva I will operate till 2023 (20000 hours between 2018 and 2023)
Electricity demand	Electricity demand: KAP aluminium smelter operation	According to 2014 May Strategy (KAP operates with two lines at 100% capacity from 2019) Means 100% total presently installed capacity (A and B line).

Scenario definition 2

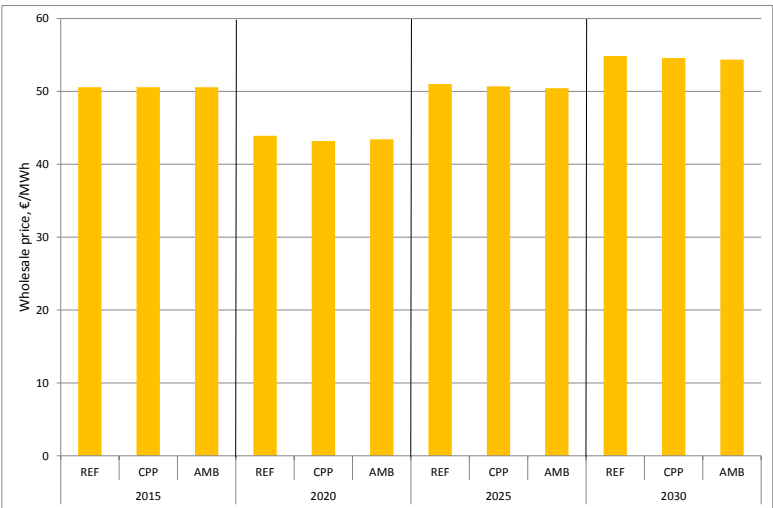
Scenario assumptions	Currently Planned Policies GHG scenario (CPP)	Ambitious GHG policy scenario (AMB)
Introduction of EU ETS	CO ₂ cost in 2020 is 40 % of the ETS price, from 2025 ETS is introduced	ETS to be introduced in 2020
Introduction year of minimum excise duty	Year of introduction: 2020	Year of introduction: 2018
Environmental standards enforcement (Large Combustion Plant Directive)	Due to requirement of LCPD directive Pljevlja I closes in 2023.	Due to requirement of LCPD directive Pljevlja I closes in 2023.
RES-E deployment	NREAPs : 826 MW Hydro, 151 MW wind, 10 MW PV and 29 MW Biomass by 2020. By 2030: 826MW Hydro, 190 MW wind, 32 PV and 39 MW Biomass	NREAPs : 826 MW Hydro, 151 MW wind, 19 MW PV and 29 MW Biomass by 2020. By 2030: 1267 MW Hydro, 229 MW wind, 32 PV and 64 MW Biomass
Conventional capacity developments	Pljevlja II comes online in 2023 (254MW) Pljevlja I closes in 2023. Maoce TPP will not be built. For LCPD: Pljeva I will operate till 2023 (20000 hours between 2018 and 2023)	Pljevlja II comes online in 2023 (254MW) Pljevlja I closes in 2023. Maoce TPP will not be built. For LCPD: Pljeva I will operate till 2023 (20000 hours between 2018 and 2023). 10 % biomass utilisation rate is assumed for Plejva II.
Electricity demand: KAP aluminium smelter operation	50% of the total installed capacity, according to the agreement on July 2015 stakeholder meeting. Only one line operating at 100%.	50% of the total installed capacity, according to the agreement on July 2015 stakeholder meeting. Only one line operating at 100%.

RES assumptions

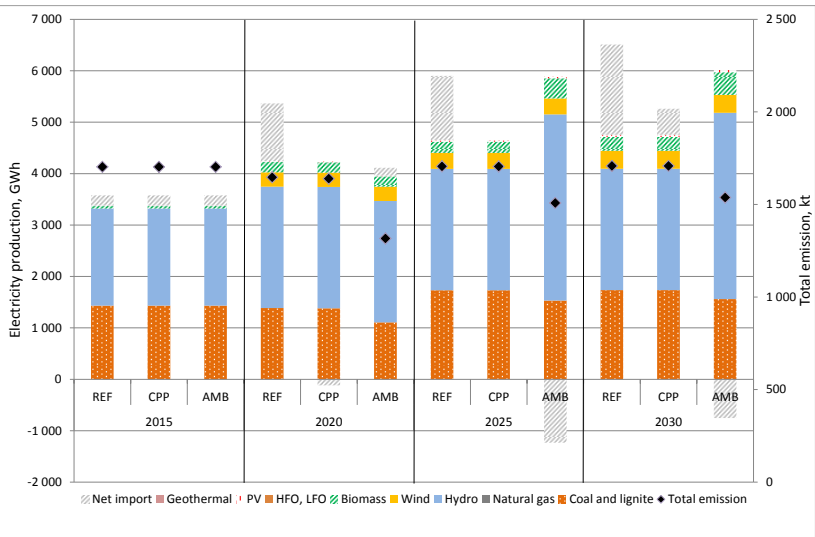
REF Scenario	2015	2016	2017	2018	2019	2020	2025	2030
Hydro*	661	744	753	821	826	826	826	826
Pumped storage	0	0	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0	0	0
Solar	3	6	7	8	9	10	22	32
Wind	0	118	126	126	151	151	172	190
Biomass	7	9	14	18	19	29	33	39

AMB Scenario	2015	2016	2017	2018	2019	2020	2025	2030
Hydro*	661	744	753	821	826	826	1 047	1 267
Pumped storage	0	0	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0	0	0
Solar	3	6	7	8	9	10	22	32
Wind	0	118	126	126	151	151	172	190
Biomass	7	9	14	18	19	29	57	64

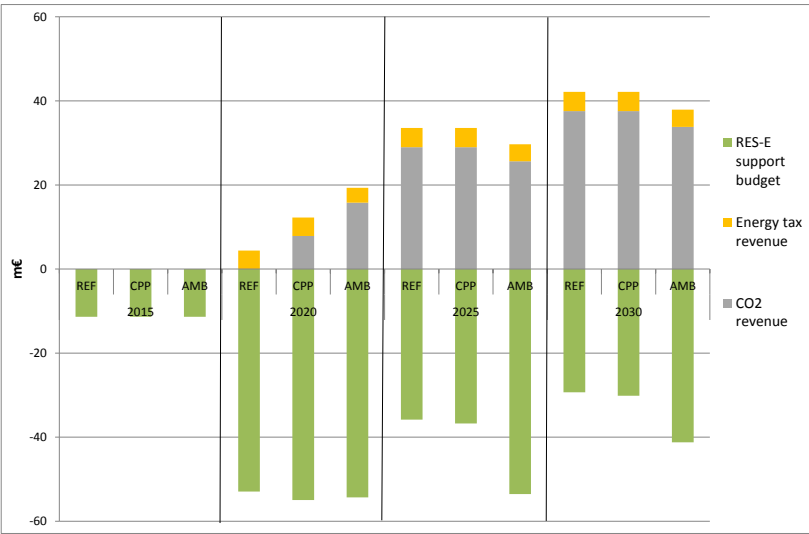
Wholesale price level (€/MWh)



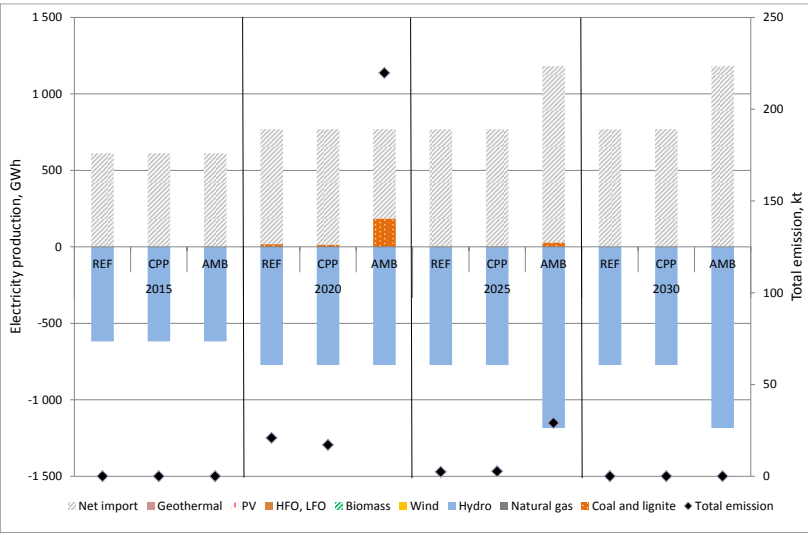
Generation mix, emissions



RES support need and CO2 revenue



Sensitivity run: Low hydro case



Thank you for your attention!