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D3.1
Models/Tools Selection Methodology

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The authors are responsible for all remaining errors and omissions.

Contents

1. Introduction

In order to achieve the goals of the European energy and climate change policy, in terms of greenhouse gas emissions, security of energy supply and competitiveness, the development and deployment of a diverse portfolio of low carbon energy technologies play a pivotal role (An Energy Policy for Europe COM (2007)1).

The European Strategic Energy Technology Plan (SET-Plan), adopted by the Commission on 22 November 2007, is the European Union's response to the challenge of accelerating the development of a low carbon future, leading to the market take-up of low carbon energy technologies. This plan comprises measures relating to planning, implementation, resources and international cooperation in the field of energy technology.

1.1. ATEsT project

The implementation of the SET-Plan involves different pillars:

- Effective Implementation:
  - Creating European Industrial Initiatives (EII), focusing on technologies for which the barriers, scale of investments and risk can best be tackled collectively.
  - Creating a European Energy Research Alliance (EERA), to enable greater co-operation across Europe of the research work going on in universities, research institutes and specialized centres.
  - Planning the transition of European energy infrastructure networks and systems.
- Joint strategic planning:
  - Creating a European Community Steering Group on Strategic Energy Technologies, which allows Member States and the Commission to plan joint actions and coordinate policies and programmes.
  - Establishment of an information system on energy technologies and their innovation aspects, geared to supporting the decision-making of the SET-Plan (SETIS).
  - Annual SET Plan summits.
- Increase in resources, both financial and human, and enhance international cooperation.

In the framework of the SET-Plan implementation pillar, related to addressing future European energy infrastructure networks and systems transition planning, the European Commission has launched an FP7 Support Action named ATEsT (Analysing Transition Planning and Systemic Energy Planning Tools for the implementation of the Energy Technology Information System).

The aim of the ATEsT project is to address the methodologies and modelling toolbox required to support the decision making of the SET-Plan Steering Group in the priority area of transition planning of the deployment of low carbon technologies and their supporting infrastructures. ATEsT is a joint effort between European research institutes (CRES, ECN, ENEA, IER, VTT, PSI, CIEMAT, EIHP) and the JRC, (the organization managing SETIS).

The “tools” that will be evaluated in the framework of ATEsT are methodologies for the analysis of energy policies and mathematical models that can be used in order to simulate/optimize the development of the energy system or analyse the transition planning in the energy system. The scope of the ATEsT project includes models and tools from both inside and outside Europe.

The objectives of the project are to:

1. Review models/tools used in European Countries, bearing in mind what is used outside Europe and what are the requirements of the SET-Plan.
2. Identify and recommend combination of tools and/or methods to be used in the Member States, across the whole of the EU or specified EUregions, and in SETIS, and gain consensus on these models.
3. Identify and recommend existing sets of data (on technologies, energy resources, statistics, etc.), and provide a roadmap for the development of the data on a European and regional level.
4. Identify the roadmap for the improvement and development of the tools and methods in order to cover the needs of the SET-Plan implementation and finally create a framework for tools necessary to plan and deploy future energy systems and policies.

1.2. Contribution of Work Package 3

The main aim of WP3 of the ATEsT project, is to develop a methodology on how to create and evaluate suitable combinations of tools (models or methodologies) in order to support energy policy making for the transition of Europe towards a low carbon society. This work package builds on the output of WP1 and WP2 of the project, where specifications[1] were defined in consultation with SET-Plan stakeholders (WP1) and a characterisation of existing tools and methods (WP2). In the following WP6, the work will pinpoint the main shortfalls of existing approaches in these areas.

In the initial project work-programme the description of WP3 was to actually deliver a list of (single) models that would be appropriate to be used in the analysis of the energy system transition of Europe, which can be translated into answering policy questions about the decisions that need to be taken. However the detailed list of specifications in WP1 and the analysis of a large inventory of models in WP2 showed that in order to answer any kind of policy question about the future of the energy system, one needs to use a combination of several models/tools, and this combination can vary depending on the type of question or the characteristics of the Member State (i.e. existing energy system and policies, climate conditions, land use, etc.). This conclusion led to a restatement of the description of this workpackage. Instead of creating a unique list of models WP3 created a methodology that can be followed in

[1] The first step for the ATEsT project was to determine which questions and procedures are considered of interest by various parties relevant to the implementation of the SET-Plan, i.e. a set of firm, broadly consented decision parameters. The list of relevant questions and procedures is presented in the specification report (Deliverable D.1.1 available at http://www.atest-project.eu/) and referred to as the ‘list of specifications’.

order to find the best available combination of models that can be used in order to answer a specific policy question. The creation of these combinations was based on a number of rules described in detail in the next section. One of the decisions that affect the combination formulation is the maximum number of models that can be used in a combination, which was limited to six, in order to limit the complexity and difficulty of model linking. The methodology was applied to a list of relevant policy questions that were formulated by the project consortium, in order to demonstrate its functionality. In order to give the flexibility of adding more models into the analysis a software tool was developed, although it was not foreseen in the proposal. The tools has minimal interface at the moment but it will be further developed in the future.

2. Methodology

The focus in this report is set on the evaluation process that can be applied to the multidimensional and complex issue of selecting the most appropriate toolbox for answering policy questions related to the SET-Plan implementation. The scope of the methodology to be used is to come up with a combination of models and tools, giving guidelines on how to choose the best available set, depending on the policy question that needs to be answered. In this sense in order to answer a policy question one needs to combine specifications identified in WP1, find models that can answer to these specifications and combine them appropriately in order to give a final answer to the policy question. In Section 3 the methodology is applied to a set of predefined policy questions, while in Section 4 a description of the steps that need to be followed in order to apply the method to a new policy question are given. Each one of these specifications needs to be assessed from the model perspective as well as from the policy question perspective. So two definitions are needed:

- The **usefulness of a model** regarding a specification, expresses how well the model can answer to this specification.
- The **importance of a specification** relative to a specific policy question, measures the relevance of this specification in answering the policy question.

Both the usefulness of the models/tools and the importance of specifications are evaluated through the judgment of experts. In the ATEsT project it wasthe project partners who did the initial evaluation based on the model description by the modeling teams, and the feedback of the modeling teams was also taken into account. Therefore it was decided to use linguistic values and to convert them into fuzzy sets [Garcia-Cascales et. al. 2007] in order to combine them in the following steps.

It is hard to find one unique tool/model to answer in full a policy question. Usually, one combines a number of models that focus on different aspects, in order to give an overall answer to the relevant question. In order to perform this combination of available models/tools, step 4 of the proposed methodology described below, uses the requirements of the policy question regarding the geographical detail, the sectoral view and technological detail. Finally the combinations are ranked using a weighted sum approach, in order to identify the combination that gets the highest score, based on the fuzzy sets definitions.

The methodology proposed follows these steps which will be described in more detail on the following pages:

Step -1: Setting the scales for the quantification of the parameters

Step -2: Ranking models according to their usefulness in answering given specifications

Step -3: Ranking specifications according to their ability to answer policy questions

Step -4: Identifying combinations of models

Step -5: Evaluation of the ability of a combination of models to answer a policy question

Step 1: Setting the scales for the quantification of the parameters

A detailed description of the approach of translating "linguistic" information into triangular fuzzy numbers that can be used in a multi-criteria decision analysis, can be found in Garcia-Cascales et al. (2007). The following pages describe how this approach has been applied to the methodology of the ATEsT project.

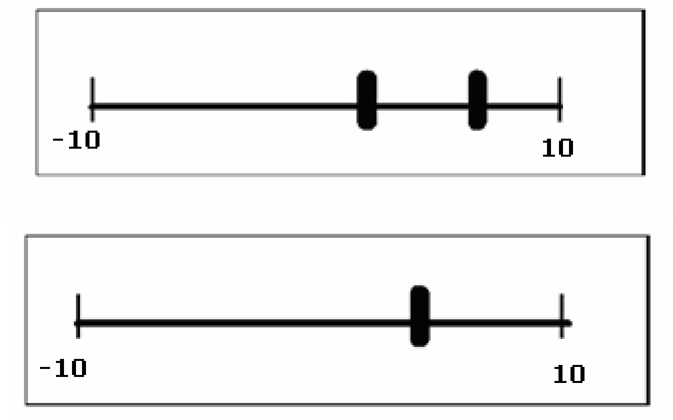
Regarding the **usefulness of the models**, the following linguistic values scale was proposed to answer the question:

> "What is the usefulness of the model in addressing a given specification?".

The linguistic weightings regarding the usefulness of the models are:

None (N), Poor (P), Medium (M), Good (G), Very Good (VG) **(1)**

Individuals are likely to have different perceptions on what they mean by defining the usefulness of a model with none, poor, medium, good and very good. In order to account for this fact, for each of these linguistic weightings a lower (a), an upper (c) and a median (b) value is assigned. (Figure 1).



(a)

(b)

Figure 1: Definition of the range (a) and the median (b)

The figure above could, for example, be the characterization for “Medium”, and is translated: “Medium” means that the quality of the model’s answer is in the range [3,7], in the [-10,10] interval. And if we were to assign only one grade, “Medium” would mean 5 (Figure 1). For each one of the words in the scale (1), the project consortium agreed on three numbers: a range (a,c) and a median (b).

Regarding the **importance weighting of a specification** relative to a specific policy question**,** the following scale was proposed to answer the question:

“What is the importance of a specification in answering a given policy question?”:

The linguistic weightings regarding the specifications importance are:

None (N), Very Low (VL), Low (L), Medium (M), High (H) **(2)**

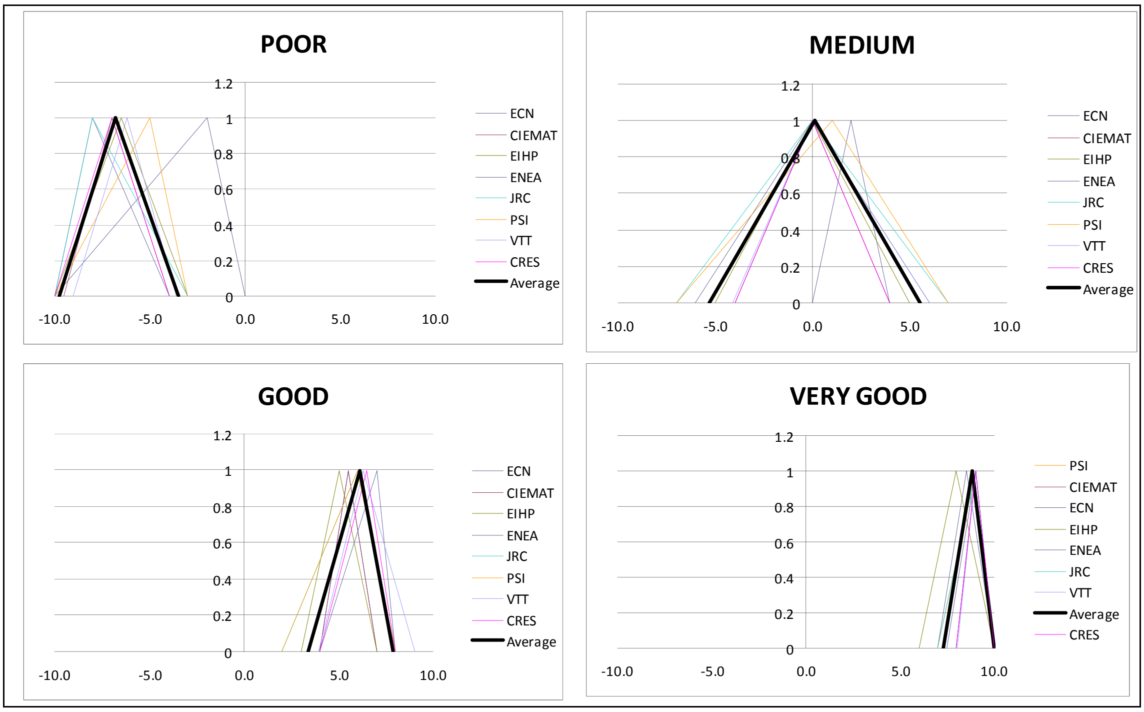
In order to quantify each one of the words in the scale (2), and to translate the linguistic information into a range that can be used in next step rating, a fuzzy set is associated with each one of the linguistic values. As for the previous parameter, three numbers (a,b,c) in the interval [0,10] are needed, in order to define it. Since the importance weighting of a specification is a weighting factor, it is defined as a positive value. None is defined as (0,0,0).

The definitions of the range for the *usefulness of the models* and the *importance weighting of the specifications* have been discussed among the project partners and a consensus has been reached among them to use the sets describe bellow. This was done in order to have a common model ranking under a common framework among the project partners:

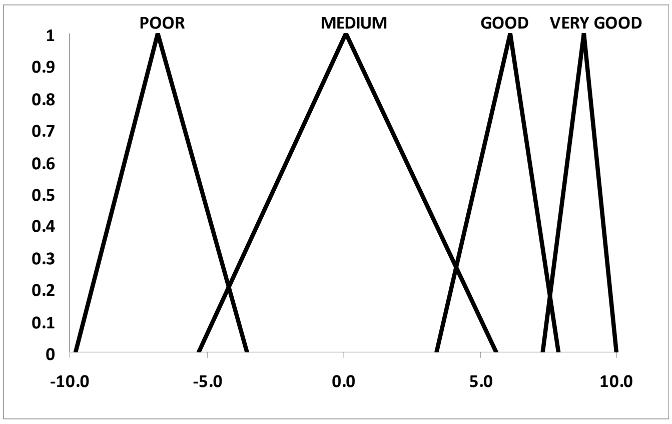
1) Regarding the usefulness of the model (i.e. how well does a model answer to a specification) the consensus sets are presented in Table 1. Figure 2 presents the input of each partner a) and the consensus sets b) in a graphical way. The consensus sets have been obtained as fuzzy averages of single contributions.

Table 1: Model usefulness scale definitions (consensus sets)

Scale	**Corresponding Interval (triangular fuzzy number)**
NONE (N)	(-10 , -10 , -10)
POOR (P)	(-9.8 , -6.8 , -3.5)
MEDIUM (M)	(-5.3 , 0.1 , 5.6)
GOOD (G)	(3.4 , 6.1 , 7.9)
VERY GOOD (VG)	(7.3 , 8.8 , 10.0)



(a)



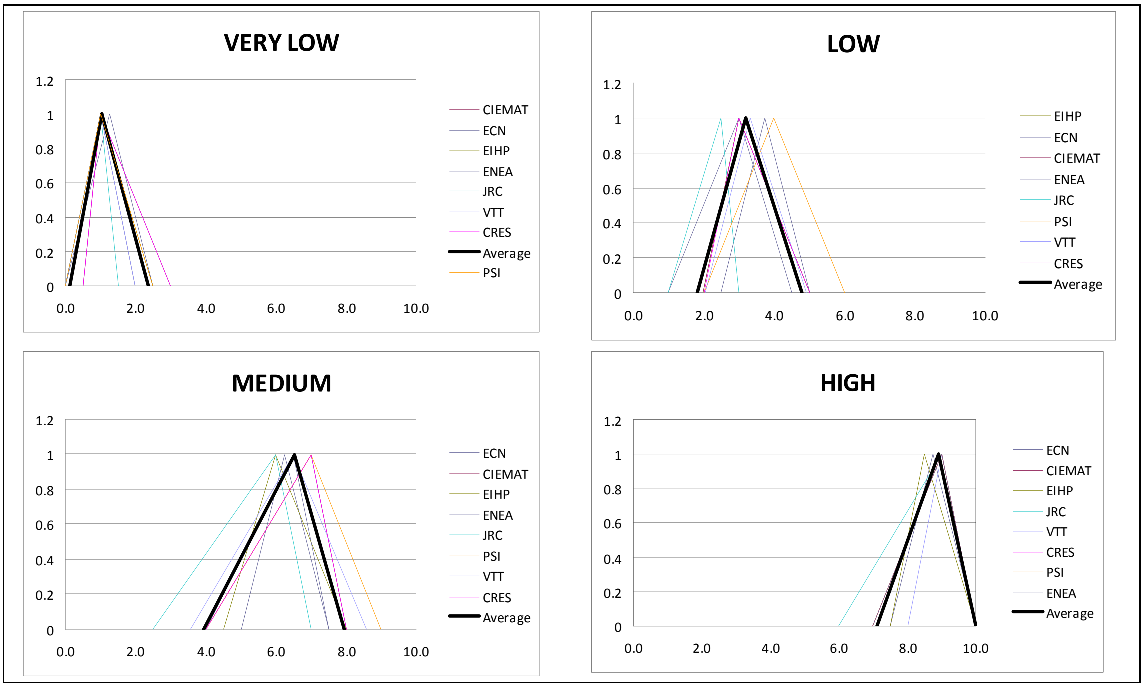
(b)

Figure 2: Usefulness of the Model; fuzzy sets definitions as proposed by the partners (a) and average consensus sets (b).

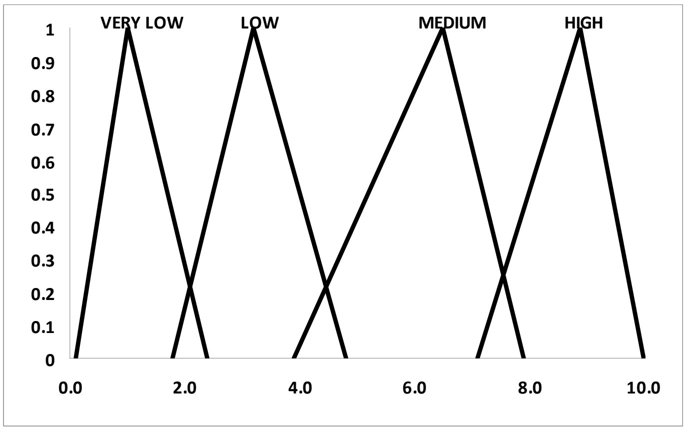
2) Regarding the *importance weighting of the specification* the consensus sets can be seen in Table 2 and the input of the project partners can be seen in Figure 3. The consensus sets have been obtained as fuzzy averages of single contributions.

Table 2: Importance weighting if the Specifications (consensus values)

Scale	Corresponding Interval (triangular fuzzy number)
NONE (N)	(0 , 0 , 0)
VERY LOW (VL)	(0.1 , 1.0 , 2.4)
LOW (L)	(1.8 , 3.2 , 4.8)
MEDIUM (M)	(3.9 , 6.5 , 7.9)
HIGH (H)	(7.1 , 8.9 , 10.0)



(a)



(b)

Figure 3: Specification importance weighting: definitions of the sets proposed by the partners (a), and average consensus sets (b).

Step 2: Ranking models according to their usefulness in answering given specifications

The aim of this step is to rank each model/tool in respect to the quality of answers it can give to each one of the specifications. This step is independent of the policy question that needs to be answered.
The Models Characterisation Report (WP2)[2] presents for each of the models/tools, its ability to answer a specification or not, along with its primary focus specification. The

[2] "D2.1 - Models Characterization Report" available at www.atest-project.eu

analysis was done using the set of specifications that were derived from the public consultation and are presented in the Specifications Report (WP1).
In order to proceed to Step 2 of the methodology, it was necessary to analyze the specifications further, breaking them down into more detailed points that can be used for a more detailed analysis of the models. This updated list of specifications can be found in Appendix A, together with an explanation and the reference to the relative section in the "Specifications report" [3]of WP1.

Then for each of the models/tool, the project experts assigned values for the *usefulness of the model* in answering each one of the specifications in the new list. The ranking was based on the literature review for the model use (proven capabilities) and/or references for model description, including the knowledge of the models by the project team. This evaluation is combined with the information included in the questionnaires used in WP2 that were filled in by the model developers. During this process each model was ranked independently by two teams of project experts. The two rankings were then compared, discussed and a common ranking was reached. These model rankings were then sent back to the modeling teams and their feedback was requested. A total of 18 replies were received, which were then re-evaluated by the project team and some of the suggestions were accepted, while in other cases the initial ranking was kept, to keep the rankings of different models comparable with each other (usually the willingness to rank high scores for "own" model or tool is high). So, at the end of Step 2 an evaluation of the existing models/tools relative to the specifications of the SET-Plan was provided. This evaluation, after the feedback procedure, is presented in Appendix B.

The process of model ranking described above was followed in order to limit the subjectivity of assessing the model's usefulness to address each specification in the list. Since the model ranking is important in the following process of model selection, the project team tried to limit the amount of subjectivity as much as possible. It is also important to note that the evaluation presented here refers to the state of the models in September 2010. Any alterations, improvements and extensions of the models after this date could not be addressed in the scope of this project. Also, model extensions or model improvements by individual organizations or project might have not been taken into account. The inclusion of new models or model updates in the toolbox would require similar work by a team of experts.

Step 3: Ranking specifications according to their ability to answer policy questions

This step depends on the specific policy question that needs to be answered. As was mentioned before, each policy question can be related to a number of specifications. Since the goal of this approach is to create a methodology to select the most suitable toolbox, depending on the policy question, each specification will have a different weight in providing an answer to this particular question. That is the importance of each specification in answering the policy question is different, and some specification might not even be relevant. So each specification will receive a

[3] "Specifications Report" can be found at: http://www.atest-project.eu/pdf/D.1.1_Specification_Report.pdf

characterization from the scale (2), ***N, VL, L, M, H,*** which will be different for different policy questions.
It is envisaged that the ATEsT project outcome will be a tool that could be easily used in order to do this analysis every time a policy question needs to be answered.

The project team has set up a number of "typical" policy questions that were used for the testing of the methodology. The list of these questions is:

1. How to achieve a low cost and low emissions energy mix ?
2. How to achieve an energy mix that maximizes employment opportunities ?
3. How to achieve an energy mix that has the maximum societal acceptance ?
4. Which are the most competitive low carbon technologies in the medium and long term ?
5. Where should new energy installations be best located ?
6. In which R&D areas should a country invest ?
7. How should a country develop energy interconnections with other European and non European countries ?
8. How to improve energy efficiency ?
9. How to improve energy security ?
10. How may changing the technological focus of the SET-Plan contribute to achieve the 20-20-20 goals at lower costs?
11. At what level of wind and PV penetration may we expect grid problems (e.g. congestion, negative market prices, etc.) ?
12. What are the external revenues of the SET-Plan ?
13. How can we effectively stimulate co-operation between public and private R&D ?
14. How can we avoid strong public opposition against renewable energy sources as seen in e.g. nuclear power? When should we start acting on that front?
15. Which sectors of society are going to be adversely affected (poor, elderly, disabled etc) by transition to these new technologies, what can be done to alleviate these impacts?

It is evident that these are general questions that require the combination of a number of specifications in order to be answered. So, for each one of these questions the specifications required must be identified and their importance in providing an answer must be ranked. In order to check the methodology Question 1-8 above were analysed and the importance of each specification in answering each of these questions was characterised. The output of this exercise is presented in Appendix C.

Step 4: Identifying combinations of models
Once step 3 is completed for a given policy question, the next step is to set up combinations of models/tools that can provide answers to the required specifications, since it is unlikely that one model/tool can provide all the answers. The process is to capture the sufficient and relevant level of technology detail, sector and geographical coverage for each policy question and use this to select the model combinations required. The set of model combinations will be unique for each policy question.
In order to make the process of creating combinations of models clear, an example is used to describe it in details. Let us assume that we are analysing two policy questions

PQ_I and PQ_{II} and the models A,B,C,D,E,F,G. Then, for each policy question the process is (see Table 3 for the example):

1) For the geographical coverage:
    a. For each policy question tick only if the geographical detail is really needed to answer the policy question. For example, in Table 3 the yellow crosses present the geographical coverage needed for Policy Question I of this example, while the blue cross presents the needs of PQII.
    b. For each model tick (binary: yes/no) if the tool can easily be applied at the following geographical levels (one or more). This can be done once for each model in the list since it does not depend on the policy question but it is a characteristic of the model.

   The relevant geographical levels are:
   a. World level (Global)
   b. EU Level (Multi-country)
   c. Member State level (Country)
   d. Regional level (more detailed compared with Country)
   e. Local (Project-related)

   The ability of a model to be "easily applied" to a geographical level can be interpreted in three different ways:
   i. models include the geographical level in an existing version,
   ii. models can easily include the geographical level, or
   iii. models can include the geographical level by adding data without the need of changing the code of the model.

2) For the sector level
   a. For each policy question tick only if the sector level is really needed to answer the policy question. For example, in Table 3 the red crosses present the necessary sectors of focus for PQI and the green cross the equivalent sectors for PQII.
      b. For each model tick (binary: yes/no) if the tool can easily be applied at the following sector levels (one or more). This can be done once for each model in the list since it does not depend on the policy question but it is a characteristic of the model.

The relevant sector levels are:
   a. Buildings (Residential & Commercial)
   b. Industry
   c. Transport
   d. Electricity and Heat Sector
   e. Gas Sector

3) For the Technology detail
    a. For each policy question tick only if the technological detail is really needed to answer the policy question. For example in Table 3 the red crosses present the technology details required by PQI and the green crosses present the details required by PQII.

b. For each model tick (binary: yes/no) if the tool includes a detailed representation of the following technologies (one or more). This can be done once for each model in the list since it does not depend on the policy question but it is a characteristic of the model.

The technology list that is used for this criterion is:

a. Technology Rich models
b. Wind
c. Photovoltaic
d. Concentrated Solar Power
e. Biofuels
f. Nuclear IV
g. Carbon Capture and Storage
h. Fuel Cells
i. Smart Grids
j. Energy Efficiency

By ticking the “Technology Rich models” box and “Electricity” sector, then all electricity generating technologies will automatically be selected, assuming that technology rich models can easily include all the power technologies.

After this assessment, a two step combination building process is applied for each policy question in order to identify which combinations of models should be considered in the evaluation:

1. Only models that have the Geographical area ticked for the policy question will enter into a set of combinations of models. So in Table 3 only the models that have yellow crosses in both columns can be used for combinations for policy question I (models A,B,C,F), and only the models that have blue crosses can be used for policy question II (models B, F, G). This gives the following possible combination of models that can handle the geographical level of detail required by policy questions PQ_I and PQ_{II}:
   For PQ_I: A, B, C, F, AB, AC, AF, BC, BF, CF, ABC, ABF, ACF, BCF, ABCF
   For PQ_{II}: B, F, G, BF, BG, FG, BFG

   During this combination building process one important parameter that should be decided is the maximum number of models that can enter into a combination, what is known as the cardinality. This is not a problem for the specific example because the number of models is limited, but in the application of the methodology into the full list of models assessed by the ATEsT project it is an important issue. In order to address this issue the analysis presented in the next section of the report was done using up to six models in a combination (cardinality equal to 6). An alternative approach that could be examined in the future is the use of a “penalty function” that will lower the ranking of a combination as the number of models increases.

2. Only the combinations of models that together cover at least all the policy-question-ticked cells for technology and sectors will enter into the evaluation. So in Table 3 the combinations for policy question I should include models with the red crosses, while for policy question II the combinations should

include models with the green crosses in the technology detail and sector categories. So for this example the possible combinations of models are:
For PQ_I: AC, CF, ABC, ACF, BCF, ABCF
For PQ_{II}: F, BF, FG, BFG

One final characteristic that is used is the type of model. So in each combination of models, only one General Equilibrium model and only one systemic model are allowed to enter (it doesn't make sense to have more than one model of these types in one combination).

Table 3: Example of models/tools combination creation methodology

	Technology Detail										**Sector**					**Geographical Coverage**				
	Technology Rich	Wind	Photovoltaic	CSP	Biofuels	Nuclear IV	CCS	Fuel Cells	Smart grids	Energy Eff	Gas	Electricity-Heat	Transport	Industry	Buildings	World	EU level	MS level	Regional level	Local Level
Policy Question																				
PQ_I	X				X							X	X	X	X		X	X		
PQ_{II}		X	X			X	X					X							X	
MODELS																				
A	X	X	x			x	X					X					X	X		
B		X	X					X				XX					X	X	X	
C					X								X	X	X		X	X		
D												X	X	X	X	X				
E	X	X	x			x	X					X						X		
F	X	X	X			X	X					XX					X	X	X	
G										X		X			X				X	

The only remaining issue is to assign the model usefulness for each combination of models, using the results of Step 2. The convention used is that for each specification a combination of models/tools gets the rank of the best tool in the combination.
In the pilot application of the methodology, the eight policy questions chosen in step 3 were analysed (Appendix D) and a full table was created for all the models in the analysis so far and is presented in Appendix E.

The combination building process described here assumes that the combination of models and tools is feasible in some way. It does not examine the difficulty of performing these combinations or the restrictions that might exist. The main reason for this is that a detailed knowledge of the exact input, output and requirements of each model is required in order to analyse these issues. As was mentioned in the description of Step 4 above, the implementation so far doesn't take into account the complexity of combining models. This could be introduced endogenously into the method by applying a penalty function any time we move to larger cardinality, however the quantification of this penalty function is rather difficult. An initial idea was to create factors for each pair of models that would represent the evaluator's perception of the difficulty of combining these models, however this would add even more subjectivity in the methodology. So the approach taken in the methodology implementation was to use a cardinality of 6 as an upper bound and to conduct an analysis with lower cardinalities (5,4,3,2) in order to assess the changes observed between the best alternatives in these runs.

Step 5 Evaluation of the ability of a combination of models to answer a policy question

This is the final step of the methodology in order to evaluate the ability of a combination of models/tools to answer to a policy question. In this step a "Decision Matrix" is created with the specifications on one dimension and the model/tools combinations on the other. The weighted sum approach (Triantaphyllou 2000) is applied to this decision matrix (Table 4), in order to find the preferred alternative among the combinations, for the specific policy question.

The classic weighted sum approach is defined mathematically as follows: Suppose that w_i is the *importance weighting of the specification* i for the specific policy question, and r_{ij} is the *usefulness of the model* combination *j* to the specification *i*. Then the overall valuation uj of each alternative combination j is calculated as:

$$u_j = \sum_{i=1}^{m} w_i \cdot r_{ij} = \left(w_1 \otimes r_{1j}\right) \oplus ... \oplus \left(w_i \otimes r_{ij}\right) \oplus .. \oplus \left(w_m \otimes r_{mj}\right)$$

In the above relationship $\oplus$ denotes the fuzzy addition and $\otimes$ denotes the fuzzy multiplication operator.

Table 4: Decision matrix format

		Specifications				
		(L)	(VL)	(M)	(N)	Importance weighting w_i of the specification i
		$Spec_1$	$Spec_2$	$Spec_i$	$Spec_m$	
Model Combinations	$Comb_1$	P	VG	N	G	Usefulness r_{ij} of model combination j in answering specification i
	$Comb_2$	G	P	P	N	
	…					
	$Comb_j$					

The preferred alternative A^* will be that which obtains the maximum value of u_j (e.g. A3 in Figure 4),

$$A^* = \left\{A_j \mid \max u_j\right\}$$

At this point, it is important to be able to express the results of the method in the same terms (the same frame of reference) in which the input was provided, in other words to express the output in linguistic terms. In order to do this one needs to calculate the distance between the fuzzy triangle of the result (ranking of a combination) and the fuzzy triangles that correspond to the model usefulness scales described in Step 1. The distance between two fuzzy numbers x=(x1,x2,x3) and y=(y1,y2,y3) is measured as

$$d(x,y) = \left(\sum_{i=1}^{3} (x_i - y_i)^3 \right)^{\frac{1}{3}}.$$

This distance between the ranking of the combinations of models and the definition of “Good” for the model usefulness is used in the results presentation in the next section for choosing the best alternatives.

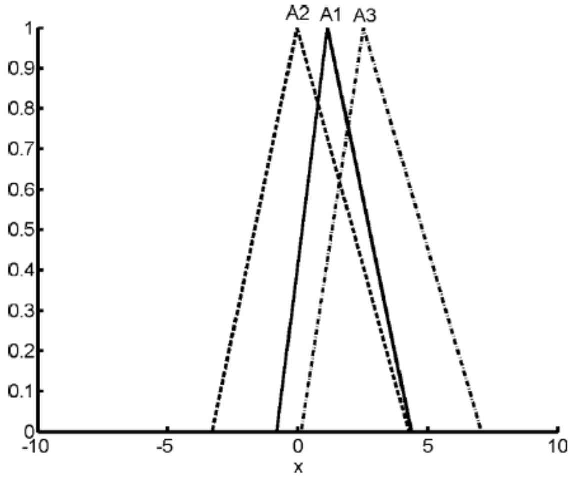


Figure 4: Evaluation of the preferred alternative

3. Pilot Results

Following the methodology described in Section 2, and the analysis and ranking presented in Appendices B-E, the results of the methodology for the eight example policy questions are presented in this section of the report.

3.1 Policy Question 1

Policy Question 1 in the list presented in Section 2 is “How to achieve a low cost and low emissions energy mix?”.
Following the combination building process of Step 4 in Section 2, the models that pass the geographic coverage criterion (which is Member State for this specific question – see Appendix D) are 43 and are presented in Figure 5 as the list of models that pass the pre-selection criteria.

PQ1 : How to achieve a low cost and low emissions energy mix

							a	b	c	distance
A1	GEME3	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	0.87305	3.55924	8.40947	3.18815
A2	GEME3	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	More_Hys	0.86352	3.54516	8.38924	3.20358
A3	GEME3	MDM-E3	RESOLVE-E	STSc	Horizonscan	More_Hys	0.83263	3.55702	8.4381	3.21437
A4	GEME3	WILMAR_TOOL	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	0.83835	3.52067	8.35826	3.23559
A5	GEME3	IER_Transmission	RESOLVE-E	STSc	Horizonscan	Climate Bonus	0.80456	3.53617	8.42928	3.24557
A6	GEME3	PRIMES	IER_Transmission	RESOLVE-E	Horizonscan	Climate Bonus	0.81644	3.51761	8.35811	3.25131
A7	GEME3	MDM-E3	RESOLVE-E	Horizonscan	Behave	More_Hys	0.79362	3.52977	8.37578	3.25784
A8	GEME3	PRIMES	RESOLVE-E	Horizonscan	Climate Bonus	More_Hys	0.80691	3.50353	8.33788	3.2666
A9	GEME3	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	SAMLAST	0.79633	3.50866	8.36171	3.2696
A10	GEME3	PRIMES	RESOLVE-E	STSc	Horizonscan	More_Hys	0.77602	3.5154	8.38674	3.27782
models that pass the qualification criteria :				{RESOLVE-E, Horizonscan, GEME3, Climate Bonus, MDM-E3,IER_Transmission,STSc, More_Hys, TIMES-PanEU, COMPETES, WILMAR_TOOL, PRIMES,NEMS,GreenNET, E3ME, SAMLAST, MECHanisms, REMARK, MTSIM,TIMES-NORDIC,POWERS, Behave, INVERT, GEMED, TIMES-FI, ESPAUT,E2M2S_IER,MURE, ENPEP, EMM, LEAP, RESOLVE-T, WILMAR,Balmorel,E2M2S_DUIS, EMELIE, UKENVI, Energy-Plan, Best, ROM,TEMPO,CGEN,WASP}						
best combinations as a function of cardinality										
1	GEME3	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus				3.18815
264	GEME3	IER_Transmission	RESOLVE-E	Horizonscan	Climate Bonus					3.39622
10181	GEME3	TIMES-PanEU	RESOLVE-E	Horizonscan						3.71558
105831	GEME3	RESOLVE-E	Horizonscan							4.16032

Figure 5: Combinations and models for PQ1.

The 10 highest ranked combinations (A1-A10) are shown in detail in Figure 5. For each combination Figure 5 presents the names of the models that participate in the combination, the three “coordinates” (a,b,c) of the fuzzy triangle for each combination and the distance (as described in Step 5 of Section 2), between the definition of GOOD and each one of these combinations. The distances of these combinations are very close to each other and this situation is represented in the graph in Figure 6, where all triangles almost coincide. Also the score difference between the 1st combination and 200th combination is about 6%. The interpretation of this small difference can be that these combinations are almost equivalent. In order to perform a more detailed analysis of the results, it was necessary to focus on their qualitative characteristics as well, so it was necessary to analyse the categories of models that participate in each combination, and to perform a statistical analysis of the models that participate in the best 200 combinations.

The frequency of the models’ appearance among the first best 200 combinations for PQ1 is shown in Figure 7. The models can be divided into 4 groups based on the following frequencies of appearance: Group1 (200 – 100), Group2 (100 – 50), Group3 (50-25) and Group 4 (25 – 0). For Policy Question 1, Group1 contains the models: Horizonscan(200), RESOLVE-E (200), GEM-E3 (149) and ClimateBonus(146), which indicates that these four models create a strong combination, for answering as efficiently as possible the policy question. Group2 consisted of [MDM-E3 (81), IER-Transmission (53)] and Group3 consistent of [STSc(47), MoreHys(44), TIMES-PanEU(33), COMPETES(30), WILMAR-TOOL(26), Primes(26)].

The combination of the four models that belong to Group1 is not necessary adequate to be used on its own. When cardinality is taken equal to 4 the best combination consists of Horizonscan, RESOLVE-E, GEM-E3 and TIMES-PanEU. When cardinality is reduced to 3 (i.e. three models in each combination) the best combination is made of GEME3, RESOLVE-E and Horizonscan.

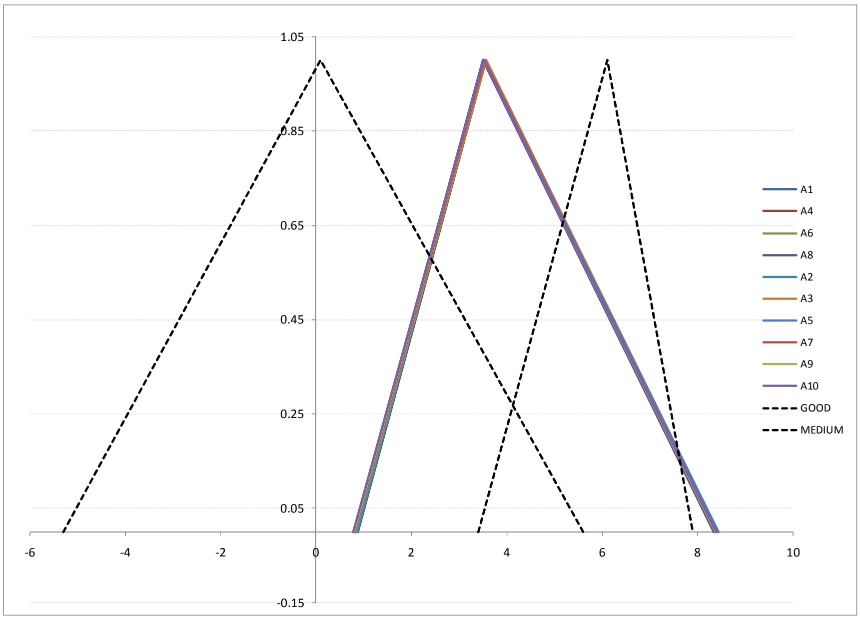


Figure 6: Fuzzy triangles of combinations for PQ1

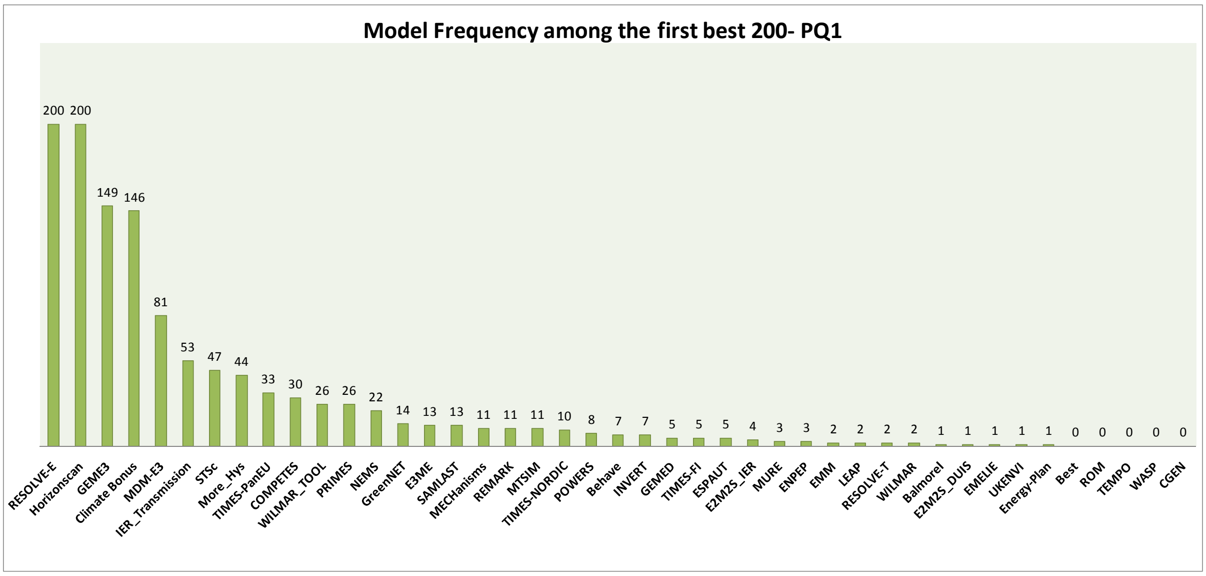


Figure 7: Frequency of model appearance in the first 200 combinations for PQ1

3.2 Policy Question 2

Policy Question 2 is “How to achieve an energy mix that maximizes employment opportunities?”. The models that enter the combination building process are again 41 since the geographical coverage criteria required in this question is on a Member State level (like in the case of PQ1). Figure 8 presents the 43 models that enter the combinations and the best 10 combinations.

PQ2 : How to achieve an energy mix that maximizes employment opportunities

							a	b	c	distance
A1	IER_Transmission	MDM-E3	RESOLVE-E	STSc	Horizonscan	Climate Bonus	1.09281	3.65193	8.90985	2.95957
A2	MDM-E3	RESOLVE-E	STSc	Horizonscan	Climate Bonus	More_Hys	1.08596	3.64494	8.90734	2.96881
A3	IER_Transmission	MDM-E3	RESOLVE-E	MECHanisms	Horizonscan	Climate Bonus	1.05883	3.66337	8.90849	2.97283
A4	GEME3	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	1.07583	3.64487	8.87926	2.97815
A5	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	GreenNET	1.053	3.65669	8.89987	2.98191
A6	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonu	More_Hys	MTSIM	1.04581	3.64666	8.88874	2.99433
A7	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonu	More_Hys	REMARK	1.04581	3.64666	8.88874	2.99433
A8	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	REMARK	1.04546	3.64362	8.88013	2.99751
A9	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	MTSIM	1.04546	3.64362	8.88013	2.99751
A10	MDM-E3	RESOLVE-E	MECHanisms	Horizonscan	Climate Bonus	More_Hys	1.03861	3.63663	8.87761	3.0067
models that pass the qualification criteria :				{Horizonscan, RESOLVE-E, Climate Bonus, MDM-E3, IER_Transmission,More_Hys,E3ME, WILMAR_TOOL, GEME3, TIMES-PanEU, MECHanisms, NEMS,STSc,SAMLAST, COMPETES, GreenNET, POWERS, REMARK, MTSIM,PRIMES,Behave, E2M2S_IER, TIMES-FI, GEMED, INVERT, ESPAUT,E2M2S_DUIS,RESOLVE-T, UKENVI, LEAP, MURE, TEMPO, TIMES-NORDIC,ENPEP,Best, EMM, WILMAR, Energy-Plan, CGEN, EMELIE,Balmorel,ROM,WASP}						
best combinations as a function of cardinality										
1	IER_Transmission	MDM-E3	RESOLVE-E	STSc	Horizonscan	Climate Bonus				2.95957
81	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus					3.06968
3568	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus						3.37594
146948	MDM-E3	RESOLVE-E	Horizonscan							3.91593

Figure 8: Combinations and models for PQ2.

Comparing the distance, between GOOD and each one of these combinations, one can see that the score are very close together, and the triangles almost coincide (Figure 9). The score difference between the 1st combination and the 200th combination is 6.31%.

The frequency of the models' occurrence among the first best 200 combinations for PQ2 is shown in Figure 10. Using the same frequency groups as in PQ1 we can see that for Policy Question 2, Group1 contains: [Horizonscan(200), RESOLVE-E (199), ClimateBonus(193) and MDM-E3(146)], which indicates that these four models create a strong combination. Indeed when cardinality was reduced to 4, these models appeared in the best combination. Group2 consisted of [IER-Transmission(64), MoreHys(53] and Group3 [E3ME(42), WILMAR-TOOL(40)].

When cardinality was reduced to three then the top combinations were MDM-E3 along with RESOLVE-E and Horizonscan.

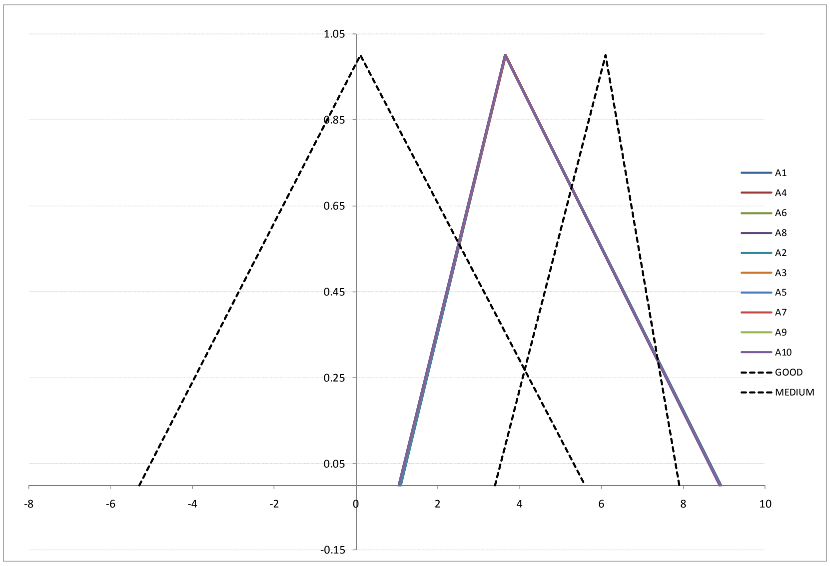


Figure 9: Fuzzy triangles of combinations for PQ2

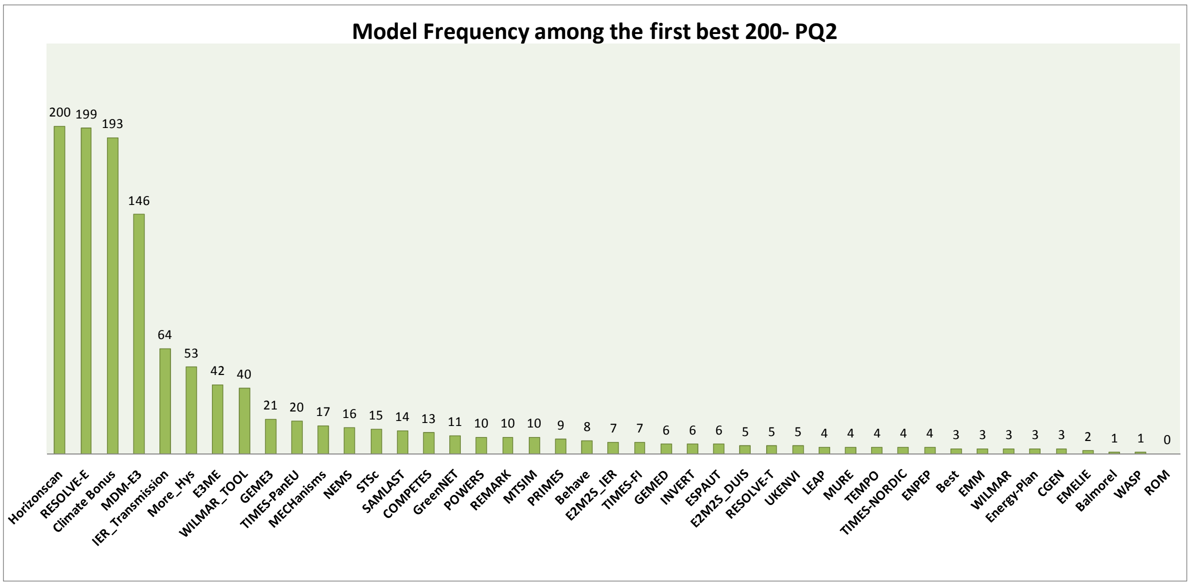


Figure 10: Frequency of model appearance in the first 200 combinations for PQ2.

3.3 Policy Question 3

For Policy Question 3 – "How to achieve an energy mix that has the maximum societal acceptance?", the models that enter the combination-building process are 16 and are shown in detail in the Figure 11. The geographical coverage level requirement for this policy question is Member State and Regional, so only models that cover both are used in the combination building process.

PQ3 : How to achieve an energy mix that has the maximum societal acceptance

							a	b	c	distance
A1	COMPETES	IER_Transmission	STSc	MECHanisms	Behave	Climate Bonus	-0.11727	2.97977	7.97866	4.19626
A2	IER_Transmission	POWERS	STSc	MECHanisms	Behave	Climate Bonus	-0.12581	2.99003	7.96543	4.19662
A3	TIMES-FI	IER_Transmission	STSc	MECHanisms	Behave	Climate Bonus	-0.14299	2.96964	7.96974	4.21996
A4	COMPETES	IER_Transmission	POWERS	STSc	MECHanisms	Climate Bonus	-0.15395	2.94881	7.96075	4.23915
A5	TIMES-FI	IER_Transmission	POWERS	STSc	MECHanisms	Climate Bonus	-0.16233	2.93237	7.92746	4.25414
A6	COMPETES	IER_Transmission	POWERS	STSc	Behave	Climate Bonus	-0.17616	2.93698	7.93611	4.26132
A7	COMPETES	WILMAR_TOOL	POWERS	STSc	MECHanisms	Climate Bonus	-0.17867	2.91476	7.91312	4.27536
A8	TIMES-FI	IER_Transmission	POWERS	STSc	Behave	Climate Bonus	-0.18455	2.92054	7.90282	4.27629
A9	TIMES-FI	COMPETES	IER_Transmission	STSc	Behave	Climate Bonus	-0.2013	2.90407	7.91823	4.29716
A10	COMPETES	WILMAR_TOOL	POWERS	STSc	Behave	Climate Bonus	-0.20088	2.90294	7.88848	4.2975
models that pass the qualification criteria :				{STSc, MECHanisms, Behave, IER_Transmission, POWERS,Climate Bonus,COMPETES, WILMAR_TOOL, TIMES-FI, LEAP, Balmorel, ENPEP,WILMAR,INVERT, CGEN, WASP}						
				best combinations as a function of cardinality						
1	COMPETES	IER_Transmission	STSc	MECHanisms	Behave	Climate Bonus				4.19626
41	IER_Transmission	POWERS	STSc	MECHanisms	Climate Bonus					4.42343
468	IER_Transmission	POWERS	STSc	Climate Bonus						4.83062

Figure 11: Combinations and models for PQ3.

The 10 highest ranked combinations are shown in detail in Figure 11 and the corresponding triangles are shown in Figure 12. The score difference between the 1st combination and 200th combination is 10.31% in this case.
Comparing the performance of the best single model (TIMES-FI) which scores on its own well behind MEDIUM while the best combination reaches GOOD.

The frequency of the models among the first best 200 combinations for PQ3 is shown in Figure 13. Using the same groups as before, for PQ3 Group1 contains: [STSc(200), MECHANISMS (110), Behave(109) and IER-Transmission(100)]. Group2 consists of {*POWERS* (94), Climatebonus (84), *COMPETES* (77), *WILMAR-TOOL* (61), *TIMES-FI* (58) }. By checking results for lower cardinalities IER-Transmission and ClimateBonus participate in the best combinations for cardinalities greater than four, while MECHanisms appear for cardinality equal to 5 and Behave for cardinality equal to 6. It is important to mention that POWERS appear in the best combination for cardinality equal to 4 or 5 while it is substituted by COMPETES for cardinality equal to 6.

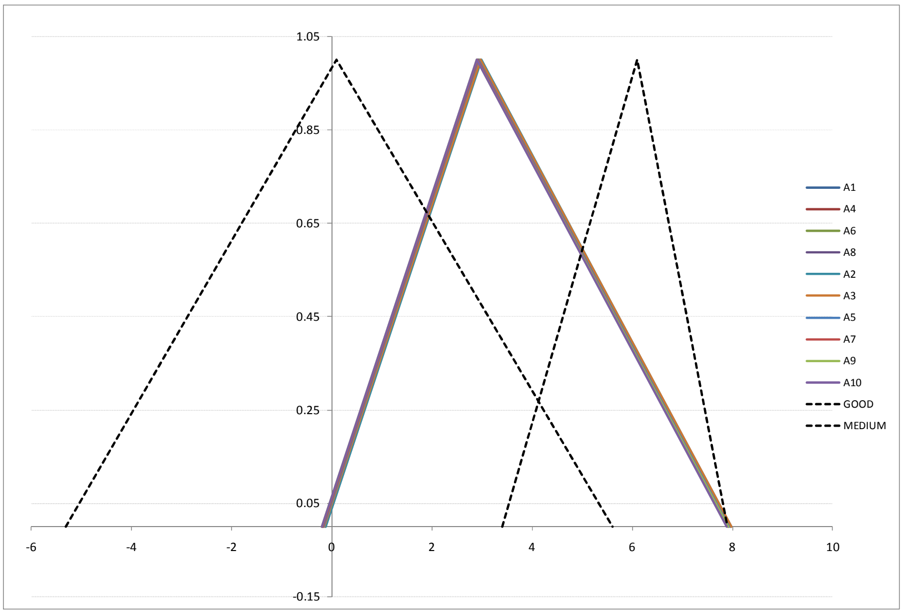


Figure 12: Fuzzy triangles of combinations for PQ3

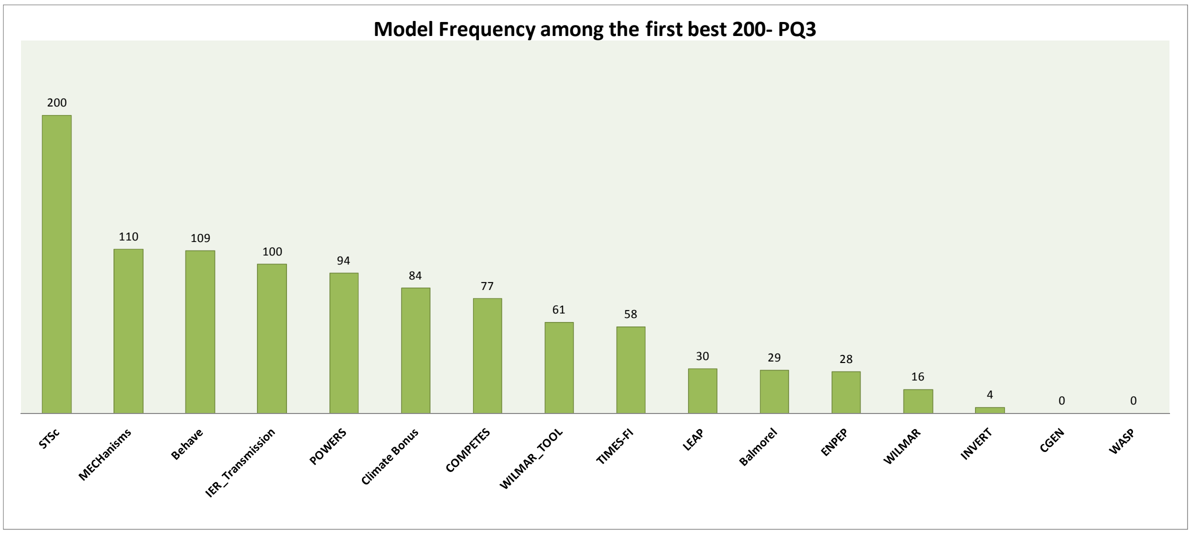


Figure 13: Frequency of model appearance in the first 200 combinations for PQ3.

3.4 Policy Question 4

In the case of Policy Question 4 "Which are the most competitive low carbon technologies in the medium and long term?" when using the strict geographical coverage rule, none of the models entered the combination building process. This was due to the fact for PQ4 the necessary geographical coverage was World, EU and MS level, and there isn't any model that can cover all these at the same time. In this case the criteria were "relaxed" allowing models that covered at least one of the geographical areas to participate in the combination building process (which led of course to the participation of almost all the available models).

PQ4 : Which are the most competitive low carbon technologies in the medium and long term

							a	b	c	distance
A1	NEMESIS	POLES	IMAGE-TIMER	Horizonscan	iKnow	SAMLAST	1.49768	4.10357	9.05511	2.36929
A2	NEMESIS	EFDA_TIMES	GRAPE	Horizonscan	iKnow	SAMLAST	1.45077	4.09544	9.06771	2.36929
A3	NEMESIS	POLES	MDM-E3	Horizonscan	iKnow	SAMLAST	1.47329	4.05712	8.9881	2.36929
A4	NEMESIS	POLES	TEMPO	Horizonscan	iKnow	SAMLAST	1.44264	4.0404	8.96824	2.36929
A5	NEMESIS	POLES	IMAGE-TIMER	MECHanisms	iKnow	SAMLAST	1.39024	4.05352	9.02663	2.36929
A6	NEMESIS	POLES	IMAGE-TIMER	STSc	iKnow	SAMLAST	1.39095	4.05374	9.02238	2.36929
A7	NEMESIS	POLES	COMPETES	IMAGE-TIMER	iKnow	SAMLAST	1.37897	4.05007	9.03113	2.36929
A8	NEMESIS	TIMES-FI	COMPETES	R_Transmissic	STSc	iKnow	1.39872	4.03623	8.99082	2.36929
A9	NEMESIS	TIMES-PanEU	GRAPE	RESOLVE-E	Horizonscan	iKnow	1.39159	4.04155	8.98182	2.36929
A10	NEMESIS	TIMES-NORDIC	GRAPE	R_Transmissic	STSc	iKnow	1.3757	4.0436	9.0119	2.36929
best combinations as a function of cardinality										
1	NEMESIS	POLES	IMAGE-TIMER	Horizonscan	iKnow	SAMLAST				2.36929
331	NEMESIS	EFDA_TIMES	Horizonscan	Climate Bonus	SAMLAST					2.6889
25509	NEMESIS	EFDA_TIMES	Horizonscan	SAMLAST						3.12591
231857	NEMESIS	TIMES-PanEU	Horizonscan							3.56971

Figure 14: Combinations and models for PQ4.

The 10 highest ranked combinations are shown in detail in Figure 14. The score difference between the 1st combination and the 200th combination is 12.3% and the triangles for each combination can be seen in Figure 15.
The frequency of the models appearance among the best 200 combinations for PQ4 is shown in Figure 16. So in this case Group1 contains the models: NEMESIS (200), i-Know (139), Horizonscan (131), which indicates that these three models create a strong combination for PQ4. Group2 consists of { SAMLAST (83), GRAPE (67), STSc (58), ClimateBonus (53)}. Looking at the results the general outcome is that the best combination for this policy question is NEMESIS, together with a systemic model and Horizonscan, which can be supplemented by SAMLAST (when cardinality=4} or {SAMLAST, Climate Bonus}(when cardinality=5). When cardinality equals to 6, {EFDA-TIMES, Climate Bonus} are substituted by {POLES, IMAGE-TIMER, i-Know}.

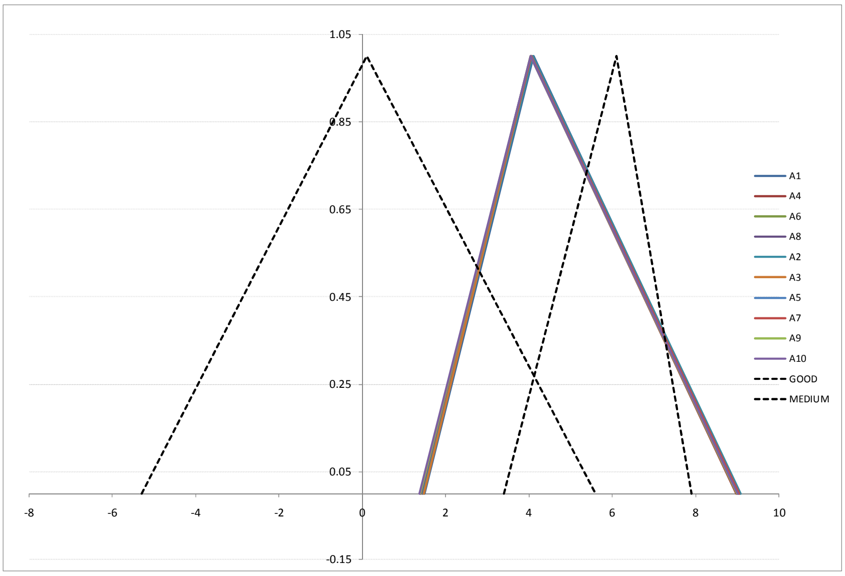


Figure 15: Fuzzy triangles of combinations for PQ4

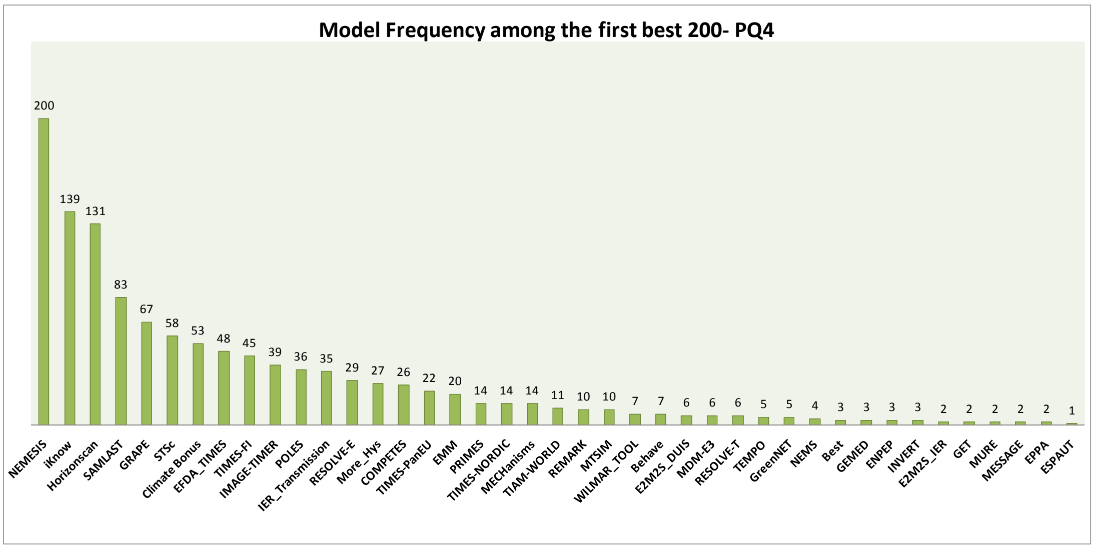


Figure 16: Frequency of model appearance in the first 200 combinations for PQ4.

3.5 Policy Question 5

For Policy Question 5 "Where should new energy installations be best located?", the geographical coverage needed is on a MS level and Regional level. Sixteen models cover both levels and enter into the combination building process. The models that enter in the combination-building process are shown in detail in Figure 17.

PQ5 : Where should new energy installations be best located

							a	b	c	distance
A1	TIMES-FI	COMPETES	IER_Transmission	STSc	MECHanisms	Climate Bonus	-0.04981	3.06931	7.70253	4.09961
A1	TIMES-FI	COMPETES	IER_Transmission	STSc	Behave	Climate Bonus	-0.07706	3.05446	7.70965	4.12702
A1	TIMES-FI	COMPETES	STSc	MECHanisms	Climate Bonus	INVERT	-0.09692	3.0448	7.71161	4.14638
A1	TIMES-FI	COMPETES	WILMAR_TOOL	STSc	MECHanisms	Climate Bonus	-0.09006	3.0214	7.63751	4.15452
A1	TIMES-FI	COMPETES	STSc	Behave	Climate Bonus	INVERT	-0.12417	3.02994	7.71873	4.17382
A1	TIMES-FI	COMPETES	WILMAR_TOOL	STSc	Behave	Climate Bonus	-0.11731	3.00654	7.64463	4.18189
A1	TIMES-FI	COMPETES	IER_Transmission	STSc	Climate Bonus	INVERT	-0.13915	3.02755	7.70356	4.18584
A1	TIMES-FI	COMPETES	WILMAR_TOOL	STSc	Climate Bonus	INVERT	-0.17073	2.99245	7.65696	4.22746
A1	TIMES-FI	COMPETES	STSc	MECHanisms	Behave	Climate Bonus	-0.18865	2.98089	7.64824	4.24653
A1	TIMES-FI	COMPETES	IER_Transmission	POWERS	STSc	Climate Bonus	-0.1911	2.98266	7.65057	4.24731
models that pass the qualification criteria :				{STSc, Climate Bonus, TIMES-FI, COMPETES, MECHanisms,Behave,IER_Transmission, INVERT, ENPEP, WILMAR_TOOL, POWERS, CGEN,Balmorel,WILMAR, LEAP, WASP}						
best combinations as a function of cardinality										
1	TIMES-FI	COMPETES	IER_Transmission	STSc	MECHanisms	Climate Bonus				2.95957
52	TIMES-FI	COMPETES	IER_Transmission	STSc	Climate Bonus					3.06968
256	TIMES-FI	COMPETES	STSc	Climate Bonus						3.37594

Figure 17: Combinations and models for PQ5.

The 10 highest ranked combinations are shown in detail in Figure 18 and the score difference between the 1st and 200th combination is about 14%.

The frequency of the models among the first best 200 combinations for PQ5 is shown in Figure 19. Using the same grouping based on the frequency as before, Group1 contains: [STSc(200), ClimateBonus (169), TIMES-FI(138) and COMPETES(100)]. Group2 consists of [MECHAnisms (80), Behave (73), IER-Transimission (70), INVERT (66), ENPEP (62),WILMAR-TOOL (60), POWERS (54)].

STSc with ClimateBonus and TIMES-FI enter into the top combinations, The best supplementary model is Mechanisms (when cardinality equals 6).

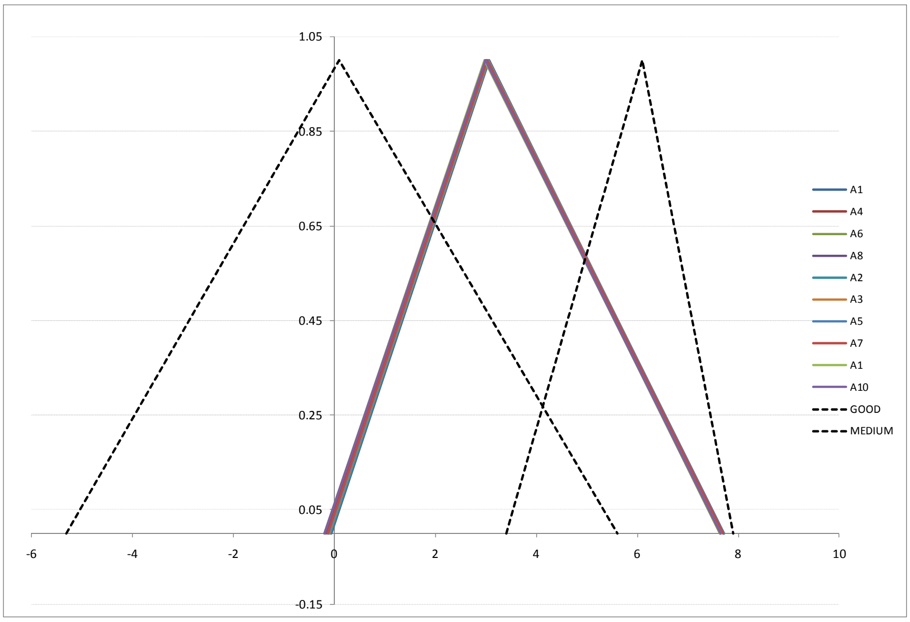


Figure 18: Fuzzy triangles of combinations for PQ5

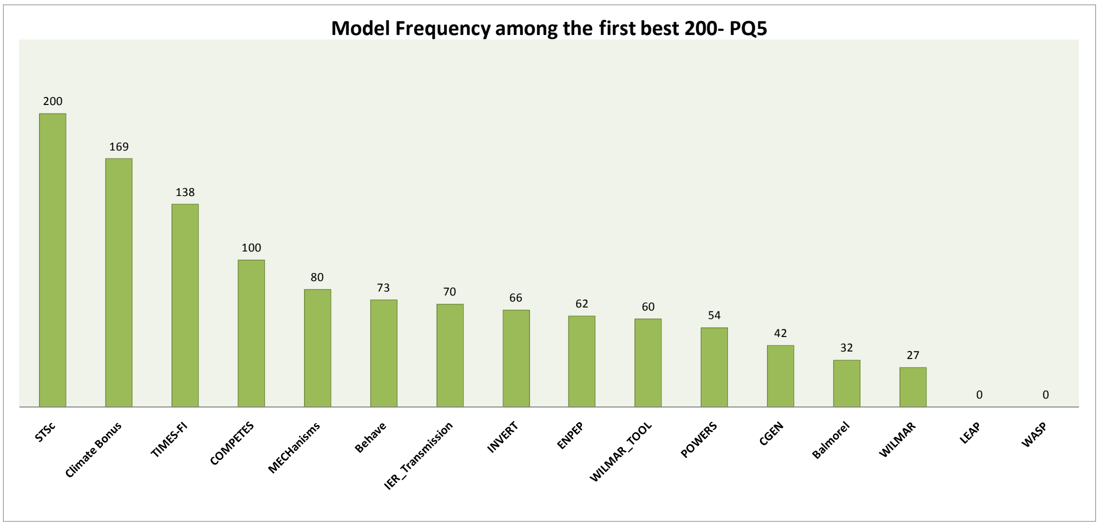


Figure 19: Frequency of model appearance in the first 200 combinations for PQ5.

3.6 Policy Question 6

The models that enter the combination-building process Policy Question 6 – "In which R&D areas should a country invest?" are 18 and are shown in detail in the Figure 20. Due to the "geographical coverage" needed for this policy question, only models that can cover at the same time MS and EU level can be chosen.

PQ6 : In which R&D areas should a country invest

							a	b	c	distance
A1	GEME3	PRIMES	COMPETES	RESOLVE-E	STSc	Horizonscan	0.36928	3.24327	8.06795	3.71198
A2	GEME3	TIMES-PanEU	COMPETES	RESOLVE-E	STSc	Horizonscan	0.37372	3.2255	8.00697	3.71969
A3	GEME3	COMPETES	RESOLVE-E	STSc	MECHanisms	Horizonscan	0.3545	3.21378	8.02489	3.73939
A4	GEME3	TIMES-PanEU	RESOLVE-E	STSc	MECHanisms	Horizonscan	0.35133	3.17865	7.9501	3.76258
A5	GEME3	COMPETES	MURE	RESOLVE-E	STSc	Horizonscan	0.3106	3.21234	8.04606	3.76952
A6	GEME3	PRIMES	RESOLVE-E	STSc	MECHanisms	Horizonscan	0.32974	3.17736	7.98578	3.77756
A7	GEME3	COMPETES	RESOLVE-E	STSc	Horizonscan	GreenNET	0.29768	3.19308	8.0052	3.78955
A8	GEME3	LEAP	COMPETES	RESOLVE-E	STSc	Horizonscan	0.31263	3.17198	7.95649	3.79211
A9	E3ME	TIMES-PanEU	MURE	RESOLVE-E	STSc	Horizonscan	0.2926	3.14833	7.94218	3.81949
A10	GEME3	TIMES-PanEU	RESOLVE-E	STSc	Horizonscan	MTSIM	0.27774	3.16408	7.95395	3.82001
models that pass the qualification criteria :				{Horizonscan, RESOLVE-E, GEME3, STSc, COMPETES,MECHanisms,MURE, TIMES-PanEU, PRIMES, E3ME, GreenNET, RESOLVE-T,SAMLAST,REMARK, MTSIM, LEAP, EMELIE, ENPEP}						
best combinations as a function of cardinality										
1	GEME3	PRIMES	COMPETES	RESOLVE-E	STSc	Horizonscan				3.71198
45	GEME3	TIMES-PanEU	RESOLVE-E	STSc	Horizonscan					3.90722
631	GEME3	TIMES-PanEU	RESOLVE-E	Horizonscan						4.21877
2239	GEME3	RESOLVE-E	Horizonscan							4.59651

Figure 20: Combinations and models for PQ6.

The 10 highest ranked combinations are shown in detail in Figure 20, and the score difference between the 1st and 200th is 9.3%.

The frequency of the models among the first best 200 combinations for PQ6 is shown in Figure 22. For PQ6, Group1 contains: Horizonscan(200), RESOLVE-E (186), GEM-E3 (141) and STSc(134) and Group2 consists of {COMPETES(80), MECHanisms(64), MURE(59)} and Group3 { TIMES-PanEU(49), PRIMES(47), E3ME(40), GreenNET(40), RESOLVE-T(30), SAMLAST(27), REMARK(25) }.

Using a maximum cardinality equal to 4, the combination {GEM-E3, TIMES-PanEU, Horizonscan, RESOLVE-E} has the higher rank. For cardinality equal to 3 and 5 the best combinations are {GEM-E3, Horizonscan, RESOLVE-E} and {GEM-E3, TIMES-PanEU, Horizonscan, STSc, RESOLVE-E} respectively.

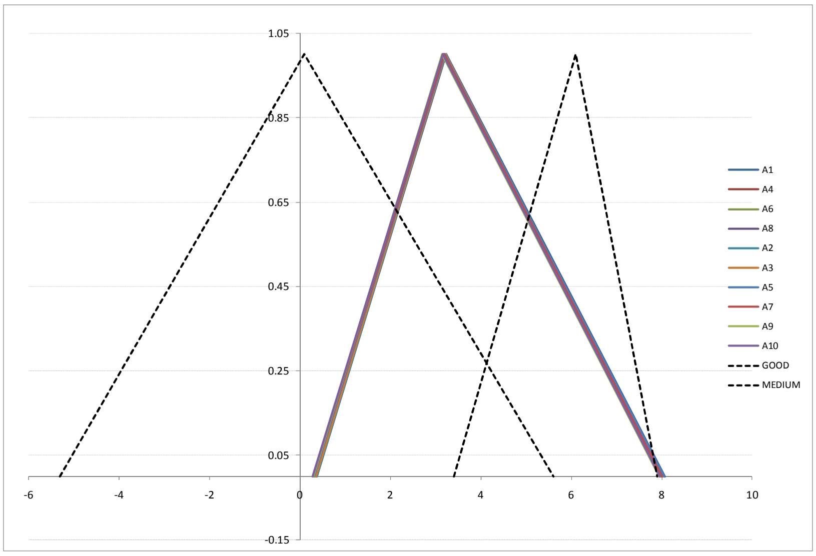


Figure 21: Fuzzy triangles of combinations for PQ6

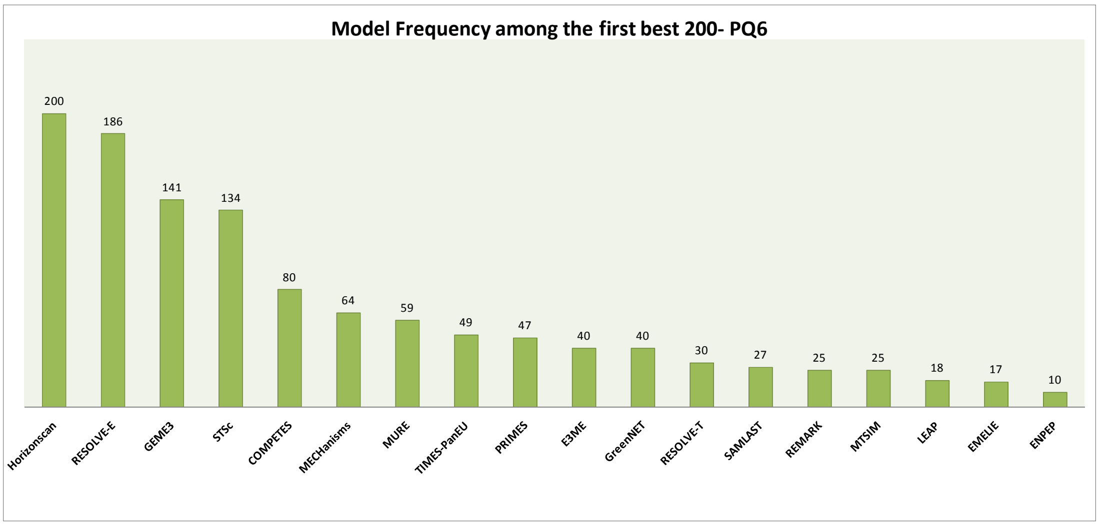


Figure 22: Frequency of model appearance in the first 200 combinations for PQ6.

3.7 Policy Question 7

Policy Question 7 is "How should a country develop interconnections with other European and non European countries?". For this Policy Question the same approach as with PQ4 was used regarding the "relaxation" of the geographical coverage criteria. The reason for that was that the configuration of PQ7 demanded models that cover geographically World, EU and MS level at the same time. So the criterion was changed slightly, by allowing models to enter the evaluation on the basis of covering at least one of the geographical levels, resulted to making all models admissible.

PQ7 : How should a country develop energy interconnections with other European and non European countries

							a	b	c	distance
A1	NEMESIS	POLES	COMPETES	Horizonscan	iKnow	SAMLAST	1.56015	4.15238	9.24967	2.23452
A2	NEMESIS	POLES	IMAGE-TIMER	Horizonscan	iKnow	SAMLAST	1.52926	4.14807	9.24947	2.25891
A3	NEMESIS	POLES	RESOLVE-E	Horizonscan	iKnow	SAMLAST	1.51823	4.14073	9.24188	2.27459
A4	WITCH	RESOLVE-E	Horizonscan	Climate Bonus	SAMLAST	GreenNET	1.50543	4.15117	9.21158	2.28597
A5	NEMESIS	POLES	Horizonscan	iKnow	SAMLAST	GreenNET	1.51617	4.13126	9.22961	2.28723
A6	MERGE	POLES	IMAGE-TIMER	Horizonscan	iKnow	SAMLAST	1.51536	4.14204	9.20309	2.28862
A7	NEMESIS	TIMES-FI	COMPETES	IMAGE-TIMER	STSc	iKnow	1.52454	4.12573	9.21166	2.29167
A8	WITCH	TIMES-FI	RESOLVE-E	STSc	iKnow	More_Hys	1.50261	4.13792	9.22626	2.2927
A9	NEMESIS	NEMS	COMPETES	RESOLVE-E	Horizonscan	iKnow	1.48377	4.15107	9.23502	2.29321
A10	NEMESIS	NEMS	RESOLVE-E	Horizonscan	iKnow	GreenNET	1.49285	4.14105	9.22465	2.29765
best combinations as a function of cardinality										
1	NEMESIS	POLES	COMPETES	Horizonscan	iKnow	SAMLAST				2.23452
605	NEMESIS	DNE	STSc	iKnow	SAMLAST					2.46804
54166	NEMESIS	TIMES-PanEU	STSc	Horizonscan						2.85428
687612	NEMESIS	TIMES-PanEU	Horizonscan							3.26747

Figure 23: Combinations and models for PQ7.

The 10 highest ranked combinations are shown in detail in Figure 23. The score difference between the 1st and 200th combination is 7.73%. The frequency of the models among the first best 200 combinations for PQ7 is shown in Figure 25. Again, models can be divided into 4 groups depending on the frequency of appearance. For PQ7 group1 contain Considering computational issues, all the runs have been conducted in a PC Intel core 2 duo s : i-Know(152), Horizonscan(131) and SAMLAST(125). Group2 consists of {NEMESIS(98), RESOLVE-E(87), WITCH(81), STSc(68), POLES(60)}.

As a general remark the strongest combination for this Policy Question is {a "CGE-Macroeconomic" model, a "Systemic" model, Horizonscan} which can be supplemented by STSc, i-Know, SAMLAST, COMPETES as cardinality increases.

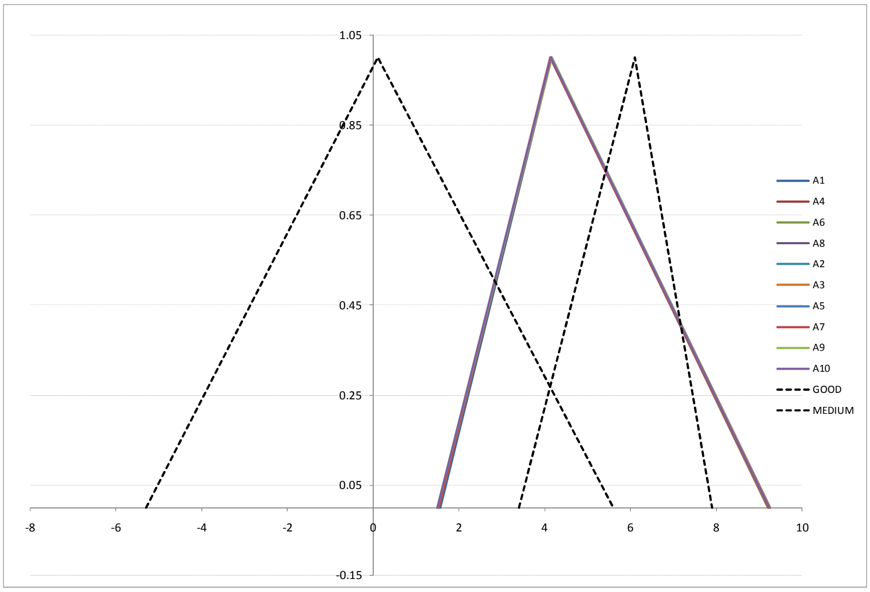


Figure 24: Fuzzy triangles of combinations for PQ7

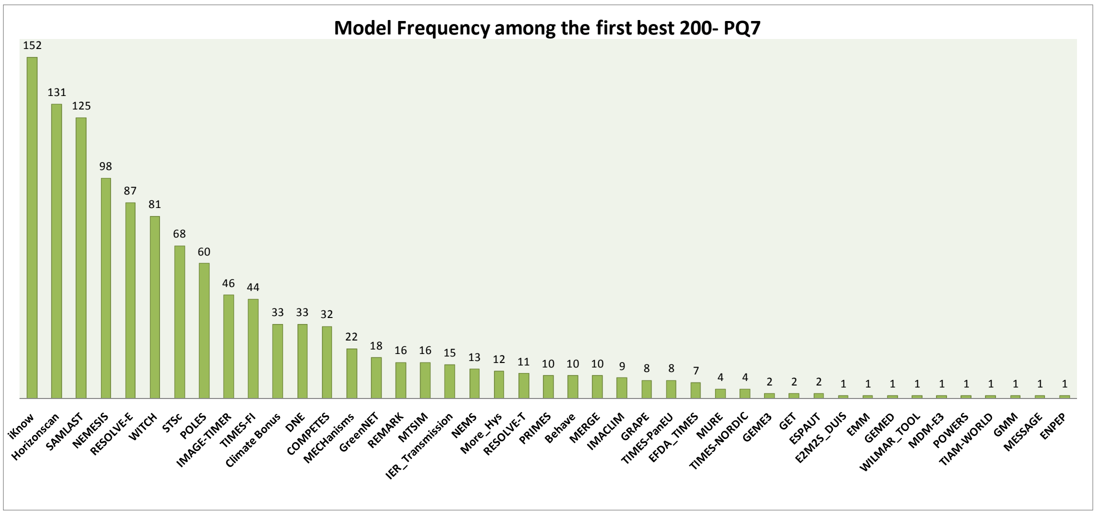


Figure 25: Frequency of model appearance in the first 200 combinations for PQ7.

3.8 Policy Question 8

The list of model combinations produced for Policy Question 8 – “How to improve energy efficiency” using 6 as the highest accepted model cardinality is equal to 2.191.523 combinations. The geographical coverage criterion allows 43 models that operate on a MS level to enter into the building-combination.

PQ8 : How to improve Energy Efficiency

							a	b	c	distance
A1	GEME3	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	1.03429	3.73911	8.50473	2.96924
A2	GEME3	WILMAR_TOOL	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	1.00592	3.7039	8.45636	2.96924
A3	GEME3	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	More_Hys	1.00231	3.70573	8.46365	2.96924
A4	GEME3	PRIMES	IER_Transmission	RESOLVE-E	Horizonscan	Climate Bonus	0.98281	3.70068	8.4562	2.96924
A5	IER_Transmission	MDM-E3	RESOLVE-E	STSc	Horizonscan	Climate Bonus	0.97992	3.69652	8.49986	2.96924
A6	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus	GreenNET	0.96623	3.69854	8.47297	2.96924
A7	IER_Transmission	MDM-E3	RESOLVE-E	MECHanisms	Horizonscan	Climate Bonus	0.96623	3.69854	8.47297	2.96924
A8	MDM-E3	RESOLVE-E	STSc	Horizonscan	Climate Bonus	More_Hys	0.96625	3.68348	8.48581	2.96924
A9	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonu	More_Hys	GreenNET	0.95256	3.68551	8.45892	2.96924
A10	GEME3	IER_Transmission	RESOLVE-E	STSc	Horizonscan	Climate Bonus	0.93232	3.69014	8.48607	2.96924
models that pass the qualification criteria :				{RESOLVE-E, Horizonscan, Climate Bonus, MDM-E3, GEME3,IER_Transmission,More_Hys, WILMAR_TOOL, COMPETES, TIMES-PanEU, E3ME, PRIMES,MECHanisms,NEMS, GreenNET, STSc, TIMES-NORDIC, GEMED, POWERS,INVERT,Behave, SAMLAST, REMARK, MTSIM, E2M2S_IER, MURE,TIMES-FI,UKENVI, ESPAUT, E2M2S_DUIS, LEAP, RESOLVE-T, WILMAR,ENPEP,Best, EMELIE, EMM, TEMPO, Energy-Plan, CGEN,Balmorel,WASP,ROM}						
best combinations as a function of cardinality										
1	GEME3	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus				2.96924
123	IER_Transmission	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus					3.14791
4436	MDM-E3	RESOLVE-E	Horizonscan	Climate Bonus						3.45942
122707	TIMES-PanEU	Horizonscan	Climate Bonus							4.10887

Figure 26: Combinations and models for PQ8.

The 10 highest ranked combinations are shown in detail in Figure 26. The score difference between the 1st and 200th combination is 6.93%.

In Policy Question 8 the PRIMES model scores on its own well behind MEDIUM while the best combination reaches GOOD, providing distance gains of about 9.24.

The frequency of the models among the first best 200 combinations for PQ8 is shown in Figure 28. For PQ8 Group1 contains: Horizonscan(200), RESOLVE-E (200), ClimateBonus(200) and MDM-E3(119) which indicates that these four models create a strong combination, for PQ8. Group2 consists of {GEM-E3(71),IER-Transmission(65), MoreHys(50)} and Group3 {WILMAR-TOOL(44)}.

For cardinality greater than 4 IER-Transmission and GEM-E3 appear to be the best models to supplement.

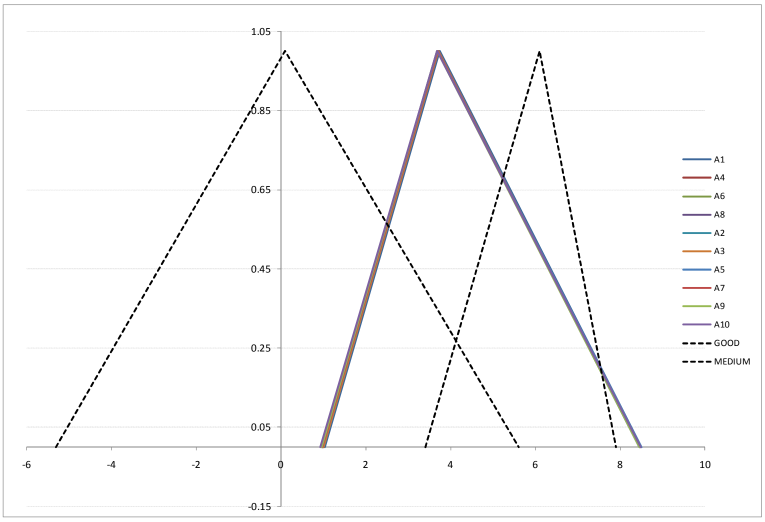


Figure 27: Fuzzy triangles of combinations for PQ8

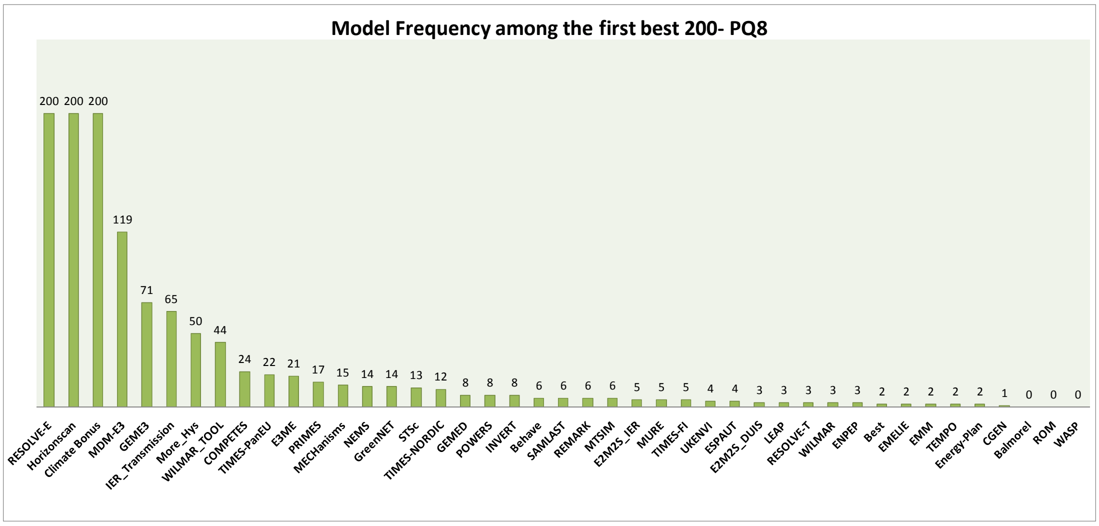


Figure 28: Frequency of model appearance in the first 200 combinations for PQ8.

3.9 Participation matrix

In order to see how often does a model enter a combination, for each one of the eight policy questions analysed above, a "participation matrix" was created (Figure 28). This provides an indication for the models/tools that are necessary for almost all the policy questions analyzed so far.

	PQ1	PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	
Balmorel	1	1	1	1	1		1	1	7/8
Best	1	1		1			1	1	5/8
COALMOD				1			1		2/8
COMPETES	1	1	1	1	1	1	1	1	8/8
E2M2S_IER	1	1		1			1	1	5/8
E2M2S_DUIS	1	1		1			1	1	5/8
E3ME	1	1		1		1	1	1	6/8
E3MG				1			1		2/8
EMELIE	1	1		1		1	1	1	6/8
EMM	1	1		1			1	1	5/8
ESTEEM									0/8
GASMOD				1			1		2/8
GEME3	1	1		1		1	1	1	6/8
GEMED	1	1		1			1	1	5/8
GEMINI-E3				1			1		2/8
GET				1			1		2/8
GRAPE				1			1		2/8
IER_Transmission	1	1	1	1	1			1	6/8
IMACLIM				1			1		2/8
IMAGE-TIMER				1			1		2/8
WILMAR_TOOL	1	1	1	1	1		1	1	7/8
LEAP	1	1	1	1	1	1	1	1	8/8
MDM-E3	1	1		1			1	1	5/8
MURE	1	1		1		1	1	1	6/8
NEWAGE				1			1		2/8
OILMOD				1			1		2/8
POLES				1			1		2/8
POWERS	1	1	1	1	1		1	1	7/8
PRIMES	1	1		1		1	1	1	6/8
RESOLVE-E	1	1		1		1	1	1	6/8
RESOLVE-T	1	1		1		1	1	1	6/8
ROM	1	1		1			1	1	5/8
TEMPO	1	1		1			1	1	5/8
TIAM-WORLD				1			1		2/8
TIMES-PanEU	1	1		1		1	1	1	6/8
TIMES-NORDIC	1	1		1			1	1	5/8
TIMES-FI	1	1	1	1	1		1	1	7/8
WILMAR	1	1	1	1	1		1	1	7/8
WITCH				1			1		2/8
STSc	1	1	1	1	1	1	1	1	8/8
MECHanisms	1	1	1	1	1	1	1	1	8/8
Horizonscan	1	1		1		1	1	1	6/8
iKnow				1			1		2/8
Behave	1	1	1	1	1		1	1	7/8
Climate Bonus	1	1	1	1	1		1	1	7/8
GMM				1			1		2/8
PACE				1			1		2/8
ADAGE				1			1		2/8
AIM				1			1		2/8
IGEM				1			1		2/8
MERGE				1			1		2/8
MESSAGE				1			1		2/8
GTAP-E				1			1		2/8
UKENVI	1	1		1			1	1	5/8
More_Hys	1	1		1			1	1	5/8
ABARE_GTEM				1			1		2/8
AMIGA				1			1		2/8
Combat				1			1		2/8
DICE				1			1		2/8
DNE				1			1		2/8
EDGE				1			1		2/8
EFDA_TIMES				1			1		2/8
Energy-Plan	1	1		1			1	1	5/8
ENPEP	1	1	1	1	1	1	1	1	8/8
ENV-Linkages				1			1		2/8
EPPA				1			1		2/8
ETP				1			1		2/8
FUND				1			1		2/8
GEM-CCGT				1			1		2/8
INVERT	1	1	1	1	1		1	1	7/8
IPAC				1			1		2/8
Minicam				1			1		2/8
MIRAGE				1			1		2/8
NEMESIS				1			1		2/8
NEMS	1	1		1			1	1	5/8
REMIND-R				1			1		2/8
RICE				1			1		2/8
SGM				1			1		2/8
WEM				1			1		2/8
WIAGEM				1			1		2/8
SAMLAST	1	1		1		1	1	1	6/8
REMARK	1	1		1		1	1	1	6/8
ESPAUT	1	1		1			1	1	5/8
MTSIM	1	1		1		1	1	1	6/8
WASP	1	1	1	1	1		1	1	7/8
CGEN	1	1	1	1	1		1	1	7/8
GreenNET	1	1		1		1	1	1	6/8

Figure 29: Model Participation matrix

4. Future application of the methodology

In order to apply the method in the future, trying to identify models that can answer a new policy question, the steps that must be followed are the following:

a) If any model has changed then the ranking has to be done again. This implies a detail analysis of the model features and a consultation with the model developers in order to include their feedback.

b) For the new policy question under consideration, the user of the methodology must first go to Step 1, part 2 (page 10) and define the levels of the specification importance weighting (i.e. define what is ***VL, L, M, H*** importance). This definition is needed since each user will have a different perception of what is the definition of each level and, since the user will use these levels to allocate the importance of each specification in the next step, he/she should define them. This will not affect any of the model rankings or any other part of the process described in Chapter 2.

c) The user should then go through Step 3 and allocate the importance of each specification in answering the policy question under consideration.

d) Finally, in Step 4 the user should fill in the combination creation methodology table, by assigning the technology, sectors and geographical coverage that is really needed for answering the policy question.

These steps will create all the necessary input to the methodology in order to create the new set of model combinations and perform the analysis for the new policy question. So for each new policy question a user should go through steps (c) and (d) above. A new user should go first through step (b) and then proceed to steps (c) and (d) for a specific policy question.

5. Conclusions

The multidimensional and complex issue of selecting the most appropriate toolbox for answering policy questions related to the SET-Plan implementation, was addressed in the previous sections. The methodology applied for the creation of combinations of models and tools, focused on giving guidelines on how to choose the best available set, depending on the policy question that needs to be answered.

In principle the procedure for model ranking and the assessment of the importance of specifications could be prone to subjectivity as the opinions of those performing the weightings and rankings may shine through. Our procedure counteracts this effect by performing each weighting and ranking twice, ensuring that each of the two is performed independent of the other and by a different referee (in our case different project partners). After that, the two results are compared and consensus is sought between the two referees on what is the appropriate ranking.

Another problem we encountered was that the fuzzy triangles for the policy questions may not provide a clear and distinct answer on what would be the best combination of models/tools to answer the policy question. The top combinations' rankings are very close to each other. The best alternative was to present the top ten combinations and also to present the frequency of appearance of each model in the top 200 combinations. In this way an indication of the models that are critical for answering a policy question was given. The combination of models was limited to 6 (cardinality equal to 6), since it was decided that a higher number of models will lead to a very complicated interconnecting process.

Overall, the proposed methodology should be seen as a guideline providing an indication of which models and tools, combined, can be appropriate for answering a policy question. The methodology doesn't, however, consider the ways in which the proposed models and tools can be combined. Possible and preferred ways of combining models and tools remains thus a task of further research.

It should also be noted, that the models and tools – and the combinations of models and tools - were now primarily assessed to demonstrate the methodology. The emphasis of this demonstration was in analytic models and tools that contribute to selected predefined policy questions that were linked to predefined specifications by the project team. In reality, there exist an unlimited number of relevant policy questions, among them also questions that focus on the ways in which key-actors' behavior, attitudes and acceptance can be influenced (limited attention has so far been paid to this type of contribution). It is thus good to keep in mind that new types of policy questions – linked to other types of specifications - may emerge. This emphasizes the need for further work in figuring out reasonable and useful ways of combining models and tools.

The experience of the partners from other projects shows that each country has its own "traditions" and models for evaluating policy questions, and it is quite challenging to move to another type of models and approaches. This is another issue that is not addressed in this report but should be taken into account when deciding about the modeling approaches for each country. The model ranking presented in the Appendices of this report could be used as indication for the areas where specific models could be improved in order to be more well suited to the SETPlan policy questions.

Once again it must be stated that the model ranking refers to the state of the models in September 2010 and does not consider any improvements done after this date.

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Project reports are available at
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Appendix A

List of Specifications
Used for Model/Tools Analysis

A detailed description can be found in the "**Specifications and Requirements of the ATEsT Toolbox**" Report available at http://www.atest-project.eu/pdf/D.1.1_Specification_Report.pdf

TRANSITION PLANNING			
SPATIAL PLANNING			
	Specification	**Description**	**Location in Specification Report**
Ca1	**Requirements for the supply chain**	How well the tool considers the supply chain of natural sources, within the geographic scope of the tool. Rate highest if it includes GIS description of resources, next level if it considers the geographical aspects by for example different categories.	Section 3.3.1, p. 19
Ca2	**Regional potential for low-C technologies**	Links to geography - Natural resource potential of an area to provide energy with a specific technology.	Section 3.3.1
Ca3	**Grid infrastructure existing and expansion within a country**	Spatial planning of grid infrastructure: electricity grids, pipelines (gas, oil, hydrogen etc) within a country. For the electricity grids this includes infrastructure expansion to connect new generation capacity. For pipelines this refers to construction.	Section 3.3.1
Ca4	**Cross-border grid infrastructure existing and expansion**	Spatial Planning of the expansion of the cross-border capacity of grids (electricity and pipelines).	Section 3.3.1, p. 19
Ca5	**Energy transport networks expansion - Non grid**	Transportation of non grid distributed energy carriers. E.g.. Transportation of biomass, gasoline. Transported by truck, railway, ship etc.	Section 3.3.1, p. 19
Ca6	**Generation capacity**	The location of the existing plants.	Section 3.3.1, p. 19
Ca7	**Generation capacity expansion**	The spatial (dynamic) expansion of plants, considering both replacement and upgrades of existing plants.	Section 3.3.1, p. 19
Ca8	**Cross-border energy infrastructure**	Physical Import dependency. How is the import described? Can the uncertainty in the delivery of energy be considered? For example: Policy issues outside Europe, like policy issues in Northern Sahara countries in the case of Desertec.	Section 3.3.1
Ca9	**Cost effective technology deployment**	How well is the spatial difference in cost captured? Focus on how well the tool considers the "cost effectiveness" of the technology deployment within the spatial dimension, e.g. where is it more cost effective to install certain new	Section 3.3.1, p. 19

		technology.	
Ca10	**Demand**	Spatial distribution of energy demand	
Ca11	**Population density**	The population density can help to provide information about the location of the residential demand of electricity, heating and cooling. For example when estimating the cost and needs of distribution.	Section 3.3.1, p. 19
Ca13	**Land use**	Considering different alternatives to use the land.	Section 3.3.1, p. 19

DEPLOYMENT PATHWAYS			
	Specification	**Description**	**Location in Specification Report**
Ca12	**Time evolution of energy demand**	Modeling the time evolution of the energy demand.	
Ca13	**Connection between local demand and national/global supply**	Assess the interaction between local demand and global supply. For example how the European demand for biomass affects the global price of biomass, the price of food etc.	Section 3.3.2, p. 20
Ca14	**Evolution of Grid infrastructure**	Time evolution of grid infrastructure within a region.	Section 3.3.2, p. 20
Ca15	**Evolution of cross-border infrastructure**	The time-evolution of the cross-border grid infrastructure.	Section 3.3.2, p. 20
Ca16	**Balancing capacity requirements**	Need of flexibility for balancing intermittency of renewables or the fluctuations of demand. For example requirements of rapid response conventional power plants (e.g. gas turbines) to balance the high penetration of renewables.	Section 3.3.2
Ca17	**Evolution of energy transport networks - Non grid**	The time evolution of supply chain logistics.	Section 3.3.2, p. 20
Ca18	**Evolution of the Generation Capacity**	The evolution of the generation capacity.	Section 3.3.2, p. 20
Ca19	**Interaction between technology deployment and industry**	A systemic approach is required combining the results from top-down and bottom-up as-assessments to deal with synergies and interdependencies between technological and industrial levels. For example the development of	Section 3.3.2, p. 20

		electricity storage is boosted by the electrical vehicles industry.	
Ca20	**Public-private agent behaviours and partnerships**	Account for agent behaviours both public and private, according to their respective role and considering also public-private partnerships.	Section 3.3.2, p. 20
Ca21	**Technology uptake**	To assess the impact of the transition of the energy system on sectoral changes (e.g. implementation of solar energy in buildings makes the construction sector stakeholder in the energy system and stimulates adoption of this new technology into their construction methods.)	Section 3.3.2
Ca22	**Time evolution of the Supply chain**	The development of the supply chain over time. How well the tool considers the needs for? Assess whether requirements for deploying a technology are or can be fulfilled reasonably. Include impact of the energy system transition (e.g. impact of changes of the energy system). For example, before wind power can be fully integrated the grid might need to be extended.	Section 3.3.2, p. 20
Ca23	**Closure of gap between demonstration and commercialization**	How well does the tool consider the gap between demonstration and commercialization of a certain technology.	Section 3.3.2, p. 21
Ca24	**Links between the energy system and the economy**	Changes in energy demand and sectoral changes resulting from changes in the energy system. For example, how well changes in demand as a result of the application of certain technologies (e.g. zero energy buildings) can be considered.	Section 3.3.2
Ca25	**Time lag between investment decision and entering into construction/operation.**	To estimate the time lag will weight the tool higher compared with including the assumed time lag in the model. Include the effect of the different regulatory frameworks in the MS on the time lag. The effect of different regulatory frameworks in Member States (e.g. the length of permitting procedures) should be accounted for in the model toolbox. Regulatory frameworks are one of the mechanisms affecting the time lag between investment decisions and actually producing electricity.	Section 3.3.2, p. 21

Ca26	**Behavioural Change**	Energy End users behaviour	
Ca26	**Market barriers**	Barriers for new entry or expansion of technologies. Example of market barrier: Capital requirements, Government policy, Regulations, Organizational, Switching costs.	Section 3.3.2, p. 22

SOCIO-ECONOMICS			
	Specification	**Description**	**Location in Specification Report**
Ca27	**Energy demand**	Overall energy demand of different economic agents (industrial sectors, households, government, etc.).	
Ca28	**Quantification of labour demand in the whole economy**	Example: how well are the direct and indirect effects of energy prices on the labour demand considered in the tool. General equilibrium model will typical score high.	Section 3.3.1, p. 19 Section 3.3.5
Ca29	**Quantification of labour demand from supply chain perspective**	Quantify direct and indirect employment that can result from the deployment of low carbon technologies (especially when the implementation phase starts) from the supply chain perspective and the technology deployment.	Section 3.3.5
Ca30	**Migration flows**	Migration flows associated to changes/transition of the energy system.	Section 3.3.1, p. 19
Ca31	**Energy prices**	Does the model consider energy prices?	Section 3.3.5
Ca32	**Energy prices for different groups**	Higher rating for models having different user groups, and moreover for different income or socio-professional household groups.	Section 3.3.5
Ca33	**Distribution of local costs and benefits.**	Effects from different technologies on local costs and benefits; the distribution of the benefits.	Section 3.3.5

ENVIRONMENTAL IMPACTS			
	Specification	**Description**	**Location in Specification Report**

Ca47	**Land-use intensity**	This means how agricultural intensive a land is used, i.e. mechanical ploughing, chemical fertilizers, pesticides etc.	Section 3.3.5, p.23
Ca48	**Emissions**		Section 3.3.5, p.23
Ca49	**Hydrological resources**	Effects from different technologies on the Hydrological resources. For example, effects on the aquifers (ground water), effects of river dams to the water levels downstream, water footprint.	Section 3.3.5, p.23
Ca50	**Protected areas**	Existence of protected areas taken into account in the sitting of technologies. (D.1.1, Section 3.3.5, pg23)	Section 3.3.5, p.23
Ca51	**Soil erosion**	Effects of the technology on soil erosion.	Section 3.3.5, p.23
Ca52	**The ecosystem**	Effects from different technologies on element in the ecosystem, e.g. flora, fauna and biodiversity.	Section 3.3.5, p.23

ACCEPTANCE AND TECHNOLOGY PERCEPTION			
	Specification	**Description**	**Location in Specification Report**
Ca34	**Public acceptance**	Public acceptance of technologies - Necessity for and level of public awareness	Section 3.3.5
Ca35	**Public perception**	Public acceptance of technologies - Necessity for and level of public understanding on - The technology in itself - How to make use of a technology - A technology’s implications	Section 3.3.5
Ca36	**Public opinion obstacles**	Public acceptance of technologies - Relations between the expectations and current implementation scale	Section 3.3.5
Ca37	**Public participation**	Public participation such as "Generally public participation seeks and facilitates the involvement of those potentially affected by or interested in a decision. The principle of public participation holds that those who are affected by a decision have a right to be involved in the decision-making process. Public participation implies that the public's contribution will influence the decision" (http://www.iap2.org/displaycommon.cfm?an=4, http://www.co-intelligence.org/CIPol_publicparticipation.html).	Section 3.3.5, p. 22

Ca38	**Financial risk perception**	Risk perception: § Individual investments; high transition and transaction costs § Immaturity of technologies (high investment, low income) § Reputation of the operator or initiator § Management of risks.	Section 3.3.5, p.23
Ca39	**Perceptions on reliability of a technology as energy source**	Mistrust in a technology as a reliable energy source. (D1.1, Section 3.3.5, pg 23)	Section 3.3.5**, p. 23**
Ca40	**Resistance based on issues of principle**	Public acceptance - Resistance from stakeholders, based on issues of principle	
Ca41	**Concerns for window dressing**	Public acceptance - Concerns on large companies being involved (only) in order to improve their image	
Ca42	**Concerns of competences developers and constructors**	Public acceptance - Concerns about competences in installation firms	
Ca43	**Perception on management local supply chain**	Public acceptance **-** Management of local supply chains § Economically efficient § Environmentally sustainable § Socially responsible § System operation concerns • Integration in the grid (especially for small-scale power generation) • Intermittency • Stability	
Ca44	**Safety issues and related perception - Concerns on health impacts**		Section 3.3.5, p. 23
Ca45	**The perception based on cost/benefits sharing**	Public perception on how fairly the benefits are distributed, e.g. if they participate to local taxes, or if they are exonerated.	Section 3.3.5
Ca46	**Competing technologies**	Influence of competing technologies on the public acceptance of a technology.	Section 3.3.5, p. 23

STRATEGIC PLANNING			
	Specification	**Description**	**Location in Specification Report**
GENERAL SPECIFICATIONS			
B1	**Resilience from extreme energy prices**	**Resilience of the energy system against shocks of extreme energy prices**	Section 3.2
B2	**Resilience from electric infrastructure failures**	Resilience of the energy system against shocks of power system failures, either grid or large scale power plants. Extra crucial for the electricity system, when electricity have to be generated at same moment as being used.	Section 3.2
B3	**Resilience from failures of energy supply**	Resilience of the energy system against shocks of failures of non electric energy supply.	Section 3.2
B4	**Resilience from extreme weather**	Resilience of the energy system against shocks of extreme weather events/conditions - e.g. cooling problems for nuclear plants due to hot weather.	Section 3.2
TECHNOLOGY PERFORMANCE AND DEVELOPMENT POTENTIAL			
B5	**Investment costs**	Investment Costs	Section 3.2.1
B6	**O&M costs**	O&M costs	Section 3.2.1
B7	**Technical performance**	Technical performance	
B8	**Environmental performance**	Environmental performance	
B9	**Cost Reduction Learning By Doing**	Cost reduction as a function of time through increased accumulated installed Capacity. Potential and expected cost reduction - as a function of deployment (economy of scale).	Section 3.2.1
B10	**Efficiency gains**	Overall efficiency gain and efficiency gain per tech/per kWh.	Section 3.2.1
B11	**Cost Learning By Researching**	Cost reduction as a function of time through Research, Development and Demonstration (RD&D).	Section 3.2.1
TECHNOLOGY DEPLOYMENT			
B12	**Identifying Technical barriers**	To what extent can the tool provide help to identify technical barriers. Technical barriers and technology complementarities (impact on the energy system structure; interdependency between different technologies: e.g. wind turbines and electric grid development)	Section 3.2.2
B13	**Identifying non Technical barriers**	To what extent can the tool provide help to identify non-technical barriers.	Section 3.2.2
B14	**Technical potential**		Section 3.2.2

B15	**Economic potential**	Economic potential (in contrast to the technical potential which is always larger or equal to the economic potential).	Section 3.2.2
B16	**Bottlenecks in technology deployment**	Bottlenecks to technology deployment (industry not ready to follow the demand).	
POLICY INDICATORS			
B17	**Support mechanisms**	Different support mechanisms (e.g. feed-in tariffs, quotas, fiscal measures, information).	Section 3.2.3
B18	**Identify lock-in situations**	Can the tool identify lock-in situations and then address policy measures aimed to change/solve them?	Section 3.2.2
B19	**System failure**	Can the tool address system failure?	Section 3.2.2
B20	**Uncertainties**	Can the tool deal with uncertainties?	Section 3.2.2
B21	**CO2 reduction per technology**	Life time CO2 emissions per technology (Life cycle emission).	Section 3.2.2
B22	**Total employment in the economy**		Section 3.2.2
B23	**Change in GDP**		Section 3.2.2
B24	**Life cycle costs**	The tools capacity to consider the life cycle costs.	Section 3.2.2
B25	**Life cycle energy input**	The tools capacity to consider the total use of energy over the entire life cycle.	Section 3.2.2
B26	**Life cycle emissions**	The tools capacity to consider the total amount of emissions over the entire life cycle.	Section 3.2.2
B27	**Competitiveness considerations for regional industry**		Section 3.2.2

INTERNATIONAL COOPERATION				
	Specification	**Description**	**Guidelines to evaluation**	**Location in Specification Report**
GENERAL SPECIFICATIONS				
E1	**JI and CDM**	The potential CO2 reduction through JI and CDM and its cost.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5
INTERNATIONAL COOPERATION ON R&D				
E2	**International Cooperation**	The possibility of the tools to identify potentialities of international cooperation on R&D. Monitor benefits of international cooperation on R&D. Assess mutual needs on R&D (win-win situations).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
E3	**Past International Cooperation**	The possibility of the tool to assess past cooperation initiatives and to estimate their results.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
E4	**Global centers of excellence**	Need for global "centers of excellence" (existence and fields of activity), e.g. by monitoring technologies with structural high cost or performance lagging behind	If the tool maps existing centers - the tool should not score higher than average. If the tool evaluates the needs of global centers - the tool should score high.	Section 3.5.1

E5	**Technology Mapping**	Technology mapping: international comparison of the state-of-the-art in different technologies (not technology fields) at the world level. Compare which technologies connect to European knowledge.		Section 3.5.1
E6	**Potential R&D cooperations**	Determine which countries are potential partners or main competitors.		Section 3.5.1
E7	**Identify large scale R&D projects**	Map total technology development investment and capabilities that need international cooperation. For example fusion technology.		Section 3.5.1
E8	**R&D outside EU**	Mapping of knowledge produced outside of the EU. Potential fields where additional R&D within EU is not needed for further Technology Learning (free-riding possibilities) since outside EU there is a high level of technical knowledge.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
INTERNATIONAL INTERACTION IN TECHNOLOGY DEPLOYMENT				
E9	**Spillover - Between Regions**	Spillover from Technology Learning between different regions of the world	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
E10	**Spillover Between Institutes/Companies**	Spillover from Technology Learning between different international companies and/or research institutes. To distinguish between horizontal and vertical spillover effects. Having vertical (cross-sectors) impacts could give an information on how the research is fundamental or not, and gives a more clear idea	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2

		of the R&D impact on Technology Learning. Horizontal is spillovers between companies/institutes within the same branch.		
E11	**Deployment of Technologies outside Europe**			Section 3.5.2
E12	**Technology Cost outside Europe**			Section 3.5.2

INNOVATION AND R&D				
	Specification	**Description**	**Guidelines to evaluation**	**Location in Specification Report**
GENERAL SPECIFICATIONS				
D1	**Long-term economic perspectives of technologies**			Section 3.4
R&D				
D2	**Long-term risk assessment**	Risks involved in research activities within a long-term perspective. Risks that R&D will not deliver the cost reductions/technology improvement hoped for.		Section 3.4
D3	**R&D spending vs. number of patents**	R&D spending output in terms of patents.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.4.1
D4	**R&D spending vs. number of publications**	R&D spending output in terms of publications.	Same as above	
D5	**R&D spending vs. Deployment**	R&D spending in terms of e.g. amounts of new installed RES-capacity.		Section 3.4.1
D6	**Link between R&D and Technology Learning**	Assess expected impacts from R&D on the technology development, e.g. econometric models based on historical observations.	Same as above	
D7	**Public vs. Private R&D - effects technology development**	Distinguish between the effects on technology development (KPIs) by public and private R&D. (The nature of public and private R&D may differ; public tends to be more fundamental, private more applied).		Section 3.4.1
D8	**Public vs. Private R&D - effectiveness of stimulating**	Is the tool capable of determining which actors are involved in technology development		Section 3.4.1

	cooperation			
D9	**Public vs. Private R&D - timing**	Can the tool start R&D support at different times and assess its effect on e.g. the overall mix of technologies later on.		Section 3.4.1
D10	**Monitoring R&D targets**	Are technologies on track with promises from e.g. roadmaps (achievements)?		Section 3.4.1
D11	**Impact assessment of actions to catch up with the intended time schedule**	Can we feed the tool with actions (e.g. increased R&D funding, lowering targets) to determine its effect to catch up a technology's development with the original time schedule (in case the technology development is delayed)?		Section 3.4.1
D12	**Monitor depletion of funding**	Amount of available funding being spent; this gives insight in whether there is a structural problem that needs more attention or a logical explanation of why developments lag behind.		Section 3.4.1
D13	**Map effectiveness of R&D funding mechanisms**	To answer policy questions like: Is R&D funding provided via effective instruments (organizations like EERA, investment subsidies, grants, awards, etc.).		Section 3.4.1
INNOVATION				
D14	**Mapping of the size of industrial sectors relative to the World**	To identify strong and weak industrial sectors		Section 3.4.2
D15	**Patenting**	Number of Patents in order to measure innovation.		
D16	**Publications**	Number of Publications in order to measure innovation.		
D17	**Trade**	Share of Energy Technologies in the international trade flows. Consider if relative or absolute advantage.		

Appendix B

Model Ranking according to the List of Specifications

Transition Planning

Transition planning

Spatial planning

ROM	SAMLAST	SGM	STSc	TEMPO	TIAM-WORLD	TIMESNordic	TIMES-FI	TIMES PanEU	UKENVI	COMBAT	COMPETES	DICE	DNE21+	WASP	WEM	WIAGEM	WILMAR	Wilmar Plan. Tool	WITCH	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
N	M	M	M	N	G	G	G	G	N	N	M	P	VG	N	M	P	N	N	N	Ca1	Requirements for the supply chain	How well the tool considers the supply chain of natural sources, within the geographic scope of the tool. Rate highest if it includes GIS description of resources, next level if it considers the geographical aspects by for example different categories.		Section 3.3.1, p. 19
P	M	G	M	N	G	G	G	G	N	N	N	N	VG	N	M	P	P	M	N	Ca2	Regional potential for low-C technologies	Links to geography - Natural resource potential of an area to provide energy with a specific technology.		Section 3.3.1
P	vg	N	M	N	P	M	M	P	N	N	G	N	G	N	N	P	P	M	N	Ca3	Grid infrastructure existing and expansion within a country	Spatial planning of grid infrastructure: electricity grids, pipelines (gas, oil, hydrogen etc) within a country. For the electricity grids this includes infrastructure expansion to connect new generation capacity. For pipelines this refers to construction.		Section 3.3.1
P	vg	N	M	N	P	G	M	G	N	N	VG	N	G	N	N	N	P	M	N	Ca4	Cross-border grid infrastructure existing and expansion	Spatial Planning of the expansion of the cross-border capacity of grids (electricity and pipelines).		Section 3.3.1, p. 19
N	N	N	M	N	M	G	G	P	N	N	N	N	M	N	P	P	N	N	N	Ca5	Energy transport networks expansion - Non grid	Transportation of non grid distributed energy carriers. E.g.. Transportation of biomass, gasoline. Transported by truck, railway, ship etc.		Section 3.3.1, p. 19
P	vg	N	M	N	G	G	G	G	N	N	VG	N	M	N	M	P	M	VG	N	Ca6	Generation capacity	The location of the existing plants.		Section 3.3.1, p. 19
P	N	N	M	N	G	G	G	G	N	N	M	P	VG	N	G	N	N	N	N	Ca7	Generation capacity expansion	The spatial (dynamic) expansion of plants, considering both replacement and upgrades of existing plants.		Section 3.3.1, p. 19
P	M	N	M	N	G	G	M	G	N	N	G	N	G	P	M	P	M	G	P	Ca8	Cross-border energy infrastructure	Physical Import dependency. How is the import described? Can the uncertainty in the delivery of energy be considered? For example: Policy issues outside Europe, like policy issues in Northern Sahara countries in the case of Desertec.		Section 3.3.1
P	G	N	N	N	G	G	M	VG	N	N	M	N	VG	P	M	N	M	G	N	Ca9	Cost effective technology deployment	How well is the spatial difference in cost captured? Focus on how well the tool considers the "cost effectiveness" of the technology deployment within the spatial dimension, e.g. where is it more cost effective to install certain new technology.		Section 3.3.1, p. 19
P	VG	N	M	N	G	G	M	G	N	N	M	M	G	N	M	G	G	VG	P	Ca10	Demand	Spatial distribution of energy demand		
N	N	N	M	N	P	N	N	N	N	N	N	P	G	N	P	P	N	G	N	Ca11	Population density	The population density can help to provide information about the location of the residential demand of electricity, heating and cooling. For example when estimating the cost and needs of distribution.		Section 3.3.1, p. 19
N	N	N	G	N	N	N	N	G	N	N	N	N	N	N	N	N	N	N	P	Ca12	Land use	Considering different alternatives to use the land.		Section 3.3.1, p. 19

E2M2s	E3ME	E3MG	EDGE	EFDA-TIMES	EMELIE	EMM	EnergyPlan	ENPEP	ENV-Linkages	EPPA	ESPAUT	ESTEEM	ETP Model	FUND	GEM-CCGT	GEM-E3	GEMED	GEMINI-E3	GET	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																					Transition planning			
																					Spatial planning			
N	M	M	M	G	N	N	P	G	P	M	P	P	G	N	P	N	P	N	N	Ca1	Requirements for the supply chain	How well the tool considers the supply chain of natural sources, within the geographic scope of the tool. Rate highest if it includes GIS description of resources, next level if it considers the geographical aspects by for example different categories.		Section 3.3.1, p. 19
N	P	M	N	G	M	P	P	M	N	p	N	P	G	P	P	N	P	N	N	Ca2	Regional potential for low-C technologies	Links to geography - Natural resource potential of an area to provide energy with a specific technology.		Section 3.3.1
N	N	N	N	P	G	N	M	P	N	p	VG	P	P	N	N	N	N	N	N	Ca3	Grid infrastructure existing and expansion within a country	Spatial planning of grid infrastructure: electricity grids, pipelines (gas, oil, hydrogen etc) within a country. For the electricity grids this includes infrastructure expansion to connect new generation capacity. For pipelines this refers to construction.		Section 3.3.1
N	M	P	N	P	G	N	P	P	N	p	G	P	P	N	N	N	N	N	N	Ca4	Cross-border grid infrastructure existing and expansion	Spatial Planning of the expansion of the cross-border capacity of grids (electricity and pipelines).		Section 3.3.1, p. 19
N	N	N	N	M	N	N	N	P	N	p	N	P	P	P	N	N	N	N	N	Ca5	Energy transport networks expansion - Non grid	Transportation of non grid distributed energy carriers. E.g.. Transportation of biomass, gasoline. Transported by truck, railway, ship etc.		Section 3.3.1, p. 19
VG	N	N	N	G	G	M	N	P	N	p	P	P	G	N	N	N	N	N	N	Ca6	Generation capacity	The location of the existing plants.		Section 3.3.1, p. 19
VG	N	N	N	G	G	N	N	P	N	p	M	P	G	N	N	N	N	N	N	Ca7	Generation capacity expansion	The spatial (dynamic) expansion of plants, considering both replacement and upgrades of existing plants.		Section 3.3.1, p. 19
N	N	M	N	G	N	N	G	M	P	p	G	N	M	P	P	N	P	N	N	Ca8	Cross-border energy infrastructure	Physical Import dependency. How is the import described? Can the uncertainty in the delivery of energy be considered? For example: Policy issues outside Europe, like policy issues in Northern Sahara countries in the case of Desertec.		Section 3.3.1
M	N	N	P	G	M	N	P	P	N	p	N	M	G	P	N	P	N	N	N	Ca9	Cost effective technology deployment	How well is the spatial difference in cost captured? Focus on how well the tool considers the "cost effectiveness" of the technology deployment within the spatial dimension, e.g. where is it more cost effective to install certain new technology.		Section 3.3.1, p. 19
G	M	M	M	G	M	P	N	M	M	G	N	P	G	P	p	P	N	P	N	Ca10	Demand	Spatial distribution of energy demand		
N	N	N	N	N	N	N	N	N	P	M	N	P	N	N	P	P	N	N	N	Ca11	Population density	The population density can help to provide information about the location of the residential demand of electricity, heating and cooling. For example when estimating the cost and needs of distribution.		Section 3.3.1, p. 19
N	N	N	N	N	N	N	N	N	P	VG	M	G	N	N	N	N	N	N	N	Ca12	Land use	Considering different alternatives to use the land.		Section 3.3.1, p. 19

Transition planning

Spatial planning

GMM	GRAPE	GreenNET-Europe	GreenNET-Europe	GTAP-E	Horizonscan	IER - Model for Power	IGEM	iKnow	IMACLIM	IMAGE-TIMER	INVERT	IPAC	LEAP	MDM-E3	MECHanisms	MERGE	MESSAGE	Minicam	Minicam	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
M	P	N	N	N	G	N	M	P	M	G	M	N	G	M	N	N	G	G	G	Ca1	Requirements for the supply chain	How well the tool considers the supply chain of natural sources, within the geographic scope of the tool. Rate highest if it includes GIS description of resources, next level if it considers the geographical aspects by for example different categories.		Section 3.3.1, p. 19
G	P	N	N	N	G	M	N	G	M	G	VG	N	G	P	N	N	G	G	G	Ca2	Regional potential for low-C technologies	Links to geography - Natural resource potential of an area to provide energy with a specific technology.		Section 3.3.1
P	N	N	N	N	G	VG	N	P	N	P	N	N	N	N	N	N	M	P	P	Ca3	Grid infrastructure existing and expansion within a country	Spatial planning of grid infrastructure: electricity grids, pipelines (gas, oil, hydrogen etc) within a country. For the electricity grids this includes infrastructure expansion to connect new generation capacity. For pipelines this refers to construction.		Section 3.3.1
P	N	N	N	N	G	M	N	P	N	P	N	N	N	P	N	N	P	M	M	Ca4	Cross-border grid infrastructure existing and expansion	Spatial Planning of the expansion of the cross-border capacity of grids (electricity and pipelines).		Section 3.3.1, p. 19
P	N	N	N	P	G	N	N	P	N	N	N	N	N	N	N	N	M	M	M	Ca5	Energy transport networks expansion - Non grid	Transportation of non grid distributed energy carriers. E.g.. Transportation of biomass, gasoline. Transported by truck, railway, ship etc.		Section 3.3.1, p. 19
G	P	N	N	N	N	VG	N	N	P	G	M	N	N	M	N	N	G	M	M	Ca6	Generation capacity	The location of the existing plants.		Section 3.3.1, p. 19
M	N	N	N	N	G	VG	N	P	P	G	M	N	N	P	N	N	G	G	G	Ca7	Generation capacity expansion	The spatial (dynamic) expansion of plants, considering both replacement and upgrades of existing plants.		Section 3.3.1, p. 19
G	N	N	N	P	G	N	N	M	N	M	N	N	N	N	N	M	G	M	M	Ca8	Cross-border energy infrastructure	Physical Import dependency. How is the import described? Can the uncertainty in the delivery of energy be considered? For example: Policy issues outside Europe, like policy issues in Northern Sahara countries in the case of Desertec.		Section 3.3.1
G	P	N	N	N	G	G	P	P	P	VG	G	N	N	N	N	N	G	VG	VG	Ca9	Cost effective technology deployment	How well is the spatial difference in cost captured? Focus on how well the tool considers the "cost effectiveness" of the technology deployment within the spatial dimension, e.g. where is it more cost effective to install certain new technology.		Section 3.3.1, p. 19
M	P	N	N	M	M	VG	G	P	M	VG	G	N	G	P	G	N	G	VG	VG	Ca10	Demand	Spatial distribution of energy demand		
P	N	N	N	P	M	G	N	P	N	M	N	N	N	N	N	N	M	M	M	Ca11	Population density	The population density can help to provide information about the location of the residential demand of electricity, heating and cooling. For example when estimating the cost and needs of distribution.		Section 3.3.1, p. 19
N	P	N	N	G	G	N	N	M	G	G	N	N	N	N	N	N	M	VG	VG	Ca12	Land use	Considering different alternatives to use the land.		Section 3.3.1, p. 19

Transition planning

MIRAGE	MoreHys	MTSIM	MURE	NEMESIS	NEMS	NEWAGE	PACE	POLES	POWERS	PRIMES	REMARK	REMIND-R	RESolve-E	RESolve-T	RICE	ROM	SAMLAST	SGM	STSc	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Spatial planning				
N	VG	N	N	N	M	P	P	G	N	M	N	M	P	G	N	N	M	M	M	Ca1	**Requirements for the supply chain**	How well the tool considers the supply chain of natural sources, within the geographic scope of the tool. Rate highest if it includes GIS description of resources, next level if it considers the geographical aspects by for example different categories.		Section 3.3.1, p. 19
N	G	N	N	N	G	P	P	G	G	M	N	G	VG	VG	N	P	M	G	M	Ca2	**Regional potential for low-C technologies**	Links to geography - Natural resource potential of an area to provide energy with a specific technology.		Section 3.3.1
N	VG	VG	N	N	M	N	N	P	P	N	VG	N	M	N	N	P	vg	N	M	Ca3	**Grid infrastructure existing and expansion within a country**	Spatial planning of grid infrastructure: electricity grids, pipelines (gas, oil, hydrogen etc) within a country. For the electricity grids this includes infrastructure expansion to connect new generation capacity. For pipelines this refers to construction.		Section 3.3.1
N	VG	VG	N	N	N	N	N	P	G	P	VG	N	M	N	N	P	vg	N	M	Ca4	**Cross-border grid infrastructure existing and expansion**	Spatial Planning of the expansion of the cross-border capacity of grids (electricity and pipelines).		Section 3.3.1, p. 19
N	N	N	N	N	M	P	P	M	N	P	N	N	N	M	N	N	N	N	M	Ca5	**Energy transport networks expansion - Non grid**	Transportation of non grid distributed energy carriers. E.g.. Transportation of biomass, gasoline. Transported by truck, railway, ship etc.		Section 3.3.1, p. 19
N	G	P	N	N	G	P	N	G	VG	M	P	N	VG	N	N	P	vg	N	M	Ca6	**Generation capacity**	The location of the existing plants.		Section 3.3.1, p. 19
N	G	M	N	N	G	P	N	G	VG	M	G	N	VG	N	N	P	N	N	M	Ca7	**Generation capacity expansion**	The spatial (dynamic) expansion of plants, considering both replacement and upgrades of existing plants.		Section 3.3.1, p. 19
N	G	VG	N	N	N	P	P	VG	N	M	VG	P	P	VG	N	P	M	N	M	Ca8	**Cross-border energy infrastructure**	Physical Import dependency. How is the import described? Can the uncertainty in the delivery of energy be considered? For example: Policy issues outside Europe, like policy issues in Northern Sahara countries in the case of Desertec.		Section 3.3.1
N	G	N	N	N	G	P	N	G	M	M	N	G	VG	VG	N	P	G	N	N	Ca9	**Cost effective technology deployment**	How well is the spatial difference in cost captured? Focus on how well the tool considers the "cost effectiveness" of the technology deployment within the spatial dimension, e.g. where is it more cost effective to install certain new technology.		Section 3.3.1, p. 19
N	G	N	N	N	VG	G	G	G	N	M	P	M	M	VG	N	P	VG	N	M	Ca10	**Demand**	Spatial distribution of energy demand		
P	G	N	N	N	P	N	P	N	N	P	N	N	N	N	N	N	N	N	M	Ca11	**Population density**	The population density can help to provide information about the location of the residential demand of electricity, heating and cooling. For example when estimating the cost and needs of distribution.		Section 3.3.1, p. 19
P	N	N	N	VG	N	N	N	N	N	P	M	N	P	N	N	N	N	N	G	Ca12	**Land use**	Considering different alternatives to use the land.		Section 3.3.1, p. 19

TEMPO	TIAM-WORLD	TIMES-FI	TIMES PanEU	TIMES Nordic	UKENVI	E2M2s - IER	E2M2s - Duisburg-Essen	Transition planning				
								Nr	**Specification**	**Description**	**Guidelines to evaluation**	**Location in Specification Report**
								Spatial planning				
N	G	G	G	G	N	N	M	Ca1	Requirements for the supply chain	How well the tool considers the supply chain of natural sources, within the geographic scope of the tool. Rate highest if it includes GIS description of resources, next level if it considers the geographical aspects by for example different categories.		Section 3.3.1, p. 19
N	G	G	G	G	N	N	M	Ca2	Regional potential for low-C technologies	Links to geography - Natural resource potential of an area to provide energy with a specific technology.		Section 3.3.1
N	P	M	P	M	N	N	P	Ca3	Grid infrastructure existing and expansion within a country	Spatial planning of grid infrastructure: electricity grids, pipelines (gas, oil, hydrogen etc) within a country. For the electricity grids this includes infrastructure expansion to connect new generation capacity. For pipelines this refers to construction.		Section 3.3.1
N	P	M	G	G	N	N	P	Ca4	Cross-border grid infrastructure existing and expansion	Spatial Planning of the expansion of the cross-border capacity of grids (electricity and pipelines).		Section 3.3.1, p. 19
N	M	G	P	G	N	N	N	Ca5	Energy transport networks expansion - Non grid	Transportation of non grid distributed energy carriers. E.g.. Transportation of biomass, gasoline. Transported by truck, railway, ship etc.		Section 3.3.1, p. 19
N	G	G	G	G	N	VG	VG	Ca6	Generation capacity	The location of the existing plants.		Section 3.3.1, p. 19
N	G	G	G	G	N	VG	G	Ca7	Generation capacity expansion	The spatial (dynamic) expansion of plants, considering both replacement and upgrades of existing plants.		Section 3.3.1, p. 19
N	G	M	G	G	N	N	P	Ca8	Cross-border energy infrastructure	Physical Import dependency. How is the import described? Can the uncertainty in the delivery of energy be considered? For example: Policy issues outside Europe, like policy issues in Northern Sahara countries in the case of Desertec.		Section 3.3.1
N	G	M	VG	G	N	M	VG	Ca9	Cost effective technology deployment	How well is the spatial difference in cost captured? Focus on how well the tool considers the "cost effectiveness" of the technology deployment within the spatial dimension, e.g. where is it more cost effective to install certain new technology.		Section 3.3.1, p. 19
N	G	M	G	G	N	G	G	Ca10	Demand	Spatial distribution of energy demand		
N	P	N	N	N	N	N	N	Ca11	Population density	The population density can help to provide information about the location of the residential demand of electricity, heating and cooling. For example when estimating the cost and needs of distribution.		Section 3.3.1, p. 19
N	N	N	G	N	N	N	N	Ca12	Land use	Considering different alternatives to use the land.		Section 3.3.1, p. 19

ROM	SAMLAST	SGM	STSc	TEMPO	TIAM-WORLD	TIMESNordic	TIMES-FI	TIMES PanEU	UKENVI	COMBAT	COMPETES	DICE	DNE21+	WASP	WEM	WIAGEM	WILMAR	Wilmar Plan. Tool	WITCH	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Transition planning				
																				Deployment pathways				
P	N	G	G	G	VG	G	M	VG	VG	M	M	P	VG	M	G	G	P	M	VG	Ca13	Time evolution of energy demand	Modeling the time evolution of the energy demand.		
N	G	M	G	P	VG	M	P	N	N	N	N	P	VG	N	G	VG	N	N	VG	Ca14	Connection between local demand and national/global supply	Assess the interaction between local demand and global supply. For example how the European demand for biomass affects the global price of biomass, the price of food etc.		Section 3.3.2, p. 20
P	G	P	G	N	P	M	M	P	N	N	M	N	M	N	N	N	M	G	N	Ca15	Evolution of Grid infrastructure	Time evolution of grid infrastructure within a region.		Section 3.3.2, p. 20
P	G	N	G	N	P	M	P	G	N	N	M	N	M	N	P	N	P	G	N	Ca16	Evolution of cross-border infrastructure	The time-evolution of the cross-border grid infrastructure.		Section 3.3.2, p. 20
G	VG	P	M	P	M	M	P	G	N	N	N	N	VG	P	M	M	VG	VG	N	Ca17	Balancing capacity requirements	Need of flexibility for balancing intermittency of renewables or the fluctuations of demand. For example requirements of rapid response conventional power plants (e.g. gas turbines) to balance the high penetration of renewables.		Section 3.3.2
N	n	P	G	N	M	M	P	P	N	N	N	N	M	N	M	N	N	N	P	Ca18	Evolution of energy transport networks - Non grid	The time evolution of supply chain logistics.		Section 3.3.2, p. 20
P	M	M	G	N	VG	VG	VG	VG	N	N	M	P	VG	vg	G	P	P	N	G	Ca19	Evolution of the Generation Capacity	The evolution of the generation capacity.		Section 3.3.2, p. 20
N	N	P	VG	N	G	N	M	N	N	N	M	N	M	N	N	P	N	N	M	Ca20	Interaction between technology deployment and industry	A systemic approach is required combining the results from top-down and bottom-up as-assessments to deal with synergies and interdependencies between technological and industrial levels. For example the development of electricity storage is boosted by the electrical vehicles industry.		Section 3.3.2, p. 20
N	M	N	VG	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca21	Public-private agent behaviours and partnerships	Account for agent behaviours both public and private, according to their respective role and considering also public-private partnerships.		Section 3.3.2, p. 20
N	N	N	VG	N	N	N	M	N	M	N	P	N	P	N	N	N	N	N	P	Ca22	Technology uptake	To assess the impact of the transition of the energy system on sectoral changes (e.g. implementation of solar energy in buildings makes the construction sector stakeholder in the energy system and stimulates adoption of this new technology into their construction methods.)		Section 3.3.2
M	G	M	VG	P	M	P	M	P	N	p	VG	N	M	N	P	N	N	P	M	Ca23	Time evolution of the Supply chain	The development of the supply chain over time. How well the tool considers the needs for? Assess whether requirements for deploying a technology are or can be fulfilled reasonably. Include impact of the energy system transition (e.g. impact of changes of the energy system). For example, before wind power can be fully integrated the grid might need to be extended.		Section 3.3.2, p. 20
N	N	N	VG	N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	M	Ca24	Closure of gap between demonstration and commercialization	How well does the tool consider the gap between demonstration and commercialization of a certain technology.		Section 3.3.2, p. 21
P	N	M	G	N	G	M	G	M	VG	M	VG	M	M	N	N	M	P	N	G	Ca25	Links between the energy system and the economy	Changes in energy demand and sectoral changes resulting from changes in the energy system. For example, how well changes in demand as a result of the application of certain technologies (e.g. zero energy buildings) can be considered.		Section 3.3.2
P	N	N	M	N	G	P	P	P	N	N	N	N	N	P	N	N	N	N	N	Ca26	Time lag between investment decision and entering into construction/operation.	To estimate the time lag will weight the tool higher compared with including the assumed time lag in the model. Include the effect of the different regulatory frameworks in the MS on the time lag. The effect of different regulatory frameworks in Member States (e.g. the length of permitting procedures) should be accounted for in the model toolbox. Regulatory frameworks are one of the mechanisms affecting the time lag between investment decisions and actually producing electricity.		Section 3.3.2, p. 21
P	M	P	G	N	N	N	N	N	N	N	M	N	N	N	N	G	N	N	N	Ca27	Behavioural Change	Energy End users behaviour		
P	N	M	G	N	M	M	M	P	G	M	VG	N	P	N	M	G	P	N	M	Ca28	Market barriers	Barriers for new entry or expansion of technologies. Example of market barrier: Capital requirements, Government policy, Regulations, Organizational, Switching costs.		Section 3.3.2, p. 22

E2M2s	E3ME	E3MG	EDGE	EFDA-TIMES	EMELIE	EMM	EnergyPlan	ENPEP	ENV-Linkages	EPPA	ESPAUT	ESTEEM	ETP Model	FUND	GEM-CCGT	GEM-E3	GEMED	GEMINI-E3	GET	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																					Transition planning			
																					Deployment pathways			
VG	G	VG	M	VG	M	N	P	VG	M	G	N	N	G	M	N	VG	P	M	N	Ca13	Time evolution of energy demand	Modeling the time evolution of the energy demand.		
N	M	VG	P	VG	N	N	N	N	M	G	M	P	G	N	G	M	M	N	N	Ca14	Connection between local demand and national/global supply	Assess the interaction between local demand and global supply. For example how the European demand for biomass affects the global price of biomass, the price of food etc.		Section 3.3.2, p. 20
N	N	N	N	P	M	N	p	N	N	P	VG	N	P	N	N	N	N	N	N	Ca15	Evolution of Grid infrastructure	Time evolution of grid infrastructure within a region.		Section 3.3.2, p. 20
N	N	P	N	P	G	P	M	M	N	P	VG	N	P	N	N	N	P	N	N	Ca16	Evolution of cross-border infrastructure	The time-evolution of the cross-border grid infrastructure.		Section 3.3.2, p. 20
VG	N	N	N	M	VG	N	VG	p	N	P	G	N	M	N	N	N	N	N	N	Ca17	Balancing capacity requirements	Need of flexibility for balancing intermittency of renewables or the fluctuations of demand. For example requirements of rapid response conventional power plants (e.g. gas turbines) to balance the high penetration of renewables.		Section 3.3.2
N	N	N	N	M	N	N	N	N	N	N	N	P	P	N	N	N	N	N	N	Ca18	Evolution of energy transport networks - Non grid	The time evolution of supply chain logistics.		Section 3.3.2, p. 20
VG	G	M	N	VG	VG	P	N	VG	N	P	P	P	VG	N	P	P	G	N	M	Ca19	Evolution of the Generation Capacity	The evolution of the generation capacity.		Section 3.3.2, p. 20
N	M	M	N	G	N	N	N	N	M	M	N	P	N	N	P	M	G	M	N	Ca20	Interaction between technology deployment and industry	A systemic approach is required combining the results from top-down and bottom-up as-assessments to deal with synergies and interdependencies between technological and industrial levels. For example the development of electricity storage is boosted by the electrical vehicles industry.		Section 3.3.2, p. 20
N	N	N	N	P	N	N	N	N	P	M	N	VG	N	N	N	P	M	P	N	Ca21	Public-private agent behaviours and partnerships	Account for agent behaviours both public and private, according to their respective role and considering also public-private partnerships.		Section 3.3.2, p. 20
N	M	M	N	M	N	N	N	M	N	N	N	G	N	N	N	P	M	N	N	Ca22	Technology uptake	To assess the impact of the transition of the energy system on sectoral changes (e.g. implementation of solar energy in buildings makes the construction sector stakeholder in the energy system and stimulates adoption of this new technology into their construction methods.)		Section 3.3.2
N	P	N	N	VG	N	N	N	N	N	N	N	P	P	N	N	N	P	N	G	Ca23	Time evolution of the Supply chain	The development of the supply chain over time. How well the tool considers the needs for? Assess whether requirements for deploying a technology are or can be fulfilled reasonably. Include impact of the energy system transition (e.g. impact of changes of the energy system). For example, before wind power can be fully integrated the grid might need to be extended.		Section 3.3.2, p. 20
N	N	N	N	P	N	N	N	N	N	N	N	VG	N	N	N	N	P	N	N	Ca24	Closure of gap between demonstration and commercialization	How well does the tool consider the gap between demonstration and commercialization of a certain technology.		Section 3.3.2, p. 21
N	VG	VG	P	VG	N	N	N	G	G	VG	N	M	M	N	G	G	G	P	P	Ca25	Links between the energy system and the economy	Changes in energy demand and sectoral changes resulting from changes in the energy system. For example, how well changes in demand as a result of the application of certain technologies (e.g. zero energy buildings) can be considered.		Section 3.3.2
N	N	N	M	G	N	N	N	N	N	N	N	M	P	N	N	N	G	N	N	Ca26	Time lag between investment decision and entering into construction/operation.	To estimate the time lag will weight the tool higher compared with including the assumed time lag in the model. Include the effect of the different regulatory frameworks in the MS on the time lag. The effect of different regulatory frameworks in Member States (e.g. the length of permitting procedures) should be accounted for in the model toolbox. Regulatory frameworks are one of the mechanisms affecting the time lag between investment decisions and actually producing electricity.		Section 3.3.2, p. 21
N	P	N	N	N	N	N	N	G	N	M	N	M	N	N	N		G	N	N	Ca27	Behavioural Change	Energy End users behaviour		
M	M	N	N	M	P	P	N	G	P	G	N	M	M	N	G	G	M	N	N	Ca28	Market barriers	Barriers for new entry or expansion of technologies. Example of market barrier: Capital requirements, Government policy, Regulations, Organizational, Switching costs.		Section 3.3.2, p. 22

Transition planning

GMM	GRAPE	GreenNET-Europe	GreenNET-Europe	GTAP-E	Horizonscan	IER - Model for Power	IGEM	iKnow	IMACLIM	IMAGE-TIMER	INVERT	IPAC	LEAP	MDM-E3	MECHanisms	MERGE	MESSAGE	Minicam	Minicam	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Deployment pathways				
G	VG	G	G	G	M	VG	VG	P	VG	VG	VG	G	G	G	G	VG	VG	VG	VG	Ca13	Time evolution of energy demand	Modeling the time evolution of the energy demand.		
G	VG	N	N	G	G	N	G	M	VG	VG	N	VG	N	M	N	VG	VG	G	G	Ca14	Connection between local demand and national/global supply	Assess the interaction between local demand and global supply. For example how the European demand for biomass affects the global price of biomass, the price of food etc.		Section 3.3.2, p. 20
P	P	G	G	N	G	VG	N	P	N	P	N	N	N	N	N	P	M	N	N	Ca15	Evolution of Grid infrastructure	Time evolution of grid infrastructure within a region.		Section 3.3.2, p. 20
P	P	N	N	N	G	M	N	P	N	N	N	N	N	P	N	N	M	P	P	Ca16	Evolution of cross-border infrastructure	The time-evolution of the cross-border grid infrastructure.		Section 3.3.2, p. 20
M	N	VG	VG	N	G	G	N	M	M	G	N	N	N	N	N	N	P	P	M	Ca17	Balancing capacity requirements	Need of flexibility for balancing intermittency of renewables or the fluctuations of demand. For example requirements of rapid response conventional power plants (e.g. gas turbines) to balance the high penetration of renewables.		Section 3.3.2
M	P	N	N	N	G	N	N	P	N	G	N	N	N	N	N	N	M	P	P	Ca18	Evolution of energy transport networks - Non grid	The time evolution of supply chain logistics.		Section 3.3.2, p. 20
VG	M	VG	VG	N	G	G	G	P	VG	VG	G	M	M	M	N	G	G	M	M	Ca19	Evolution of the Generation Capacity	The evolution of the generation capacity.		Section 3.3.2, p. 20
G	M	N	N	N	VG	N	M	G	VG	M	N	N	N	M	M	M	G	M	M	Ca20	Interaction between technology deployment and industry	A systemic approach is required combining the results from top-down and bottom-up as-assessments to deal with synergies and interdependencies between technological and industrial levels. For example the development of electricity storage is boosted by the electrical vehicles industry.		Section 3.3.2, p. 20
N	N	N	N	N	VG	N	N	VG	N	N	N	N	N	N	VG	N	N	N	N	Ca21	Public-private agent behaviours and partnerships	Account for agent behaviours both public and private, according to their respective role and considering also public-private partnerships.		Section 3.3.2, p. 20
G	M	N	N	N	VG	N	N	G	VG	N	N	N	N	M	VG	N	N	N	N	Ca22	Technology uptake	To assess the impact of the transition of the energy system on sectoral changes (e.g. implementation of solar energy in buildings makes the construction sector stakeholder in the energy system and stimulates adoption of this new technology into their construction methods.)		Section 3.3.2
N	VG	N	N	N	VG	P	M	G	P	P	N	N	P	N	N	N	G	M	M	Ca23	Time evolution of the Supply chain	The development of the supply chain over time. How well the tool considers the needs for? Assess whether requirements for deploying a technology are or can be fulfilled reasonably. Include impact of the energy system transition (e.g. impact of changes of the energy system). For example, before wind power can be fully integrated the grid might need to be extended.		Section 3.3.2, p. 20
P	P	N	N	N	VG	N	N	G	N	N	N	N	N	N	VG	N	N	N	N	Ca24	Closure of gap between demonstration and commercialization	How well does the tool consider the gap between demonstration and commercialization of a certain technology.		Section 3.3.2, p. 21
VG	VG	N	N	M	M	N	G	P	VG	M	N	VG	N	VG	N	VG	M	G	G	Ca25	Links between the energy system and the economy	Changes in energy demand and sectoral changes resulting from changes in the energy system. For example, how well changes in demand as a result of the application of certain technologies (e.g. zero energy buildings) can be considered.		Section 3.3.2
M	N	N	N	N	N	N	N	N	N	N	N	N	P	P	G	N	P	P	P	Ca26	Time lag between investment decision and entering into construction/operation.	To estimate the time lag will weight the tool higher compared with including the assumed time lag in the model. Include the effect of the different regulatory frameworks in the MS on the time lag. The effect of different regulatory frameworks in Member States (e.g. the length of permitting procedures) should be accounted for in the model toolbox. Regulatory frameworks are one of the mechanisms affecting the time lag between investment decisions and actually producing electricity.		Section 3.3.2, p. 21
P	N	N	N	P	G	N	N	M	P	N	N	N	N	P	VG	N	N	P	P	Ca27	Behavioural Change	Energy End users behaviour		
M	M	M	M	M	G	N	N	M	M	P	G	N	N	M	VG	N	P	P	P	Ca28	Market barriers	Barriers for new entry or expansion of technologies. Example of market barrier: Capital requirements, Government policy, Regulations, Organizational, Switching costs.		Section 3.3.2, p. 22

Transition planning

MIRAGE	MoreHys	MTSIM	MURE	NEMESIS	NEMS	NEWAGE	PACE	POLES	POWERS	PRIMES	REMARK	REMIND-R	RESolve-E	RESolve-T	RICE	ROM	SAMLAST	SGM	STSc	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Deployment pathways				
N	VG	N	VG	M	VG	G	G	VG	VG	VG	N	G	M	P	VG	P	N	G	G	Ca13	Time evolution of energy demand	Modeling the time evolution of the energy demand.		
M	N	N	N	N	M	G	VG	VG	M	G	P	P	M	G	G	N	G	M	G	Ca14	Connection between local demand and national/global supply	Assess the interaction between local demand and global supply. For example how the European demand for biomass affects the global price of biomass, the price of food etc.		Section 3.3.2, p. 20
N	G	VG	N	N	M	N	N	P	P	N	VG	N	M	N	N	P	G	P	G	Ca15	Evolution of Grid infrastructure	Time evolution of grid infrastructure within a region.		Section 3.3.2, p. 20
N	N	VG	N	N	N	P	N	P	G	M	VG	N	M	N	N	P	G	N	G	Ca16	Evolution of cross-border infrastructure	The time-evolution of the cross-border grid infrastructure.		Section 3.3.2, p. 20
N	N	VG	N	N	G	N	M	P	M	P	VG	N	P	N	N	G	VG	P	M	Ca17	Balancing capacity requirements	Need of flexibility for balancing intermittency of renewables or the fluctuations of demand. For example requirements of rapid response conventional power plants (e.g. gas turbines) to balance the high penetration of renewables.		Section 3.3.2
N	N	N	N	N	p	N	N	M	N	P	N	P	N	M	N	N	n	P	G	Ca18	Evolution of energy transport networks - Non grid	The time evolution of supply chain logistics.		Section 3.3.2, p. 20
N	VG	N	N	N	G	P	P	VG	VG	VG	M	G	VG	N	N	P	M	M	G	Ca19	Evolution of the Generation Capacity	The evolution of the generation capacity.		Section 3.3.2, p. 20
N	N	N	N	N	P	N	P	M	P	M	N	N	N	P	N	N	N	P	VG	Ca20	Interaction between technology deployment and industry	A systemic approach is required combining the results from top-down and bottom-up as-assessments to deal with synergies and interdependencies between technological and industrial levels. For example the development of electricity storage is boosted by the electrical vehicles industry.		Section 3.3.2, p. 20
N	N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	M	N	VG	Ca21	Public-private agent behaviours and partnerships	Account for agent behaviours both public and private, according to their respective role and considering also public-private partnerships.		Section 3.3.2, p. 20
N	G	N	N	N	N	N	N	P	N	N	N	N	M	M	N	N	N	N	VG	Ca22	Technology uptake	To assess the impact of the transition of the energy system on sectoral changes (e.g. implementation of solar energy in buildings makes the construction sector stakeholder in the energy system and stimulates adoption of this new technology into their construction methods.)		Section 3.3.2
N	VG	N	N	N	N	N	N	G	N	M	N	P	M	M	P	M	G	M	VG	Ca23	Time evolution of the Supply chain	The development of the supply chain over time. How well the tool considers the needs for? Assess whether requirements for deploying a technology are or can be fulfilled reasonably. Include impact of the energy system transition (e.g. impact of changes of the energy system). For example, before wind power can be fully integrated the grid might need to be extended.		Section 3.3.2, p. 20
N	N	N	M	N	N	N	N	P	N	M	N	N	N	N	N	N	N	N	VG	Ca24	Closure of gap between demonstration and commercialization	How well does the tool consider the gap between demonstration and commercialization of a certain technology.		Section 3.3.2, p. 21
N	N	N	N	N	VG	G	G	G	P	G	N	G	P	N	VG	P	N	M	G	Ca25	Links between the energy system and the economy	Changes in energy demand and sectoral changes resulting from changes in the energy system. For example, how well changes in demand as a result of the application of certain technologies (e.g. zero energy buildings) can be considered.		Section 3.3.2
N	N	N	N	N	N	N	N	G	P	M	N	N	G	N	N	P	N	N	M	Ca26	Time lag between investment decision and entering into construction/operation.	To estimate the time lag will weight the tool higher compared with including the assumed time lag in the model. Include the effect of the different regulatory frameworks in the MS on the time lag. The effect of different regulatory frameworks in Member States (e.g. the length of permitting procedures) should be accounted for in the model toolbox. Regulatory frameworks are one of the mechanisms affecting the time lag between investment decisions and actually producing electricity.		Section 3.3.2, p. 21
N	P	N	M	M	N	P	G	N	N	P	N	P	N	N	N	P	M	P	G	Ca27	Behavioural Change	Energy End users behaviour		
N	N	N	M	N	M	M	G	M	M	G	N	G	G	M	N	P	N	M	G	Ca28	Market barriers	Barriers for new entry or expansion of technologies. Example of market barrier: Capital requirements, Government policy, Regulations, Organizational, Switching costs.		Section 3.3.2, p. 22

TEMPO	TIAM-WORLD	TIMES-FI	TIMES PanEU	TIMES Nordic	UKENVI	E2M2s - IER	E2M2s - Duisburg-Essen	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								Transition planning				
								Deployment pathways				
G	VG	M	VG	G	VG	VG	P	Ca13	Time evolution of energy demand	Modeling the time evolution of the energy demand.		
P	VG	P	N	M	N	N	N	Ca14	Connection between local demand and national/global supply	Assess the interaction between local demand and global supply. For example how the European demand for biomass affects the global price of biomass, the price of food etc.		Section 3.3.2, p. 20
N	P	M	P	M	N	N	G	Ca15	Evolution of Grid infrastructure	Time evolution of grid infrastructure within a region.		Section 3.3.2, p. 20
N	P	P	G	M	N	N	G	Ca16	Evolution of cross-border infrastructure	The time-evolution of the cross-border grid infrastructure.		Section 3.3.2, p. 20
P	M	P	G	M	N	VG	G	Ca17	Balancing capacity requirements	Need of flexibility for balancing intermittency of renewables or the fluctuations of demand. For example requirements of rapid response conventional power plants (e.g. gas turbines) to balance the high penetration of renewables.		Section 3.3.2
N	M	P	P	M	N	N	P	Ca18	Evolution of energy transport networks - Non grid	The time evolution of supply chain logistics.		Section 3.3.2, p. 20
N	VG	VG	VG	VG	N	VG	VG	Ca19	Evolution of the Generation Capacity	The evolution of the generation capacity.		Section 3.3.2, p. 20
N	G	M	N	N	N	N	N	Ca20	Interaction between technology deployment and industry	A systemic approach is required combining the results from top-down and bottom-up as-assessments to deal with synergies and interdependencies between technological and industrial levels. For example the development of electricity storage is boosted by the electrical vehicles industry.		Section 3.3.2, p. 20
N	N	N	N	N	N	N	N	Ca21	Public-private agent behaviours and partnerships	Account for agent behaviours both public and private, according to their respective role and considering also public-private partnerships.		Section 3.3.2, p. 20
N	N	M	N	N	M	N	N	Ca22	Technology uptake	To assess the impact of the transition of the energy system on sectoral changes (e.g. implementation of solar energy in buildings makes the construction sector stakeholder in the energy system and stimulates adoption of this new technology into their construction methods.)		Section 3.3.2
P	M	M	P	P	N	N	N	Ca23	Time evolution of the Supply chain	The development of the supply chain over time. How well the tool considers the needs for? Assess whether requirements for deploying a technology are or can be fulfilled reasonably. Include impact of the energy system transition (e.g. impact of changes of the energy system). For example, before wind power can be fully integrated the grid might need to be extended.		Section 3.3.2, p. 20
N	N	M	N	N	N	N	N	Ca24	Closure of gap between demonstration and commercialization	How well does the tool consider the gap between demonstration and commercialization of a certain technology.		Section 3.3.2, p. 21
N	G	G	M	M	VG	N	P	Ca25	Links between the energy system and the economy	Changes in energy demand and sectoral changes resulting from changes in the energy system. For example, how well changes in demand as a result of the application of certain technologies (e.g. zero energy buildings) can be considered.		Section 3.3.2
N	G	P	P	P	N	N	P	Ca26	Time lag between investment decision and entering into construction/operation.	To estimate the time lag will weight the tool higher compared with including the assumed time lag in the model. Include the effect of the different regulatory frameworks in the MS on the time lag. The effect of different regulatory frameworks in Member States (e.g. the length of permitting procedures) should be accounted for in the model toolbox. Regulatory frameworks are one of the mechanisms affecting the time lag between investment decisions and actually producing electricity.		Section 3.3.2, p. 21
N	N	N	N	N	N	N	N	Ca27	Behavioural Change	Energy End users behaviour		
N	M	M	P	M	G	M	M	Ca28	Market barriers	Barriers for new entry or expansion of technologies. Example of market barrier: Capital requirements, Government policy, Regulations, Organizational, Switching costs.		Section 3.3.2, p. 22

Transition planning

ROM	SAMLAST	SGM	STSc	TEMPO	TIAM-WORLD	TIMESNordic	TIMES-FI	TIMES PanEU	UKENVI	COMBAT	COMPETES	DICE	DNE21+	WASP	WEM	WAGEM	WILMAR	Wilmar Plan. Tool	WITCH	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Socio-Economics				
P	M	G	N	G	VG	G	G	G	VG	M	P	G	VG	N	G	VG	P	P	M	Ca29	**Energy demand**	Overall energy demand of different economic agents (industrial sectors, households, government, etc.).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments - the tool should score high.	
N	N	M	N	N	N	N	N	N	VG	N	N	N	N	N	N	G	N	N	N	Ca30	**Quantification of labour demand in the whole economy**	Example: how well are the direct and indirect effects of energy prices on the labour demand considered in the tool. General equilibrium model will typical score high.		Section 3.3.1, p. 19
N	N	P	N	N	N	N	N	N	G	N	N	N	N	N	N	G	N	N	N	Ca31	**Quantification of labour demand from supply chain perspective**	Quantify direct and indirect employment that can result from the deployment of low carbon technologies (especially when the implementation phase starts) from the supply chain perspective and the technology deployment.		Section 3.3.5
N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	Ca32	**Migration flows**	Migration flows associated to changes/transition of the energy system.		Section 3.3.5
M	G	G	M	M	VG	G	G	G	G	G	VG	G	G	M	G	VG	G	VG	VG	Ca33	**Energy prices**	Does the model consider energy prices?	Tools with endogenously prices will rate higher compared with tools with exogenous prices.	Section 3.3.1, p. 19
P	n	P	N	N	M	N	P	G	N	N	P	N	G	N	M	P	N	N	N	Ca34	**Energy prices for different groups**	Higher rating for models having different user groups, and moreover for different income or socio-professional household groups.		Section 3.3.5
N	G	P	G	N	N	N	P	N	N	N	G	N	N	N	N	P	N	N	M	Ca35	**Distribution of local costs and benefits.**	Effects from different technologies on local costs and benefits; the distribution of the benefits.		Section 3.3.5

Transition planning

Socio-Economics

Nr	E2M2s	E3ME	E3MG	EDGE	EFDA-TIMES	EMELIE	EMM	EnergyPlan	ENPEP	ENV-Linkages	EPPA	ESPAUT	ESTEEM	ETP Model	FUND	GEM-CCGT	GEM-E3	GEMED	GEMINI-E3	GET
Ca29	P	VG	VG	M	VG	N	M	p	VG	M	G	N	N	G	N	VG	VG	G	VG	VG
Ca30	N	VG	VG	M	N	N	N	N	N	G	G	N	N	N	N	VG	VG	VG	VG	N
Ca31	N	G	VG	N	N	N	N	N	N	M	M	N	N	N	N	G	G	G	M	N
Ca32	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	P	N
Ca33	VG	VG	VG	M	VG	G	VG	M	VG	M	G	M	G	G	N	G	P	G	VG	VG
Ca34	N	P	N	N	G	N	P	N	N	P	M	N	N	N	N	M	P	G	VG	N
Ca35	N	N	N	N	P	N	N	N	N	P	P	N	VG	N	N	P	P	VG	N	N

Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
Ca29	**Energy demand**	Overall energy demand of different economic agents (industrial sectors, households, government, etc.).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments - the tool should score high.	
Ca30	**Quantification of labour demand in the whole economy**	Example: how well are the direct and indirect effects of energy prices on the labour demand considered in the tool. General equilibrium model will typical score high.		Section 3.3.1, p. 19
Ca31	**Quantification of labour demand from supply chain perspective**	Quantify direct and indirect employment that can result from the deployment of low carbon technologies (especially when the implementation phase starts) from the supply chain perspective and the technology deployment.		Section 3.3.5
Ca32	**Migration flows**	Migration flows associated to changes/transition of the energy system.		Section 3.3.5
Ca33	**Energy prices**	Does the model consider energy prices?	Tools with endogenously prices will rate higher compared with tools with exogenous prices.	Section 3.3.1, p. 19
Ca34	**Energy prices for different groups**	Higher rating for models having different user groups, and moreover for different income or socio-professional household groups.		Section 3.3.5
Ca35	**Distribution of local costs and benefits.**	Effects from different technologies on local costs and benefits; the distribution of the benefits.		Section 3.3.5

Transition planning

GMM	GRAPE	GreenNET-Europe	GreenNET-Europe	GTAP-E	Horizonscan	IER - Model for Power	IGEM	iKnow	IMACLIM	IMAGE-TIMER	INVERT	IPAC	LEAP	MDM-E3	MECHanisms	MERGE	MESSAGE	Minicam	Minicam	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Socio-Economics				
G	VG	VG	VG	G	M	N	VG	M	M	G	G	VG	G	G	VG	VG	VG	M	M	Ca29	**Energy demand**	Overall energy demand of different economic agents (industrial sectors, households, government, etc.).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments - the tool should score high.	
P	N	N	N	VG	M	N	VG	P	VG	N	N	VG	N	VG	N	VG	N	P	P	Ca30	**Quantification of labour demand in the whole economy**	Example: how well are the direct and indirect effects of energy prices on the labour demand considered in the tool. General equilibrium model will typical score high.		Section 3.3.1, p. 19
N	N	N	N	M	M	N	P	P	N	N	N	N	N	G	N	VG	N	N	N	Ca31	**Quantification of labour demand from supply chain perspective**	Quantify direct and indirect employment that can result from the deployment of low carbon technologies (especially when the implementation phase starts) from the supply chain perspective and the technology deployment.		Section 3.3.5
N	N	N	N	P	G	N	N	M	N	N	N	N	N	N	N	N	N	N	N	Ca32	**Migration flows**	Migration flows associated to changes/transition of the energy system.		Section 3.3.5
VG	VG	M	M	G	M	VG	VG	P	VG	G	M	VG	VG	VG	P	G	VG	VG	VG	Ca33	**Energy prices**	Does the model consider energy prices?	Tools with endogenously prices will rate higher compared with tools with exogenous prices.	Section 3.3.1, p. 19
M	N	N	N	P	M	N	N	M	N	N	N	N	N	G	N	N	VG	G	G	Ca34	**Energy prices for different groups**	Higher rating for models having different user groups, and moreover for different income or socio-professional household groups.		Section 3.3.5
N	N	N	N	P	G	N	N	G	N	N	N	N	n	P	VG	N	N	P	P	Ca35	**Distribution of local costs and benefits.**	Effects from different technologies on local costs and benefits; the distribution of the benefits.		Section 3.3.5

Transition planning

MIRAGE	MoreHys	MTSIM	MURE	NEMESIS	NEMS	NEWAGE	PACE	POLES	POWERS	PRIMES	REMARK	REMIND-R	RESolve-E	RESolve-T	RICE	ROM	SAMLAST	SGM	STSc	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Socio-Economics				
G	VG	N	VG	VG	VG	VG	VG	G	G	VG	N	G	N	M	VG	P	M	G	N	Ca29	Energy demand	Overall energy demand of different economic agents (industrial sectors, households, government, etc.).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments - the tool should score high.	
VG	N	N	N	VG	VG	G	VG	N	N	N	N	G	N	N	VG	N	N	M	N	Ca30	Quantification of labour demand in the whole economy	Example: how well are the direct and indirect effects of energy prices on the labour demand considered in the tool. General equilibrium model will typical score high.		Section 3.3.1, p. 19
G	N	N	N	G	N	G	VG	N	N	N	N	M	N	N	N	N	N	P	N	Ca31	Quantification of labour demand from supply chain perspective	Quantify direct and indirect employment that can result from the deployment of low carbon technologies (especially when the implementation phase starts) from the supply chain perspective and the technology deployment.		Section 3.3.5
P	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	P	N	Ca32	Migration flows	Migration flows associated to changes/transition of the energy system.		Section 3.3.5
G	M	M	N	VG	G	G	G	VG	VG	VG	M	G	P	M	VG	M	G	G	M	Ca33	Energy prices	Does the model consider energy prices?	Tools with endogenously prices will rate higher compared with tools with exogenous prices.	Section 3.3.1, p. 19
M	N	N	N	VG	M	P	M	G	VG	G	N	M	N	N	N	P	n	P	N	Ca34	Energy prices for different groups	Higher rating for models having different user groups, and moreover for different income or socio-professional household groups.		Section 3.3.5
N	N	N	N	N	P	P	P	P	N	P	N	P	N	N	N	N	G	P	G	Ca35	Distribution of local costs and benefits.	Effects from different technologies on local costs and benefits; the distribution of the benefits.		Section 3.3.5

TEMPO	TIAM-WORLD	TIMES-FI	TIMES PanEU	TIMES Nordic	UKENVI	E2M2s - IER	E2M2s - Duisburg-Essen	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								Transition planning				
								Socio-Economics				
G	VG	G	G	G	VG	P	P	Ca29	**Energy demand**	Overall energy demand of different economic agents (industrial sectors, households, government, etc.).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments - the tool should score high.	
N	N	N	N	N	VG	N	N	Ca30	**Quantification of labour demand in the whole economy**	Example: how well are the direct and indirect effects of energy prices on the labour demand considered in the tool. General equilibrium model will typical score high.		Section 3.3.1, p. 19
N	N	N	N	N	G	N	N	Ca31	**Quantification of labour demand from supply chain perspective**	Quantify direct and indirect employment that can result from the deployment of low carbon technologies (especially when the implementation phase starts) from the supply chain perspective and the technology deployment.		Section 3.3.5
N	N	N	N	N	N	N	N	Ca32	**Migration flows**	Migration flows associated to changes/transition of the energy system.		Section 3.3.5
M	VG	G	G	G	G	VG	M	Ca33	**Energy prices**	Does the model consider energy prices?	Tools with endogenously prices will rate higher compared with tools with exogenous prices.	Section 3.3.1, p. 19
N	M	P	G	N	N	N	N	Ca34	**Energy prices for different groups**	Higher rating for models having different user groups, and moreover for different income or socio-professional household groups.		Section 3.3.5
N	N	P	N	N	N	N	N	Ca35	**Distribution of local costs and benefits.**	Effects from different technologies on local costs and benefits; the distribution of the benefits.		Section 3.3.5

ROM	SAMLAST	SGM	STSc	TEMPO	TIAM-WORLD	TIMESNordic	TIMES-FI	TIMES PanEU	UKENVI	COMBAT	COMPETES	DICE	DNE21+	WASP	WEM	WIAGEM	WILMAR	Wilmar Plan. Tool	WITCH	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Transition planning				
																				Acceptance and technology perception				
N	N	N	M	N	N	N	N	P	N	N	N	N	N	N	P	N	N	N	N	Ca36	Public acceptance	Public acceptance of technologies - Necessity for and level of public awareness		Section 3.3.5
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca37	Public perception	Public acceptance of technologies - Necessity for and level of public understanding on		Section 3.3.5
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	N	Ca38	Public opinion obstacles	- The technology in itself		Section 3.3.5
N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca39	Public participation	- How to make use of a technology		Section 3.3.5, p. 22
N	N	N	M	M	G	N	P	P	N	N	N	N	N	N	N	N	N	N	N	Ca40	Financial risk perception	- A technology's implications		Section 3.3.5, p.23
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca41	Perceptions on reliability of a technology as energy source	Public acceptance of technologies - Relations between the expectations and current implementation scale		Section 3.3.5, **p. 23**
N	N	N	G	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	N	Ca42	Resistance based on issues of principle	Public participation such as "Generally public participation seeks and facilitates the involvement of those potentially affected by or interested in a decision. The principle of public participation holds that those who are affected by a decision have a right to be involved in the decision-making process. Public participation implies that the public's contribution will influence the decision" (http://www.iap2.org/displaycommon.cfm?an=4, http://www.co-intelligence.org/CIPol_publicparticipation.html).		
N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca43	Concerns for window dressing	Risk perception:		
N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca44	Concerns of competences developers and constructors	§ Individual investments; high transition and transaction costs		
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca45	Perception on management local supply chain	§ Immaturity of technologies (high investment, low income)		
N	N	N	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca46	Safety issues and related perception - Concerns on health impacts	§ Reputation of the operator or initiator		Section 3.3.5, p. 23
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca47	The perception based on cost/benefits sharing	§ Management of risks.		Section 3.3.5
N	N	N	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca48	Competing technologies	Mistrust in a technology as a reliable energy source.		Section 3.3.5, p. 23
																				Environmental impacts				
N	N	M	M	N	N	N	N	P	N	N	N	N	P	N	N	N	N	N	P	Ca49	Land-use intensity	This means how agricultural intensive a land is used, i.e. mechanical ploughing, chemical fertilizers, pesticides etc.		Section 3.3.5, p.23
N	G	VG	G	VG	G	G	VG	VG	VG	VG	VG	G	VG	M	G	G	G	G	VG	Ca50	Emissions			Section 3.3.5, p.23
N	G	P	G	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	Ca51	Hydrological resources	Effects from different technologies on the Hydrological resources. For example, effects on the aquifers (ground water), effects of river dams to the water levels downstream, water footprint.		Section 3.3.5, p.23
N	N	N	G	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	Ca52	Protected areas	Existence of protected areas taken into account in the sitting of technologies. (D.1.1, Section 3.3.5, pg23)		Section 3.3.5, p.23
N	N	P	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ca53	Soil erosion	Effects of the technology on soil erosion.		Section 3.3.5, p.23
N	N	P	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	Ca54	The ecosystem	Effects from different technologies on element in the ecosystem, e.g. flora, fauna and biodiversity.		Section 3.3.5, p.23

E2M2s	E3ME	E3MG	EDGE	EFDA-TIMES	EMELIE	EMM	EnergyPlan	ENPEP	ENV-Linkages	EPPA	ESPAUT	ESTEEM	ETP Model	FUND	GEM-CCGT	GEM-E3	GEMED	GEMINI-E3	GET	Transition planning				
																				Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Acceptance and technology perception				
N	N	N	N	N	N	N	N	P	N	N	N	VG	N	N	N	N	N	N	N	Ca36	Public acceptance	Public acceptance of technologies - Necessity for and level of public awareness		Section 3.3.5
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	Ca37	Public perception	Public acceptance of technologies - Necessity for and level of public understanding on		Section 3.3.5
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	Ca38	Public opinion obstacles	- The technology in itself		Section 3.3.5
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	Ca39	Public participation	- How to make use of a technology		Section 3.3.5, p. 22
N	N	N	N	M	N	N	N	N	N	N	N	G	N	N	N	P	N	N	N	Ca40	Financial risk perception	- A technology's implications		Section 3.3.5, p.23
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	Ca41	Perceptions on reliability of a technology as energy source	Public acceptance of technologies - Relations between the expectations and current implementation scale		Section 3.3.5, **p. 23**
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	Ca42	Resistance based on issues of principle	Public participation such as "Generally public participation seeks and facilitates the involvement of those potentially affected by or interested in a decision. The principle of public participation holds that those who are affected by a decision have a right to be involved in the decision-making process. Public participation implies that the public's contribution will influence the decision" (http://www.iap2.org/displaycommon.cfm?an=4, http://www.co-intelligence.org/CIPol_publicparticipation.html).		
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	Ca43	Concerns for window dressing	Risk perception:		
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	Ca44	Concerns of competences developers and constructors	§ Individual investments; high transition and transaction costs		
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	P	N	N	N	Ca45	Perception on management local supply chain	§ Immaturity of technologies (high investment, low income)		
N	N	N	N	N	N	N	N	N	N	M	N	VG	N	G	N	P	N	N	N	Ca46	Safety issues and related perception - Concerns on health impacts	§ Reputation of the operator or initiator		Section 3.3.5, p. 23
N	N	N	N	N	N	N	N	n	N	N	N	VG	N	N	N	N	N	N	N	Ca47	The perception based on cost/benefits sharing	§ Management of risks.		Section 3.3.5
N	N	N	N	N	N	N	N	N	N	N	N	M	N	N	N	N	N	N	N	Ca48	Competing technologies	Mistrust in a technology as a reliable energy source.		Section 3.3.5, p. 23
																				Environmental impacts				
N	N	N	N	N	N	N	N	N	P	G	G	P	N	N	N	N	N	N	N	Ca49	Land-use intensity	This means how agricultural intensive a land is used, i.e. mechanical ploughing, chemical fertilizers, pesticides etc.		Section 3.3.5, p.23
G	G	VG	G	G	G	M	VG	VG	G	VG	N	M	G	VG	G	VG	M	VG	VG	Ca50	Emissions			Section 3.3.5, p.23
N	N	N	N	N	N	N	N	N	N	N	N	M	N	N	N	N	N	N	N	Ca51	Hydrological resources	Effects from different technologies on the Hydrological resources. For example, effects on the aquifers (ground water), effects of river dams to the water levels downstream, water footprint.		Section 3.3.5, p.23
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	Ca52	Protected areas	Existence of protected areas taken into account in the sitting of technologies. (D.1.1, Section 3.3.5, pg23)		Section 3.3.5, p.23
N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	Ca53	Soil erosion	Effects of the technology on soil erosion.		Section 3.3.5, p.23
N	N	N	N	N	N	N	N	N	P	M	N	G	N	VG	N	N	N	N	N	Ca54	The ecosystem	Effects from different technologies on element in the ecosystem, e.g. flora, fauna and biodiversity.		Section 3.3.5, p.23

GMM	GRAPE	GreenNET-Europe	GreenNET-Europe	GTAP-E	Horizonscan	IER - Model for Power	IGEM	iKnow	IMACLIM	IMAGE-TIMER	INVERT	IPAC	LEAP	MDM-E3	MECHanisms	MERGE	MESSAGE	Minicam	Minicam	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Transition planning				
																				Acceptance and technology perception				
N	N	N	M	N	G	N	N	VG	N	N	N	N	P	N	M	N	N	N	N	Ca36	Public acceptance	Public acceptance of technologies - Necessity for and level of public awareness		Section 3.3.5
N	N	N	N	N	G	N	N	VG	N	N	N	N	n	N	M	N	N	N	N	Ca37	Public perception	Public acceptance of technologies - Necessity for and level of public understanding on		Section 3.3.5
N	N	N	N	N	VG	N	N	VG	N	N	N	N	N	N	P	N	N	N	N	Ca38	Public opinion obstacles	- The technology in itself		Section 3.3.5
N	N	N	N	N	M	N	N	VG	N	N	N	N	N	N	VG	N	N	N	N	Ca39	Public participation	- How to make use of a technology		Section 3.3.5, p. 22
P	N	N	N	N	VG	N	N	G	N	N	N	N	n	N	M	N	P	N	N	Ca40	Financial risk perception	- A technology's implications		Section 3.3.5, p.23
N	N	N	N	N	VG	N	N	VG	N	N	N	N	N	N	P	N	N	N	N	Ca41	Perceptions on reliability of a technology as energy source	Public acceptance of technologies - Relations between the expectations and current implementation scale		Section 3.3.5, **p. 23**
N	N	N	N	N	P	N	N	VG	N	N	N	N	N	N	P	N	N	N	N	Ca42	Resistance based on issues of principle	Public participation such as "Generally public participation seeks and facilitates the involvement of those potentially affected by or interested in a decision. The principle of public participation holds that those who are affected by a decision have a right to be involved in the decision-making process. Public participation implies that the public's contribution will influence the decision" (http://www.iap2.org/displaycommon.cfm?an=4, http://www.co-intelligence.org/CIPol_publicparticipation.html).		
N	N	N	N	N	P	N	N	G	N	N	N	N	N	N	P	N	N	N	N	Ca43	Concerns for window dressing	Risk perception:		
N	N	N	N	N	G	N	N	G	N	N	N	N	N	N	VG	N	N	N	N	Ca44	Concerns of competences developers and constructors	§ Individual investments; high transition and transaction costs		
N	N	N	N	N	G	N	N	VG	N	N	N	N	N	N	P	N	N	N	N	Ca45	Perception on management local supply chain	§ Immaturity of technologies (high investment, low income)		
P	N	N	N	N	G	N	N	G	N	N	N	N	N	N	M	N	N	N	N	Ca46	Safety issues and related perception - Concerns on health impacts	§ Reputation of the operator or initiator		Section 3.3.5, p. 23
N	N	N	N	N	G	N	N	VG	N	N	N	N	N	N	G	N	N	N	N	Ca47	The perception based on cost/benefits sharing	§ Management of risks.		Section 3.3.5
N	N	N	N	N	VG	N	N	VG	N	N	N	N	n	N	P	N	N	N	N	Ca48	Competing technologies	Mistrust in a technology as a reliable energy source.		Section 3.3.5, p. 23
																				Environmental impacts				
N	VG	N	N	P	G	N	N	G	N	VG	N	N	N	N	N	N	P	G	G	Ca49	Land-use intensity	This means how agricultural intensive a land is used, i.e. mechanical ploughing, chemical fertilizers, pesticides etc.		Section 3.3.5, p.23
G	VG	N	N	VG	G	G	N	G	G	VG	VG	G	VG	G	N	VG	G	VG	VG	Ca50	Emissions			Section 3.3.5, p.23
N	N	N	N	N	G	N	N	G	N	M	N	N	N	N	N	N	P	N	N	Ca51	Hydrological resources	Effects from different technologies on the Hydrological resources. For example, effects on the aquifers (ground water), effects of river dams to the water levels downstream, water footprint.		Section 3.3.5, p.23
N	N	N	N	N	G	N	N	G	N	P	N	N	N	N	N	N	P	P	P	Ca52	Protected areas	Existence of protected areas taken into account in the sitting of technologies. (D.1.1, Section 3.3.5, pg23)		Section 3.3.5, p.23
N	N	N	N	N	G	N	N	G	N	N	N	N	N	N	N	N	N	N	N	Ca53	Soil erosion	Effects of the technology on soil erosion.		Section 3.3.5, p.23
N	N	N	N	N	G	N	N	G	N	G	N	M	N	N	N	VG	N	N	N	Ca54	The ecosystem	Effects from different technologies on element in the ecosystem, e.g. flora, fauna and biodiversity.		Section 3.3.5, p.23

Transition planning

MIRAGE	MoreHys	MTSIM	MURE	NEMESIS	NEMS	NEWAGE	PACE	POLES	POWERS	PRIMES	REMARK	REMIND-R	RESolve-E	RESolve-T	RICE	ROM	SAMLAST	SGM	STSc	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Acceptance and technology perception				
N	N	N	M	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	M	Ca36	**Public acceptance**	Public acceptance of technologies - Necessity for and level of public awareness		Section 3.3.5
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	M	Ca37	**Public perception**	Public acceptance of technologies - Necessity for and level of public understanding on		Section 3.3.5
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	M	Ca38	**Public opinion obstacles**	- The technology in itself		Section 3.3.5
N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	Ca39	**Public participation**	- How to make use of a technology		Section 3.3.5, p. 22
N	N	N	M	N	N	N	N	P	N	P	N	N	G	P	N	N	N	N	M	Ca40	**Financial risk perception**	- A technology's implications		Section 3.3.5, p.23
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	M	Ca41	**Perceptions on reliability of a technology as energy source**	Public acceptance of technologies - Relations between the expectations and current implementation scale		Section 3.3.5, **p. 23**
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	G	Ca42	**Resistance based on issues of principle**	Public participation such as "Generally public participation seeks and facilitates the involvement of those potentially affected by or interested in a decision. The principle of public participation holds that those who are affected by a decision have a right to be involved in the decision-making process. Public participation implies that the public's contribution will influence the decision" (http://www.iap2.org/displaycommon.cfm?an=4, http://www.co-intelligence.org/CIPol_publicparticipation.html).		
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	Ca43	**Concerns for window dressing**	Risk perception:		
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	Ca44	**Concerns of competences developers and constructors**	§ Individual investments; high transition and transaction costs		
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	M	Ca45	**Perception on management local supply chain**	§ Immaturity of technologies (high investment, low income)		
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	G	Ca46	**Safety issues and related perception - Concerns on health impacts**	§ Reputation of the operator or initiator		Section 3.3.5, p. 23
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	M	Ca47	**The perception based on cost/benefits sharing**	§ Management of risks.		Section 3.3.5
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	G	Ca48	**Competing technologies**	Mistrust in a technology as a reliable energy source.		Section 3.3.5, p. 23
																				Environmental impacts				
M	N	N	N	G	N	N	N	N	N	N	N	N	N	N	N	N	N	M	M	Ca49	**Land-use intensity**	This means how agricultural intensive a land is used, i.e. mechanical ploughing, chemical fertilizers, pesticides etc.		Section 3.3.5, p.23
N	G	G	VG	VG	M	G	G	G	VG	G	N	VG	N	G	VG	N	G	VG	G	Ca50	**Emissions**			Section 3.3.5, p.23
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	G	P	G	Ca51	**Hydrological resources**	Effects from different technologies on the Hydrological resources. For example, effects on the aquifers (ground water), effects of river dams to the water levels downstream, water footprint.		Section 3.3.5, p.23
N	N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	G	Ca52	**Protected areas**	Existence of protected areas taken into account in the sitting of technologies. (D.1.1, Section 3.3.5, pg23)		Section 3.3.5, p.23
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	G	Ca53	**Soil erosion**	Effects of the technology on soil erosion.		Section 3.3.5, p.23
N	N	N	N	N	N	N	N	N	N	N	N	M	N	N	G	N	N	P	G	Ca54	**The ecosystem**	Effects from different technologies on element in the ecosystem, e.g. flora, fauna and biodiversity.		Section 3.3.5, p.23

TEMPO	TIAM-WORLD	TIMES-FI	TIMES PanEU	TIMES Nordic	UKENVI	E2M2s - IER	E2M2s - Duisburg-Essen	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								Transition planning				
								Acceptance and technology perception				
N	N	N	P	N	N	N	N	Ca36	**Public acceptance**	Public acceptance of technologies - Necessity for and level of public awareness		Section 3.3.5
N	N	N	N	N	N	N	N	Ca37	**Public perception**	Public acceptance of technologies - Necessity for and level of public understanding on		Section 3.3.5
N	N	N	N	N	N	N	N	Ca38	**Public opinion obstacles**	- The technology in itself		Section 3.3.5
N	N	N	N	N	N	N	N	Ca39	**Public participation**	- How to make use of a technology		Section 3.3.5, p. 22
M	G	P	P	N	N	N	N	Ca40	**Financial risk perception**	- A technology's implications		Section 3.3.5, p.23
N	N	N	N	N	N	N	N	Ca41	**Perceptions on reliability of a technology as energy source**	Public acceptance of technologies - Relations between the expectations and current implementation scale		Section 3.3.5, **p. 23**
N	N	N	N	N	N	N	N	Ca42	**Resistance based on issues of principle**	Public participation such as "Generally public participation seeks and facilitates the involvement of those potentially affected by or interested in a decision. The principle of public participation holds that those who are affected by a decision have a right to be involved in the decision-making process. Public participation implies that the public's contribution will influence the decision" (http://www.iap2.org/displaycommon.cfm?an=4, http://www.co-intelligence.org/CIPol_publicparticipation.html).		
N	N	N	N	N	N	N	N	Ca43	**Concerns for window dressing**	Risk perception:		
N	N	N	N	N	N	N	N	Ca44	**Concerns of competences developers and constructors**	§ Individual investments; high transition and transaction costs		
N	N	N	N	N	N	N	N	Ca45	**Perception on management local supply chain**	§ Immaturity of technologies (high investment, low income)		
N	N	N	N	N	N	N	N	Ca46	**Safety issues and related perception - Concerns on health impacts**	§ Reputation of the operator or initiator		Section 3.3.5, p. 23
N	N	N	N	N	N	N	N	Ca47	**The perception based on cost/benefits sharing**	§ Management of risks.		Section 3.3.5
N	N	N	N	N	N	N	N	Ca48	**Competing technologies**	Mistrust in a technology as a reliable energy source.		Section 3.3.5, p. 23
								Environmental impacts				
N	N	N	P	N	N	N	N	Ca49	**Land-use intensity**	This means how agricultural intensive a land is used, i.e. mechanical ploughing, chemical fertilizers, pesticides etc.		Section 3.3.5, p.23
VG	G	VG	VG	G	VG	G	VG	Ca50	**Emissions**			Section 3.3.5, p.23
N	N	N	P	N	N	N	N	Ca51	**Hydrological resources**	Effects from different technologies on the Hydrological resources. For example, effects on the aquifers (ground water), effects of river dams to the water levels downstream, water footprint.		Section 3.3.5, p.23
N	N	N	P	N	N	N	N	Ca52	**Protected areas**	Existence of protected areas taken into account in the sitting of technologies. (D.1.1, Section 3.3.5, pg23)		Section 3.3.5, p.23
N	N	N	N	N	N	N	N	Ca53	**Soil erosion**	Effects of the technology on soil erosion.		Section 3.3.5, p.23
								Ca54	**The ecosystem**	Effects from different technologies on element in the ecosystem, e.g. flora, fauna		Section 3.3.5, p.23

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ROM	SAMLAST	SGM	STSc	TEMPO	TIAM-WORLD	TIMESNordic	TIMES-FI	TIMES PanEU	UKENVI	COMBAT	COMPETES	DICE	DNE21+	WASP	WEM	WIAGEM	WILMAR	Wilmar Plan. Tool	WITCH	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																					Strategic planning			
																				GENERAL SPECIFICATIONS				
M	VG	M	G	N	G	G	M	VG	M	N	G	G	VG	m	M	N	P	N	M	B1	**Resilience from extreme energy prices**	Resilience of the energy system against shocks of extreme energy prices		Section 3.2
M	VG	P	G	N	M	P	P	M	N	N	G	N	VG	M	N	N	M	VG	N	B2	**Resilience from electric infrastructure failures**	Resilience of the energy system against shocks of power system failures, either grid or large scale power plants. Extra crucial for the electricity system, when electricity have to be generated at same moment as being used.		Section 3.2
P	G	P	G	N	M	G	P	G	N	N	G	N	G	N	P	N	P	N	N	B3	**Resilience from failures of energy supply**	Resilience of the energy system against shocks of failures of non electric energy supply.		Section 3.2
M	VG	N	G	N	G	P	N	M	N	N	G	M	N	N	N	N	P	VG	N	B4	**Resilience from extreme weather**	Resilience of the energy system against shocks of extreme weather events/conditions - e.g. cooling problems for nuclear plants due to hot weather.		Section 3.2
																				TECHNOLOGY PERFORMANCE AND DEVELOPMENT POTENTIAL				
M	P	G	N	G	VG	VG	VG	VG	P	N	P	N	VG	vg	G	M	N	N	G	B5	**Investment costs**	Investment Costs		Section 3.2.1
M	vg	G	N	G	VG	VG	VG	VG	P	N	G	N	VG	vg	P	N	VG	VG	G	B6	**O&M costs**	O&M costs		Section 3.2.1
M	vg	M	P	G	VG	G	VG	VG	P	N	VG	N	VG	g	G	P	VG	VG	G	B7	**Technical performance**	Technical performance		
M	P	VG	P	VG	VG	G	M	G	P	N	VG	G	VG	g	G	P	G	G	G	B8	**Environmental performance**	Environmental performance		
N	N	P	N	N	G	P	N	M	N	N	N	N	G	N	G	P	N	N	VG	B9	**Cost Reduction Learning By Doing**	Cost reduction as a function of time through increased accumulated installed Capacity. Potential and expected cost reduction - as a function of deployment (economy of scale).		Section 3.2.1
M	G	N	N	M	VG	G	M	G	N	N	VG	N	VG	N	G	M	N	N	G	B10	**Efficiency gains**	Overall efficiency gain and efficiency gain per tech/per kWh.		Section 3.2.1
N	N	N	N	N	N	P	N	P	N	N	N	N	N	N	N	P	N	N	VG	B11	**Cost Learning By Researching**	Cost reduction as a function of time through Research, Development and Demonstration (RD&D).		Section 3.2.1

Strategic planning

E2M2s	E3ME	E3MG	EDGE	EFDA-TIMES	EMELIE	EMM	EnergyPlan	ENPEP	ENV-Linkages	EPPA	ESPAUT	ESTEEM	ETP Model	FUND	GEM-CCGT	GEM-E3	GEMED	GEMINI-E3	GET	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				GENERAL SPECIFICATIONS				
N	G	G	P	G	M	M	G	M	M	P	M	P	G	P	P	VG	G	VG	N	B1	**Resilience from extreme energy prices**	Resilience of the energy system against shocks of extreme energy prices		Section 3.2
N	N	N	N	M	M	M	N	p	N	N	VG	P	P	P	N	P	G	N	N	B2	**Resilience from electric infrastructure failures**	Resilience of the energy system against shocks of power system failures, either grid or large scale power plants. Extra crucial for the electricity system, when electricity have to be generated at same moment as being used.		Section 3.2
N	P	P	N	M	M	N	N	p	M	P	VG	P	G	P	N	N	G	N	N	B3	**Resilience from failures of energy supply**	Resilience of the energy system against shocks of failures of non electric energy supply.		Section 3.2
N	N	N	N	M	N	N	N	n	N	N	VG	P	P	M	N	N	N	N	N	B4	**Resilience from extreme weather**	Resilience of the energy system against shocks of extreme weather events/conditions - e.g. cooling problems for nuclear plants due to hot weather.		Section 3.2
																				TECHNOLOGY PERFORMANCE AND DEVELOPMENT POTENTIAL				
VG	M	G	N	VG	VG	N	VG	VG	P	M	G	N	VG	VG	N	P	M	P	VG	B5	**Investment costs**	Investment Costs		Section 3.2.1
VG	M	G	N	VG	VG	VG	VG	VG	N	P	G	N	VG	G	N	P	G	P	VG	B6	**O&M costs**	O&M costs		Section 3.2.1
VG	M	G	N	VG	VG	G	VG	VG	N	N	G	N	G	N	N	N	G	N	VG	B7	**Technical performance**	Technical performance		
G	M	G	N	VG	G	P	VG	VG	P	M	N	M	G	VG	N	M	G	N	VG	B8	**Environmental performance**	Environmental performance		
G	G	G	N	G	P	N	N	p	N	G	N	N	P	G	N	N	VG	N	G	B9	**Cost Reduction Learning By Doing**	Cost reduction as a function of time through increased accumulated installed Capacity. Potential and expected cost reduction - as a function of deployment (economy of scale).		Section 3.2.1
G	M	M	N	VG	P	P	N	n	P	P	N	N	G	G	N	N	G	N	VG	B10	**Efficiency gains**	Overall efficiency gain and efficiency gain per tech/per kWh.		Section 3.2.1
N	M	M	N	M	N	N	N	n	N	N	N	N	P	M	N	N	P	N	G	B11	**Cost Learning By Researching**	Cost reduction as a function of time through Research, Development and Demonstration (RD&D).		Section 3.2.1

Strategic planning

GMM	GRAPE	GreenNET-Europe	GreenNET-Europe	GTAP-E	Horizonscan	IER - Model for Power Plant and	IGEM	iKnow	IMACLIM	IMAGE-TIMER	INVERT	IPAC	LEAP	MDM-E3	MECHanisms	MERGE	MESSAGE	Minicam	Minicam	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				GENERAL SPECIFICATIONS				
G	P	M	M	M	VG	N	VG	VG	VG	VG	M	VG	G	G	N	VG	G	G	G	B1	**Resilience from extreme energy prices**	Resilience of the energy system against shocks of extreme energy prices		Section 3.2
M	N	N	N	N	VG	M	P	VG	N	P	M	N	m	N	N	N	M	P	P	B2	**Resilience from electric infrastructure failures**	Resilience of the energy system against shocks of power system failures, either grid or large scale power plants. Extra crucial for the electricity system, when electricity have to be generated at same moment as being used.		Section 3.2
M	N	N	N	N	VG	N	M	VG	VG	VG	N	G	m	P	N	G	M	P	P	B3	**Resilience from failures of energy supply**	Resilience of the energy system against shocks of failures of non electric energy supply.		Section 3.2
P	N	N	N	N	VG	M	N	VG	N	N	N	N	p	N	N	N	G	P	P	B4	**Resilience from extreme weather**	Resilience of the energy system against shocks of extreme weather events/conditions - e.g. cooling problems for nuclear plants due to hot weather.		Section 3.2
																				TECHNOLOGY PERFORMANCE AND DEVELOPMENT POTENTIAL				
VG	VG	VG	VG	N	N	VG	N	N	VG	G	VG	VG	vg	M	P	VG	VG	M	M	B5	**Investment costs**	Investment Costs		Section 3.2.1
VG	VG	VG	VG	N	N	VG	N	N	VG	G	VG	VG	vg	M	P	VG	VG	G	G	B6	**O&M costs**	O&M costs		Section 3.2.1
VG	G	G	G	N	P	VG	N	P	VG	G	VG	VG	vg	M	M	VG	G	G	G	B7	**Technical performance**	Technical performance		
VG	G	N	N	P	P	G	N	P	VG	VG	VG	VG	vg	G	M	VG	VG	G	G	B8	**Environmental performance**	Environmental performance		
VG	N	VG	VG	N	N	N	G	N	VG	G	VG	N	m	M	M	G	VG	P	P	B9	**Cost Reduction Learning By Doing**	Cost reduction as a function of time through increased accumulated installed Capacity. Potential and expected cost reduction - as a function of deployment (economy of scale).		Section 3.2.1
VG	P	VG	VG	N	N	N	N	N	VG	G	N	N	m	M	M	N	G	VG	VG	B10	**Efficiency gains**	Overall efficiency gain and efficiency gain per tech/per kWh.		Section 3.2.1
M	N	N	N	N	N	N	N	N	VG	N	M	N	n	M	N	N	P	P	P	B11	**Cost Learning By Researching**	Cost reduction as a function of time through Research, Development and Demonstration (RD&D).		Section 3.2.1

Strategic planning

MIRAGE	MoreHys	MTSIM	MURE	NEMESIS	NEMS	NEWAGE	PACE	POLES	POWERS	PRIMES	REMARK	REMIND-R	RESolve-E	RESolve-T	RICE	ROM	SAMLAST	SGM	STSc	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				GENERAL SPECIFICATIONS				
G	G	M	M	VG	VG	G	N	M	VG	G	M	M	P	P	VG	M	VG	M	G	B1	**Resilience from extreme energy prices**	Resilience of the energy system against shocks of extreme energy prices		Section 3.2
N	P	VG	P	N	M	N	N	P	VG	P	VG	N	N	N	N	M	VG	P	G	B2	**Resilience from electric infrastructure failures**	Resilience of the energy system against shocks of power system failures, either grid or large scale power plants. Extra crucial for the electricity system, when electricity have to be generated at same moment as being used.		Section 3.2
N	P	N	M	N	VG	G	N	P	VG	P	N	M	P	G	N	P	G	P	G	B3	**Resilience from failures of energy supply**	Resilience of the energy system against shocks of failures of non electric energy supply.		Section 3.2
N	N	N	P	N	N	N	N	N	VG	N	N	N	N	N	G	M	VG	N	G	B4	**Resilience from extreme weather**	Resilience of the energy system against shocks of extreme weather events/conditions - e.g. cooling problems for nuclear plants due to hot weather.		Section 3.2
																				TECHNOLOGY PERFORMANCE AND DEVELOPMENT POTENTIAL				
N	VG	VG	VG	M	VG	G	G	VG	VG	VG	VG	G	VG	G	N	M	P	G	N	B5	**Investment costs**	Investment Costs		Section 3.2.1
N	VG	VG	VG	M	VG	N	N	M	VG	VG	VG	G	VG	G	N	M	vg	G	N	B6	**O&M costs**	O&M costs		Section 3.2.1
N	VG	G	VG	N	VG	P	P	M	VG	G	G	G	G	G	N	M	vg	M	P	B7	**Technical performance**	Technical performance		
N	VG	G	VG	G	VG	P	P	G	VG	M	N	G	N	G	N	M	P	VG	P	B8	**Environmental performance**	Environmental performance		
N	N	N	G	VG	N	P	P	VG	P	G	N	G	VG	VG	P	N	N	P	N	B9	**Cost Reduction Learning By Doing**	Cost reduction as a function of time through increased accumulated installed Capacity. Potential and expected cost reduction - as a function of deployment (economy of scale).		Section 3.2.1
N	N	N	VG	VG	G	N	G	VG	P	P	N	G	VG	P	N	M	G	N	N	B10	**Efficiency gains**	Overall efficiency gain and efficiency gain per tech/per kWh.		Section 3.2.1
N	N	N	M	VG	N	P	P	G	N	M	N	N	N	N	N	N	N	N	N	B11	**Cost Learning By Researching**	Cost reduction as a function of time through Research, Development and Demonstration (RD&D).		Section 3.2.1

TEMPO	TIAM-WORLD	TIMES-FI	TIMES PanEU	TIMES Nordic	UKENVI	E2M2s - IER	E2M2s - Duisburg-Essen	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								Strategic planning				
								GENERAL SPECIFICATIONS				
N	G	M	VG	G	M	N	M	B1	**Resilience from extreme energy prices**	Resilience of the energy system against shocks of extreme energy prices		Section 3.2
N	M	P	M	P	N	N	P	B2	**Resilience from electric infrastructure failures**	Resilience of the energy system against shocks of power system failures, either grid or large scale power plants. Extra crucial for the electricity system, when electricity have to be generated at same moment as being used.		Section 3.2
N	M	P	G	G	N	N	P	B3	**Resilience from failures of energy supply**	Resilience of the energy system against shocks of failures of non electric energy supply.		Section 3.2
N	G	N	M	P	N	N	N	B4	**Resilience from extreme weather**	Resilience of the energy system against shocks of extreme weather events/conditions - e.g. cooling problems for nuclear plants due to hot weather.		Section 3.2
								TECHNOLOGY PERFORMANCE AND DEVELOPMENT POTENTIAL				
G	VG	VG	VG	VG	P	VG	VG	B5	**Investment costs**	Investment Costs		Section 3.2.1
G	VG	VG	VG	VG	P	VG	VG	B6	**O&M costs**	O&M costs		Section 3.2.1
G	VG	VG	VG	G	P	VG	G	B7	**Technical performance**	Technical performance		
VG	VG	M	G	G	P	G	G	B8	**Environmental performance**	Environmental performance		
N	G	N	M	P	N	G	P	B9	**Cost Reduction Learning By Doing**	Cost reduction as a function of time through increased accumulated installed Capacity. Potential and expected cost reduction - as a function of deployment (economy of scale).		Section 3.2.1
M	VG	M	G	G	N	G	N	B10	**Efficiency gains**	Overall efficiency gain and efficiency gain per tech/per kWh.		Section 3.2.1
N	N	N	P	P	N	N	N	B11	**Cost Learning By Researching**	Cost reduction as a function of time through Research, Development and Demonstration (RD&D).		Section 3.2.1

Strategic planning

ROM	SAMLAST	SGM	STSc	TEMPO	TIAM-WORLD	TIMESNordic	TIMES-FI	TIMES PanEU	UKENVI	COMBAT	COMPETES	DICE	DNE21+	WASP	WEM	WAGEM	WILMAR	Wilmar Plan. Tool	WITCH	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				TECHNOLOGY DEPLOYMENT				
M	G	P	P	N	G	M	P	P	N	N	VG	N	M	P	P	P	P	VG	M	B12	**Identifying Technical barriers**	To what extent can the tool provide help to identify technical barriers. Technical barriers and technology complementarities (impact on the energy system structure; interdependency between different technologies: e.g. wind turbines and electric grid development)		Section 3.2.2
N	G	P	VG	N	N	P	P	N	M	N	G	N	P	N	N	P	N	N	P	B13	**Identifying non Technical barriers**	To what extent can the tool provide help to identify non-technical barriers.		Section 3.2.2
N	P	M	N	P	N	M	VG	G	M	N	N	N	VG	P	M	P	N	N	M	B14	**Technical potential**		if the tool considers regional differences--> higher rating	Section 3.2.2
N	P	M	N	P	G	G	VG	VG	M	N	VG	N	VG	M	M	VG	N	N	G	B15	**Economic potential**	Economic potential (in contrast to the technical potential which is always larger or equal to the economic potential).	if the tool considers regional differences--> higher rating	Section 3.2.2
N	N	P	G	P	M	P	N	P	N	N	M	N	P	N	N	P	N	N	M	B16	**Bottlenecks in technology deployment**	Bottlenecks to technology deployment (industry not ready to follow the demand).		
																				POLICY INDICATORS				
M	M	G	M	P	G	G	M	VG	G	N	G	N	G	P	G	G	M	N	M	B17	**Support mechanisms**	Different support mechanisms (e.g. feed-in tariffs, quotas, fiscal measures, information).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments of different technologies - the tool should score high.	Section 3.2.3
P	P	N	G	P	G	P	M	M	N	N	N	N	M	N	P	M	P	N	N	B18	**Identify lock-in situations**	Can the tool identify lock-in situations and then address policy measures aimed to change/solve them?		Section 3.2.2
M	VG	P	N	N	P	N	P	N	N	N	N	N	P	N	N	P	P	N	N	B19	**System failure**	Can the tool address system failure?		Section 3.2.2
M	G	M	M	N	VG	M	M	G	N	N	P	VG	N	M	M	P	G	G	M	B20	**Uncertainties**	Can the tool deal with uncertainties?		Section 3.2.2
N	N	VG	N	M	P	G	G	VG	N	N	VG	N	N	P	M	M	G	N	M	B21	**CO_2 reduction per technology**	Life time CO_2 emissions per technology (Life cycle emission).		Section 3.2.2
N	N	VG	M	N	N	N	N	N	VG	N	N	N	N	N	N	VG	N	N	M	B22	**Total employment in the economy**			Section 3.2.2
N	N	VG	M	N	P	N	P	N	VG	N	N	N	N	N	N	VG	N	N	G	B23	**Change in GDP**			Section 3.2.2
N	N	G	N	N	G	M	G	M	N	N	N	N	N	M	P	N	P	N	N	B24	**Life cycle costs**	The tools capacity to consider the life cycle costs.		Section 3.2.2
N	N	VG	N	N	N	M	G	M	N	N	N	N	N	M	N	N	P	N	N	B25	**Life cycle energy input**	The tools capacity to consider the total use of energy over the entire life cycle.		Section 3.2.2
N	N	VG	N	P	P	M	G	M	N	N	N	N	N	M	P	N	P	N	N	B26	**Life cycle emissions**	The tools capacity to consider the total amount of emissions over the entire life cycle.		Section 3.2.2
N	N	P	M	N	P	N	N	N	M	N	VG	N	M	N	N	G	N	N	G	B27	**Competitiveness considerations for regional industry**			Section 3.2.2

E2M2s	E3ME	E3MG	EDGE	EFDA-TIMES	EMELIE	EMM	EnergyPlan	ENPEP	ENV-Linkages	EPPA	ESPAUT	ESTEEM	ETP Model	FUND	GEM-CCGT	GEM-E3	GEMED	GEMINI-E3	GET	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Strategic planning				
																				TECHNOLOGY DEPLOYMENT				
N	N	N	N	G	N	M	M	n	N	N	P	P	M	N	N	N	M	N	VG	B12	Identifying Technical barriers	To what extent can the tool provide help to identify technical barriers. Technical barriers and technology complementarities (impact on the energy system structure; interdependency between different technologies: e.g. wind turbines and electric grid development)		Section 3.2.2
N	N	N	N	M	N	N	P	N	N	P	N	VG	P	N	N	N	N	N	M	B13	Identifying non Technical barriers	To what extent can the tool provide help to identify non-technical barriers.		Section 3.2.2
N	N	N	N	G	M	M	M	n	N	P	N	N	P	N	N	P	M	N	G	B14	Technical potential		if the tool considers regional differences--> higher rating	Section 3.2.2
N	M	M	N	G	M	M	G	G	N	P	N	N	G	N	M	P	M	N	G	B15	Economic potential	Economic potential (in contrast to the technical potential which is always larger or equal to the economic potential).	if the tool considers regional differences--> higher rating	Section 3.2.2
N	N	N	N	G	N	N	N	n	N	N	N	M	P	N	N	N	N	N	N	B16	Bottlenecks in technology deployment	Bottlenecks to technology deployment (industry not ready to follow the demand).		
																				POLICY INDICATORS				
G	G	G	N	VG	G	N	M	VG	M	G	N	G	G	G	G	VG	VG	P	M	B17	Support mechanisms	Different support mechanisms (e.g. feed-in tariffs, quotas, fiscal measures, information).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments of different technologies - the tool should score high.	Section 3.2.3
N	N	N	N	G	N	N	N	n	N	N	N	VG	P	M	N	VG	M	P	N	B18	Identify lock-in situations	Can the tool identify lock-in situations and then address policy measures aimed to change/solve them?		Section 3.2.2
N	N	N	N	M	N	N	G	n	N	N	M	M	N	P	N	P	M	N	N	B19	System failure	Can the tool address system failure?		Section 3.2.2
G	P	M	N	G	N	VG	N	N	P	G	M	VG	M	M	N	N	M	N	N	B20	Uncertainties	Can the tool deal with uncertainties?		Section 3.2.2
N	M	M	N	P	P	P	P	n	N	P	N	P	G	VG	N	VG	M	N	VG	B21	CO2 reduction per technology	Life time CO2 emissions per technology (Life cycle emission).		Section 3.2.2
N	VG	VG	G	N	N	N	N	N	G	VG	N	N	N	VG	VG	VG	G	VG	N	B22	Total employment in the economy			Section 3.2.2
N	VG	VG	G	P	N	N	N	n	VG	VG	N	N	N	M	VG	VG	VG	VG	N	B23	Change in GDP			Section 3.2.2
P	N	N	N	G	N	N	N	n	N	P	N	N	M	P	N	VG	N	P	N	B24	Life cycle costs	The tools capacity to consider the life cycle costs.		Section 3.2.2
N	N	N	N	N	N	N	N	n	N	P	N	N	M	M	N	VG	N	N	N	B25	Life cycle energy input	The tools capacity to consider the total use of energy over the entire life cycle.		Section 3.2.2
N	N	N	N	N	N	N	N	n	N	P	N	N	M	VG	N	VG	N	N	N	B26	Life cycle emissions	The tools capacity to consider the total amount of emissions over the entire life cycle.		Section 3.2.2
N	VG	VG	M	P	N	N	N	n	G	G	N	M	N	N	G	P	P	VG	N	B27	Competitiveness considerations for regional industry			Section 3.2.2

GMM	GRAPE	GreenNET-Europe	GreenNET-Europe	GTAP-E	Horizonscan	IER - Model for Power Plant and	IGEM	iKnow	IMACLIM	IMAGE-TIMER	INVERT	IPAC	LEAP	MDM-E3	MECHanisms	MERGE	MESSAGE	Minicam	Minicam	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Strategic planning				
																				TECHNOLOGY DEPLOYMENT				
G	M	VG	VG	N	G	VG	N	G	VG	P	G	N	G	N	P	N	M	P	P	B12	**Identifying Technical barriers**	To what extent can the tool provide help to identify technical barriers. Technical barriers and technology complementarities (impact on the energy system structure; interdependency between different technologies: e.g. wind turbines and electric grid development)		Section 3.2.2
M	P	M	M	P	VG	N	N	VG	G	N	G	N	G	N	VG	N	N	P	P	B13	**Identifying non Technical barriers**	To what extent can the tool provide help to identify non-technical barriers.		Section 3.2.2
M	G	VG	VG	N	M	N	N	M	VG	VG	G	N	G	N	N	N	N	VG	VG	B14	**Technical potential**		if the tool considers regional differences--> higher rating	Section 3.2.2
G	VG	VG	VG	P	P	N	M	P	VG	VG	G	G	G	M	N	N	G	VG	VG	B15	**Economic potential**	Economic potential (in contrast to the technical potential which is always larger or equal to the economic potential).	if the tool considers regional differences--> higher rating	Section 3.2.2
G	P	VG	VG	P	G	N	N	M	N	N	N	N	N	N	G	N	N	P	P	B16	**Bottlenecks in technology deployment**	Bottlenecks to technology deployment (industry not ready to follow the demand).		
																				POLICY INDICATORS				
G	G	M	M	P	N	N	M	N	VG	G	VG	VG	vg	G	VG	G	G	M	G	B17	**Support mechanisms**	Different support mechanisms (e.g. feed-in tariffs, quotas, fiscal measures, information).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments of different technologies - the tool should score high.	Section 3.2.3
M	N	P	P	N	M	N	N	M	VG	M	N	N	N	N	N	N	P	P	P	B18	**Identify lock-in situations**	Can the tool identify lock-in situations and then address policy measures aimed to change/solve them?		Section 3.2.2
P	N	P	P	P	VG	N	N	G	VG	P	N	N	N	N	N	N	P	P	P	B19	**System failure**	Can the tool address system failure?		Section 3.2.2
M	G	M	M	G	M	N	N	VG	N	N	N	N	N	M	G	N	VG	P	P	B20	**Uncertainties**	Can the tool deal with uncertainties?		Section 3.2.2
P	VG	N	N	N	N	N	N	P	VG	G	G	G	G	M	N	N	M	M	M	B21	**CO2 reduction per technology**	Life time CO2 emissions per technology (Life cycle emission).		Section 3.2.2
N	P	N	N	VG	M	N	VG	P	VG	N	N	VG	N	VG	N	VG	N	M	N	B22	**Total employment in the economy**			Section 3.2.2
P	VG	N	N	VG	M	N	VG	P	VG	P	N	VG	N	VG	N	VG	VG	G	G	B23	**Change in GDP**			Section 3.2.2
M	VG	VG	VG	N	N	N	N	N	N	N	N	N	N	N	N	N	G	P	P	B24	**Life cycle costs**	The tools capacity to consider the life cycle costs.		Section 3.2.2
P	VG	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	P	N	N	B25	**Life cycle energy input**	The tools capacity to consider the total use of energy over the entire life cycle.		Section 3.2.2
P	VG	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	P	N	N	B26	**Life cycle emissions**	The tools capacity to consider the total amount of emissions over the entire life cycle.		Section 3.2.2
N	P	N	N	G	M	N	G	M	VG	N	N	G	N	VG	N	VG	N	P	P	B27	**Competitiveness considerations for regional industry**			Section 3.2.2

Strategic planning

MIRAGE	MoreHys	MTSIM	MURE	NEMESIS	NEMS	NEWAGE	PACE	POLES	POWERS	PRIMES	REMARK	REMIND-R	RESolve-E	RESolve-T	RICE	ROM	SAMLAST	SGM	STSc	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				TECHNOLOGY DEPLOYMENT				
N	N	P	G	N	N	N	P	N	N	P	P	G	N	M	N	M	G	P	P	B12	**Identifying Technical barriers**	To what extent can the tool provide help to identify technical barriers. Technical barriers and technology complementarities (impact on the energy system structure; interdependency between different technologies: e.g. wind turbines and electric grid development)		Section 3.2.2
N	N	N	G	N	N	N	P	N	N	P	N	N	P	N	N	N	G	P	VG	B13	**Identifying non Technical barriers**	To what extent can the tool provide help to identify non-technical barriers.		Section 3.2.2
N	G	N	G	N	VG	N	P	G	N	G	N	M	M	N	N	N	P	M	N	B14	**Technical potential**		if the tool considers regional differences--> higher rating	Section 3.2.2
N	G	N	G	N	M	N	VG	G	N	G	N	M	VG	M	N	N	P	M	N	B15	**Economic potential**	Economic potential (in contrast to the technical potential which is always larger or equal to the economic potential).	if the tool considers regional differences--> higher rating	Section 3.2.2
N	N	N	G	N	N	N	P	G	N	N	N	M	M	G	N	N	N	P	G	B16	**Bottlenecks in technology deployment**	Bottlenecks to technology deployment (industry not ready to follow the demand).		
																				POLICY INDICATORS				
N	M	N	VG	N	M	G	G	VG	VG	VG	N	G	VG	G	G	M	M	G	M	B17	**Support mechanisms**	Different support mechanisms (e.g. feed-in tariffs, quotas, fiscal measures, information).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments of different technologies - the tool should score high.	Section 3.2.3
N	VG	N	P	N	N	N	N	G	N	G	N	N	VG	VG	N	P	P	N	G	B18	**Identify lock-in situations**	Can the tool identify lock-in situations and then address policy measures aimed to change/solve them?		Section 3.2.2
N	N	M	P	N	P	N	N	P	N	P	M	P	P	N	N	M	VG	P	N	B19	**System failure**	Can the tool address system failure?		Section 3.2.2
N	N	N	P	N	N	N	N	G	M	M	N	N	G	G	N	M	G	M	M	B20	**Uncertainties**	Can the tool deal with uncertainties?		Section 3.2.2
N	G	N	G	M	P	N	M	G	N	M	N	G	N	G	N	N	N	VG	N	B21	**CO2 reduction per technology**	Life time CO2 emissions per technology (Life cycle emission).		Section 3.2.2
VG	N	N	N	VG	VG	VG	VG	N	N	N	N	G	N	N	VG	N	N	VG	M	B22	**Total employment in the economy**			Section 3.2.2
VG	N	N	N	VG	VG	VG	VG	N	N	N	N	G	N	N	VG	N	N	VG	M	B23	**Change in GDP**			Section 3.2.2
N	N	N	G	M	N	N	N	G	P	G	N	G	N	N	N	N	N	G	N	B24	**Life cycle costs**	The tools capacity to consider the life cycle costs.		Section 3.2.2
N	N	N	G	M	N	N	N	G	N	G	N	N	N	N	N	N	N	VG	N	B25	**Life cycle energy input**	The tools capacity to consider the total use of energy over the entire life cycle.		Section 3.2.2
N	N	N	G	M	N	N	N	G	P	M	N	N	N	M	N	N	N	VG	N	B26	**Life cycle emissions**	The tools capacity to consider the total amount of emissions over the entire life cycle.		Section 3.2.2
VG	N	N	N	N	G	G	G	N	N	N	N	G	P	N	G	N	N	P	M	B27	**Competitiveness considerations for regional industry**			Section 3.2.2

TEMPO	TIAM-WORLD	TIMES-FI	TIMES PanEU	TIMES Nordic	UKENVI	E2M2s - IER	E2M2s - Duisburg-Essen	Strategic planning				
								Nr	**Specification**	**Description**	**Guidelines to evaluation**	**Location in Specification Report**
								TECHNOLOGY DEPLOYMENT				
N	G	P	P	M	N	N	G	B12	**Identifying Technical barriers**	To what extent can the tool provide help to identify technical barriers. Technical barriers and technology complementarities (impact on the energy system structure; interdependency between different technologies: e.g. wind turbines and electric grid development)		Section 3.2.2
N	N	P	N	P	M	N	P	B13	**Identifying non Technical barriers**	To what extent can the tool provide help to identify non-technical barriers.		Section 3.2.2
P	N	VG	G	M	M	N	N	B14	**Technical potential**		if the tool considers regional differences--> higher rating	Section 3.2.2
P	G	VG	VG	G	M	N	N	B15	**Economic potential**	Economic potential (in contrast to the technical potential which is always larger or equal to the economic potential).	if the tool considers regional differences--> higher rating	Section 3.2.2
P	M	N	P	P	N	N	N	B16	**Bottlenecks in technology deployment**	Bottlenecks to technology deployment (industry not ready to follow the demand).		
								POLICY INDICATORS				
P	G	M	VG	G	G	G	G	B17	**Support mechanisms**	Different support mechanisms (e.g. feed-in tariffs, quotas, fiscal measures, information).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments of different technologies - the tool should score high.	Section 3.2.3
P	G	M	M	P	N	N	G	B18	**Identify lock-in situations**	Can the tool identify lock-in situations and then address policy measures aimed to change/solve them?		Section 3.2.2
N	P	P	N	N	N	N	M	B19	**System failure**	Can the tool address system failure?		Section 3.2.2
N	VG	M	G	M	N	G	G	B20	**Uncertainties**	Can the tool deal with uncertainties?		Section 3.2.2
M	P	G	VG	G	N	N	VG	B21	**CO2 reduction per technology**	Life time CO2 emissions per technology (Life cycle emission).		Section 3.2.2
N	N	N	N	N	VG	N	N	B22	**Total employment in the economy**			Section 3.2.2
N	P	P	N	N	VG	N	P	B23	**Change in GDP**			Section 3.2.2
N	G	G	M	M	N	P	VG	B24	**Life cycle costs**	The tools capacity to consider the life cycle costs.		Section 3.2.2
N	N	G	M	M	N	N	M	B25	**Life cycle energy input**	The tools capacity to consider the total use of energy over the entire life cycle.		Section 3.2.2
P	P	G	M	M	N	N	G	B26	**Life cycle emissions**	The tools capacity to consider the total amount of emissions over the entire life cycle.		Section 3.2.2
N	P	N	N	N	M	N	N	B27	**Competitiveness considerations for regional**			Section 3.2.2

International Cooperation

ROM	SAMLAST	SGM	STSc	TEMPO	TIAM-WORLD	TIMESNordic	TIMES-FI	TIMES PanEU	UKENVI	COMBAT	COMPETES	DICE	DNE21+	WASP	WEM	WIAGEM	WILMAR	Wilmar Plan. Tool	WITCH	Nr	Specification	Description	Guidlines to evaluation	Location in Specification Report
																				International cooperation				
																				GENERAL SPECIFICATIONS				
N	N	G	G	N	VG	M	M	P	M	VG	N	G	VG	P	M	M	P	N	VG	E1	JI and CDM	The potential CO_2 reduction through JI and CDM and its cost.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5
																				INTERNATIONAL COOPERATION ON R&D				
N	N	P	VG	N	N	N	N	N	N	P	N	M	N	N	P	N	N	N	VG	E2	International Cooperation	The possibility of the tools to identify potentialities of international cooperation on R&D. Monitor benefits of international cooperation on R&D. Assess mutual needs on R&D (win-win situations).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	P	VG	N	N	N	N	N	N	N	N	M	N	N	N	N	N	N	N	E3	Past International Cooperation	The possibility of the tool to assess past cooperation initiatives and to estimate their results.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	P	VG	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	E4	Global centers of excellence	Need for global "centers of excellence" (existence and fields of activity), e.g. by monitoring technologies with structural high cost or performance lagging behind	If the tool maps existing centres - the tool should not score higher than average. If the tool evaluates the needs of global centres - the tool should score high.	Section 3.5.1
N	N	M	VG	N	M	N	N	N	N	N	N	N	N	N	M	N	N	N	N	E5	Technology Mapping	Technology mapping: international comparison of the state-of-the-art in different technologies (not technology fields) at the world level. Compare which technologies connect to European knowledge.		Section 3.5.1
N	N	P	VG	N	N	N	N	N	N	N	N	P	N	N	P	N	N	N	M	E6	Potential R&D cooperations	Determine which countries are potential partners or main competitors.		Section 3.5.1
N	N	P	G	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	N	E7	Identify large scale R&D projects	Map total technology development investment and capabilities that need international cooperation. For example fusion technology.		Section 3.5.1
N	N	P	G	N	P	P	N	N	N	N	N	N	N	N	P	N	N	N	G	E8	R&D outside EU	Mapping of knowledge produced outside of the EU. Potential fields where additional R&D within EU is not needed for further Technology Learning (free-riding possibilities) since outside EU there is a high level of technical knowledge.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
																				INTERNATIONAL INTERACTION IN TECHNOLOGY DEPLOYMENT				
N	N	N	M	N	M	P	N	N	N	N	N	N	G	N	P	M	N	N	VG	E9	Spillover - Between Regions	Spillover from Technology Learning between different regions of the world	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	E10	Spillover Between Institutes/Companies	Spillover from Technology Learning between different international companies and/or research institutes. To distinguish between horizontal and vertical spillover effects. Having vertical (cross-sectors) impacts could give an information on how the research is fundamental or not, and gives a more clear idea of the R&D impact on Technology Learning. Horizontal is spillovers between companies/institutes within the same branch.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	N	M	M	N	G	P	N	N	N	N	N	N	VG	N	M	N	N	N	VG	E11	Deployment of Technologies outside Europe			Section 3.5.2
N	N	M	M	N	G	M	N	N	N	N	N	N	VG	N	M	N	N	N	VG	E12	Technology Cost outside Europe			Section 3.5.2

International cooperation

E2M2s	E3ME	E3MG	EDGE	EFDA-TIMES	EMELIE	EMM	EnergyPlan	ENPEP	ENV-Linkages	EPPA	ESPAUT	ESTEEM	ETP Model	FUND	GEM-CCGT	GEM-E3	GEMED	GEMINI-E3	GET	Nr	Specification	Description	Guidlines to evaluation	Location in Specification Report
																				GENERAL SPECIFICATIONS				
N	p	P	VG	G	N	N	N	p	G	M	N	P	G	M	G	G	N	G	N	E1	**JI and CDM**	The potential CO2 reduction through JI and CDM and its cost.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5
																				INTERNATIONAL COOPERATION ON R&D				
N	N	G	N	P	N	N	N	N	N	N	N	P	P	P	N	N	N	N	N	E2	**International Cooperation**	The possibility of the tools to identify potentialities of international cooperation on R&D. Monitor benefits of international cooperation on R&D. Assess mutual needs on R&D (win-win situations).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	N	N	N	N	N	N	N	N	N	N	P	N	P	N	N	N	N	N	E3	**Past International Cooperation**	The possibility of the tool to assess past cooperation initiatives and to estimate their results.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	E4	**Global centers of excellence**	Need for global "centers of excellence" (existence and fields of activity), e.g. by monitoring technologies with structural high cost or performance lagging behind	If the tool maps existing centres - the tool should not score higher than average. If the tool evaluates the needs of global centres - the tool should score high.	Section 3.5.1
N	N	N	N	G	N	N	N	N	N	N	N	N	P	P	N	N	N	P	N	E5	**Technology Mapping**	Technology mapping: international comparison of the state-of-the-art in different technologies (not technology fields) at the world level. Compare which technologies connect to European knowledge.		Section 3.5.1
N	N	P	N	N	N	N	N	N	N	N	N	P	N	M	N	N	N	N	N	E6	**Potential R&D cooperations**	Determine which countries are potential partners or main competitors.		Section 3.5.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	E7	**Identify large scale R&D projects**	Map total technology development investment and capabilities that need international cooperation. For example fusion technology.		Section 3.5.1
N	N	G	N	N	N	N	N	N	N	P	N	N	M	N	N	N	N	N	N	E8	**R&D outside EU**	Mapping of knowledge produced outside of the EU. Potential fields where additional R&D within EU is not needed for further Technology Learning (free-riding possibilities) since outside EU there is a high level of technical knowledge.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
																				INTERNATIONAL INTERACTION IN TECHNOLOGY DEPLOYMENT				
N	G	G	N	P	N	N	N	N	N	P	N	VG	P	VG	N	N	N	N	N	E9	**Spillover - Between Regions**	Spillover from Technology Learning between different regions of the world	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	N	N	N	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	N	E10	**Spillover Between Institutes/Companies**	Spillover from Technology Learning between different international companies and/or research institutes. To distinguish between horizontal and vertical spillover effects. Having vertical (cross-sectors) impacts could give an information on how the research is fundamental or not, and gives a more clear idea of the R&D impact on Technology Learning. Horizontal is spillovers between companies/institutes within the same branch.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	N	G	M	G	N	N	N	N	P	P	N	N	G	P	N	P	N	P	N	E11	**Deployment of Technologies outside Europe**			Section 3.5.2
N	N	G	M	G	N	N	N	N	P	P	N	N	G	M	N	P	N	P	N	E12	**Technology Cost outside Europe**			Section 3.5.2

International cooperation

GMM	GRAPE	GreenNET-Europe	GreenNET-Europe	GTAP-E	Horizonscan	IER - Model for Power	IGEM	iKnow	IMACLIM	IMAGE-TIMER	INVERT	IPAC	LEAP	MDM-E3	MECHanisms	MERGE	MESSAGE	Minicam	Minicam	Nr	Specification	Description	Guidlines to evaluation	Location in Specification Report
																				GENERAL SPECIFICATIONS				
G	VG	N	N	G	M	N	N	M	VG	VG	N	N	N	N	N	G	VG	G	G	E1	JI and CDM	The potential CO2 reduction through JI and CDM and its cost.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5
																				INTERNATIONAL COOPERATION ON R&D				
M	N	N	N	N	VG	N	N	VG	VG	N	N	N	N	N	N	VG	N	N	N	E2	International Cooperation	The possibility of the tools to identify potentialities of international cooperation on R&D. Monitor benefits of international cooperation on R&D. Assess mutual needs on R&D (win-win situations).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	N	N	N	N	N	N	M	P	N	N	N	N	N	N	VG	N	N	N	E3	Past International Cooperation	The possibility of the tool to assess past cooperation initiatives and to estimate their results.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	N	N	N	VG	N	N	VG	N	N	N	N	N	N	N	N	N	N	N	E4	Global centers of excellence	Need for global "centers of excellence" (existence and fields of activity), e.g. by monitoring technologies with structural high cost or performance lagging behind	If the tool maps existing centres - the tool should not score higher than average. If the tool evaluates the needs of global centres - the tool should score high.	Section 3.5.1
G	N	M	M	N	VG	N	N	VG	P	N	N	G	N	N	N	N	N	N	N	E5	Technology Mapping	Technology mapping: international comparison of the state-of-the-art in different technologies (not technology fields) at the world level. Compare which technologies connect to European knowledge.		Section 3.5.1
P	N	N	N	N	VG	N	N	VG	P	N	N	N	N	N	N	N	N	N	N	E6	Potential R&D cooperations	Determine which countries are potential partners or main competitors.		Section 3.5.1
P	N	N	N	N	VG	N	N	VG	N	N	N	N	N	N	N	N	N	N	N	E7	Identify large scale R&D projects	Map total technology development investment and capabilities that need international cooperation. For example fusion technology.		Section 3.5.1
G	N	N	N	N	VG	N	N	VG	P	N	N	N	N	N	N	N	N	N	N	E8	R&D outside EU	Mapping of knowledge produced outside of the EU. Potential fields where additional R&D within EU is not needed for further Technology Learning (free-riding possibilities) since outside EU there is a high level of technical knowledge.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
																				INTERNATIONAL INTERACTION IN TECHNOLOGY DEPLOYMENT				
M	P	N	N	N	M	N	N	M	M	G	N	N	N	N	M	G	VG	P	P	E9	Spillover - Between Regions	Spillover from Technology Learning between different regions of the world	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	N	N	N	N	M	N	N	M	M	N	N	N	N	N	VG	N	N	N	N	E10	Spillover Between Institutes/Companies	Spillover from Technology Learning between different international companies and/or research institutes. To distinguish between horizontal and vertical spillover effects. Having vertical (cross-sectors) impacts could give an information on how the research is fundamental or not, and gives a more clear idea of the R&D impact on Technology Learning. Horizontal is spillovers between companies/institutes within the same branch.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
G	VG	N	N	N	VG	N	N	G	N	VG	N	N	N	N	N	N	VG	G	G	E11	Deployment of Technologies outside Europe			Section 3.5.2
G	VG	N	N	N	P	N	N	M	N	VG	N	N	N	N	N	N	VG	G	G	E12	Technology Cost outside Europe			Section 3.5.2

MIRAGE	MoreHys	MTSIM	MURE	NEMESIS	NEMS	NEWAGE	PACE	POLES	POWERS	PRIMES	REMARK	REMIND-R	RESolve-E	RESolve-T	RICE	ROM	SAMLAST	SGM	STSc	Nr	Specification	Description	Guidlines to evaluation	Location in Specification Report
																				International cooperation				
																				GENERAL SPECIFICATIONS				
N	N	N	N	N	N	N	M	VG	N	M	N	P	N	N	VG	N	N	G	G	E1	JI and CDM	The potential CO2 reduction through JI and CDM and its cost.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5
																				INTERNATIONAL COOPERATION ON R&D				
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	G	N	N	P	VG	E2	International Cooperation	The possibility of the tools to identify potentialities of international cooperation on R&D. Monitor benefits of international cooperation on R&D. Assess mutual needs on R&D (win-win situations).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	G	N	N	P	VG	E3	Past International Cooperation	The possibility of the tool to assess past cooperation initiatives and to estimate their results.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	VG	E4	Global centers of excellence	Need for global "centers of excellence" (existence and fields of activity), e.g. by monitoring technologies with structural high cost or performance lagging behind	If the tool maps existing centres - the tool should not score higher than average. If the tool evaluates the needs of global centres - the tool should score high.	Section 3.5.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	M	VG	E5	Technology Mapping	Technology mapping: international comparison of the state-of-the-art in different technologies (not technology fields) at the world level. Compare which technologies connect to European knowledge.		Section 3.5.1
N	N	N	N	M	N	N	N	N	N	N	N	N	N	N	N	N	N	P	VG	E6	Potential R&D cooperations	Determine which countries are potential partners or main competitors.		Section 3.5.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	G	E7	Identify large scale R&D projects	Map total technology development investment and capabilities that need international cooperation. For example fusion technology.		Section 3.5.1
N	N	N	N	VG	N	N	N	N	N	N	N	N	N	N	N	N	N	P	G	E8	R&D outside EU	Mapping of knowledge produced outside of the EU. Potential fields where additional R&D within EU is not needed for further Technology Learning (free-riding possibilities) since outside EU there is a high level of technical knowledge.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
																				INTERNATIONAL INTERACTION IN TECHNOLOGY DEPLOYMENT				
N	N	N	N	G	P	P	M	M	N	N	N	N	G	G	G	N	N	N	M	E9	Spillover - Between Regions	Spillover from Technology Learning between different regions of the world	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	N	N	N	VG	N	N	N	N	N	N	N	N	N	N	N	N	N	N	M	E10	Spillover Between Institutes/Companies	Spillover from Technology Learning between different international companies and/or research institutes. To distinguish between horizontal and vertical spillover effects. Having vertical (cross-sectors) impacts could give an information on how the research is fundamental or not, and gives a more clear idea of the R&D impact on Technology Learning. Horizontal is spillovers between companies/institutes within the same branch.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	N	N	N	G	N	N	N	M	N	N	N	G	N	N	N	N	N	M	M	E11	Deployment of Technologies outside Europe			Section 3.5.2
N	N	N	N	VG	N	N	N	M	N	N	N	G	N	N	N	N	N	M	M	E12	Technology Cost outside Europe			Section 3.5.2

TEMPO	TIAM-WORLD	TIMES-FI	TIMES PanEU	TIMES Nordic	UKENVI	E2M2s - IER	E2M2s - Duisburg-Essen	Nr	Specification	Description	Guidlines to evaluation	Location in Specification Report
								International cooperation				
								GENERAL SPECIFICATIONS				
N	VG	M	P	M	M	N	M	E1	**JI and CDM**	The potential CO2 reduction through JI and CDM and its cost.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5
								INTERNATIONAL COOPERATION ON R&D				
N	N	N	N	N	N	N	N	E2	**International Cooperation**	The possibility of the tools to identify potentialities of international cooperation on R&D. Monitor benefits of international cooperation on R&D. Assess mutual needs on R&D (win-win situations).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	N	N	N	N	N	N	E3	**Past International Cooperation**	The possibility of the tool to assess past cooperation initiatives and to estimate their results.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
N	N	N	N	N	N	N	N	E4	**Global centers of excellence**	Need for global "centers of excellence" (existence and fields of activity), e.g. by monitoring technologies with structural high cost or performance lagging behind	If the tool maps existing centres - the tool should not score higher than average. If the tool evaluates the needs of global centres - the tool should score high.	Section 3.5.1
N	M	N	N	N	N	N	N	E5	**Technology Mapping**	Technology mapping: international comparison of the state-of-the-art in different technologies (not technology fields) at the world level. Compare which technologies connect to European knowledge.		Section 3.5.1
N	N	N	N	N	N	N	N	E6	**Potential R&D cooperations**	Determine which countries are potential partners or main competitors.		Section 3.5.1
N	N	N	N	N	N	N	N	E7	**Identify large scale R&D projects**	Map total technology development investment and capabilities that need international cooperation. For example fusion technology.		Section 3.5.1
N	P	N	N	P	N	N	N	E8	**R&D outside EU**	Mapping of knowledge produced outside of the EU. Potential fields where additional R&D within EU is not needed for further Technology Learning (free-riding possibilities) since outside EU there is a high level of technical knowledge.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
								INTERNATIONAL INTERACTION IN TECHNOLOGY DEPLOYMENT				
N	M	N	N	P	N	N	N	E9	**Spillover - Between Regions**	Spillover from Technology Learning between different regions of the world	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	N	N	N	N	N	N	N	E10	**Spillover Between Institutes/Companies**	Spillover from Technology Learning between different international companies and/or research institutes. To distinguish between horizontal and vertical spillover effects. Having vertical (cross-sectors) impacts could give an information on how the research is fundamental or not, and gives a more clear idea of the R&D impact on Technology Learning. Horizontal is spillovers between companies/institutes within the same branch.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
N	G	N	N	P	N	N	N	E11	**Deployment of Technologies outside Europe**			Section 3.5.2
N	G	N	N	M	N	N	N	E12	**Technology Cost**			Section 3.5.2

Innovation and R&D

ROM	SAMLAST	SGM	STSc	TEMPO	TIAM-WORLD	TIMESNordic	TIMES-FI	TIMES PanEU	UKENVI	COMBAT	COMPETES	DICE	DNE21+	WASP	WEM	WIAGEM	WILMAR	Wilmar Plan. Tool	WITCH	Innovation and R&D				
																				Nr	**Specification**	**Description**	**Guidelines to evaluation**	**Location in Specification Report**
																				GENERAL SPECIFICATIONS				
N	N	G	P	N	VG	G	G	VG	P	M	VG	N	VG	M	G	M	M	M	VG	D1	Long-term economic perspectives of			Section 3.4
																				R&D				
N	N	N	M	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	D2	Long-term risk assessment	Risks involved in research activities within a long-term perspective. Risks that R&D will not deliver the cost reductions/technology improvement hoped for.		Section 3.4
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D3	R&D spendings vs. number of patents	R&D spending output in terms of patents.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D4	R&D spendings vs. number of publications	R&D spending output in terms of publications.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	VG	D5	R&D spendings vs. Deployment	R&D spendings in terms of e.g. amounts of new installed RES-capacity.		Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	VG	D6	Link between R&D and Technology Learning	Assess expected impacts from R&D on the technology development, e.g. econometric models based on historical observations.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D7	Public vs. Private R&D - effects technology development	Distinguish between the effects on technology development (KPIs) by public and private R&D. (The nature of public and private R&D may differ; public tends to be more fundamental, private more applied).		Section 3.4.1
N	N	N	VG	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D8	Public vs. Private R&D - effectiveness of stimulating cooperation	Is the tool capable of determining which actors are involved in technology development		Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D9	Public vs. Private R&D - timing	Can the tool start R&D support at different times and assess its effect on e.g. the overall mix of technologies later on.		Section 3.4.1
N	N	N	M	N	N	P	N	P	N	N	N	N	N	N	P	N	N	N	N	D10	Monitoring R&D targets	Are technologies on track with promises from e.g. roadmaps (achievements)?		Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	N	D11	Impact assessment of actions to catch up with the intended time schedule	Can we feed the tool with actions (e.g. increased R&D funding, lowering targets) to determine its effect to catch up a technology's development with the original time schedule (in case the technology development is delayed)?		Section 3.4.1
N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	D12	Monitor depletion of funding	Amount of available funding being spent; this gives insight in whether there is a structural problem that needs more attention or a logical explanation of why developments lag behind.		Section 3.4.1
N	N	N	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D13	Map effectiveness of R&D funding mechanisms	To answer policy questions like:		Section 3.4.1
																				INNOVATION				
N	N	P	M	N	N	P	N	N	N	N	N	N	M	N	P	G	N	N	N	D14	Mapping of the size of industrial sectors relative to the World	To identify strong and weak industrial sectors		Section 3.4.2
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D15	Patenting	Number of Patents in order to measure innovation.		
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D16	Publications	Number of Publications in order to measure innovation.		
N	N	N	P	N	M	N	N	N	N	N	N	N	P	N	N	G	N	N	VG	D17	Trade	Share of Energy Technologies in the international trade flows. Consider if relative or absolute advantage		

Innovation and R&D

E2M2s	E3ME	E3MG	EDGE	EFDA-TIMES	EMELIE	EMM	EnergyPlan	ENPEP	ENV-Linkages	EPPA	ESPAUT	ESTEEM	ETP Model	FUND	GEM-CCGT	GEM-E3	GEMED	GEMINI-E3	GET	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																					GENERAL SPECIFICATIONS			
VG	M	M	N	VG	G	P	N	m	N	P	N	M	G	M	P	P	N	N	vg	D1	Long-term economic perspectives of technologies			Section 3.4
																					R&D			
N	N	N	N	P	N	N	N	N	N	N	N	P	P	N	N	N	N	N	N	D2	Long-term risk assessment	Risks involved in research activities within a long-term perspective. Risks that R&D will not deliver the cost reductions/technology improvement hoped for.		Section 3.4
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D3	R&D spendings vs. number of patents	R&D spending output in terms of patents.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D4	R&D spendings vs. number of publications	R&D spending output in terms of publications.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D5	R&D spendings vs. Deployment	R&D spendings in terms of e.g. amounts of new installed RES-capacity.		Section 3.4.1
N	M	M	N	M	N	N	N	n	N	N	N	N	P	N	N	N	N	N	N	D6	Link between R&D and Technology Learning	Assess expected impacts from R&D on the technology development, e.g. econometric models based on historical observations.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D7	Public vs. Private R&D - effects technology development	Distinguish between the effects on technology development (KPIs) by public and private R&D. (The nature of public and private R&D may differ; public tends to be more fundamental, private more applied).		Section 3.4.1
N	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	D8	Public vs. Private R&D - effectiveness of stimulating cooperation	Is the tool capable of determining which actors are involved in technology development		Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D9	Public vs. Private R&D - timing	Can the tool start R&D support at different times and assess its effect on e.g. the overall mix of technologies later on.		Section 3.4.1
N	N	N	N	M	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	D10	Monitoring R&D targets	Are technologies on track with promises from e.g. roadmaps (achievements)?		Section 3.4.1
N	N	N	N	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D11	Impact assessment of actions to catch up with the intended time schedule	Can we feed the tool with actions (e.g. increased R&D funding, lowering targets) to determine its effect to catch up a technology's development with the original time schedule (in case the technology development is delayed)?		Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	D12	Monitor depletion of funding	Amount of available funding being spent; this gives insight in whether there is a structural problem that needs more attention or a logical explanation of why developments lag behind.		Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D13	Map effectiveness of R&D funding mechanisms	To answer policy questions like:		Section 3.4.1
																					INNOVATION			
N	N	N	N	N	N	N	N	N	M	M	N	N	N	N	G	M	N	M	N	D14	Mapping of the size of industrial sectors relative to the World	To identify strong and weak industrial sectors		Section 3.4.2
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D15	Patenting	Number of Patents in order to measure innovation.		
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D16	Publications	Number of Publications in order to measure innovation.		
																				D17	Trade	Share of Energy Technologies in the international trade		

GMM	GRAPE	GreenNET-Europe	GreenNET-Europe	GTAP-E	Horizonscan	IER - Model for Power	IGEM	iKnow	IMACLIM	IMAGE-TIMER	INVERT	IPAC	LEAP	MDM-E3	MECHanisms	MERGE	MESSAGE	Minicam	Minicam	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Innovation and R&D				
																				GENERAL SPECIFICATIONS				
VG	VG	VG	VG	N	G	VG	N	G	M	M	M	G	M	M	N	M	VG	G	G	D1	**Long-term economic perspectives of technologies**			Section 3.4
																				R&D				
N	N	P	P	N	VG	N	N	VG	N	N	N	M	N	N	N	N	N	N	N	D2	**Long-term risk assessment**	Risks involved in research activities within a long-term perspective. Risks that R&D will not deliver the cost reductions/technology improvement hoped for.		Section 3.4
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D3	**R&D spendings vs. number of patents**	R&D spending output in terms of patents.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D4	**R&D spendings vs. number of publications**	R&D spending output in terms of publications.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	D5	**R&D spendings vs. Deployment**	R&D spendings in terms of e.g. amounts of new installed RES-capacity.		Section 3.4.1
M	N	N	N	N	G	N	N	M	M	N	N	N	N	P	N	N	P	N	N	D6	**Link between R&D and Technology Learning**	Assess expected impacts from R&D on the technology development, e.g. econometric models based on historical observations.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
P	N	N	N	N	G	N	N	G	N	N	N	N	N	N	N	N	P	N	N	D7	**Public vs. Private R&D - effects technology development**	Distinguish between the effects on technology development (KPIs) by public and private R&D. (The nature of public and private R&D may differ; public tends to be more fundamental, private more applied).		Section 3.4.1
P	N	N	N	N	G	N	N	G	N	N	N	N	N	N	N	N	N	N	N	D8	**Public vs. Private R&D - effectiveness of stimulating cooperation**	Is the tool capable of determining which actors are involved in technology development		Section 3.4.1
P	N	N	N	N	N	N	N	G	N	N	N	N	N	N	N	N	P	N	N	D9	**Public vs. Private R&D - timing**	Can the tool start R&D support at different times and assess its effect on e.g. the overall mix of technologies later on.		Section 3.4.1
G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	D10	**Monitoring R&D targets**	Are technologies on track with promises from e.g. roadmaps (achievements)?		Section 3.4.1
M	N	N	N	N	M	N	N	G	G	N	N	N	N	N	N	N	P	N	N	D11	**Impact assessment of actions to catch up with the intended time schedule**	Can we feed the tool with actions (e.g. increased R&D funding, lowering targets) to determine its effect to catch up a technology's development with the original time schedule (in case the technology development is delayed)?		Section 3.4.1
N	N	N	N	N	N	N	N	M	G	N	N	N	N	N	N	N	N	N	N	D12	**Monitor depletion of funding**	Amount of available funding being spent; this gives insight in whether there is a structural problem that needs more attention or a logical explanation of why developments lag behind.		Section 3.4.1
N	N	N	N	N	M	N	N	G	N	N	N	N	N	N	N	N	N	N	N	D13	**Map effectiveness of R&D funding mechanisms**	To answer policy questions like:		Section 3.4.1
																				INNOVATION				
P	N	N	N	M	VG	N	N	VG	P	M	N	N	N	N	N	N	N	G	G	D14	**Mapping of the size of industrial sectors relative to the World**	To identify strong and weak industrial sectors		Section 3.4.2
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D15	**Patenting**	Number of Patents in order to measure innovation.		
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D16	**Publications**	Number of Publications in order to measure innovation.		
M	N	N	N	N	M	N	N	M	N	P	N	G	N	N	N	VG	N	N	N	D17	**Trade**	Share of Energy Technologies in the international trade flows. Consider if relative or absolute advantage		

MIRAGE	MoreHys	MTSIM	MURE	NEMESIS	NEMS	NEWAGE	PACE	POLES	POWERS	PRIMES	REMARK	REMIND-R	RESolve-E	RESolve-T	RICE	ROM	SAMLAST	SGM	STSc	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
																				Innovation and R&D				
																				GENERAL SPECIFICATIONS				
N	VG	N	G	N	P	P	M	VG	M	G	N	M	G	M	N	N	N	G	P	D1	Long-term economic perspectives of technologies			Section 3.4
																				R&D				
N	N	N	N	M	N	N	N	P	N	N	N	M	N	G	N	N	N	N	M	D2	Long-term risk assessment	Risks involved in research activities within a long-term perspective. Risks that R&D will not deliver the cost reductions/technology improvement hoped for.		Section 3.4
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D3	R&D spendings vs. number of patents	R&D spending output in terms of patents.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D4	R&D spendings vs. number of publications	R&D spending output in terms of publications.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
N	N	N	N	VG	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D5	R&D spendings vs. Deployment	R&D spendings in terms of e.g. amounts of new installed RES-capacity.		Section 3.4.1
N	N	N	N	VG	P	P	N	G	N	G	N	N	N	N	N	N	N	N	N	D6	Link between R&D and Technology Learning	Assess expected impacts from R&D on the technology development, e.g. econometric models based on historical observations.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
N	N	N	N	G	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D7	Public vs. Private R&D - effects technology development	Distinguish between the effects on technology development (KPIs) by public and private R&D. (The nature of public and private R&D may differ; public tends to be more fundamental, private more applied).		Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	VG	D8	Public vs. Private R&D - effectiveness of stimulating cooperation	Is the tool capable of determining which actors are involved in technology development		Section 3.4.1
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D9	Public vs. Private R&D - timing	Can the tool start R&D support at different times and assess its effect on e.g. the overall mix of technologies later on.		Section 3.4.1
N	N	N	N	N	N	N	N	G	N	N	N	N	N	N	N	N	N	N	M	D10	Monitoring R&D targets	Are technologies on track with promises from e.g. roadmaps (achievements)?		Section 3.4.1
N	N	N	N	VG	N	N	N	G	N	N	N	N	G	M	N	N	N	N	N	D11	Impact assessment of actions to catch up with the intended time schedule	Can we feed the tool with actions (e.g. increased R&D funding, lowering targets) to determine its effect to catch up a technology's development with the original time schedule (in case the technology development is delayed)?		Section 3.4.1
N	N	N	N	VG	N	N	N	N	N	N	N	N	VG	N	N	N	N	N	N	D12	Monitor depletion of funding	Amount of available funding being spent; this gives insight in whether there is a structural problem that needs more attention or a logical explanation of why developments lag behind.		Section 3.4.1
N	N	N	N	VG	N	N	N	N	N	N	N	N	G	P	N	N	N	N	G	D13	Map effectiveness of R&D funding mechanisms	To answer policy questions like:		Section 3.4.1
																				INNOVATION				
VG	N	N	N	G	P	P	G	N	N	N	N	M	N	N	N	N	N	P	M	D14	Mapping of the size of industrial sectors relative to the World	To identify strong and weak industrial sectors		Section 3.4.2
N	N	N	N	VG	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D15	Patenting	Number of Patents in order to measure innovation.		
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D16	Publications	Number of Publications in order to measure innovation.		
																				D17	Trade	Share of Energy Technologies in the international trade		

Innovation and R&D

TEMPO	TIAM-WORLD	TIMES-FI	TIMES PanEU	TIMES Nordic	UKENVI	E2M2s - IER	E2M2s - Duisburg-Essen	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								GENERAL SPECIFICATIONS				
N	VG	G	VG	G	P	VG	G	D1	**Long-term economic perspectives of technologies**			Section 3.4
								R&D				
N	N	N	N	P	N	N	P	D2	**Long-term risk assessment**	Risks involved in research activities within a long-term perspective. Risks that R&D will not deliver the cost reductions/technology improvement hoped for.		Section 3.4
N	N	N	N	N	N	N	N	D3	**R&D spendings vs. number of patents**	R&D spending output in terms of patents.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.4.1
N	N	N	N	N	N	N	N	D4	**R&D spendings vs. number of publications**	R&D spending output in terms of publications.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
N	N	N	N	N	N	N	N	D5	**R&D spendings vs. Deployment**	R&D spendings in terms of e.g. amounts of new installed RES-capacity.		Section 3.4.1
N	N	N	N	N	N	N	N	D6	**Link between R&D and Technology Learning**	Assess expected impacts from R&D on the technology development, e.g. econometric models based on historical observations.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
N	N	N	N	N	N	N	N	D7	**Public vs. Private R&D - effects technology development**	Distinguish between the effects on technology development (KPIs) by public and private R&D. (The nature of public and private R&D may differ; public tends to be more fundamental, private more applied).		Section 3.4.1
N	N	N	N	N	N	N	N	D8	**Public vs. Private R&D - effectiveness of stimulating cooperation**	Is the tool capable of determining which actors are involved in technology development		Section 3.4.1
N	N	N	N	N	N	N	N	D9	**Public vs. Private R&D - timing**	Can the tool start R&D support at different times and assess its effect on e.g. the overall mix of technologies later on.		Section 3.4.1
N	N	N	P	P	N	N	N	D10	**Monitoring R&D targets**	Are technologies on track with promises from e.g. roadmaps (achievements)?		Section 3.4.1
N	N	N	N	N	N	N	N	D11	**Impact assessment of actions to catch up with the intended time schedule**	Can we feed the tool with actions (e.g. increased R&D funding, lowering targets) to determine its effect to catch up a technology's development with the original time schedule (in case the technology development is delayed)?		Section 3.4.1
N	N	N	N	P	N	N	N	D12	**Monitor depletion of funding**	Amount of available funding being spent; this gives insight in whether there is a structural problem that needs more attention or a logical explanation of why developments lag behind.		Section 3.4.1
N	N	N	N	N	N	N	N	D13	**Map effectiveness of R&D funding mechanisms**	To answer policy questions like:		Section 3.4.1
								INNOVATION				
N	N	N	N	P	N	N	N	D14	**Mapping of the size of industrial sectors relative to the World**	To identify strong and weak industrial sectors		Section 3.4.2
N	N	N	N	N	N	N	N	D15	**Patenting**	Number of Patents in order to measure innovation.		
N	N	N	N	N	N	N	N	D16	**Publications**	Number of Publications in order to measure innovation.		
N	M	N	N	N	N	N	N	D17	**Trade**	Share of Energy Technologies in the international trade flows. Consider if relative or absolute advantage.		

Appendix C

Specifications' Importance for pilot Policy Questions

CRES								Transition planning				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	**Nr**	**Specification**	**Description**	**Guidelines to evaluation**	**Location in Specification Report**
								Spatial planning				
H	VL	VL	H	H	M	M	M	Ca1	**Requirements for the supply chain**	How well the tool considers the supply chain of natural sources, within the geographic scope of the tool. Rate highest if it includes GIS description of resources, next level if it considers the geographical aspects by for example different categories.		Section 3.3.1, p. 19
H	M	VL	H	H	M	H	N	Ca2	**Regional potential for low-C technologies**	Links to geography - Natural resource potential of an area to provide energy with a specific technology.		Section 3.3.1
H	M	L	H	H	M	H	L	Ca3	**Grid infrastructure existing and expansion within a country**	Spatial planning of grid infrastructure: electricity grids, pipelines (gas, oil, hydrogen etc) within a country. For the electricity grids this includes infrastructure expansion to connect new generation capacity. For pipelines this refers to construction.		Section 3.3.1
H	L	L	H	H	M	H	L	Ca4	**Cross-border grid infrastructure existing and expansion**	Spatial Planning of the expansion of the cross-border capacity of grids (electricity and pipelines).		Section 3.3.1, p. 19
M	M	L	H	H	M	H	L	Ca5	**Energy transport networks expansion - Non grid**	Transportation of non grid distributed energy carriers. E.g.. Transportation of biomass, gasoline. Transported by truck, railway, ship etc.		Section 3.3.1, p. 19
M	M	L	H	H	M	M	L	Ca6	**Generation capacity**	The location of the existing plants.		Section 3.3.1, p. 19
H	H	M	H	H	M	M	L	Ca7	**Generation capacity expansion**	The spatial (dynamic) expansion of plants, considering both replacement and upgrades of existing plants.		Section 3.3.1, p. 19
M	M	L	H	H	M	H	L	Ca8	**Cross-border energy infrastructure**	Physical Import dependency. How is the import described? Can the uncertainty in the delivery of energy be considered? For example: Policy issues outside Europe, like policy issues in Northern Sahara countries in the case of Desertec.		Section 3.3.1
H	H	M	H	H	H	H	H	Ca9	**Cost effective technology deployment**	How well is the spatial difference in cost captured? Focus on how well the tool considers the "cost effectiveness" of the technology deployment within the spatial dimension, e.g. where is it more cost effective to install certain new technology.		Section 3.3.1, p. 19
M	M	M	M	M	M	H	H	Ca10	**Demand**	Spatial distribution of energy demand		
M	H	H	M	H	L	N	H	Ca11	**Population density**	The population density can help to provide information about the location of the residential demand of electricity, heating and cooling. For example when estimating the cost and needs of distribution.		Section 3.3.1, p. 19
M	M	H	M	H	L	L	M	Ca12	**Land use**	Considering different alternatives to use the land.		Section 3.3.1, p. 19

CRES								Transition planning				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								Deployment pathways				
H	M	M	H	M	M	M	H	Ca13	Time evolution of energy demand	Modeling the time evolution of the energy demand.		
H	M	M	H	H	M	M	H	Ca14	Connection between local demand and national/global supply	Assess the interaction between local demand and global supply. For example how the European demand for biomass affects the global price of biomass, the price of food etc.		Section 3.3.2, p. 20
H	M	M	H	H	M	H	M	Ca15	Evolution of Grid infrastructure	Time evolution of grid infrastructure within a region.		Section 3.3.2, p. 20
H	M	L	H	H	M	H	M	Ca16	Evolution of cross-border infrastructure	The time-evolution of the cross-border grid infrastructure.		Section 3.3.2, p. 20
H	L	VL	H	H	M	L	L	Ca17	Balancing capacity requirements	Need of flexibility for balancing intermittency of renewables or the fluctuations of demand. For example requirements of rapid response conventional power plants (e.g. gas turbines) to balance the high penetration of renewables.		Section 3.3.2
H	M	M	H	H	M	H	M	Ca18	Evolution of energy transport networks - Non grid	The time evolution of supply chain logistics.		Section 3.3.2, p. 20
H	M	M	H	H	H	H	M	Ca19	Evolution of the Generation Capacity	The evolution of the generation capacity.		Section 3.3.2, p. 20
M	M	VL	M	M	H	N	M	Ca20	Interaction between technology deployment and industry	A systemic approach is required combining the results from top-down and bottom-up as-assessments to deal with synergies and interdependencies between technological and industrial levels. For example the development of electricity storage is boosted by the electrical vehicles industry.		Section 3.3.2, p. 20
M	H	VL	M	L	H	N	M	Ca21	Public-private agent behaviours and partnerships	Account for agent behaviours both public and private, according to their respective role and considering also public-private partnerships.		Section 3.3.2, p. 20
H	M	L	H	H	H		H	Ca22	Technology uptake	To assess the impact of the transition of the energy system on sectoral changes (e.g. implementation of solar energy in buildings makes the construction sector stakeholder in the energy system and stimulates adoption of this new technology into their construction methods.)		Section 3.3.2
M	M	M	H	H	H	VL	M	Ca23	Time evolution of the Supply chain	The development of the supply chain over time. How well the tool considers the needs for? Assess whether requirements for deploying a technology are or can be fulfilled reasonably. Include impact of the energy system transition (e.g. impact of changes of the energy system). For example, before wind power can be fully integrated the grid might need to be extended.		Section 3.3.2, p. 20
M	M	VL	H	H	H	VL	H	Ca24	Closure of gap between demonstration and commercialization	How well does the tool consider the gap between demonstration and commercialization of a certain technology.		Section 3.3.2, p. 21
H	M	L	M	L	M	N	M	Ca25	Links between the energy system and the economy	Changes in energy demand and sectoral changes resulting from changes in the energy system. For example, how well changes in demand as a result of the application of certain technologies (e.g. zero energy buildings) can be considered.		Section 3.3.2
H	M	VL	H	M	M	L	M	Ca26	Time lag between investment decision and entering into construction/operation.	To estimate the time lag will weight the tool higher compared with including the assumed time lag in the model. Include the effect of the different regulatory frameworks in the MS on the time lag. The effect of different regulatory frameworks in Member States (e.g. the length of permitting procedures) should be accounted for in the model toolbox. Regulatory frameworks are one of the mechanisms affecting the time lag between investment decisions and actually producing electricity.		Section 3.3.2, p. 21
M	M	H	M	M	L	L	H	Ca27	Behavioural Change	Energy End users behaviour		
H	M	L	H	H	M	M	H	Ca28	Market barriers	Barriers for new entry or expansion of technologies. Example of market barrier: Capital requirements, Government policy, Regulations, Organizational, Switching costs.		Section 3.3.2, p. 22

CRES								Transition planning				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								Socio-Economics				
H	M	M	M	M	M	M	H	Ca29	**Energy demand**	Overall energy demand of different economic agents (industrial sectors, households, government, etc.).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments - the tool should score high.	
L	H	L	L	VL	M	N	VL	Ca30	**Quantification of labour demand in the whole economy**	Example: how well are the direct and indirect effects of energy prices on the labour demand considered in the tool. General equilibrium model will typical score high.		Section 3.3.1, p. 19
L	H	L	L	VL	M	N	VL	Ca31	**Quantification of labour demand from supply chain perspective**	Quantify direct and indirect employment that can result from the deployment of low carbon technologies (especially when the implementation phase starts) from the supply chain perspective and the technology deployment.		Section 3.3.5
L	H	L	L	VL	VL	N	VL	Ca32	**Migration flows**	Migration flows associated to changes/transition of the energy system.		Section 3.3.5
H	M	M	M	M	M	N	H	Ca33	**Energy prices**	Does the model consider energy prices?	Tools with endogenously prices will rate higher compared with tools with exogenous prices.	Section 3.3.1, p. 19
H	M	M	M	M	M	N	H	Ca34	**Energy prices for different groups**	Higher rating for models having different user groups, and moreover for different income or socio-professional household groups.		Section 3.3.5
M	M	L	L	L	L	N	L	Ca35	**Distribution of local costs and benefits.**	Effects from different technologies on local costs and benefits; the distribution of the benefits.		Section 3.3.5

CRES								Transition planning				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	**Nr**	**Specification**	**Description**	**Guidelines to evaluation**	**Location in Specification Report**
								Acceptance and technology perception				
L	L	H	L	H	VL	M	H	Ca36	**Public acceptance**	Public acceptance of technologies - Necessity for and level of public awareness		Section 3.3.5
L	L	H	L	H	VL	M	H	Ca37	**Public perception**	Public acceptance of technologies - Necessity for and level of public understanding on		Section 3.3.5
L	L	H	L	H	VL	M	H	Ca38	**Public opinion obstacles**	- The technology in itself		Section 3.3.5
L	L	H	L	H	VL	VL	H	Ca39	**Public participation**	- How to make use of a technology		Section 3.3.5, p. 22
L	L	H	L	H	VL	VL	H	Ca40	**Financial risk perception**	- A technology's implications		Section 3.3.5, p.23
L	L	H	L	H	VL	N	M	Ca41	**Perceptions on reliability of a technology as energy source**	Public acceptance of technologies - Relations between the expectations and current implementation scale		Section 3.3.5, **p. 23**
L	L	H	L	H	VL	M	H	Ca42	**Resistance based on issues of principle**	Public participation such as "Generally public participation seeks and facilitates the involvement of those potentially affected by or interested in a decision. The principle of public participation holds that those who are affected by a decision have a right to be involved in the decision-making process. Public participation implies that the public's contribution will influence the decision" (http://www.iap2.org/displaycommon.cfm?an=4, http://www.co-intelligence.org/CIPol_publicparticipation.html).		
L	L	H	L	H	VL	N	H	Ca43	**Concerns for window dressing**	Risk perception:		
L	L	H	L	H	VL	N	H	Ca44	**Concerns of competences developers and constructors**	§ Individual investments; high transition and transaction costs		
L	L	H	L	H	VL	N	H	Ca45	**Perception on management local supply chain**	§ Immaturity of technologies (high investment, low income)		
L	L	H	L	H	VL	M	H	Ca46	**Safety issues and related perception - Concerns on health impacts**	§ Reputation of the operator or initiator		Section 3.3.5, p. 23
L	L	H	L	H	VL	N	H	Ca47	**The perception based on cost/benefits sharing**	§ Management of risks.		Section 3.3.5
L	L	H	L	H	VL	L	H	Ca48	**Competing technologies**	Mistrust in a technology as a reliable energy source.		Section 3.3.5, p. 23

CRES								Transition planning				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								Environmental impacts				
H	L	M	L	H	M	M	N	Ca49	Land-use intensity	This means how agricultural intensive a land is used, i.e. mechanical ploughing, chemical fertilizers, pesticides etc.		Section 3.3.5, p.23
H	L	M	H	H	M	L	M	Ca50	Emissions			Section 3.3.5, p.23
M	L	M	L	H	M	N	N	Ca51	Hydrological resources	Effects from different technologies on the Hydrological resources. For example, effects on the aquifers (ground water), effects of river dams to the water levels downstream, water footprint.		Section 3.3.5, p.23
M	L	M	L	H	L	M	N	Ca52	Protected areas	Existence of protected areas taken into account in the sitting of technologies. (D.1.1, Section 3.3.5, pg23)		Section 3.3.5, p.23
M	L	M	L	H	L	N	N	Ca53	Soil erosion	Effects of the technology on soil erosion.		Section 3.3.5, p.23
H	L	M	M	H	L	M	N	Ca54	The ecosystem	Effects from different technologies on element in the ecosystem, e.g. flora, fauna and biodiversity.		Section 3.3.5, p.23

CRES								Strategic planning				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	**Nr**	**Specification**	**Description**	**Guidelines to evaluation**	**Location in Specification Report**
								GENERAL SPECIFICATIONS				
L	VL	N	L	N	M	N	M	**B1**	Resilience from extreme energy prices	Resilience of the energy system against shocks of extreme energy prices		Section 3.2
L	VL	N	L	N	M	M	N	**B2**	Resilience from electric infrastructure failures	Resilience of the energy system against shocks of power system failures, either grid or large scale power plants. Extra crucial for the electricity system, when electricity have to be generated at same moment as being used.		Section 3.2
L	VL	N	L	N	M	N	N	**B3**	Resilience from failures of energy supply	Resilience of the energy system against shocks of failures of non electric energy supply.		Section 3.2
L	VL	N	L	N	M	M	N	**B4**	Resilience from extreme weather	Resilience of the energy system against shocks of extreme weather events/conditions - e.g. cooling problems for nuclear plants due to hot weather.		Section 3.2
								TECHNOLOGY PERFORMANCE AND DEVELOPMENT POTENTIAL				
H	L	N	H	H	M	H	H	**B5**	**Investment costs**	Investment Costs		Section 3.2.1
H	L	N	H	H	M	H	H	**B6**	**O&M costs**	O&M costs		Section 3.2.1
H	L	N	H	H	M	H	H	**B7**	**Technical performance**	Technical performance		
H	L	N	H	H	M	H	H	**B8**	**Environmental performance**	Environmental performance		
H	L	N	H	H	H	H	H	**B9**	**Cost Reduction Learning By Doing**	Cost reduction as a function of time through increased accumulated installed Capacity. Potential and expected cost reduction - as a function of deployment (economy of scale).		Section 3.2.1
H	L	N	H	H	H	H	H	**B10**	**Efficiency gains**	Overall efficiency gain and efficiency gain per tech/per kWh.		Section 3.2.1
H	L	N	H	H	H	H	H	**B11**	**Cost Learning By Researching**	Cost reduction as a function of time through Research, Development and Demonstration (RD&D).		Section 3.2.1

CRES								Strategic planning				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								TECHNOLOGY DEPLOYMENT				
H	N	N	H	H	M	H	H	B12	Identifying Technical barriers	To what extent can the tool provide help to identify technical barriers. Technical barriers and technology complementarities (impact on the energy system structure; interdependency between different technologies: e.g. wind turbines and electric grid development)		Section 3.2.2
M	N	VL	H	H	M	H	H	B13	Identifying non Technical barriers	To what extent can the tool provide help to identify non-technical barriers.		Section 3.2.2
H	M	L	H	H	H	H	H	B14	Technical potential		if the tool considers regional differences--> higher rating	Section 3.2.2
H	M	L	H	H	H	H	H	B15	Economic potential	Economic potential (in contrast to the technical potential which is always larger or equal to the economic potential).	if the tool considers regional differences--> higher rating	Section 3.2.2
H	M	L	H	H	H	H	H	B16	Bottlenecks in technology deployment	Bottlenecks to technology deployment (industry not ready to follow the demand).		
								POLICY INDICATORS				
H	H	L	H	H	M	M	H	B17	Support mechanisms	Different support mechanisms (e.g. feed-in tariffs, quotas, fiscal measures, information).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the impact on the technology deployments of different technologies - the tool should score high.	Section 3.2.3
M	M	N	M	M	L	M	L	B18	Identify lock-in situations	Can the tool identify lock-in situations and then address policy measures aimed to change/solve them?		Section 3.2.2
M	L	N	M	M	L	M	N	B19	System failure	Can the tool address system failure?		Section 3.2.2
M	M	N	M	M	M	M	L	B20	Uncertainties	Can the tool deal with uncertainties?		Section 3.2.2
H	VL	N	H	M	M	N	H	B21	CO_2 reduction per technology	Life time CO_2 emissions per technology (Life cycle emission).		Section 3.2.2
L	H	M	L	VL	L	N	N	B22	Total employment in the economy			Section 3.2.2
M	H	L	M	L	L	N	M	B23	Change in GDP			Section 3.2.2
H	VL	N	M	M	M	VL	H	B24	Life cycle costs	The tools capacity to consider the life cycle costs.		Section 3.2.2
H	VL	N	M	M	M	VL	H	B25	Life cycle energy input	The tools capacity to consider the total use of energy over the entire life cycle.		Section 3.2.2
H	VL	N	H	M	M	VL	H	B26	Life cycle emissions	The tools capacity to consider the total amount of emissions over the entire life cycle.		Section 3.2.2
L	M	VL	L	M	H	L	L	B27	Competitiveness considerations for regional industry			Section 3.2.2

CRES								International cooperation				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	Nr	Specification	Description	Guidlines to evaluation	Location in Specification Report
								GENERAL SPECIFICATIONS				
VL	N	N	M	H	N	N	N	E1	JI and CDM	The potential CO2 reduction through JI and CDM and its cost.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5
								INTERNATIONAL COOPERATION ON R&D				
VL	VL	N	VL	H	M	L	L	E2	International Cooperation	The possibility of the tools to identify potentialities of international cooperation on R&D. Monitor benefits of international cooperation on R&D. Assess mutual needs on R&D (win-win situations).	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
VL	VL	N	N	M	M	L	N	E3	Past International Cooperation	The possibility of the tool to assess past cooperation initiatives and to estimate their results.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
VL	L	N	VL	M	M	L	L	E4	Global centers of excellence	Need for global "centers of excellence" (existence and fields of activity), e.g. by monitoring technologies with structural high cost or performance lagging behind	If the tool maps existing centres - the tool should not score higher than average. If the tool evaluates the needs of global centres - the tool should score high.	Section 3.5.1
L	VL	N	M	H	H	M	H	E5	Technology Mapping	Technology mapping: international comparison of the state-of-the-art in different technologies (not technology fields) at the world level. Compare which technologies connect to European knowledge.		Section 3.5.1
L	VL	N	L	M	H	M	M	E6	Potential R&D cooperations	Determine which countries are potential partners or main competitors.		Section 3.5.1
L	L	N	M	M	H	L	M	E7	Identify large scale R&D projects	Map total technology development investment and capabilities that need international cooperation. For example fusion technology.		Section 3.5.1
L	N	N	M	M	H	L	M	E8	R&D outside EU	Mapping of knowledge produced outside of the EU. Potential fields where additional R&D within EU is not needed for further Technology Learning (free-riding possibilities) since outside EU there is a high level of technical knowledge.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.1
								INTERNATIONAL INTERACTION IN TECHNOLOGY DEPLOYMENT				
L	L	VL	M	H	H	L	H	E9	Spillover - Between Regions	Spillover from Technology Learning between different regions of the world	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
L	L	N	M	H	H	L	H	E10	Spillover Between Institutes/Companies	Spillover from Technology Learning between different international companies and/or research institutes. To distinguish between horizontal and vertical spillover effects. Having vertical (cross-sectors) impacts could give an information on how the research is fundamental or not, and gives a more clear idea of the R&D impact on Technology Learning. Horizontal is spillovers between companies/institutes within the same branch.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.5.2
M	N	VL	H	H	H	M	H	E11	Deployment of Technologies outside Europe			Section 3.5.2
M	N	N	H	H	H	M	H	E12	Technology Cost outside Europe			Section 3.5.2

CRES								Innovation and R&D				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								GENERAL SPECIFICATIONS				
H	L	L	H	H	H	H	H	D1	Long-term economic perspectives of technologies			Section 3.4
								R&D				
M	L	L	M	M	M	H	M	D2	Long-term risk assessment	Risks involved in research activities within a long-term perspective. Risks that R&D will not deliver the cost reductions/technology improvement hoped for.		Section 3.4
L	N	VL	L	L	H	VL	L	D3	R&D spendings vs. number of patents	R&D spending output in terms of patents.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	Section 3.4.1
VL	N	N	L	L	H	VL	L	D4	R&D spendings vs. number of publications	R&D spending output in terms of publications.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
M	L	L	H	H	H	VL	L	D5	R&D spendings vs. Deployment	R&D spendings in terms of e.g. amounts of new installed RES-capacity.		Section 3.4.1
M	L	VL	H	H	H	VL	M	D6	Link between R&D and Technology Learning	Assess expected impacts from R&D on the technology development, e.g. econometric models based on historical observations.	If the tool includes the Specification - the tool should not score higher than average. If the tool evaluates the Specification - the tool should score high.	
L	L	VL	M	L	H	VL	L	D7	Public vs. Private R&D - effects technology development	Distinguish between the effects on technology development (KPIs) by public and private R&D. (The nature of public and private R&D may differ; public tends to be more fundamental, private more applied).		Section 3.4.1
L	L	VL	M	L	H	VL	L	D8	Public vs. Private R&D - effectiveness of stimulating cooperation	Is the tool capable of determining which actors are involved in technology development		Section 3.4.1
L	N	N	M	L	H	VL	L	D9	Public vs. Private R&D - timing	Can the tool start R&D support at different times and assess its effect on e.g. the overall mix of technologies later on.		Section 3.4.1
M	L	N	M	L	H	VL	L	D10	Monitoring R&D targets	Are technologies on track with promises from e.g. roadmaps (achievements)?		Section 3.4.1
M	L	N	M	L	H	VL	L	D11	Impact assessment of actions to catch up with the intended time schedule	Can we feed the tool with actions (e.g. increased R&D funding, lowering targets) to determine its effect to catch up a technology's development with the original time schedule (in case the technology development is delayed)?		Section 3.4.1
L	N	N	M	L	H	VL	L	D12	Monitor depletion of funding	Amount of available funding being spent; this gives insight in whether there is a structural problem that needs more attention or a logical explanation of why developments lag behind.		Section 3.4.1
M	L	N	M	L	H	VL	L	D13	Map effectiveness of R&D funding mechanisms	To answer policy questions like:		Section 3.4.1
								INNOVATION				
L	VL	L	M	M	H	M	M	D14	Mapping of the size of industrial sectors relative to the World	To identify strong and weak industrial sectors		Section 3.4.2
M	N	N	L	L	H	N	M	D15	Patenting	Number of Patents in order to measure innovation.		
M	N	N	L	L	H	N	M	D16	Publications	Number of Publications in order to measure innovation		

CRES								Innovation and R&D				
PQ 01	PQ 02	PQ 03	PQ 04	PQ 05	PQ 06	PQ 07	PQ 08	Nr	Specification	Description	Guidelines to evaluation	Location in Specification Report
								INNOVATION				
L	VL	L	M	M	H	M	M	D14	**Mapping of the size of industrial sectors relative to the World**	To identify strong and weak industrial sectors		Section 3.4.2
M	N	N	L	L	H	N	M	D15	**Patenting**	Number of Patents in order to measure innovation.		
M	N	N	L	L	H	N	M	D16	**Publications**	Number of Publications in order to measure innovation.		
M	L	VL	H	M	H	M	M	D17	**Trade**	Share of Energy Technologies in the international trade flows. Consider if relative or absolute advantage.		

Appendix D

Policy Questions – Combination Methodology

Policy Question’s Analysis for the Combination creation methodology

	Technology Detail										Sector							Geographical Coverage				
Policy Question	Technology Rich	Wind	Photovoltaic	CSP	Biofuels	Nuclear IV	CCS	Fuel Cells	Smart grids	Energy Eff	Coal	Oil	Gas	Electricity	Transport	Industry	Buildings	World	EU level	MS level	Regional level	Local Level
PQ 01	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x		
PQ 02	x										x	x	x	x	x	x	x			x		
PQ 03	x										x	x	x	x						x	x	
PQ 04	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x		
PQ 05	x	x	x	x	x	x	x	x	x		x	x	x	x						x	x	
PQ 06	x										x	x	x	x	x	x	x		x	x		
PQ 07	x								x		x	x	x	x				x	x	x		
PQ 08	x									x					x	x	x			x		

Appendix E

Models' Analysis - Combination Methodology

	MODELS	Technology Detail										Sector							Geographical Coverage					Model Type	
		Technology Rich	Wind	Photovoltaic	CSP	Biofuels	Nuclear IV	CCS	Fuel Cells	Smart grids	Energy Eff	Coal	Oil	Gas	Electricity	Transport	Industry	Buildings	World	EU level	MS level	Regional level	Local Level	Systemic	CGE-Macroeconomic
1	BALMOREL	x	x	x	x		x		x						x						x	x	x		
2	BEST														x						x				
3	COALMOD (COALMOD-World)											x							x						
4	COMPETES	x	x	x			x	x			x				x					x	x	x			
5	E2M2s	x	x	x	x		x								x						x				
6	E3ME		x	x	x		x	x	x			x	x	x	x					x	x				x
7	E3MG		x	x	x		x	x	x			x	x	x	x				x						x
8	EMELIE		x	x	x				x						x					x	x				
9	EMM		x	x	x		x	x	x	x					x						x				
10	ESTEEM		x	x		x		x	x					x	x	x							x		
11	GASMOD													x						x					
12	GEM-E3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x				x
13	GEMED														x						x				
14	GEMINI-E3											x	x	x	x				x						x
15	GET							x				x	x	x	x	x			x						
16	GRAPE						x	x				x	x	x	x	x	x		x						
17	IER - Model for Power Plant and Transmission Expansion		x	x	x		x	x	x						x						x	x	x		
18	IMACLIM	x	x			x	x	x			x	x	x	x	x	x	x	x	x	x					x
19	IMAGE-TIMER	x	x	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x					
20	**Wilmar Planning Tool** (mainly consisting of Joint Market Model (JMM) and Scenario Tree Tool)		x	x	x										x						x	x	x		
21	LEAP	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	
22	MDM-E3	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x			x				
23	"Long-term energy demand model" consisting in three sub-models: MURE-Residential, ISIndustry, TEP-Tertiary.										x				x		x	x		x	x				
24	NEWAGE											x	x	x	x	x	x	x	x	x					x
25	OILMOD												x						x						
26	POLES											x	x	x	x				x					x	
27	POWERS	x	x	x			x	x	x						x		x				x	x			
28	PRIMES	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x			x	
29	**RESolve-E** (formerly known as ADMIRE-REBUS)		x	x	x										x					x	x				
30	RESolve-T					x										x				x	x				
31	ROM		x	x	x										x	x					x				
32	TEMPO	x				x			x		x					x					x				
33	TIAM-World	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x				x	
34	TIMES PanEU	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x			x	
	TIMES Nordic	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x			x	
	TIMES FI	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x		x	
35	WILMAR	x	x												x	x					x	x			
36	WITCH																		x						x
37	STSc SocioTechnical Scenario											x	x	x	x	x	x	x	x	x	x	x			
38	MECHanisms										x							x		x	x	x	x		
39	Horizon Scan											x	x	x	x	x	x	x	x	x	x				
40	iKnow											x	x	x	x	x	x	x		x					
41	Behave/PRECEDE-PROCEED Planning Model											x	x	x	x	x		x			x	x	x		
42	GoReNEST framework																								

		Technology Detail										Sector							Geographical Coverage					Model Type	
	MODELS	Technology Rich	Wind	Photovoltaic	CSP	Biofuels	Nuclear IV	CCS	Fuel Cells	Smart grids	Energy Eff	Coal	Oil	Gas	Electricity	Transport	Industry	Buildings	World	EU level	MS level	Regional level	Local Level	Systemic	CGE-Macroeconomic
43	Climate Bonus/Carbon footprinting, monitoring, feedback & rewards																								
44	GMM	x										x	x	x	x	x	x		x					x	
45	PACE											x	x	x	x				x						x
46	ADAGE											x	x	x	x	x	x		x	x					x
47	AIM											x	x	x	x	x	x	x	x						x
48	IGEM																			x					x
49	MERGE											x	x	x	x				x						x
50	MESSAGE	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x				x	
51	GTAP-E	x										x	x	x	x	x	x	x		x					x
52	UKENVI										x	x	x	x	x	x	x	x			x				x
53	MoreHys								x						x	x	x	x			x				
54	ABARE-GTEM											x	x	x	x	x	x	x	x						x
55	AMIGA											x	x	x	x	x	x	x	x						x
56	COMBAT																								
57	DICE											x	x	x	x	x	x	x	x						x
58	DNE21+	x	x	x	x		x					x	x	x	x	x	x	x	x					x	
59	EDGE																								
60	EFDA-TIMES	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x					x	
61	EnergyPLAN																								
62	ENPEP-BALANCE	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x		x	
63	ENV-Linkages											x	x	x	x	x	x	x	x						x
64	EPPA											x	x	x	x		x		x						
65	ETP model	x										x	x	x	x	x	x	x	x					x	
66	FUND										x	x	x	x	x	x	x	x	x						x
67	GEM-CCGT											x	x		x		x		x						x
68	INVERT		x	x	x						x				x			x			x	x			
69	IPAC											x	x	x	x	x	x	x	x						x
70	MINI-CAM		x	x	x		x	x				x	x	x	x									x	
71	MIRAGE											x	x	x	x				x						x
72	NEMESIS		x	x	x		x	x				x	x	x	x	x	x	x		x					x
73	NEMS		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x			x	
74	REMIND-R	x										x	x	x	x	x	x	x	x					x	
75	RICE											x	x	x	x	x	x	x	x						x
76	SGM											x	x	x	x	x	x		x						x
77	WEM											x	x	x	x	x	x	x	x					x	
78	WIAGEM											x	x	x	x				x						x
79	SAMLAST	x	x	x	x		x			x					x					x	x				
80	REMARK														x					x	x				
81	ESPAUT														x						x				
82	MTSIM														x					x	x				
83	WASP	x	x	x	x		x		x						x						x	x			
84	CGEN													x	x						x	x			
85	GreenNET-Europe model	x													x					x	x				