MILESECURE-2050

Multidimensional Impact of the Low-carbon European Strategy on Energy Security, and Socio-Economic Dimension up to 2050 Perspective

SSH.2012.2.2-2 – 320169

Deliverable 3.2
Report describing Scenarios for
Societal Energy Transition

Date: 29/05/2015
Version: FINAL

Prepared by:
ECOLOGIC INSTITUTE

Based in parts on contributions by:
IEn, ENERGSYS, POLITO, ENEA, LSC, SMASH

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 320169

DOCUMENT CONTROL

PROJECT NUMBER / CONTRACT NUMBER :	**FP7-SSH-2012-2-320169**
PROJECT TITLE :	**MILESECURE-2050-** Multidimensional Impact of the Low-carbon European Strategy on Energy Security, and Socio-Economic Dimension up to 2050 perspective
CONTRACTUAL DATE OF DELIVERY:	31/01/2015
ACTUAL DATE OF DELIVERY:	29/5/2015
DISSEMINATION LEVEL (PU/PP/RE/CO)[1]:	**PU**
NATURE OF DOCUMENT (P/R/D/O)[2]:	**R**
DOCUMENT CLASS (DEL/MR/PR/FR/RR)[3]:	**DEL**

DOCUMENT NUMBER:	**MILESECURE-2050 WP3/ Ecologic Institute/ Deliverable 3.2**
TITLE OF DOCUMENT:	**MILESECURE-2050 Deliverable 3.2 - Report describing scenarios for societal energy transition**
WORK-PACKAGE CONTRIBUTING TO THE DOCUMENT:	**WP3: Societal processes for energy transition**

[1] Dissemination level: PU = Public; PP = Restricted to other programme participants; RE = Restricted to a group specified by the Consortium; CO = Confidential, only for member of the Consortium

[2] Nature: P = Prototype; R = Report; D = Demonstrator; O = Other

[3] Class: DEL = Deliverable; MR = Management report; PR = Progress report; FR = Final report; RR = Peer review report

AUTHOR (S) :	**Max Gruenig (ECOLOGIC)** max.gruenig@ecologic.eu **Andreas Prahl (ECOLOGIC)** andreas.prahl@ecologic.eu **Katherine Weingartner (ECOLOGIC)** katherine.weingartner@ecologic.eu **Adam Umer (Energsys)** aumer@energsys.com.pl **Zygmunt Parczewski (IEn)** zygmunt.parczewski@ien.com.pl **Oscar Amerighi (ENEA)** oscar.amerighi@enea.it **Giovanni Caiati (LSC)** giovanni.caiati@gmail.com **Jacopo Toniolo (POLITO)** jacopo.toniolo@polito.it **Christophe Cassen (SMASH)** cassen@centre-cired.fr
REVIEWER (S):	**Catherine Barlow (USAL)** C.Barlow1@salford.ac.uk **Govert Valkenburg (MUST)** g.valkenburg@maastrichtuniversity.nl

Abstract: The purpose of this report is to enable the use of non-technical information in quantitative modelling, i.e. to connect the research on societal drivers and barriers, so-called factors, from past work on the societal processes for energy transition (WP3) with modelling designed to produce future scenarios (WP4). This is the first time non-technical aspects of the energy transition are quantified in a harmonised approach and then integrated in modelling processes. This report builds upon the work of Deliverable 3.1 by using factor assessments for the year 2012 as well as insights from national experts to develop factor foresights for Germany, Italy, Poland and the EU for years 2020, 2030 and 2050, expressed in narratives developed for both centralised and decentralised systems of government. These factors have been previously identified as important to future energy security in the EU. The report primarily serves as a methodology paper.

Disclaimer

*The information, documentation and figures available in this deliverable are written by the MILESECURE-2050 Consortium partners under EC co-financing (project **FP7-SSH-2012-2- 320169**) and does not necessarily reflect the view of the European Commission.*

The information in this document is provided "as is", and no guarantee or warranty is given that the information is fit for any particular purpose. The user uses the information at his or her sole risk and liability.

Table of Contents

Executive summary ..... **i**
1. Introduction **2**
2. Methodology **3**
2.1 Refining the list of factors **3**
2.2 Identifying indicators **5**
2.3 Developing an assessment methodology for 2012 factors **5**
2.4 Methodology for factor projections up to 2050 ..... **7**
3. Factor assessment **9**
3.1 Factor assessment for 2012 ..... **9**
3.2 Factor Foresights for 2020, 2030 and 2050 ..... **11**
4. Low-carbon Energy Security Narratives **17**
4.1 German narratives **17**
4.2 Italian narratives **28**
4.3 Polish narratives **40**
4.4 European narratives **51**
5. Summary **62**
6. Annex **64**

List of Tables

Table 2-1 List of final set of factors (with E, S and P attribution) 4
Table 3-1 2012 Overall factor assessment values by country 9
Table 3-2 Factor Foresights for 2020 11
Table 3-3 Factor Foresights for 2030 13
Table 3-4 Factor Foresights for 2050 15
Table 6-1 Complete List of Indicators 64

Abbreviations:

EC	European Commission
EU	European Union
GHG	Greenhouse gas emissions
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
MILESECURE	Multidimensional Impact of the Low-carbon European Strategy on Energy Security, and Socio-Economic Dimension up to 2050 perspective
NGO	Non-governmental Organisation
PCA	Principal Component Analysis

Jargon / defintions:

Anticipatory Experience	European locales where a low-carbon transition has taken place on a local scale
Assessment Matrix	A grid of quantitative values based on a qualitative ranking of Anticipatory Experiences; the first step in the Quantitative Evaluation
Domain	Regime or category to which Factors belong
Factor	Significant influencer on energy transition. Can encapsulate either transition drivers or transition barriers within its scope, depending on context.
Final Framework	Organisational and framing structure of key drivers and barriers in energy transition, based on synthesis of entire research proccess
Preliminary Framework	Initial hypothesis of comprehensive organisation and structure for Factors in energy transition
Quantitative Evaluation	Statistical analysis conducted on Anticipatory Experiences after they had been scored according to the Preliminary Framework

Executive summary

The purpose of this report is to enable the use of non-technical information in quantitative modelling, i.e. to connect the research on societal drivers and barriers, or factors as they are called here, from past work on the societal processes for energy transition (WP3) with modelling designed to produce future scenarios (WP4). This is the first time non-technical aspects of the energy transition are quantified in a harmonised approach and then integrated into modelling processes.

To do this, several steps were taken.

In addition to the 15 factors determined in Deliverable 3.1, three factors more closely related to human energy were introduced. These 18 factors are grouped horizontally into six factor areas (participatory decision making; policy context; adoption, implementation and uptake of innovative technological solutions; financial and entrepreneurial aspects; external factors; repositioning of individuals in the energy system in transition) and vertically into three temporal stages (pre-conditions; triggers; impact).

For each of the now 18 factors, relevant indicators were identified which were then assessed using base year 2012 on an assessment range from -2 to +2, where -2 represented the most negative result [absolute barrier] and +2 represented the most positive result [absolute driver]. Different methodologies were used to assess different types of indicators which were used to determine factor assessment values for Germany, Italy, Poland and the EU for the base year 2012. The addition of qualitative assessments to national 2012 factor assessment values yielded 2012 Overall factor assessment values.

In a next step, we extrapolated factor foresights for Germany, Italy, Poland and the entire EU for the years 2020, 2030 and 2050 for two different scenarios to explore alternative futures for Europe based on potential anticipatory experience development and environmental and energy security issues.

The underlying scenarios were aligned with WP4: Societal Energy Transition (SET) Scenario and Centrally driven Energy Transition (CENT) Scenario. SET describes a decentralised bottom-up energy transition, whereas CENT represents a top-down, government-driven scenario.

Based on the factor foresights, narratives were developed for each of the three countries and the EU as a whole to describe the role of the selected factors as drivers and barriers of energy transition over time based on conditions set by the two scenarios, SET and CENT.

The secondary output of this task is the quantitative assessment of identified drivers and barriers of energy transition for both 2012 and future timeframes in the context of two distinct scenarios. These assessments will then contribute to WP4 modelling tasks.

The primary output of the research is the development of a novel methodology for merging qualitative and quantitative information and for comparing energy transition progress across different countries and over time without focusing on the technical energy system, but instead on the human energy or polito-social system.

1. Introduction

The purpose of this report is to enable the use of non-technical information in quantitative modelling, i.e. to connect the research on societal drivers and barriers, or factors as they are called here, from past work on the societal processes for energy transition (WP3) with modelling designed to produce future scenarios (WP4). This is the first time non-technical aspects of the energy transition are quantified in a harmonised approach and then integrated into modelling processes.

This report builds upon the work of Deliverable 3.1 by using 2012 factor assessments as well as insights from national experts to develop factor foresights for Germany, Italy, Poland and the EU for years 2020, 2030 and 2050, expressed in narratives developed for both centralised and decentralised systems of government. These factors have been previously identified as important to future energy security in the EU. The report primarily serves as a methodology paper and is broken down into three main sections.

The first section explains the methodology of the deliverable which includes the addition of three factors from Deliverable 3.1, how indicators for each factor were identified, development of an assessment methodology for 2012 factors and the method for making factor projections for 2020, 2030 and 2050.

The second section shows the results of factor assessments for 2012 as well as factor foresight assessments for 2020, 2030 and 2050.

In the third section, narratives were written based on 2012 factor assessments and factor foresight assessments for 2020, 2030 and 2050 according to two scenarios, one describing a decentralised government structure and the other a centralised structure. They show the role of factors as drivers or barriers of energy transition over time on the national level for Germany, Italy and Poland and on the EU level as a whole.

2. Methodology

The goal of the analysis is to connect the research on societal drivers and barriers from past work on the societal processes for energy transition (WP3) with modelling designed to produce future scenarios (WP4). Research conducted in WP3 provides options and factors which will have particular influence in the following societal processes in future WP4 modelling scenarios: technical, political, economic, environmental, lifestyle and cultural processes. Some quantification was necessary to feed the qualitative results from the drivers and barriers framework from Deliverable 3.1 into the models used in WP4. The primary output of this task is the quantitative assessment of the status of identified drivers and barriers of energy transition for current and future scenarios for 2020, 2030 and 2050. These assessments will then contribute to WP4 modelling tasks.

2.1 Refining the list of factors

Our research on the drivers of the societal processes for low-carbon energy transition focuses on factors in three domains: *Market, External and Governance factors (E), Social, Political Movement and Grassroots factors (S) and Personal, Cultural and Site-specific factors (P)*.

Furthermore, factors are grouped with regard to their temporal dimension into three stages in the transition process: i) drivers which are pre-conditions in the run-up to the transition; ii) drivers which are triggers for the implementation of measures and programs; and iii) drivers which foster the impacts of the actions.

Building on feedback on the initial 15 factors in D3.1, three new factors were added to the set which relate more directly to human energy as defined in WP2. In particular, these are factors included in the repositioning of individuals in the energy systems in transition. These new factors and brief descriptions of each are below.

Attention toward practical issues of everyday life
This factor describes the phenomenon of citizens paying new attention to various aspects of their lives which are involved in energy transition. Citizen attention to food (addressing personal consumption patterns, concerns over food quality and food origin, and cooking for pleasure), health (increase in health culture), physical well-being (sports, fitness, body care become more and more important) and waste management (citizen become more aware of the entire life cycle of their consumes and increase their skill of reusing and recycling waste) are examples.

Increased resort to muscular strength allow energy saving
This factor is characterized by the increased use of the body to provide energy saving in the mobility and housing sectors, including increased practices of walking or cycling and a greater use of body warmth in lieu of heating system use, for example.

Spreading of energy literacy and of energy citizenship
People develop a tangible sense of their energy consumption and self-perception is reframed in a way that allows people to feel physically part of the energy system. They are aware of how personal decisions impact the environment and global community. Finally, individual consumption choices are made to achieve the objective of energy transition instead of maximizing physical well-being and avoiding fatigue.

Therefore, the resulting final list of 18 factors is:

Table 2-1 List of final set of factors (with E, S and P attribution)

Factor area	Factor Type	Factor Number	Factor Title
Participatory decision making	Pre-conditions	1.1	Openness of individuals to social change and change processes (S)
	Triggers	1.2.	Engagement of individuals in local projects, existence of change agents (S)
	Impact	1.3	New socio-cultural power structures; change in participatory processes (S)
Policy context	Pre-conditions	2.1	Political leadership (covering various levels of governance) (S)
	Triggers	2.2	Legal framework, incentives, regulation (E)
	Impact	2.3	New political power structures (S)
Adoption, implementation and uptake of innovative technological solutions	Pre-conditions	3.1	Professionals with education and capacity to support societal transition (E)
	Triggers	3.2	Effective implementation (project management, technical training, information) (P)
	Impact	3.3	New interaction of individuals with technology, society and environment (P)
Financial and entrepreneurial aspects	Pre-conditions	4.1	Positive economic impact of demonstration projects / measures (P)
	Triggers	4.2	Relevant project funding models (S)
	Impact	4.3	Evolution of new business models (S)
External (economic, political, geopolitical) factors	Pre-conditions	5.1	Market signals (E)
	Triggers	5.2	Massive shocks, external disruptions to system (E)
	Impact	5.3	New financial and economic paradigm (S)
Repositioning of individuals in the energy systems in transition factors	Pre-conditions	6.1	Attention toward practical issues of everyday life (P)
	Triggers	6.2	Increased resort to muscular strength allow energy saving (P)
	Impact	6.3	Spreading of energy literacy and of energy citizenship (P)

In order to quantify the qualitative drivers and barriers to be used in WP4 modelling, several steps were taken. First, indicators were identified which corresponded to the factors determined in D3.1. Secondly, these indicators were assessed and the assessments were used to inform the evaluation of the corresponding factors. Thirdly, after a qualitative evaluation of the resulting factor assessments was taken to account for any bias generated from the selected indicators, overall factor assessments were determined. Finally, these values were used to predict factor assessment values for 2020, 2030 and 2050 for various scenarios which will be included in WP4 modelling.

2.2 Identifying indicators

The first step in the process was to identify indicators for each factor. After exploring a range of data sources, relevant indicators were selected for each factor and presented to all involved partners for review. Values for each of the agreed upon indicators were recorded for each of the chosen countries as well as the EU as a whole. These countries include Germany, Italy and Poland which were selected to represent various energy regions within the EU. For a full list of indicators, please refer to Table 7.1 Complete List of Indicators in the Annex of this document.

2.3 Developing an assessment methodology for 2012 factors

The indicators were then assessed using base year 2012 and an assessment range from -2 to +2, where -2 represented the most negative result [absolute barrier] and +2 represented the most positive result [absolute driver]. To account for the different types of data, three different methodologies were used to assess indicators.

1) Where a scale of 0% to 100% was possible as an outcome of the indicator values, we used the whole range to translate results to our scale of [-2;2]. Here, 0% would correspond to a value of -2 and 100% to a value of +2. This was predominantly the case for the *Participatory decision making* and *Repositioning of individuals in the energy systems in transition* factor groups where data was mostly in the form of public opinion. For example, indicator 1.2.1 measures the effectiveness of local/regional voting on influencing political decision making based on citizen opinion polling conducted in EU-28 Member States. The resulting scale for this polling ranged from 0% to 100%.

The indicator value for Germany for Indicator 1.2.1 was 83%. This information was entered into the following formula where -2 represent the minimum for the indicator assessment scale and 2 represents the maximum:

$$-2 + 0.83*(2 – (-2)) = 1.32$$

Thus, the derived factor assessment for Germany was 1.32.

2) For some indicators, the maximum values were either unknown, did not exist or were not reasonable given the nature of the indicator. Consider e.g. indicator 3.1.1, public expenditure on education as percentage of GDP. In this example, the same range of results from 0% to 100% is available. Yet it would not be sensible to use the whole range for the assessment since values lower than 100% of GDP spent on education can still be regarded as strong drivers (and spending 100% of GDP on education would not be sensible).

Another example is indicator 3.3.1, patents in environment-related technologies. This indicator does not provide a percentage scale. Thus the maximum is unknown. An assessment based on observed EU-28 values could therefore be considered, using the lowest EU-28 value as a minimum (-2) and the highest EU-28 value as a maximum (+2). However, in the interpretation of such an assessment, the lowest EU value would be considered an absolute barrier despite the fact that there are still considerable amounts of environment-related technology patents being developed. It can thus be argued that the absolute barrier should rather be set at 0 patents being developed, thus using 0 as the minimum value.

In these instances, the highest EU-28 value was used as a maximum and the minimum was set at 0. This approach provides the needed flexibility to evaluate certain indicators.

The indicator value for Poland for Indicator 3.1.1 was 4.94%. The minimum value was set to 0 and the maximum value, 8.75%, was based on the EU-28 maximum for this data set. This information was entered into the following formula where -2 represents the minimum for the indicator assessment scale and 2 represents the maximum:

$$-2 + (0.0494 – 0)*(2 – (-2)) / (0.0875 – 0) = 0.26$$

Thus, the derived factor result for Poland was 0.26.

3) As the process of assessing indicators progressed, it was found that for some indicators, it was also not possible or useful to set 0 as the minimum value. This was the case e.g. for indicator 5.1.1, GDP per capita. Setting 0 as the minimum value would have meant that all countries would score very high points on this indicator. It can also be argued that low values, although higher than 0, can still be regarded as strong barriers. For these reasons, the EU-28 country with the lowest GDP per capita value set the minimum value and the EU-28 country with the highest value set the maximum value. Extreme outliers were taken out of the data set, such as Luxemburg in the case of GDP per capita.

Another example is indicator 5.1.4, household savings rate. This indicator has negative values for some countries, thus minimum and maximum values are unknown. The EU-28 country with the lowest value set the minimum value and the EU-28 country with the highest value set the maximum value in this case as well.

The indicator value for 5.1.1 was 26800 EUR for Italy. The EU-28 minimum value was 5600 EUR and the maximum value was 44900 EUR (Luxemburg with 82400 EUR was taken out of the range). This information was entered into the following formula where -2 represents the minimum for the indicator assessment scale and 2 represents the maximum:

$$-2 + (26800 – 5600)*(2 – (-2)) / (44900 – 5600) = 0.16$$

Thus, the derived factor result for Italy was 0.16.

Initial factor value estimations were derived from the assessment of the individual indicators. The average of all indicators for a certain factor was taken to determine the preliminary overall factor assessment for each country. Based on these values, qualitative assessments were made by country specialists to complement the quantitative indicator assessment. This provided the opportunity to adjust the assessment based on the limited quantitative assessment to better reflect the factor score for a country. The overall factor assessments were therefore determined by both the initial indicator based assessment and the proceeding qualitative assessments conducted through expert judgment.

The Overall factor assessment values for the EU were calculated using the CLAN methodology. Each factor for Germany, Poland and Italy was weighted with the population of the cluster to which it belonged. Three clusters of countries have been identified for Europe: cluster L, M and H. The rational for this can be found in the

WP4 Cluster Analysis Report. The following formula was then applied at the EU level for 2012 to determine the EU Overall factor assessment value:

[PL Overall factor score)*population in cluster L] + [IT (Overall factor score)*population in cluster M] + [DE (Overall factor score)*number of people in cluster H]/ (Population cluster L+M+H)

2.4 Methodology for factor projections up to 2050

Once the overall factor assessments were made for each country and the EU, factor foresights were made for the years 2020, 2030 and 2050 for two different scenarios to explore alternative futures for Europe based on potential anticipatory experience development and environmental and energy security issues.

Short descriptions of the scenarios can be found in the box below:

Societal Energy Transition (SET) Scenario
The SET scenario takes a bottom-up approach and features a decentralized energy transition mainly driven by changes in lifestyles and changes in governance modes. In the SET scenario, we assume increases in the development of local energy communities and the importance of grass roots initiatives and participation processes in decision making concerning energy transition. Local policy, driven by a range of local actors, increasingly favours the development of small LCE. Ultimately, a new structure of producers and consumers of energy gradually appears that includes micro and small and medium-sized (<50 MW) power plant units. Public infrastructures at the regional and local level are increasingly modernized. Local projects receive more funding opportunities and local entrepreneurship can be strongly developed. The number of initiatives in favour of mini and micro-generation RES as well as significant improvement in energy efficiency in buildings takes place. All of these factors will pave the way for effective development and practical implementation of the human energy concept which can lead to noticeable effects on societal energy transition by 2050. EU emission reduction objectives of -20%, -40% and -80% respectively in 2020, 2030 and 2050 (to 2005 levels) as described in the EU 3*20 package, Roadmap 2050 and Frame 2030) are reached in this scenario. Other nations are likely to achieve their Copenhagen pledges.

Centrally driven Energy Transition (CENT) Scenario
Contrary to the SET scenario, the CENT scenario features a centralized energy transition for Europe and Member States, mainly driven by central, large-scale technologies and the implementation of large interconnection projects. It is driven by top-down governance approaches. Changes in lifestyle and, in particular, the development of human energy are limited. The centralized system (both in political and technological respects) delays the involvement of local communities in participation processes regarding energy transition issues. National and EU regulations in the energy sector mainly favour low carbon energy (LCE) large-scale technologies while the development of small power units is limited. Incentives for innovation at the local level are relatively low. R&D dynamics show that main financial resources are directed mainly to large power plants, Ultimately, this centralized energy policy strategy complicates and limits the implementation of the 'human energy concept' and thus the process of societal energy transition. EU emission reduction objectives of -20%, -40% and -80% respectively in 2020, 2030 and 2050 (to 2005 levels) as described in the EU 3*20 package, Roadmap 2050 and Frame 2030) are also reached in this scenario. Other nations are likely to achieve their Copenhagen pledges.

The foresights for 2020, 2030 and 2050 were made by referring to 2012 Overall factor assessments, using energy strategy and scenario documents on the national and EU level and consulting expert judgment. The developed factor value projections were accompanied by the development of factor-specific narratives, describing each country's future path, (see section 4). For the EU foresights for 2020, 2030 and 2050, the same formula which was used to calculate the 2012 Overall factor assessments was used but with national foresight values for these years as inputs instead of national 2012 Overall factor assessment values.

In an effort to account for the uncertainty of future changes and to simplify the model input for the further analysis, foresight values for 2020, 2030 and 2050 were evaluated on a scale from -2 to +2 using increments of 0.5. Although this might lead to less precise forecasting, the previously described benefits of this approach resulted in this method being chosen. The quantitative factor value results of this exercise provide the inputs to feed into the Socio Metric Transition Model (SMET) of energy transition scenarios, which will be used to closely examine the link with policy analysis given alternative views about the various dimensions of the future (geopolitics, societal changes, technological changes, resources endowments, environmental risks).

3. Factor assessment

3.1 Factor assessment for 2012

Due to the method described above, country specific values were rounded to the nearest tenth, reflecting the influence of the qualitative assessments. EU values were calculated using the formula described previously.

Table 3-1 2012 Overall factor assessment values by country

Factor	Factor Type	2012 Overall factor assessment Germany	2012 Overall factor assessment Italy	2012 Overall factor assessment Poland	2012 Overall factor assessment EU
1. Participatory decision making	1.1 Openness of individuals to social change and change processes	0.7	0.8	0.6	0.71
	1.2 Engagement of individuals in local projects, existence of change agents	0.7	0.6	0.0	0.53
	1.3 New socio-cultural power structures, change in participatory processes	0.2	-0.1	-0.3	0.02
2. Policy context	2.1 Political leadership (covering various levels of governance)	1.0	1.0	-1.0	0.60
	2.2 Legal framework, incentives, regulation	1.2	0.9	0.3	0.94
	2.3 New political power structures	0.6	0.2	-0.5	0.28
3. Adoption, implementation and uptake of innovative technological solutions	3.1 Professionals with education and capacity to support societal transition	0.5	0.1	0.5	0.40
	3.2 Effective implementation (project management, technical training, information)	0.2	0.1	-0.2	0.09
	3.3 New interaction of individuals with technology, society and environment	0.8	0.2	-0.7	0.35
4. Financial and entrepreneurial aspects	4.1 Positive economic impact of demonstration projects / measures	1.0	-0.2	-0.6	0.37
	4.2 Relevant project funding models	1.2	0.8	-1.0	0.66
	4.3 Evolution of new business models	1.1	0.5	-0.6	0.61

Factor	Factor Type	2012 Overall factor assessment Germany	2012 Overall factor assessment Italy	2012 Overall factor assessment Poland	2012 Overall factor assessment EU
5. External (economic, political, geopolitical) factors	5.1 Market signals	1.1	0.5	-0.2	0.69
	5.2 Massive shocks, external disruptions to system	0.5	0.8	-0.2	0.44
	5.3 New financial and economic paradigm	0.5	0.5	-0.3	0.34
6. Repositioning of individuals in the energy systems in transition factors	6.1 Attention toward practical issues of everyday life	-0.8	-0.7	-1.6	-0.93
	6.2 Increased resort to muscular strength allow energy savings	-0.8	-0.6	-1.1	-0.81
	6.3 Spreading energy literacy and energy citizenship	-0.2	-0.5	-1.2	-0.48

3.2 Factor Foresights for 2020, 2030 and 2050

Table 3-2 Factor Foresights for 2020

Factor	Factor Type	Germany SET	Germany CENT	Italy SET	Italy CENT	Poland SET	Poland CENT	EU SET	EU CENT
1. Participatory decision making	1.1 Openness of individuals to social change and change processes	1	0.5	1	0.5	1	0.5	1	0.5
	1.2 Engagement of individuals in local projects, existence of change agents	1	0	1	0.5	0.5	0	1	0
	1.3 New socio-cultural power structures, change in participatory processes	0.5	-0.5	0.5	-0.5	0	-0.5	0.5	-0.5
2. Policy context	2.1 Political leadership (covering various levels of governance)	1	0.5	1	1	0	-0.5	1	0.5
	2.2 Legal framework, incentives, regulation	1.5	1	1	1	0.5	0.5	1	1
	2.3 New political power structures	1	0	0	0	0	0	0.5	0
3. Adoption, implementation and uptake of innovative technological solutions	3.1 Professionals with education and capacity to support societal transition	0.5	0.5	0.5	0	1	0.5	0.5	0.5
	3.2 Effective implementation (project management, technical training, information)	0.5	0.5	0.5	0	0.5	0	0.5	0.5
	3.3 New interaction of individuals with technology, society and environment	1	1	0.5	0.5	0	-0.5	0.5	0.5

Factor	Factor Type	Germany SET	Germany CENT	Italy SET	Italy CENT	Poland SET	Poland CENT	EU SET	EU CENT
4. Financial and entrepreneurial aspects	4.1 Positive economic impact of demonstration projects / measures	1	1	0	0	-0.5	-0.5	0.5	0.5
	4.2 Relevant project funding models	1.5	1	1	0.5	0	-0.5	1	0.5
	4.3 Evolution of new business models	1.5	1	0.5	0.5	0	0	1	0.5
5. External (economic, political, geopolitical) factors	5.1 Market signals	1.5	1.5	0.5	0.5	0.5	0	1	1
	5.2 Massive shocks, external disruptions to system	0.5	1	0.5	1	0	-0.5	0.5	0.5
	5.3 New financial and economic paradigm	0.5	0.5	0.5	0.5	0	0	0.5	0.5
6. Repositioning of individuals in the energy systems in transition factors	6.1 Attention toward practical issues of everyday life	0.5	0	0	-1	-0.5	-1	0	-0.5
	6.2 Increased resort to muscular strength allow energy savings	0.5	-0.5	0	-0.5	0	-0.5	0.5	-0.5
	6.3 Spreading energy literacy and energy citizenship	0.5	0	0	-0.5	0.5	-0.5	0.5	0

Table 3-3 Factor Foresights for 2030

Factor	Factor Type	Germany SET	Germany CENT	Italy SET	Italy CENT	Poland SET	Poland CENT	EU SET	EU CENT
1. Participatory decision making	1.1 Openness of individuals to social change and change processes	1.5	0	1.5	0	2	0	1.5	0
	1.2 Engagement of individuals in local projects, existence of change agents	1.5	-1	1	-0.5	1	-0.5	1.5	-1
	1.3 New socio-cultural power structures, change in participatory processes	1.5	-1	1	-1	0.5	-0.5	1	-1
2. Policy context	2.1 Political leadership (covering various levels of governance)	1.5	0.5	1.5	0.5	0.5	0	1.5	0
	2.2 Legal framework, incentives, regulation	1.5	1	1	1	1.5	0.5	1.5	1
	2.3 New political power structures	1.5	-0.5	0.5	-0.5	1	0	1	-0.5
3. Adoption, implementation and uptake of innovative technological solutions	3.1 Professionals with education and capacity to support societal transition	1.5	1	1	0.5	1.5	1	1.5	1
	3.2 Effective implementation (project management, technical training, information)	1.5	1	1	0.5	1.5	0.5	1.5	1
	3.3 New interaction of individuals with technology, society and environment	1.5	1	1	0.5	1	0	1.5	0.5

Factor	Factor Type	Germany SET	Germany CENT	Italy SET	Italy CENT	Poland SET	Poland CENT	EU SET	EU CENT
4. Financial and entrepreneurial aspects	4.1 Positive economic impact of demonstration projects / measures	1.5	1	1	0.5	1	0	1.5	0.5
	4.2 Relevant project funding models	1.5	1	1.5	1	0.5	0	1.5	1
	4.3 Evolution of new business models	1.5	1	1.5	1	1	0.5	1.5	1
5. External (economic, political, geopolitical) factors	5.1 Market signals	1.5	1.5	0.5	1	1	0.5	1	1
	5.2 Massive shocks, external disruptions to system	0	0.5	0.5	1	1	0.5	0.5	0.5
	5.3 New financial and economic paradigm	1	1	1	0.5	1.5	0.5	1	1
6. Repositioning of individuals in the energy systems in transition factors	6.1 Attention toward practical issues of everyday life	1	0.5	0.5	-0.5	0.5	0	1	0
	6.2 Increased resort to muscular strength allow energy savings	1	-0.5	1	0	1	0	1	-0.5
	6.3 Spreading energy literacy and energy citizenship	1	0.5	0.5	0	1	0	1	0.5

Table 3-4 Factor Foresights for 2050

Factor	Factor Type	Germany SET	Germany CENT	Italy SET	Italy CENT	Poland SET	Poland CENT	EU SET	EU CENT
1. Participatory decision making	1.1 Openness of individuals to social change and change processes	2	-0.5	2	-1	2	-0.5	2	-1
	1.2 Engagement of individuals in local projects, existence of change agents	2	-1.5	1.5	-1	2	-1	2	-1.5
	1.3 New socio-cultural power structures, change in participatory processes	2	-1.5	1.5	-1.5	1.5	-0.5	2	-1.5
2. Policy context	2.1 Political leadership (covering various levels of governance)	1.5	0.5	1.5	0.5	1.5	0.5	1.5	0.5
	2.2 Legal framework, incentives, regulation	1.5	1	1.5	1	2	1	1.5	0.5
	2.3 New political power structures	2	-0.5	1	-0.5	1.5	0	1.5	-0.5
3. Adoption, implementation and uptake of innovative technological solutions	3.1 Professionals with education and capacity to support societal transition	1.5	1	1	0.5	2	2	1	1.5
	3.2 Effective implementation (project management, technical training, information)	1.5	1	1.5	0.5	2	1	1	1.5
	3.3 New interaction of individuals with technology, society and environment	2	1	2	1	2	1	1	2

Factor	Factor Type	Germany SET	Germany CENT	Italy SET	Italy CENT	Poland SET	Poland CENT	EU SET	EU CENT
4. Financial and entrepreneurial aspects	4.1 Positive economic impact of demonstration projects / measures	1.5	1	1	1	2	1	1.5	1
	4.2 Relevant project funding models	1.5	1	1.5	1	1.5	1	1.5	1
	4.3 Evolution of new business models	1.5	1	1.5	1	1.5	1	1.5	1
5. External (economic, political, geopolitical) factors	5.1 Market signals	1.5	1.5	1	1.5	2	1	1.5	1.5
	5.2 Massive shocks, external disruptions to system	0	0	1	1.5	1.5	1	0.5	0.5
	5.3 New financial and economic paradigm	1.5	1	1.5	1	1.5	1	1.5	1
6. Repositioning of individuals in the energy systems in transition factors	6.1 Attention toward practical issues of everyday life	1	0.5	1	0	1.5	0	1	0.5
	6.2 Increased resort to muscular strength allow energy savings	1.5	0	1.5	0	1.5	0.5	1.5	0
	6.3 Spreading energy literacy and energy citizenship	1.5	0.5	1	0	1.5	0.5	1.5	0.5

4. Low-carbon Energy Security Narratives

This section shows the narratives that have been developed together with the future projections of the factors and their roles as drivers and barriers of energy transition over time. The full list of foresights for 2020, 2030 and 2050 can be found in section 3. They have been developed using the storylines of the scenarios (SET, CENT), energy strategy and scenario documents on the national and EU level and expert judgment.

The narratives are sorted according to country, factor and scenario (SET, CENT).

4.1 German narratives

a. Participatory decision making

Openness of individuals to social change and change processes

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.70	SET	1	1.5	2
	CENT	0.5	0	-0.5

SET

In this scenario, citizens take a proactive role in being part of a movement to advance the energy system. In Germany, there is a growing interest and involvement in grassroots and eco-initiatives. Awareness of current environmental niche areas, such as energy efficiency, organic food and the environmental footprint of consumer goods, is becoming more widespread. Starting from an already favourable level, this factor is expected to gradually increase in importance as a driver in Germany up to 2050. For example, one indicator used in the factor assessment for 2012 for Germany shows that in 2012, 89 percent of German citizens believed that they played an active role in environmental protection. This percentage is projected to steadily increase up to 2050 in this scenario which encourages individual engagement.

CENT

Openness of individuals to social change is also necessary in some ways for energy transition. However, in this scenario, citizens play a more passive role as consumers and users. Participation in grassroots activities and interest in local eco-initiatives shrinks from the current level. Citizens become more reactive to top-down changes in the energy system and expect changes to be made in this way. Active local involvement is therefore something that is tolerated but less active bottom-up support is needed to make changes to the energy system in a centralized system. This factor therefore develops over time from a small driver to being a small barrier for energy transition until 2050.

Engagement of individuals in local projects, existence of change agents

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.70	SET	1	1.5	2
	CENT	0	-1	-1.5

SET
German citizens increasingly spearhead local eco-initiatives and found citizen owned companies such as cooperatives. Rather than relying on outside, top-down involvement and support, the community is taking its future into its own hands. Engagement is important as actions are created from the bottom-up in this scenario and therefore, proactive citizens are crucial. Starting from an already favourable level, this factor is expected to increase in importance until 2050, marking it as a strong driver.

CENT
The current level of citizen involvement is reduced as most projects are implemented from the top. Thus, citizens do not play an active role in project creation and implementation but rather a passive role through minimal involvement to increase public acceptance. Since measures are implemented top-down, local engagement is less important, or can actually develop towards being a barrier, if the local involvement contradicts the top-down plans to be implemented. The active engagement of individuals in local projects and as overall change agents constitutes a barrier for energy transition. This factor develops towards being a strong barrier until 2050. The rate of decrease in the factor value is less steep from 2030 to 2050 because the initial transition towards a central energy system will have passed, leading to a more gradual future change.

New socio-cultural power structures, change in participatory processes

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.20	SET	0.5	1.5	2
	CENT	-0.5	-1	-1.5

SET
A democratization of decisions in society, new public interest and organized participatory action are developing in Germany. The influence of citizen interest groups and associations in the decision making process is growing. For example, in 2012, 41 percent of German citizens predicted that the impact of people on the fight against climate change in 15 years would be positive. This percentage as well as the importance of this factor as a driver is predicted to steadily increase until 2050.

CENT
As the ownership of the energy infrastructure is mainly in the hands of a few large players in this scenario, there is no development of new socio-cultural power

structures. The influence of citizen interest groups and associations in the decision making process is diminishing. Democratizing decision making and public engagement constitutes a barrier towards energy transition. The opposite trend is therefore seen in the percentage of German citizens who predict that the impact of people on the fight against climate change in 15 years. This percentage and the importance of this factor as a barrier initially drop sharply by 2020 and then continue to gradually decrease until 2050.

b. Policy context

Political Leadership

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
1.00	SET	1	1.5	1.5
	CENT	0.5	0.5	0.5

SET

In response to citizens serving as active change agents on the local level, it is important to have proper national level frameworks to engage with these agents in a productive way. This results in the development of more adequate legislation and policy mechanisms to support local initiatives. More individual engagement creates a more diverse political landscape with more active players. Stronger leadership is needed to coordinate all of these components of the political system as well as to challenge powerful interest groups from central industries which try to intervene in political leadership. On the local level, many municipalities have already discovered the opportunities offered by climate policies for themselves. Motivation is often economic, e.g. there are efforts to increase local value added. As a result of all of these factors, the role of political leadership as a driver stays at a high level up to 2020 and increases gradually up to 2030. From here, the role of the driver remains constant up to 2050.

CENT

Although political leadership is important for this scenario, such as in terms of calming opposition and assuring citizens of the value of various actions within the system, local leadership is not of utmost importance in energy transition. Legislation and policy mechanisms support large project types decided upon on the federal or national level. Local political leadership becomes gradually less significant up to 2030 as EU policies remain centralized and has a neutral impact by 2030. It then increases back to 2020 levels by 2050.

Legal frameworks, incentives, regulation

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
1.20	SET	1.5	1.5	1.5
	CENT	1	1	1

SET
In Germany, there is an ambitious overall target framework, particularly regarding the phase-out of nuclear energy and reduction of GHG emissions. The Energiekonzept from 2010 is an example of one of these important German legal frameworks. The uptake of renewable energies and energy efficiency actions keeps being supported by policies where needed to ensure a broad market penetration. The legal framework creates financial support and investment advantages for small players in the energy market. Policies to further diversify the ownership structure in favour of small players will be introduced. An example is the current discussion in the German state of Mecklenburg Western Pommerania, to oblige renewable energy project developers to financially involve the local community where the system will be built. The framework also supports the employment of infrastructure for a decentralized energy system. In comparison to CENT, this framework is slightly more important in a SET scenario as SET has more decentralized players with less influence and financial power. Big corporations may have the potential to reap more benefits than small local players if the legal framework is not completely favourable. The role of mechanisms, incentives and instruments put in place to scale eco-initiatives as drivers for societal energy transition increases slightly from a currently high level by 2020 and remains fairly constant up to 2050.

CENT
The legal framework, incentives and regulation keep supporting energy transition where needed to ensure a broad market penetration. However, the legal framework disadvantages small players and encourages large investors to invest in the energy market and support the employment of infrastructure for a more central energy system. In the longer run, the importance of this factor as a driver of energy transition decreases by 2020 and then remain constant until 2050.

New political power structures

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.60	SET	1	1.5	2
	CENT	0	-0.5	-0.5

SET
Although German societal energy transition already involves a large number of small actors, in a more decentralized system, decentralized players in the energy system gain an even stronger influence. This is mirrored in power relations towards the central energy suppliers and their influence on national decision making. The role of new political power structures as drivers gradually increases up to 2050.

CENT
The large number of small actors in the German energy transition is gradually taken out of the system in favour of the four big energy suppliers which gain market share. Thus, power structures move towards and build up around these actors.
New political power structures in terms of a participatory governance system are therefore barriers in energy transition. As a result, the influence of this factor drops until 2030 when it then remains constant until 2050.

c. Adoption, implementation and uptake of innovative technological solutions

Professionals with education and capacity to support societal transition

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.50	SET	0.5	1.5	1.5
	CENT	0.5	1	1

SET
The new opportunities being created in the emerging energy paradigm create interest and demand in specialized education programs. There is a strong demand for a specialized and skilled workforce. However, due to the significant time investment required by professional education, noticeable changes in the amount of professionals prepared to support societal transition in the energy sector does not take place by 2020. By 2030, there is a significant increase in this area which then remains relatively constant until 2050.

CENT
The new opportunities being created in the new energy paradigm create interest and demand in specialized education programs. There is a strong demand for a specialized workforce. However, due to the significant time investment required by professional education, noticeable changes in the amount of professionals prepared to support societal transition in the energy sector does not take place by 2020. By 2030, there is an increase in this area which then stabilizes until 2050. However, the importance of this factor as a driver is lower than in the decentralized scenario in which a more widespread and extensive demand of qualified professionals is assumed.

Effective implementation (project management, technical training, information)

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.20	SET	0.5	1.5	1.5
	CENT	0.5	1	1

SET
The shorter lifetime of projects in comparison to professional education allows project managers to improve project management approaches based on quicker feedback from projects. Combined with the shorter timeframe for technical trainings and greater access to new information, effective implementation increases slightly by 2020 and greatly increases until 2030. Beyond 2030, effective implementation will remain stable.

CENT
The shorter lifetime of projects in comparison to professional education allows project managers to improve project management approaches based on quicker feedback from projects. Combined with the shorter timeframe for technical trainings and greater access to new information, the influence of effective implementation as a driver increases gradually until 2030. It remains at those levels until 2050. The importance of this factor as a driver is lower than in the decentralized scenario, as decentralized projects have a smaller amount of capital available to absorb problems in project implementation.

New interaction of individuals with technology, society and environment

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.80	SET	1	1.5	2
	CENT	1	1	1

SET
Individual engagement with technology, society and the environment increases slightly by 2020 and continues to gradually increase up to 2050. This is due to the impacts of education in technology and environmental issues and the gradual increased integration of these factors into general society and everyday life over time. The educational system is increasingly adapted to provide the right set of skills to support societal energy transition. The excellent innovation capacity of local companies as well as high levels of individual innovation capacities enable Germany to benefit from innovation-driven positive economic, social and environmental impacts.

CENT
Personal relationships with technology and the environment slightly improve by 2020 due to the impacts of currently established education available in technology and the environment. However, these personal relationships remain constant up to 2030 and lower than in the decentralized scenario as the result of a less individually-focused system.

d. Financial and entrepreneurial aspects

Positive economic impact of demonstration projects

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
1.00	SET	1	1.5	1.5
	CENT	1	1	1

SET
Decentralized governance is gradually implemented as the role of local communities and authorities as well as local funding sources increases. The positive impacts of demonstration projects promoting partnerships among public, private and community sectors remain relatively constant at an already high level until 2020. These gradually increase until 2030. After 2030, the positive impacts remain constant at 2030 levels until 2050. This describes the distributional impacts from the local perspective.

CENT
In the short-term, the role of demonstration project impacts from the local perspective as a driver remain constant until 2050 but lower than in the decentralized scenario. The presence of partnerships among public, private and community sectors becomes less relevant in a centralized system.

Relevant project funding models

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
1.20	SET	1.5	1.5	1.5
	CENT	1	1	1

SET
In Germany, there is already a wide spectrum of funding models for decentralized community energy projects based on equity (e.g. energy cooperatives) and debt capital (such as subsidized credits from the development bank KfW). A slight increase in the diversity of relevant funding models is expected up to 2020, improving its role as a driver. It then remains constant until 2050.

CENT
In this scenario, project funding models will decrease slightly by 2020 because those that prove unsuccessful from 2012 will be removed in a centralized system with no new innovative models being proposed. Consequently, the factor projections for the CENT scenario are less than in SET. Funding methods which prove to work remain the standard financial methods over time. This is why the influence of the factor remains constant until 2050.

Evolution of new business models

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
1.10	SET	1.5	1.5	1.5
	CENT	1	1	1

SET
The innovative capacity of the German economy is already at a high level if indicators such as patents in environment-related technologies are considered. This level of entrepreneurial innovations is expected to increase slightly until 2020, also mirroring improving return opportunities from sustainable energy investments. It then remains constant until 2050.

CENT
The innovative capacity of the German economy is currently at a high level if indicators such as patents in environment-related technologies are considered. In this scenario, the level of entrepreneurial innovations until 2020 is expected to decrease slightly due to the reduced number of actors and technological diversity. It then remains constant until 2050.

e. External (economic, political, geopolitical) factors

Market Signals

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
1.10	SET	1.5	1.5	1.5
	CENT	1.5	1.5	1.5

SET
Germany is currently experiencing a positive environment for business activity measured by indicators such as GDP development, household savings and ease of doing business. This positive economic environment is expected to improve slightly until 2020 and then remains constant until 2050 in this scenario.

CENT
Germany is currently experiencing a positive environment for business activity measured by indicators such as GDP development, household savings and ease of doing business. This positive economic environment is expected to improve slightly until 2020 and then remains constant until 2050 in this scenario. Although the SET and CENT systems operate differently within Germany, citizens in both are still part of a capital market system. Therefore, they respond equally to market signals for goods and services driven by supply and demand incentives on the local and global markets.

Massive shocks, external disruptions to the system

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.50	SET	0.5	0	0
	CENT	1	0.5	0

SET
Germany's vulnerability to massive shocks in the energy system is moderate if measured by indicators such as energy dependence or change of public sentiment after the Fukushima disaster. Thus, external shocks are only considered to be a moderate driver to societal energy transition. This remains constant until 2020 and reduces further towards 2030 due to energy efficiency investments and a rising share of renewable energy in the system. Consequently, energy dependency is reduced. Vulnerability to shocks remains at a neutral level up to 2050.

CENT
Germany's vulnerability to massive shocks in the energy system is moderate if measured by indicators such as energy dependence or change of public sentiment after the Fukushima disaster. Thus, external shocks are only considered to be a moderate driver to energy transition. This increases towards 2020 because as the system initially becomes more centralized, it temporarily becomes more vulnerable to outside shocks. It then gradually reduces to current levels by 2030, partially due to the establishment of a rational transnational grid system and larger scale RES installations. After 2030, vulnerability continues to gradually decrease until 2050.

New financial and economic paradigm

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.50	SET	0.5	1	1.5
	CENT	0.5	1	1

SET
Until 2020, this driver remains constant as the results of the new financial and economic paradigm take time to be seen. It then gradually increases up to 2050 as the increasing role of sustainable energy industries within the economic context of Germany and the rising economic benefits and financial income streams resulting from these industries come to fruition. This leads to a positive revision of the value of the environment and eco-initiatives over time.

CENT
Until 2020, this driver remains constant as the results of the new financial and economic paradigm take time to be seen. It then gradually increases up to 2030 as the increasing role of sustainable energy industries within the economic context of Germany and the rising economic benefits and financial income streams resulting

from these industries come to fruition. Unlike in the SET scenario where constant financial innovation is encouraged, a successful financial and economic paradigm in a CENT scenario will become the standard paradigm over time. By 2030, a successful paradigm, proven over time, exists and remains until 2050. Though not as strong as in SET, this CENT scenario leads to a positive revision of the value of the environment and eco-initiatives over time.

f. Repositioning of individuals in the energy systems in transition

Attention toward practical issues of everyday life

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.80	SET	0.5	1	1
	CENT	0	0.5	0.5

SET

The role of local communities experiences a redefinition. Attention toward practical issues of everyday life substantially increases by 2020, creating a strong driver compared to today. This results from a movement which promotes societal eco-awareness. This gradually increases up to 2030 when it then stabilizes up to 2050. Local food purchase is used as an example. In 2012, 44 percent of Germans had a tendency to buy locally produced and seasonal food. By 2020, this number is projected to notably increase, levelling off by 2030 and staying at this level into 2050.

CENT

In cooperation with minimal influences from local communities, centrally planned and distributed repositioning practices will take place. The centralized system institutionalizes ways in which citizens engage in the energy system in their everyday lives. The initial effects of the transition to this institutionalized system are more dramatic, accounting for the greater increase in the influence of this factor until 2020 where it becomes neutral. From there, it increases at a slower rate before stabilizing in 2030. Stabilization occurs because by 2030, German citizens reach a point where attention towards practical issues of everyday life as they relate to the energy system is maximized. In the CENT scenario, the percentage of Germans who had a tendency to buy locally produced and seasonal food in 2012 will increase, though not as much as in the SET scenario. It increases until 2030 and stays at this level until 2050.

Increased resort to muscular strength allow energy saving

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.80	SET	0.5	1	1.5
	CENT	-0.5	-0.5	0

SET
Though use of public transportation increases as an alternative to personal motorized vehicles, citizens increasingly engage in non-motorized forms of transport as a way to personally contribute to energy savings and influence their health. In 2012, 12 percent of Germans said they cycle several times a day. This percentage is projected to significantly increase by 2020 as societal changes promote more individual activity to save energy. From there, it increases steadily until 2050.

CENT
The central government incentivizes public transportation to save energy. Citizens use these alternatives more than in SET and therefore do not invest as much in non-motorized individual efforts to save energy such as walking or biking. For this reason, the increased resort of muscular strength constitutes a barrier in the CENT scenario. The factor values increase slightly over time until the factor becomes neutral in 2050.

Spreading of energy literacy and of energy citizenship

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.20	SET	0.5	1	1.5
	CENT	0	0.5	0.5

SET
The spreading of energy literacy and of energy citizenship increases significantly by 2020 and gradually increases up to 2050 due to the rising importance of decentralised energy provision and energy efficiency. This involves and affects a large amount of citizens. Grassroots and eco-initiatives will have a supporting influence in this development. In 2012, 44 percent of Germans said they bought an energy-efficient appliance in an effort to fight climate change. This percentage continues to gradually increase until 2050.

CENT
Citizens continue to be educated on energy policies and structures through central initiatives. The spreading of energy literacy and of energy citizenship increases slightly to become neutral by 2020 and gradually increases to become a weak driver in 2030, remaining at this level until 2050. It remains a weak driver because in a centralized system, energy citizenship and individual contributions to the energy system are not as important. It is not neutral because energy literacy is still of moderate importance in a central system.

4.2 Italian narratives

a. Participatory decision making

Openness of individuals to social change and change processes

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.80	SET	1	1.5	2
	CENT	0.5	0	-1

SET
In this scenario, citizens take a proactive role in being part of a movement to advance the energy system. In Italy, there is a growing interest and involvement in grassroots and eco-initiatives. Awareness of current environmental niche areas, such as energy efficiency and organic food, is becoming more important in customer choices. Starting from an already favourable level, this factor is expected to gradually increase in importance as a driver in Italy up to 2050. For example, one indicator used in the factor assessment for 2012 for Italy shows that in 2012, 85 percent of Italian citizens believed that the state of environment has an influence on their quality of life. This percentage is projected to steadily increase up to 2050 in this scenario which encourages individual engagement.

CENT
Openness of individuals to social change is also necessary in some ways for energy transition. However, in this scenario, citizens play a more passive role as consumers and users. Participation in grassroots activities and interest in local eco-initiatives shrinks from the current level. Citizens become more reactive to top-down changes in the energy system and expect changes to be made in this way. Active local involvement is therefore something that is tolerated but less active bottom-up support is needed to make changes to the energy system in a centralised setting. This factor therefore develops over time from a moderate driver to being a moderate barrier for energy transition until 2050.

Engagement of individuals in local projects, existence of change agents

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.60	SET	1	1	1.5
	CENT	0.5	-0.5	-1

SET
Local eco-initiatives and self-sustaining communities are spread throughout Italy. Rather than relying on outside, top-down involvement and support, the community is taking its future into its own hands. Engagement is important as actions are created through bottom-up approaches in this scenario, making proactive citizens crucial to

the process. Starting from an already favourable level, this factor is expected to gradually increase in importance until 2050, marking it as a strong driver.

CENT

The current level of citizen involvement is reduced as most projects are implemented from the top. Nevertheless, centralized decision making helps citizen acceptance in the beginning of the process. As time goes on and measures continue to be implemented from the top-down, local engagement becomes less important. It becomes a barrier if local involvement contradicts top-down implementation plans. In the medium to long term, the active engagement of individuals in local projects and as overall change agents constitutes a barrier for energy transition. Hence, this factor develops towards being a moderate barrier until 2050.

New socio-cultural power structures, change in participatory processes

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.10	SET	0.5	1	1.5
	CENT	-0.5	-1	-1.5

SET

Local forms of participatory processes, new public interest and local power structures are developing in Italy, but are still in their infancy. At present, the perception about the impact of citizen participation on environmental issues is mixed. In 2012, 54 percent of Italian citizens predicted that the impact of people on the fight against climate change in 15 years would be positive, while only 34 percent predicted the same about environmental protection. In this scenario, the influence of citizen interest groups and associations in the decision making process increases steadily until 2050 New socio-cultural power structures and changes in participatory processes which foster positive development in citizen participation increase gradually until 2050. At this time, the factor becomes a strong driver.

CENT

As the ownership of the energy infrastructure is mainly in the hands of a few large players in this scenario, there is no development of new socio-cultural power structures. The influence of citizen interest groups and associations in the decision making process is diminishing. Democratizing decision making and public engagement constitute a barrier towards energy transition. Therefore, whereas the percentage of Italian citizens who predict that the impact of people on the fight against climate change in 15 years increases in the SET scenario, in this scenario, it is projected to decrease. This factor continues to decrease steadily until 2050 when it becomes a strong barrier.

b. Policy context

Political Leadership

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
1.00	SET	1	1.5	1.5
	CENT	1	0.5	0.5

SET

In response to citizens serving as active change agents on the local level, it is important to have proper national level frameworks to engage with these agents in a productive way. This results in the development of more adequate legislation and policy mechanisms to support local initiatives. More individual engagement creates a more diverse political landscape with more active players. Stronger leadership is needed to coordinate all of these components of the political system as well as to challenge powerful interest groups from central industries which try to intervene in political leadership. On the local level, many municipalities have already discovered the opportunities offered by climate policies for themselves. Motivation is often economic, e.g. there are efforts to increase local value added. As a result of all of these factors, the role of political leadership as a driver stays constant up to 2020 and increases gradually up to 2030. From here, the role of the driver remains constant up to 2050.

CENT

Political leadership is important for this scenario in terms of calming opposition and assuring citizens of the value of different implemented measures within the system. That is why local leadership remains of medium importance until 2020. Beyond this point, legislation and policy mechanisms supporting large-scale projects are more commonly implemented on the regional and national levels. For this reason, local political leadership becomes less significant by 2030 and continues at this level until 2050.

Legal frameworks, incentives, regulation

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.90	SET	1	1	1.5
	CENT	1	1	1

SET

In Italy, there is an ambitious overall target framework, particularly regarding the reduction of GHG emissions and increased RES production. Incentive schemes for RES, PV in particular, have been very generous so far and have allowed Italy to reach its medium-term target in terms of RES share in electricity generation. Though such incentive schemes led to an exponential increase in terms of PV installation and made Italy one of the most attractive markets worldwide in 2012, they did not

translate into a similar development of the PV domestic industry since the market boom mostly relied on imports of PV panels from abroad (notably Germany and China). Nevertheless, other schemes such as the white certificates system have worked very well. Recent incentives such as the “Conto Termico” for thermal energy try to focus on financial incentives for small players, but have so far seen limited results. Since the current incentive framework has been working well in terms of the targets Italy set, the importance of this factor increases slightly by 2020 and then remains constant until 2030. It then increases modestly until 2050. This reflects the time it will take to develop a comprehensive system which addresses the challenges mentioned here and implement it within the larger legal framework in a decentralized energy system scenario.

CENT

The legal framework, incentives and regulation keep supporting the energy transition where needed to ensure a broad market penetration. The importance of the factor increases slightly by 2020 based on legal frameworks, incentives and regulation which were implemented prior to the centralisation of the system but remains constant beyond that point until 2050. This is because the legal framework favours large investors and infrastructure improvements over small players in this scenario and this framework does not change much once implemented.

New political power structures

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.20	SET	0	0.5	1
	CENT	0	-0.5	-0.5

SET

Historically, a few medium to large players with significant market share decided or heavily affected the political power structure in Italy. The recently approved "Strategia Energetica Nazionale" (National Energy Strategy) is moving in a different direction. This is because it was the object of an online public consultation where citizens, NGOs, associations, etc. could provide their own feedback on the draft version of the document. In this case, the public was involved as an advisory board with a non-institutional role in defining the strategy and could provide non-binding suggestions on the document. The initial large-scale impacts of these new political power structures do not become apparent until after 2020 when the importance of this factor gradually increases until 2050. For this reason, it appears that the importance of these structures slightly decreases until 2020 when the results of previous new structures are realized.

CENT

Almost all the medium and small actors in the Italian energy transition are gradually taken out of the system in favour of a few big energy suppliers which gain market share. Thus, power structures move towards and build up around these actors. New political power structures in terms of a participatory governance system are therefore small barriers to energy transition. As a result, the influence of this factor drops until 2030 when it then remains constant until 2050. This is because after 2030, the political power structures in place remain without new ones being added.

c. Adoption, implementation and uptake of innovative technological solutions

Professionals with education and capacity to support societal transition

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.10	SET	0.5	1	1
	CENT	0	0.5	0.5

SET

The general abundance of technicians, high-skilled workers and engineers that Italy enjoys and which is projected to continue into the future means that Italy was not lacking professionals with the education and capacity to support societal transition in 2012, marking it as a slight driver at this time. Because of this, the importance of training professionals to support societal transition and demand for a specialised workforce beyond what already exists is of medium importance. The new opportunities being created in the rising new energy paradigm create interest and demand in specialised education programmes. Due to the significant time investment required by professional education, minor changes in the amount of professionals prepared to support societal transition in the energy sector will take place by 2020. By 2030, there is an increase in this area which then remains constant until 2050. This increase combined with the already high amount of available professionals both now and in the future supports the transition process in Italy.

CENT

The current general abundance of technicians, high-skilled workers and engineers in Italy implies that there is not an urgent need to train professionals to support societal transition in the short term. From 2012 to 2020, the importance of this factor slightly decreases. This is because as the energy system becomes more centralized, fewer professionals are needed than in the decentralized system. As more large-scale projects develop, the need for these professionals slightly increases and then remains constant at this level once the desired large-scale projects are implemented. For this reason, the importance of this factor increases from 2020 to 2030 and then remains constant until 2050, though at lower values than in the SET scenario.

Effective implementation (project management, technical training, information)

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.10	SET	0.5	1	1.5
	CENT	0	0.5	0.5

SET
In Italy, the time needed for complete project development from the idea to the commissioning stage is extensive. Indeed, it is comparable with the time needed for professional education. That is why effective implementation increases gradually as a driver until 2050.

CENT
The importance of this factor as a driver is lower than in the decentralised scenario, as decentralised projects have a smaller amount of capital available to absorb problems in project implementation. In the short term (from 2012 to 2020), no substantial changes can be observed in this factor that plays a neutral role in the energy transition process. In the medium to long term, effective implementation of large-scale projects slightly improves and this factor turns into a moderate driver of energy transition.

New interaction of individuals with technology, society and environment

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.20	SET	0.5	1	2
	CENT	0.5	0.5	1

SET
Individual engagement with technology, society and the environment increases slightly by 2020 and continues to gradually increase up to 2030. From 2030 to 2050, the full potential of the new energy paradigm in terms of the way individuals interact with technology, society and the environment in a more decentralized way is realised. Therefore, this factor increases significantly to become a strong driver in 2050. This is due to the impacts of education in technology and environmental issues and the gradual increased integration of these factors into general society and everyday life over time. The educational system is increasingly adapted to provide the right set of skills to support societal energy transition. The excellent innovation capacities of local companies, as well as high levels of individual innovation capacity, enable Italy to benefit from innovation-driven positive economic, social and environmental impacts.

CENT
The relationships of individuals with technology and the environment change slightly by 2020 due to the impact of the currently established education system. No substantial change can be observed in the medium term since, in the centralized scenario, the prevailing energy paradigm is very similar to the present one. In the long term, however, changes in the energy paradigm will take place and will have the time to fully integrate themselves into the society. Hence, individuals will have the opportunity to adapt to these changes and will be able to properly and effectively interact with technology. The role of this factor as a driver will be less strong than in the SET scenario as a result of a less individually-focused system.

d. Financial and entrepreneurial aspects

Positive economic impact of demonstration projects

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.20	SET	0	1	1
	CENT	0	0.5	1

SET
Decentralized governance is gradually implemented as the role of local communities and authorities as well as local funding sources increases. The current economic situation in Italy indicates that this factor was a slight barrier in 2012. In the future, the factor slightly increases to become neutral by 2020. Then, the positive impacts of demonstration projects promoting partnerships among public, private and community sectors fully develop by 2030 which explains the increase from 2020 to 2030. After 2030, the positive impacts remain constant at 2030 levels until 2050. This describes the distributional impacts from the local perspective.

CENT
In the short-term, the economic impact of demonstration projects does not substantially affect the energy transition process and this factor remains neutral. Its role becomes more evident in the medium to long term when the full potential of current demonstration projects is realised and the presence of partnerships among public, private and community sectors becomes relevant - even for large-scale projects, such as CCS, in a centralized energy system.

Relevant project funding models

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.80	SET	1	1.5	1.5
	CENT	0.5	1	1

SET
In Italy, there is already a sufficiently wide spectrum of funding models for decentralised community energy projects regarding equity (e.g. energy cooperatives) as well as debt capital. A slight increase in the diversity of relevant funding models is expected up to 2020 with a more significant increase by 2030 due to the continued development of new funding models. After 2030, successful funding models remain in place which explains why the importance of the factor remains constant until 2050.

CENT
In this scenario, project funding models will decrease slightly by 2020 because those that prove unsuccessful from 2012 will be removed in a centralized system with few innovative models being proposed. Afterwards, funding methods which prove to work remain the standard financial methods over time with very limited additions of new funding models for large-scale projects. This is why the influence of the factor remains constant until 2050 but at a lower level than in the SET scenario.

Evolution of new business models

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.50	SET	0.5	1.5	1.5
	CENT	0.5	1	1

SET
The innovative capacity of the Italian economy is already a modest driver if indicators such as patents in environment-related technologies are considered. This level of entrepreneurial innovations is expected to remain constant by 2020 and then strongly increases by 2030. In fact, by this time, new business models will be put forward to fully seize the opportunities of the energy paradigm change required by the SET scenario. From there, it remains constant until 2050.

CENT
The innovative capacity of the Italian economy is currently a modest driver if indicators such as patents in environment-related technologies are considered. In this scenario, the level of entrepreneurial innovations until 2020 is expected to remain constant and then increase by 2030. It then remains constant until 2050. The increase in new business models notably increases from 2020 to 2030 because this is the amount of time needed for previously implemented business models to prove themselves to be successful. Successful models are institutionalized and remain a part of the system until 2050. The importance of this factor as a driver in this scenario is lower than in the SET scenario, at least in the medium to long term, since the opportunities offered to business innovators involved in larger-scale projects will be lower than in the SET scenario.

e. External (economic, political, geopolitical) factors

Market Signals

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.50	SET	0.5	0.5	1
	CENT	0.5	1	1.5

SET

Italy is currently experiencing a stagnation period in business activity measured by indicators such as GDP development, household savings and ease of doing business. This economic environment is expected to remain stable by 2030 and improve slightly until 2050. The SET scenario creates widespread opportunities for individuals, firms and other actors in the energy system, Market signals can provide guidance to investors but are more easily distorted in the short than in the long term. Hence, market signals become a more effective driver for this scenario in the longer term. By 2050, this becomes a moderate driver in Italy.

CENT

Italy is currently experiencing a stagnation period in business activity measured by indicators such as GDP development, household savings and ease of doing business. This economic environment is expected to remain stable by 2020 and improve slightly from 2030 to 2050. In both scenarios, market signals affect citizens but in the CENT scenario, market signals are mediated by policymakers, large companies and other big players. Hence, the relative importance of this factor as a driver is higher in the CENT scenario because citizens do not respond in a uniform way to the signals coming from local and global markets.

Massive shocks, external disruptions to the system

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.80	SET	0.5	0.5	1
	CENT	1	1	1.5

SET

Italy's vulnerability to massive shocks in the energy system is relevant if measured with indicators such as energy dependence or change in public sentiment after the Fukushima disaster. Italy proved to be responsive to dramatic events in the energy sphere such as the Chernobyl and Fukushima nuclear accidents, but this response was often guided by the present public sentiment rather than by a proper cost-benefit assessment from a medium to long term perspective. Indeed, external shocks are only considered to be a moderate driver for societal energy transition. From 2012 to 2020, resistance to shocks slightly increases as the result of initial investments in RES and energy efficiency. It then remains stable until 2030.

CENT

Italy's vulnerability to massive shocks in the energy system is relevant if measured with indicators such as energy dependence or change in public sentiment after the Fukushima disaster. Italy proved to be very responsive to dramatic events in the energy sphere such as the Chernobyl and Fukushima nuclear accidents, but this response was often guided by the present public sentiment rather than by a proper cost-benefit assessment from a medium to long term perspective. This factor affects the CENT scenario more heavily than in the SET scenario because as the system initially becomes centralised and establishes more large-scale plants, it temporarily becomes more reactive to outside shocks. For this reason, the importance of this factor increases slightly by 2020 and remains at this level until 2030. From 2030 to 2050, it increases further due to the existence of large scale plants.

New financial and economic paradigm

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.50	SET	0.5	1	1.5
	CENT	0.5	0.5	1

SET
Until 2020, this driver remains constant as the results of the new financial and economic paradigm take time to be seen. It then gradually increases up to 2050 as the increasing role of sustainable energy industries within the economic context of Italy and the rising economic benefits and financial income streams resulting from these industries come to fruition. This leads to a positive revision of the value of the environment and eco-initiatives over time.

CENT
Until 2030, this driver remains constant as the results of the new financial and economic paradigm take time to be seen. Unlike in the SET scenario where constant financial innovation is encouraged, a successful financial and economic paradigm in a CENT scenario will become the standard paradigm over time. By 2020, a successful paradigm, proven over time, exists and remains until 2030. It then gradually increases up to 2050 as the increasing role of sustainable energy industries within the economic context of Italy and the rising economic benefits and financial income streams resulting from these industries come to fruition. Though not as strong as in SET, this CENT scenario leads to a positive revision of the value of the environment and eco-initiatives over time.

f. Repositioning of individuals in the energy systems in transition

Attention toward practical issues of everyday life

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.70	SET	0	0.5	1
	CENT	-1	-0.5	0

SET
The role of local communities experiences a redefinition. Attention toward practical issues of everyday life substantially increases by 2020 to become neutral. This results from a movement which promotes societal eco-awareness and gradually increases until 2050. Local food purchase is used as an example. In 2012, 33 percent of Italians had a tendency to buy locally produced and seasonal food. This number is projected to steadily increase until 2050.

CENT

Together with minimal influences from local communities, centrally planned and distributed repositioning practices take place. The centralized system institutionalizes ways in which citizens engage in the energy system in their everyday lives. The initial effects of the transition to this institutionalized system have a negative impact on people's way of living since it imposes changes to their current lifestyles. For this reason, the factor becomes a moderate barrier by 2020. Afterwards, people get acquainted with this institutionalised system and their resistance to change gradually decreases until 2050 when this factor becomes neutral. Using the above-mentioned example, the percentage of Italians who had a tendency to buy locally produced and seasonal food in 2012 decreases in this scenario until 2020 and then increases steadily until 2050.

Increased resort to muscular strength allow energy saving

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.60	SET	0	1	1.5
	CENT	-0.5	0	0

SET

Though use of public transportation increases as an alternative to personal motorized vehicles, citizens increasingly engage in non-motorized forms of transport as a way to personally contribute to energy savings and contribution towards their health. In 2012, 8 percent of Italians said they cycle several times a day. This percentage is projected to significantly increase by 2020 as societal changes promote more individual activity to save energy. From there, it increases steadily until 2050.

CENT

The central government incentivizes public transportation to save energy. Citizens use these alternatives more than in the SET scenario and therefore do not invest as much in non-motorized individual efforts to save energy such as walking or biking. For this reason, the increased resort of muscular strength constitutes a barrier in the CENT scenario. The factor values increase slightly over time until the factor becomes neutral in 2030 and remain neutral by 2050.

Spreading of energy literacy and of energy citizenship

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.50	SET	0	0.5	1
	CENT	-0.5	0	0

SET

The spreading of energy literacy and energy citizenship increases by 2020 and gradually increases up to 2050 due to the rising importance of decentralised energy provision and energy efficiency. This involves and affects a large number of citizens. Grassroots and eco-initiatives have a supporting influence in this development. In

2012, 27 percent of Italians said they bought an energy-efficient appliance as an effort to fight climate change. This percentage continues to gradually increase until 2050.

CENT

Citizens continue to be educated on energy policies and structures through central initiatives. The spreading of energy literacy and energy citizenship increases slightly to become neutral by 2030 and remain at this level until 2050. The energy paradigm that emerges from the CENT scenario has strong similarities with the current one and does not require the diffusion and rooting of a new energy culture or a more active role of citizens in the energy system.

4.3 Polish narratives

a. Participatory decision making

Openness of individuals to social change and change processes

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.60	SET	1	2	2
	CENT	0.5	0	-0.5

SET
There are purposeful developments in the participation process of local communities in decision making concerning societal energy transition. In Poland, there is a growing interest and involvement in grassroots and eco-initiatives. Citizen awareness of environmental issues and their openness to social change and the change process increase. This openness is projected to continue to develop in Poland, slightly increasing by 2020 and reaching a high level by 2030. It will then remain at that level into 2050. For example, in 2012, 75 percent of Polish citizens said they believed they played an active role in environmental protection. This percentage is predicted to increase until it reaches a high level in 2030 and remains at this level until 2050.

CENT
Actions by the state delay the development of the participation process of local communities in energy transition decision making. Although openness of citizens to social change and its processes are necessary for energy transition, citizens play a more passive role as users and consumers in this scenario. As the central system becomes more established, citizens begin to be more reactive to top-down changes, expecting changes to be made in this way. Active involvement in Poland decreases steadily until 2050, at which time it acts as a barrier to energy transition. This is because bottom-up openness to social change is likely to go against already established top-down social change processes and would cause tension in the social system. In this scenario, therefore, the percentage of Polish citizens who believed they played an active role in environmental protection would decrease up to 2050.

Engagement of individuals in local projects, existence of change agents

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.00	SET	0.5	1	2
	CENT	0	-0.5	-1

SET
Polish citizens experience ownership of local projects and grassroots and eco-initiatives increase. Engagement is fostered from the bottom-up instead of relying on changes from the top-down. Citizens become more proactive and overall

engagement of individuals as change agents consequently increases steadily up to 2050 when it becomes a strong driver for societal energy transition.

CENT
Citizen involvement in local projects and their role as change agents steadily decreases in Poland until 2050. This is because most projects are implemented from the top. Citizens accept these projects and play a passive role in energy transition. Individual engagement becomes a barrier by 2050 as individual engagement in local projects is likely to clash with top-down projects in a way that is disruptive to energy transition by that time.

New socio-cultural power structures, change in participatory processes

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.30	SET	0	0.5	1.5
	CENT	-0.5	-0.5	-0.5

SET
More Polish citizens are interested in engaging in decision making and their influence through interest groups and associations becomes more important to the decision making process. In 2012, 39 percent of Polish citizens predicted that the impact of people on the fight against climate change in 15 years would be positive. This percentage as well as the importance of this factor as a driver is predicted to steadily increase until 2050.

CENT
As the ownership of the energy infrastructure is mainly in the hands of a few large players in this scenario, there is no development of new socio-cultural power structures. The influence of citizen interest groups and associations in the decision making process is diminishing. Democratizing decision making and public engagement constitutes a barrier towards energy transition. The opposite trend is therefore seen in the percentage of Polish citizens who predict that the impact of people on the fight against climate change in 15 years. This percentage and the importance of this factor as a barrier increase by 2020 and then remain at this level until 2050. This is because in Poland, socio-cultural power structures that were ineffective from 2012 are eliminated by 2020, resulting in the structures that will remain until 2050.

b. Policy context

Political Leadership

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-1.00	SET	0	0.5	1.5
	CENT	-0.5	0	0.5

SET

As more citizens serve as active change agents on the local level, including through local government and organizations, the development of more adequate legislation and policy mechanisms to support local initiatives becomes more important. More individual engagement creates a more diverse political landscape with more active players. Stronger leadership is needed to coordinate all of these components of the political system as well as to challenge powerful interest groups from central industries which try to intervene in political leadership. Though motivation is often economic, there are efforts to increase local value added in climate policies at the local level. For all of these reasons, the importance of this factor greatly increases until 2020, reflecting the initially more significant changes generated by strong political leadership and continues to steadily increase until 2050 when it becomes a strong driver for societal energy transition.

CENT

Local leadership is not of utmost importance for energy transition. Legislation and policy mechanisms support large project types decided upon on the federal or national level. In Poland, improvements in political leadership are nonetheless necessary to supporting this scenario, such as in terms of calming opposition and assuring citizens of the value of various actions within the system. For this reason, local political leadership steadily increases until 2050, at which time it becomes a weak driver, but is still of less importance than in the SET scenario.

Legal frameworks, incentives, regulation

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.30	SET	0.5	1.5	2
	CENT	0.5	0.5	1

SET

Changes in the law favour the development of societal energy transition in the direction of micro and small LCE. Big producers are constrained in taking over small RES and in the construction of large emission structures. The introduced process of local activity is growing rapidly but bearing responsibility for the security of energy supply. Following this trend, the influence of legal frameworks, incentives and regulations gradually increases until 2050 when it becomes a strong driver to societal energy transition.

CENT

Legal frameworks in Poland support large investors in constructing larger-scale energy infrastructure. Small players are disadvantaged. This concentration of players to support a central system minimizes the importance of local leadership in comparison to the SET scenario. In Poland, the importance of legal frameworks increases slightly by 2020 and continues at this level until 2030. This increase is necessary to establish the necessary foundational legal frameworks to support a central system. From 2030 to 2050, improvements to the legal system are made after seeing the results of previous legislation over time. This explains the increase in the importance of this factor by 2050.

New political power structures

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.50	SET	0	1	1.5
	CENT	0	0	0

SET
The increased social awareness (imports from leading countries: DE, UK, Scandinavia) accelerates the development of NGO movements which serve as animators in creating local transition leaders. They gradually gain an increasing influence on political decisions on both the local and central level. The big energy sector (all power units producing 'black electricity') is gradually charged with fees for the restructuring of regions affected by the transition, for example: Upper Silesia in Poland. The revenues from these CO2 emissions fees are partially directed to support large-scale societal restructuring processes for the region. A new structure of producers and consumers of energy is gradually formed in micro and small and medium-sized (<50 MW) power units. For all of these reasons, the importance of this factor gradually increases until 2050.

CENT
Small actors are gradually taken out of the energy transition system in favour of larger energy producers that gain market share. This results in a political power structure which remains until 2050. In Poland, the importance of this factor is neutral for energy transition in the future, as there are no new political power structures proposed once the new structure formed between 2012 and 2020 is established.

c. Adoption, implementation and uptake of innovative technological solutions

Professionals with education and capacity to support societal transition

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.50	SET	1	1.5	2
	CENT	0.5	1	2

SET
The new opportunities being created in the emerging energy paradigm create interest and demand in specialised education programmes. There is a strong demand for a specialised and skilled workforce. However, due to the significant time investment required by professional education, increases in the number of professionals prepared to support societal transition in the energy sector take place gradually in Poland until 2050, at which time it becomes a strong driver for energy transition.

CENT

The emerging energy paradigm attracts demand and interest in specialized education programs. However, due to the significant time investment required by professional education, noticeable changes in the amount of professionals prepared to support societal transition in the energy sector does not take place until 2030 and then increases more significantly by 2050 to become a strong driver of societal energy transition. Notable improvements in the number of professionals equipped to support societal transition occurs later than in the SET scenario because less widespread and extensive demand for qualified professionals is assumed. Highly educated professionals are needed to service nuclear and ultra-supercritical power units in a central system. Although there are fewer actors in this system, these professionals are nevertheless important to energy transition.

Effective implementation (project management, technical training, information)

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.20	SET	0.5	1.5	2
	CENT	0	0.5	1

SET

The shorter lifetime of projects in comparison to professional education allows project managers to improve project management approaches based on quicker feedback from projects. In Poland, the initial impact of the implementation of technical trainings, information and effective project management, combined with the shorter timeframe for technical trainings and greater access to new information, results in a substantial increase in the importance of this factor until 2030. It then increases more gradually until 2050.

CENT

The shorter lifetime of projects in comparison to professional education allows project managers to improve project management approaches based on quicker feedback from projects. Combined with the shorter timeframe for technical trainings and greater access to new information, the influence of effective implementation as a driver increases gradually until 2050. The importance of this factor as a driver is lower than in the decentralised scenario. Centralised projects require larger investments of capital which partially insulate them from effective implementation challenges more likely to be seen in smaller scale projects.

New interaction of individuals with technology, society and environment

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.70	SET	0	1	2
	CENT	-0.5	0	1

SET
Good conditions in Poland direct attention to the need to make a conscious choice to return to rail transport in passenger and freight. There is a significant development of public transport in cities. Legal regulations stimulate R & D actions and the implementation of technological innovations, not only in RES but also in fuel cells and energy storage, incl. bio-methane and hydrogen. Expenditures in the R & D sector are focused on micro- and mini-energy technologies and accelerate their development. This is due to an increased interest from local governments and banks (financial infrastructure). Larger cities in particular now have financial funds for the promotion and implementation of technological innovations. Accordingly, significant increases in the influence of this factor gradually take place until 2050 when the factor becomes a strong driver for societal energy transition.

CENT
Legal changes and incentives for innovation at the local level come slowly which delay the cost competitiveness aspect of technological innovation by society. Financial and personal sources of R & D are directed mainly to the development of large-scale technologies (e.g. ultra-supercritical fossil fuels units, dedicated RES, cross-border transmission networks and others). They absorb national capital and slow down innovation development (technological, product, marketing) in the areas of micro and mini-generation and networks of lower voltages. For these reasons, the importance of this factor gradually increases until 2050, at which time it becomes a moderate driver. This is less than in the SET scenario, reflecting the delay in technological innovation and its incorporation into individual lives in this scenario.

d. Financial and entrepreneurial aspects

Positive economic impact of demonstration projects

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.60	SET	-0.5	1	2
	CENT	-0.5	0	1

SET
Decentralized governance is gradually implemented as the role of local communities and authorities as well as local funding sources increases. The positive impacts of demonstration projects promoting partnerships among public, private and community sectors remain minimal by 2020 but greatly increase by 2030. It continues to rise, though not as dramatically, until 2050 when it becomes a strong driver. This describes the distributional impacts from the local perspective.

CENT
In the short-term, the role of demonstration project impacts from the local perspective as a barrier slightly reduces by 2020. It continues to decrease until 2030 when it becomes neutral. From this point, it increases until 2050 but does not reach levels as high as in the SET scenario. This is because the presence of partnerships among public, private and community sectors becomes less relevant in a centralized system.

Relevant project funding models

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-1.00	SET	0	0.5	1.5
	CENT	-0.5	0	1

SET
Changes in political and legal processes lead to (with some delay of 2-5-8 years as reconstruction of infrastructure is time- and cost consuming) a significant increase in innovative activeness. Funding opportunities for LCE local projects also increase significantly because barriers to wealth and availability capital disappear. Even small banks and local communities are capable of increased financial support for micro- and small projects. This accounts for the initially large increase in the influence of this factor by 2020 and its continued increase until 2050.

CENT
Large energy companies take over financially more attractive LCE technologies (PV and others), which significantly reduces effects of market competition. In this system, the importance of funding models for these few company leaders is less than in the SET scenario. This can be seen in the gradual increase in this factor until 2050, when it becomes a moderate driver.

Evolution of new business models

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.56	SET	0	1	1.5
	CENT	0	0.5	1

SET
In Poland, local entrepreneurship can be strongly developed, particularly if resources are aimed at pro-efficiency actions in buildings (thermo-modernization). The evolution of business models to accommodate for entrepreneurial diversity in this scenario leads to the gradual increase in the significance of this factor until 2050.

CENT
Political and legal actions do not allow for significant changes in the financing system of LCE decentralized technologies. Main resources are still directed primarily to large power plants including the development of nuclear and transmission networks such as cross-border interconnections. This causes a shortage of capital for other purposes, including financing the rapid development of distribution networks (medium and low voltage), taking into account 'smart grids & cities'. Consequently, evolution of new business models take place gradually until 2050 when it becomes a moderate driver. This is because new business models are not as relevant in a centralized system.

e. External (economic, political, geopolitical) factors

Market Signals

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.20	SET	0.5	1	2
	CENT	0	0.5	1

SET

Poland is currently experiencing a somewhat challenging business environment according to indicators such as GDP development, household savings and ease of doing business. However, this is projected to notably improve in the short term and continue to improve until 2050 based on strong investor activity observed in industry and new innovative RES development power units. The macroeconomic fundamentals such as GDP growth rate and significant EU aid, interlinked with creative approaches from Polish specialists, strongly leverage business development. Additionally, public debt and other macro – indexes become very encouraging to domestic and foreign investors.

CENT

The somewhat challenging business environment in Poland improves more slowly in a centralized system. In this scenario, there is less market competition as a result of fewer powerful market players. This explains the gradual increase in the importance of market signals which is lower than in the SET scenario.

Massive shocks, external disruptions to the system

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.20	SET	0	1	1.5
	CENT	-0.5	0.5	1

SET

In 2012, Poland is slightly resistant to massive shocks as a trigger to societal energy transition in the energy system if measured by indicators such as energy dependence or change of public sentiment after the Fukushima disaster. Poland is slightly resistant to these shocks because it has lower energy dependence resulting from its notable use of its own coal supplies. However, after 2012, Poland reduces its use of coal in favour of diversifying supply and moving towards more sustainable energy sources. Poland has less potential renewable resources than other Member States and therefore begins to become more dependent on Russian gas to fill the gap in energy supply. For this reason, Poland becomes gradually more vulnerable to massive shocks until 2050 despite energy efficiency investments and a rising share of renewable energy in the system. By 2020, the influence of massive shocks and

external disruptions to the Polish system becomes neutral. It then increases until 2050 to become a strong driver of societal energy transition.

CENT
Poland increases its resistance to massive shocks and external disruptions until 2020 and then becomes significantly more vulnerable to these until 2030. After 2030, vulnerability increases at a slower rate. In the midst of Poland's transition to an energy supply more dependent on Russian gas and renewable energy, vulnerabilities increase but not as greatly as in the SET scenario. This is because large-scale projects contribute to further diversifying the Polish energy mix away from gas, though as hard coal mines gradually close because they are too costly, gas continues to play a large role in Poland. The Polish government finalizes plans to construct a few large-scale power units and nuclear plants.

New financial and economic paradigm

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.30	SET	0	1.5	1.5
	CENT	0	0.5	1

SET
The importance of this factor slightly increases by 2020. It then experiences significant growth by 2030 as the increasing role of sustainable energy industries within the economic context of Poland and the rising economic benefits and financial income streams resulting from these industries come to fruition. It remains at 2030 levels until 2050. This leads to a positive revision of the value of the environment and eco-initiatives over time.

CENT
There is a slight increase in the importance of this factor by 2020 as the result of new financial and economic initiatives which were implemented previously. There is then a gradual increase until 2050. In a centralized system, constant financial innovation is not encouraged, leading to less importance being placed on new financial and economic paradigms. Core paradigms set the standard and are gradually improved upon over time, accounting for the less pronounced but continuous increase in the importance of the factor in Poland. Though not as strong as in SET, this CENT scenario leads to a positive revision of the value of the environment and eco-initiatives over time.

f. Repositioning of individuals in the energy systems in transition factors

Attention toward practical issues of everyday life

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-1.60	SET	-0.5	0.5	1.5
	CENT	-1	0	0

SET

In 2012, the role of local communities in Poland experiences a redefinition. Attention toward practical issues of everyday life substantially increases by 2020 and continues to significantly increase until 2050. New initiatives promoting societal eco-awareness have powerful impacts on individuals who go from experiencing attention toward practical issues of everyday life as a substantial barrier to societal energy transition to experiencing it as a strong driver in 2050. Local food purchase is used as an example. In 2012, 22 percent of Polish citizens had a tendency to buy locally produced and seasonal food. By 2020, this number is projected to notably increase and continue to experience significant increases until 2050.

CENT

In cooperation with minimal influences from local communities, centrally planned and distributed repositioning practices will take place. The centralized system institutionalizes ways in which citizens engage in the energy system in their everyday lives. Because this engagement is top-down driven, increases in this scenario occur more slowly and do not reach the levels of influence seen in the SET scenario. It is important that citizens in a centralized system have a certain level of awareness of everyday sustainable practices to incorporate into their everyday lives to support centralized energy transition. For this reason, awareness increases by 2020 and continues to increase until 2030. At this time, the influence of the factor becomes neutral and continues this trend until 2050. In this scenario, the percentage of Poles who had a tendency to buy locally produced and seasonal food in 2012 will increase, though not as much as in the SET scenario, and then level off in 2030.

Increased resort to muscular strength allow energy saving

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-1.10	SET	0	1	1.5
	CENT	-0.5	0	0.5

SET

Though use of public transportation increases as an alternative to personal motorized vehicles, citizens increasingly engage in non-motorized forms of transport as a way to personally contribute to energy savings and influence their health. In 2012, five percent of Polish citizens said they cycle several times a day. This percentage is

projected to significantly increase by 2020 as societal changes promote more individual activity to save energy. From there, it increases steadily until 2050.

CENT
The central government incentivizes public transportation to save energy. Citizens use these alternatives more than in SET and therefore do not invest as much in non-motorized individual efforts to save energy such as walking or biking. For this reason, the importance of the increased resort of muscular strength continues to increase as in the SET scenario but does so more slowly to become a slight driver in 2050.

Spreading of energy literacy and of energy citizenship

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-1.20	SET	0.5	1	1.5
	CENT	-0.5	0	0.5

SET
The spreading of energy literacy and of energy citizenship increases significantly by 2020 and gradually increases up to 2050 due to the rising importance of decentralised energy provision and energy efficiency. This involves and affects a large number of citizens. Grassroots and eco-initiatives have a supporting influence in this development. In 2012, 26 percent of Polish citizens said they bought an energy-efficient appliance in an effort to fight climate change. This percentage initially increases substantially and then continues to increase more gradually until 2050.

CENT
Citizens continue to be educated on energy policies and structures through central initiatives. The spreading of energy literacy and of energy citizenship increases significantly by 2020, reflecting initial results of government initiatives to increase citizen knowledge of their personal energy consumption patterns and contributions to energy transition. It continues to increase at a slower rate until 2050 when it becomes a weak driver of energy transition. It remains a weak driver because in a centralized system, energy citizenship and individual contributions to the energy system are not as important as in SET but is still important to this scenario.

4.4 European narratives

a. Participatory decision making

Openness of individuals to social change and change processes

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.71	SET	1	1.5	2
	CENT	0.5	0	-0.5

SET
In this scenario, citizens in all member states take a proactive role in being part of a movement to advance the energy system. In most European countries there is a growing interest and involvement in grassroots and eco-initiatives. Awareness of current environmental niche areas, such as energy efficiency, organic food and the environmental footprint of consumer goods, is becoming more widespread. Starting from an already favourable level, this factor is expected to gradually increase in importance as a driver in Europe up to 2050.

CENT
In this scenario, citizens in Member States play a more passive role as consumers and users. Participation in grassroots activities and interest in local eco-initiatives shrinks from the current level. Citizens become more reactive to top-down changes in the energy system and expect changes to be made in this way. Active local involvement is therefore something that is tolerated but less active bottom-up support is needed to make changes to the energy system in a centralised system. This factor therefore develops over time to become a small barrier for energy transition until 2050.

Engagement of individuals in local projects, existence of change agents

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.53	SET	1	1.5	2
	CENT	0	-1	-1.5

SET
In all Member States, there is an increased development of local communities and grass roots initiatives in the participation process of decision-making concerning energy transition. Citizens increasingly spearhead local eco-initiatives and found citizen owned companies such as cooperatives. Rather than relying on outside, top-down involvement and support, the community is taking their future into their own hands. Engagement is important as actions are taken using a bottom-up approach. Proactive citizens are therefore crucial. Starting from an already favourable level, this factor is expected to increase in importance until 2050, marking it as a strong driver.

CENT

The current level of citizen involvement is reduced as most projects are implemented from the top. The centralized organisation (both politically and technically) delays the involvement of local communities in participation processes regarding energy transition issues. This is partly the result of the design of (i) legal and formal regulations of the energy sector and (ii) an economic and financial system not adapted to the development of local initiatives. Thus, citizens do not play an active role in project creation and implementation but rather a passive role through minimal involvement to increase public acceptance. Since measures are implemented using a top-down approach, local engagement is less important and develops towards becoming a strong barrier by 2050, since the local involvement contradicts the top-down plans to be implemented. The active engagement of individuals in local projects and as overall change agents rather constitutes a barrier for a central energy transition. The rate of decrease in the factor value is less steep from 2030 to 2050 because the initial transition has passed, leading to a more gradual future change.

New socio-cultural power structures, change in participatory processes

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.02	SET	0.5	1	2
	CENT	-0.5	-1	-1.5

SET

A democratisation of decision making in society, new public interest and organised participatory action are developing in most European countries. The influence of citizen interest groups and associations in the decision making process is growing, in particular within EU institutions. This factor is predicted to steadily increase as a driver until 2050.

CENT

As the ownership of the energy infrastructure is mainly in the hands of a few large players in this scenario, there is minimal development of new socio-cultural power structures. The influence of citizen interest groups and associations in the decision making process is diminishing. European opened deliberation processes have limited impacts. Democratising decision making and public engagement constitutes a barrier towards energy transition. The importance of this factor as a barrier initially drops sharply by 2020 and then continues to gradually decrease until 2050.

b. Policy context

Political Leadership

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.60	SET	1	1.5	1.5
	CENT	0.5	0.5	0.5

SET

Local policy plays a major role at the EU level as a range of local actors including NGO's, city councils, neighborhood initiatives and energy production cooperatives engage within EU Member States and within EU Institutions. On the local level, many municipalities already discover opportunities offered by climate policies. Motivation is often economic although there are efforts to increase local value added. More individual engagement creates a more diverse political landscape with more active players. Stronger leadership is needed to coordinate all of these components of the political system as well as to challenge powerful interest groups from central industries which try to intervene in political leadership. As a result of all of these factors, the role of political leadership as a driver stays at a high level up to 2020 and increases gradually up to 2030. From this date, the role of the driver remains constant up to 2050.

CENT

Although political leadership is important for CENT, such as in terms of calming opposition and assuring citizens of the value of various actions within the system, local leadership is not of utmost importance to energy transition. This is the reason why, in 2020, local leadership remains a driver of medium importance to energy transition. Legislation and policy mechanisms support large project types decided upon on the regional or national level. Local political leadership becomes less significant by 2020 and remains at this level until 2050.

Legal frameworks, incentives, regulation

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.94	SET	1	1.5	1.5
	CENT	1	1	1

SET

At the EU level, there is an ambitious overall target framework, particularly regarding the reduction of GHG emissions and the increasing of RES production. In particular, EU continues to play an exemplary leadership role in climate negotiations (Gupta et al., 2000) by implementing its own climate objectives which are included in the EU 3*20 package, the Roadmap 2050 and Frame 2030 which outline European emission reduction objectives of -20%, -40% and -80% respectively in 2020, 2030 and 2050 (based on 2005 levels). This gradually impacts the content of regulations which increasingly favour the development of energy transition particularly in the direction of micro and small LCE (low carbon energy) in Member States. Improved legislation and policy mechanisms to support local initiatives in Member States and at the EU level (European Institutions) are implemented. Ultimately, this framework supports the employment of infrastructure for a societal energy transition.

CENT

At the EU level, there is an ambitious overall target framework, specifically regarding the reduction of GHG emissions and the increasing of RES production. In particular, the EU continues to play an exemplary leadership role in climate negotiations (Gupta et al., 2000) by implementing its own climate objectives which are included in the EU 3*20 package, the Roadmap 2050 and Frame 2030 which outline European emission reduction objectives of -20%, -40% and -80% respectively in 2020, 2030 and 2050

(based on 2005 levels). The legal framework, incentives and regulation keep supporting the energy transition where needed to ensure a broad market penetration. However, the legal framework disadvantages small players and encourages large investors to invest in the energy market and support the employment of infrastructure for a more central energy system. National and EU regulations in the energy sector predominantly favour LCE large-scale technologies, including large meta-network projects and object-oriented projects (Northsea, DESERTEC) whereas the development of small power units is limited by regulations and not adapted to support mechanisms. In the longer run, the importance of this factor as a driver of energy transition remains constant until 2050.

New political power structures

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.28	SET	0.5	1	1.5
	CENT	0	-0.5	-0.5

SET
Decentralised players in the energy system gain a stronger influence even in countries marked by more centralised energy systems (Italy, France). This is reflected in power relations towards central energy suppliers and the influence of decentralised players on national decision-making. The role of new political power structures gradually increases up to 2050.

CENT
In EU Member States, almost all the medium and small actors in energy transition are gradually taken out of the system in favour of a few big energy suppliers which gain market share. Thus, power structures move towards and build up around these actors. This is triggered by EU regulation in favour of a common energy market and interconnected networks. New political power structures utilising participatory governance systems are therefore small barriers to energy transition. As a result, the influence of this factor drops until 2030 when it then remains constant until 2050.

c. Adoption, implementation and uptake of innovative technological solutions

Professionals with education and capacity to support societal transition

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.40	SET	0.5	1.5	1.5
	CENT	0.5	1	1

SET
In Member States, the new opportunities being created in the emerging energy paradigm trigger interest and demand in specialised education programmes. There is a strong demand for a specialised workforce in all Member States. However, due to the significant time investment required by professional education, minor changes in the amount of professionals prepared to support societal transition in the energy sector take place until 2020. After this time, there is a significant increase in the importance of the factor as professionals finish their professional education. This remains constant until 2050. EU future framework programs following H2020 aim to finance specific training programs.

CENT
Notable improvements in the number of professionals equipped to support societal transition occurs at a slower rate than in the SET scenario because less widespread and extensive demand for qualified professionals is assumed. By 2030, there is an increase in this area due to the development of big green infrastructures and interconnected networks which require highly educated professionals to service nuclear and ultra-supercritical power units, for example. Although there are fewer actors in this system, these professionals are nevertheless important to energy transition. Incentives for innovation at the local level are relatively slow as R & D efforts are directed mainly to the development of large-scale technologies (RES, cross-border networks and others). This gap results in crowding out effects that slow down innovation development (technological, product, marketing) in the areas of small RES. The importance of this factor remains at 2030 levels until 2050, but at lower values than in the SET scenario.

Effective implementation (project management, technical training, information)

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.09	SET	0.5	1.5	1.5
	CENT	0.5	1	1

SET
Legal regulations stimulate R&D actions and the implementation of technological innovations - not only RES. The shorter lifetime of projects in comparison to professional education allows project managers to improve project management approaches based on quicker feedback from projects. Combined with the shorter timeframe for technical trainings and greater access to new information, effective implementation increases slightly by 2020 and greatly increases until 2030. Beyond 2030, effective implementation remains stable.

CENT
Legal regulations stimulate R&D actions and the implementation of technological innovations - not only RES. The shorter lifetime of projects in comparison to professional education allows project managers to improve project management approaches based on quicker feedback from projects. Combined with the shorter timeframe for technical trainings and greater access to new information, effective implementation increases slightly by 2020 and greatly increases until 2030. Beyond 2030, effective implementation will remain stable. The importance of this factor as a

driver is lower than in the decentralised scenario, as decentralised projects have a smaller amount of capital available to absorb problems in project implementation.

New interaction of individuals with technology, society and environment

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.35	SET	0.5	1.5	2
	CENT	0.5	0.5	1

SET
Individual engagement with technology, society and the environment increases slightly by 2020 and more significantly by 2030, continuing to gradually increase beyond this point until 2050. This is due to the impacts of increased training in technology and environmental issues and the increased integration of these factors into general society and everyday life, it takes until 2030 to see a great increase resulting from these impacts as the results of trainings and changes in lifestyle take time to become apparent. The educational system is more and more adapted to provide the right set of skills to engage in a societal energy transition. The excellent innovation capacity of local companies, as well as high levels of individual innovation capacity, let the EU benefit from innovation-driven positive economic, social and environmental impacts.

CENT
Personal relationships with technology and the environment slightly improve by 2020 due to the impacts of currently established education available in technology and the environment. The importance of these interactions increase slightly by 2020 and remain stable until 2030 when it increases slightly again by 2050. The increase seen in 2030 in the SET scenario takes places later and is less dramatic because this scenario is less individually-focused.

d. Financial and entrepreneurial aspects

Positive economic impact of demonstration projects

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.37	SET	0.5	1.5	1.5
	CENT	0.5	0.5	1

SET
At the EU level, decentralised governance is gradually implemented as the role of local communities and authorities as well as local funding sources increase. The importance of the factor slightly increases by 2020 and greatly increases by 2030 when the positive impacts of previously established demonstration projects promoting partnerships among public, private and community sectors are seen.

CENT

After an initial increase by 2020, the role of demonstration project impacts from the local perspective as a driver remains constant until 2050 when it slightly increases. The presence of partnerships among public, private and community sectors becomes less relevant in a centralised system since it is not as focused on local actors or individuals.

Relevant project funding models

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.66	SET	1	1.5	1.5
	CENT	0.5	1	1

SET

The redirection of investments is made possible by the emergence of new systems of financing more connected to the needs of local low energy projects. They specifically provide more funding opportunities of LCE local projects and hence limit barriers in terms of capital availability. European funding in favour of specific innovation programs and restructuring financial charges imposed on 'dirty' energies (e.g. in the form of fees for CO2) are supported by a monetary policy at the service of European investment and climate. This policy conducted by the EU central bank aims to give a low carbon direction to future growth and thus reinforce its historical leadership on climate issues. It helps banks to open more credit lines through a system of carbon assets which would benefit from a public guarantee for the financing of low carbon projects at the local level (Aglietta et al., 2015). Financial actors such as small banks and local communities are hence capable of wider financial support for micro- and small projects. Ultimately, an increase in the diversity of relevant funding models is expected up to 2030. It then remains constant until 2050.

CENT

R&D dynamics show that main financial resources are directed primarily to large power plants, including nuclear and transmission network development (including cross-border connections). This causes a shortage of capital for other purposes, including financing the rapid development of distribution networks (medium and low voltage), taking into account 'smart grids & cities'. These activities significantly postpone changes towards energy transition. Moreover, large energy companies take over financially more attractive LCE technologies (Photovoltaic and others), which significantly reduces effects of market competition, and consequently maintains energy prices at a higher level. In this scenario, project funding models decrease slightly by 2020 because those that prove unsuccessful from 2012 are removed in a centralised system with few innovative models being proposed. Consequently, the factor projections for the CENT scenario are less than in SET. Funding methods which prove to work remain the standard financial methods over time. This is why the influence of the factor remains constant from 2030 to 2050.

Evolution of new business models

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.61	SET	1	1.5	1.5
	CENT	0.5	1	1

SET
The innovative capacity of the European economy is already at a medium level if indicators such as patents in environment-related technologies are considered. As a result of the development of new systems of financing and increased returns on sustainable energy investments, this level of entrepreneurial innovation is expected to gradually increase until 2030 when it remains at this level until 2050.

CENT
The innovative capacity of the European economy is already at a medium level if indicators such as patents in environment-related technologies are considered. Consequently, evolution of new business models take place gradually until 2030 when it becomes a moderate driver. The importance of the factor then remains at 2030 levels until 2050. This is because new business models are not as relevant in a centralised system.

e. External (economic, political, geopolitical) factors

Market Signals

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.70	SET	1	1	1.5
	CENT	1	1	1.5

SET
The EU is currently experiencing a relative period of stagnation for business activity measured by indicators such as GDP development, household savings and ease of doing business. This economic environment is expected to improve by 2020 and then slightly improve again by 2050 as a result of the development and proven success of new business models in the energy transition sector by that time.

CENT
The EU is currently experiencing a relative period of stagnation for business activity measured by indicators such as GDP development, household savings and ease of doing business although with significant differences between Northern and Southern countries. This economic environment is expected to improve by 2020 and then slightly improve again by 2050. In both the SET and the CENT scenarios market signals will affect citizens but in the CENT scenario market signals will be mediated by policymakers, large companies, and other big players, while in the SET scenario

citizens will not respond in an uniform way to the signals coming from local and global markets.

Massive shocks, external disruptions to the system

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.44	SET	0.5	0.5	0.5
	CENT	0.5	0.5	0.5

SET

Europe's vulnerability to massive shocks in the energy system is relatively significant although it masks different situations among Member States. Multiplied initiatives in favour of micro- and mini-generation RES and significant improvement in energy efficiency in buildings, transport (rail - multimodal, public in cities) and industry reduce countries' sensitivity to changes in international fuel prices and external geopolitical changes. Higher penetration of RES in the energy mix temporarily increases energy prices while stimulating pro-efficiency actions which in turn stabilize or reduce energy costs paid by households and companies in the medium and long term. Therefore, external shocks are only considered to be a moderate driver of societal energy transition. The importance of the factor remains moderate from 2020 to 2050.

CENT

Europe's vulnerability to massive shocks in the energy system is relatively significant although it masks different situations among Member States. In this scenario, the EU first tries to secure energy supply and limit its dependency (on Russian gas, for instance) through agreements with third countries to complement the emergence of a European Union of Energy. Europe could follow the "maximum diversification" scenario developed in Deliverable 1.4 marked by full utilisation of the geographical diversity of energy suppliers (North America and Africa for instance). Ultimately, this accelerates the development of a strong network of cross-border connections (such as the DESERTEC project). One adverse effect could be an increasing vulnerability to fluctuations in international energy markets or terrorist attacks. Multiplied initiatives in favour of large-scale RES projects and significant improvement in energy efficiency in buildings, transport (rail - multimodal, public in cities) and industry reduce countries' sensitivity to changes in international fuel prices and external geopolitical changes. Higher penetration of RES in the energy mix temporarily increases energy prices while stimulating pro-efficiency actions which in turn stabilize or reduce energy costs paid by households and companies in the medium and long term. Therefore, external shocks are only considered to be a moderate driver to energy transition. This factor affects the CENT scenario slightly stronger than in the SET scenario due to the large scale plant and energy system considered, which makes it more reactive to outside shocks. However, the differences between the two scenarios are small and omitted due to the rounding towards 0.5 increments.

New financial and economic paradigm

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
0.34	SET	0.5	1	1.5
	CENT	0.5	1	1

SET

The importance of this factor gradually increases until 2050 as the increasing role of sustainable energy industries in all Member States and the rising economic benefits and financial income streams resulting from these industries come to fruition. This leads to a positive revision of the value of the environment and eco-initiatives over time.

CENT

The importance of this factor gradually increases until 2030as the increasing role of sustainable energy industries within the economic context of the EU and the rising economic benefits and financial income streams resulting from these industries come to fruition. Unlike in the SET scenario where constant financial innovation is encouraged, a successful financial and economic paradigm in a CENT scenario becomes the standard paradigm over time. By 2030, a successful paradigm, proven over time, exists and remains until 2050. Though not as strong as in SET, this scenario leads to a positive revision of the value of the environment and eco-initiatives over time.

f. Repositioning of individuals in the energy systems in transition

Attention toward practical issues of everyday life

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.93	SET	0	1	1
	CENT	-0.5	0	0.5

SET

In all Member States, attention toward practical issues in the framework of local communities substantially increases by 2030. It then remains at this level until 2050. The practical implementation of various facets of human energy can provide co-benefits in terms of social health (reduction of pollution and noise), greater comfort and satisfaction in personal life which increases overtime as the importance of the factor increases.

CENT

In parallel with minimal influences from local communities, centrally planned and distributed repositioning practices take place. The centralised system institutionalises ways in which citizens engage in the energy system in their everyday lives. However, centralised energy policies and strategies complicate and hinder the process of

societal energy transition which explains this factor's more limited impact as a driver up to 2050 compared to the SET scenario.

Increased resort to muscular strength allow energy saving

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.81	SET	0.5	1	1.5
	CENT	-0.5	-0.5	0

SET
Though use of public transportation increases as an alternative to personal motorized vehicles, citizens increasingly engage in all Member States in non-motorized forms of transport such as biking or walking as a way to personally contribute to energy savings and contribution towards their health. The influence of this factor increases steadily until 2050.

CENT
The central government incentivises public transportation to save energy. Citizens use these alternatives more than in SET and therefore do not invest as much in non-motorized individual efforts to save energy such as walking or biking. For this reason, the increased resort of muscular strength constitutes a barrier in this scenario. The importance of the factor increases slightly by 2020 and then remains at that level until 2050 when public transportation infrastructure is largely completed and citizen use of this transportation becomes a natural part of their everyday routine.

Spreading of energy literacy and of energy citizenship

Overall Factor Assessment Value 2012		2020 Factor Assessment Projection	2030 Factor Assessment Projection	2050 Factor Assessment Projection
-0.48	SET	0.5	1	1.5
	CENT	0	0.5	0.5

SET
The spreading of energy literacy and energy citizenship increases by 2020 and gradually increases up to 2050 due to the rising importance of decentralised energy provision and energy efficiency. This involves and affects a large amount of citizens. Grassroots and eco-initiatives have a supporting influence in this development.

CENT
European citizens continue to be educated on energy policies and structures through central initiatives. The spreading of energy literacy and of energy citizenship increases slightly by 2030 and remain at this level until 2050. It is not as important as in the SET scenario because top-down approaches instil these values in society, leaving citizens to engage, but passively. They respond to government initiatives and do not take their own initiative in these areas when compared to citizen behaviour in the SET scenario.

5. Summary

This paper began by developing indicators for each of the factors, i.e. drivers and barriers of the energy transition determined from D3.1. In addition to these factors, three new factors, namely attention toward practical issues of everyday life, increased resort to muscular strength allow energy saving and spreading of energy literacy and of energy citizenship were developed. Selected indicators for each factor were used to develop factor assessments for 2012 for Germany, Poland, Italy and the EU based on quantitative and qualitative evaluations. Narratives were written for each of these countries and the EU based on the 2012 factor assessments and factor foresights developed for 2020, 2030 and 2050. The narratives forecast how the 18 factors will evolve from 2012 to 2020, 2030 and 2050 in both centralised and decentralised scenarios. These foresights will provide the needed inputs for WP4 modelling tasks.

This is the first time non-technical aspects of the energy transition are quantified in a harmonised approach and then integrated in modelling processes.

Several insights were gathered through the development of the methodology of this deliverable:

Once indicators describing each factor were compiled, it became apparent that the methodology to assess these indicators needed to be diversified to account for the different types of indicators. This resulted in the creation of three assessment approaches.

- The first evaluates indicators on a scale ranging from 0% to 100% where 0% corresponds to a value of -2 [absolute barrier] and 100% to a value of +2 [absolute driver] to energy transition.
- The second uses 0 as the minimum (-2) and the highest EU-28 value as the maximum (+2).
- The third uses the lowest EU-28 value for a given indicator as a minimum (-2) and the highest EU-28 value as a maximum (+2). These varying assessments were necessary to properly assess indicators and use them to assess 2012 factor assessments.

An average was taken of all indicator assessment values for each factor to determine the 2012 factor assessments. It is recognized that taking the average is not the only approach, though it was the one used in this case. Consultation with national experts was then used to adjust 2012 factor assessments to determine the 2012 Overall factor assessments. To calculate the Overall factor assessment values for the EU, a separate formula was used. This was decided upon as a way to account for other factors such as variations in population across the EU to provide for a more accurate 2012 Overall assessment for the EU.

Foresight values for each factor were determined by referencing 2012 Overall factor assessments, expert judgement and energy strategy and scenario documents on the national and EU level. Foresight values were evaluated on a scale from -2 to +2 using increments of 0.5. There are other approaches that could have been taken which may have been more precise but this method was chosen in an effort to account for the uncertainty of future changes and to simplify the model input for future analysis. Foresight values for 2020, 2030 and 2050 were determined by national experts using 2012 Overall factor assessments as a baseline. It was decided that this would be the most effective way to make projections for these years for both the SET and CENT scenarios. To stay consistent, the formula used to calculate the

2012 EU Overall factor assessment values was used to calculate foresight values for 2020, 2030 and 2050. Instead of using national 2012 Overall factor assessment values, however, national foresight values for each year were used to determine EU foresight values for these years.

Factor assessment values for 2012, 2020, 2030 and 2050 for each country and the EU informed narratives depicted possible developments in both SET and CENT scenarios. Variations in the narratives exist among the countries which reflect different energy security mixes within the EU. Though alternative approaches could have been taken throughout this task, methodological decisions were made in an attempt to yield the most relevant results to feed into WP4 modelling tasks.

Above all, the primary output of the research is the development of a novel methodology for merging qualitative and quantitative information and for comparing energy transition progress across different countries and over time without focusing on the technical energy system, but instead on the human energy or polito-social system.

As a potential next step, the methodology can be further refined by applying it to more countries and validating it with stakeholders.

6. Annex

Table 6-1 Complete List of Indicators

	Factor Type	Indicator Number	Indicator Title
1. Participatory decision making	1.1 Openness of individuals to social change and change processes	1.1.1.	Citizens believe that they play active role in environmental protection
		1.1.2.	Cutting down energy consumption
		1.1.3.	Willingness to buy eco-friendly products even if more money
		1.1.4.	Importance of environment to quality of life
		1.1.5.	Importance of NGOs in political decision making
		1.1.6.	Trust in NGOs to influence political decision making
		1.1.7.	Buying environmentally friendly products can make a real difference
		1.1.8.	Importance of resource efficiency
		1.1.9.	Citizen efforts to reduce household waste
	1.2 Engagement of individuals in local projects, existence of change agents	1.2.1.	Effectiveness of local/regional voting on influencing political decision making
		1.2.2.	Effectiveness of national voting on influencing political decision making
		1.2.3.	Citizens think they should take the lead role in influencing the actions of companies through the purchasing decisions they make
	1.3 New socio-cultural power structures, change in participatory processes	1.3.1.	Voter turnout in national elections
		1.3.2.	How informed EU citizens feel about development of science and tech
		1.3.3.	Public involvement desired in decision making process about science and tech
		1.3.4.	Predicted impact of people on fight against climate change in 15 years
		1.3.5.	Predicted impact of people on environmental protection in 15 years
2. Policy context	2.1 Political leadership (covering various levels of governance)	2.1.1.	Government Energy Action Plans- Number of signatories per country
	2.2 Legal framework, incentives, regulation	2.2.1.	Assessment of progress towards climate and energy targets for 2020 RES/Gross final energy
		2.2.2.	Assessment of progress towards climate and energy targets for 2020 RES electricity/Electricity
		2.2.3.	Share of environmental research in state expenditure for civil R&D
		2.2.4.	Evaluation of RES support schemes (such as stability, extent etc.)
	2.3 New political	2.3.1.	Public involvement in creation of latest

y de cis	Factor Type	Indicator Number	Indicator Title
	power structures		national strategic documents, of NEEAPs and NREAPs
3. Adoption, implementation and uptake of innovative technological solutions	3.1 Professionals with education and capacity to support societal transition	3.1.1.	Public expenditure on education, per cent of GDP
		3.1.2.	Tertiary educational attainment by sex, age group 30-34
		3.1.3.	Share of environmental research in state expenditure for civil R&D
	3.2 Effective implementation (project management, technical training, information)	3.2.1.	Company difficulties in setting up resource efficient actions
		3.2.2.	Lifelong Learning
	3.3 New interaction of individuals with technology, society and environment	3.3.1.	Patents in environment-related technologies
		3.3.2.	Global Green Economy Index
		3.3.3.	Satisfaction with returns on resource efficiency investments (pg. 54)
		3.3.4.	Innovation introduced by type
4. Financial and entrepreneurial aspects	4.1 Positive economic impact of demonstration projects / measures	4.1.1.	National employment by RES as share of total national employment
		4.1.2.	Turnover by RES (pg. 72) as share of national turnover in manufacturing, construction and professional, scientific and technical activities
	4.2 Relevant project funding models	4.2.1.	Share of RES installed capacity held by types of investors
	4.3 Evolution of new business models	4.3.1.	Start Up Rankings by country
		4.3.2.	Research and development personnel, % of labour force
		4.3.3.	Total RD&D expenditures
5. External (economic, political, geopolitical) factors	5.1 Market signals	5.1.1.	GDP per capita by country
		5.1.2.	Growth rates of low-carbon environmental goods and services in LCEGS by Top 50 countries
		5.1.3.	Ease of Doing Business Statistics By Country
		5.1.4.	Household savings rate
		5.1.5.	Overall structure of consumption expenditure by detailed COICOP level (1 000): Electricity, gas and other fuels
	5.2 Massive shocks, external disruptions to system	5.2.1.	% change in approval of nuclear energy pre and post Fukushima, global view
		5.2.2.	Self Supply Security measured by total primary energy dependence
	5.3 New financial and economic paradigm	5.3.1.	Energy intensity of the economy
		5.3.2.	Shares of environmental and labour taxes in total tax revenues from taxes and social contributions

y de cis	Factor Type	Indicator Number	Indicator Title
		5.3.3.	Turnover by RES (pg. 72) as share of national turnover in manufacturing, construction and professional, scientific and technical activities
6. Repositioning of individuals in the energy systems in transition factors	6.1 Attention toward practical issues of everyday life	6.1.1.	Tendency to buy locally produced and seasonal food
		6.1.2.	Area under organic farming %
		6.1.3.	Frequency of exercising or playing sports
	6.2 Increased resort to muscular strength allow energy savings	6.2.1.	Regularity of use of environmentally friendly alternatives to car
		6.2.2.	Frequency of using public transportation
		6.2.3.	Frequency of cycling
		6.2.4.	Frequency of walking
	6.3 Spreading energy literacy and energy citizenship	6.3.1.	Tendency to switch to an energy supplier which offers a greater share of energy from renewables
		6.3.2.	Personal action taken to fight climate change
		6.3.3.	Types of actions taken to fight climate change (reduce waste)
		6.3.4.	Types of actions taken to fight climate change (buy efficient appliance)
		6.3.5.	Types of actions taken to fight climate change (buy car with low fuel consumption)
		6.3.6.	Types of actions taken to fight climate change (avoid taking short-haul flight)