



Project ENDORSE

Energy Downstream Service
Providing energy components for GMES
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D5.1 Summary of the assessment of products by users

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<i>Authors and Affiliation:</i>	Elena Gaboardi, Mariano Peluso iCons Srl, contributions from ARMINES, DLR, TSV, Flyby, HS Ulm, ENTPE, 3E, JRC
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SUMMARY

This deliverable provides the outcomes of WP5, Task 5001 of the ENDORSE project, "Prime users' assessment of products". This task aimed at testing the products developed in WP4, assessing their compliance with the benchmark defined in WP2 (Task 2001) and providing feedback for refinement to be carried out in WP4.

Task 5001 confirmed the capability of the ENDORSE consortium to actively involve the prime users and to exploit their support for the assessment and refinement of the developed products.

The assessment exercise took place in the period January-May 2012, with a slight delay in the workplan. With respect to the original plan, as envisaged in the DoW and presented in D2.1, there was one deviation: Flagsol GmbH replaced Solar Millennium AG as prime user for product S3. The resources were spent as planned. The report is delivered much later than planned. The original schedule was too tight to allow approval of final written comments by users when necessary. In addition, services S1 and S4 from Armines met severe delays because of various difficulties ranging from finding meeting dates with very busy persons to the desire of the users to include in the assessment process more experts or bodies than originally planned. S2 developed by FlyBy with Enel Green Power also incurred in several delays. The results of the method developed for S2 have been tested for the ARCHIMEDE CSP plant that is currently being activated at Priolo Gargallo (Sicily, Italy); at the moment (June 2012) the results have been only successfully checked against measured data retrieved from literature. The validation phase has not been possible yet because of a delay in the prime user's CSP plants construction program: it will be exploited as soon as the ARCHIMEDE CSP plant production data will be made available by the prime user (Enel Green Power Spa).

The applied approach and methodologies of ENDORSE proved to be flexible enough to serve a variety of products and organization. At the same time, the common approach and the consistent tools ensure comparability of the results.

Overall, all the consulted prime users expressed a very favorable assessment of the developed ENDORSE products. The defined benchmarks for product properties have been satisfactorily met, with only minor exceptions and deviations. This can be considered as an achieved milestone within ENDORSE, as the presence of the requested parameters and the compliance with the requirements are the basic condition for acceptance. The exploitation of data for product development was carried out as planned in D2.1, with only minor deviations. Quality control has been a common practice in the assessment of the ENDORSE products. The procedures for assessing the quality of methods, models and references have been extensively applied and no major weaknesses have been detected. The level of satisfaction recorded for the various ENDORSE products is fairly high, so is the level of improvement that the users expect in comparison with the previously adopted methods. Coherently with the assessment expressed on the single aspects, the overall evaluation is equally very satisfactory.

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1. Objectives, approach and scope of the assessment

1.1. Objectives

The project ENDORSE aims at a user-driven development of new, and/or enhancement of existing, downstream services in renewable energies, by exploiting the GMES Core Services together with other EO/in-situ data and modeling.

ENDORSE deals with regional services promoting the energy use from sun, wind, and biomass. It also addresses the electricity grid management and building engineering through day-lighting in buildings. The consortium has teamed with relevant users that are representative of a large number of users in other European regions, to stimulate the development of sustainable and transferable downstream services.

WP5 of ENDORSE "Users' assessment" aims at involving users in the assessment of the developed products and services. The first activity of WP5 has been Task 5001 "Prime users' assessment of products", which aimed at testing the developed products, to assess their compliance with the benchmark defined in WP2 (Task 2001) and provide feedback for refinement. The ultimate goal is to fully check, address and incorporate the users' requirements before the final implementation of products.

1.2. Approach

Task 5001 took place in the second year of ENDORSE, between January and May 2012. It consisted of testing, validating and refining the first version of the products developed in WP4 and based on the users' requirements collected and analysed in WP2. The assessment protocol had been previously defined by the prime users and by the respective beneficiaries in WP2 (Task 2001).

The assessment exercise was organized by the ENDORSE partners with their prime users. The variety of products involved required a flexible approach. Actually, various modalities were adopted, ranging from interviews to focus groups, in some case relying on a prototype. The applied methodology was nevertheless common to all the products in order to ensure comparability of the results; it was based on a checklist and a compliance matrix that allows the ENDORSE consortium to check if and to which extent the users' requirements have been met.

Besides compliance with the previously defined benchmark, the assessment exercise also aimed at assessing the impacts of the developed products on the organization of work and the perceived value added versus the currently adopted solutions. For assessing the level of satisfaction and the degree of impact, a five points scale was used from 1 (minimum) to 5 (maximum).

1.3. Prime users involved in the assessment of products

The composition of the panel of prime users is reported in the following exhibit. With respect to the panel involved in the collection of requirements (presented in D2.1) there have been a few changes, namely:

- S1 The prime-user CG06 asked for including the service DREAL-PACA of the French Ministry in charge of environment
- S3 Flagsol GmbH replaced Solar Millennium AG as prime user. This change in the responsibility from SMAG's project development to a software development and operating & maintenance section in October 2011 reflects the well progressing implementation of the service prototype at Flagsol GmbH. Additionally, this is a formal response on the fact that Solar Millennium AG had to announce its insolvency in December 2011.
- S4: an expert from USA was added to the list of persons involved in the assessment at the request of the prime-user Total – Gas & Power.

Exhibit 1. Prime users assessing the ENDORSE products

<i>Product code and name</i>	<i>Prime User</i>
S1: "Local Atlas Generation"	1) General Council of the Alpes-Maritimes Department, France; 2) ADEME PACA, France; 3) DREAL-PACA, France
S2: "Design CSPS"	Enel Green Power
S3: "Irradiance forecasts"	Flagsol GmbH
S4: "TMY"	1) Dominique Clément; 2) Total SA – Gas & Power branch
S5: "CSP-GIS"	Kernenergien, Germany
W1: "Wind AEO"	EDFLuminus, Belgium
E1: "Load Balancing"	SWU Netz GmbH, Germany
B1 "Mapping biomass potential"	Eberswalde Forestry competence center, Germany
B2 "Certification of sustainable bioenergy use"	International Sustainability and Carbon Certification (ISCC) GmbH, Germany
D1 "Lighting energy savings"	ESTIA SA, France

S1

The French Environment and Energy Management Agency (**ADEME**, FR) is a public agency under the joint authority of the Ministry for Ecology, Sustainable Development, Transport and Housing, the Ministry for Higher Education and Research, and the Ministry for Economy, Finance and Industry. Its mission is to encourage, supervise, coordinate, facilitate and undertake operations with the aim of protecting the environment and managing energy. ADEME has regional agencies for a more efficient implementation of its program and missions.

CG06, Conseil Général des Alpes-Maritimes, is the agency in charge of the execution of the local policies in the district “Alpes Maritimes”, belonging to the Region Provence – Alpes – Côte d’Azur (PACA). In collaboration with ADEME-PACA, it undertakes activities for the promotion of renewable energies and a more efficient use of energy in all domains.

DREAL (Direction Régionale de l’Environnement, de l’Aménagement et du Logement) of Provence (PACA Region) is a regional agency under the authority of the French Ministry in charge of environment and works on the implementation of the policies in sustainable development. Of particular interest to ENDORSE, is its Web site offering interactive maps of environment. Maps relating to energy support the role of DREAL and could be integrated in this Web site.

S2

Enel Green Power (GP) is the Enel Group (IT) company dedicated to developing and managing energy generation from renewable sources at an international level, with a presence in Europe and the American continent. Installed capacity from wind, solar, geothermal, hydroelectric water flow and biomass energy sources is over 4,500 MW and there are 618 plants in operation around the world.

S3

Flagsol is an independently operating company, being owned by Solar Millennium AG with 75% and by Ferrostaal with 25%. Flagsol is not part of the insolvency process undergone by Solar Millenium and is interested to continue the development of the FoSyS service from the current prototype to a commercial state. With the overtaking of the project lead and termination of the feasibility study Flagsol will have the full intellectual property rights, in order to sell or to enhance CSP-FoSyS.

S4

The company **Total** and its subsidiaries are investing in technologies for producing electricity from solar energy. The product TMY will help in the design and performance assessment of complex solar energy-based systems. The numerical codes simulating the production and performances of concentrated solar power systems request TMY as inputs. TMYs are rare in areas of interest to Total. Once a site has been selected, a contract is issued towards a consulting company to obtain a TMY that will be input to the simulator. This takes usually a few weeks and administrative efforts. If by chance, the results for this site are not suitable, other sites must be analysed and hence, other TMYs should be purchased. A service that provides at short notice and fast delivery TMYs for virtually any site will be highly appreciated.

In the last 12 months, the scale of solar business within Total has significantly changed: Total SA acquired 60% stake in a major Photovoltaic system producer and PV developer (Sunpower). With the entry of this new subsidiary in the Group, the volume of Total solar activities has significantly increased.

Dominique Clément is a consultant to investors in photovoltaic (PV) systems for producing electricity. He is using TMY to simulate the production and performances of PV systems using a well-known simulator PVSYSY, from University of Geneva.

S5

Kernenergien is a consulting company in the sector of solar sustainable energy. The portfolio of offer includes conception, planning and development of solar power stations. The range of activities comprises thermodynamic design layout, economic analysis as well as project development, project organisation and project handling of solar power stations.

W1

SPE-Luminus is the second largest player in the Belgian energy market. Total production capacity is about 2,000 MW. 12% of SPE-Luminus' production capacity is derived from renewable energy sources produced within Belgium. (End 2010, 107MW installed capacity of wind parks)

E1

SWU is a German utility owned by the town of Ulm and Neu-Ulm. SWU is active in the energy and transport sector and has about 1000 employees. The project partner is SWU Netze GmbH, responsible for the operation of the local electricity, gas and water grid.

SWU aims at providing 100% of the electricity demand of private households from renewable energy sources until 2020. SWU owns and operates several renewable energy systems. In the distribution grid of SWU the number and power of decentralized renewable energy systems is rapidly increasing. Within the next few years the power output of these systems will be greater than the load on Sundays. Driving force of this development are photovoltaic energy systems in the low voltage grid.

B1

The **Eberswalde Forestry Competence Center** (LFE) is an integral component of the national forest administration Brandenburg and provides practical services for the entire forest and forestry sector. The Centre undertakes research on a wide range of topics including: inventory; biodiversity; biometry; forest soils; forest enterprise management; forest entomology; forest mapping; wood supply processes; hunting; phytopathology; forest administration; silviculture; forest biotope mapping; forest fires; forest ecology; forest protection.

B2

ISCC Association (e.V.) and ISCC System GmbH have developed together with stakeholders the first international certification system to prove sustainability and greenhouse gas savings for all kinds of biomass. ISCC System has been approved by the German Authority BLE (Bundesanstalt für Landwirtschaft und Ernährung) as the first Certification System for sustainable Biomass and Biofuels according to the German Biokraftstoff-Nachhaltigkeitsverordnung (Biokraft-NachV).

ISCC is an international certification system for biomass and biofuels (fuels and electricity) that describes the rules and procedures for certification. ISCC does not issue certificates. This is done by Certifying Bodies' (CBs).

Important decisions on the definition and further development of the system are taken by the ISCC Association (e.V.). Meo Carbon Solutions GmbH is operator of the ISCC System.

D1

ESTIA is an engineering bureau located on the campus of Ecole Polytechnique Fédérale de Lausanne. It is a start-up from the Solar Energy and Building Physics research laboratory (LESO-PB) from EPFL. For more than 10 years, ESTIA has developed, maintained and sold, the software called DIAL-Europe. This software estimates the annual performance of daylight in a building and as a consequence, the annual electricity consumption used for lighting. DIAL-Europe is easy to use; its interface is simple, it does not require an extensive knowledge in daylighting and lighting. It is now widely used in Europe, by engineering bureaus working on the design and retrofit of low energy buildings.

1.4. The product assessment exercise

The variety of products involved required a flexible approach in the methods for testing and validating the ENDORSE products, as described in Section 1.2. A review meeting was organised for each product and prototypes used to validate the requirements and to provide feedback for refinement.

The following exhibit provides an overview of the methods that have been applied to assess the users' requirements for the various ENDORSE products.

Exhibit 2. Applied methods for assessing the ENDORSE products

	Interview	Focus Group	Test	Other (specify)	N. of people	Usage of the prototype
S1		X			3	Yes
S2		X ¹			2	Yes
S3	X	-	X	Hand-on training at the power plant	9 ²	Yes
S4	X ³	-	-		3 ⁴	Yes
S5	X	-	X	-	1	Yes
W1		-	X	-	3	Yes
E1	-	X	-	-	5	No
B1	X	-	-	-	2	Yes
B2	X	-	-	-	1	Yes
D1	-	X		-	3	⁵

¹ The assessment was carried out in two steps: a meeting in February 2012 and a conference call in June 2012. In the first meeting, Flyby presented the development status of the S2 product and the first results were discussed. Then in the conference call further results achieved in the meanwhile were discussed.

² One from Flagsol GmbH, 8 from end-users (plant operators, shift leader)

³ The interview included a presentation of product characteristic, discussion about utilisation, simulation and assessment of TMY, achievement of preliminary defined targets as well as possible supplementary functionality development.

⁴ Dominique Clément, two persons from Total

⁵ The assessment was based on a) the presentation of computation method and the algorithms selected or developed specifically for the product; b) the experimental validation of the product and c) discussion about the features of the service which will give access to the products (inputs and outputs)

2. Product assessment

2.1. Assessment of S1

Relying on the users' requirements, as presented in D2.1 of ENDORSE, product S1 was defined as a digital local atlas of irradiation and solar energy related parameters. The Atlas can be defined as a suite of geo-referenced maps, relative to solar energy, recent, of tested quality and easily accessible. It shall serve as a reference tool for local policies on energy and investor attraction. It will have a local focus on a specific area, full exploiting the information and resources of the site under interest. The purpose is to offer and combine several maps of different quantities: solar irradiation, temperature, ground elevation, administrative / land-use.

2.1.1. Users' benchmark for product validation

This section provides the users' assessment about the product properties as presented in Deliverable 2.1 of ENDORSE. The assessed properties are in line with the users' requirements, with the exception of monthly averages for a few parameters.

<i>User's requirement as per WP2 D2.1</i>		<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance</i>
Parameters	Monthly mean of daily irradiation (global) on horizontal surface	75%	Lack of monthly averages
	Monthly mean of daily irradiation (direct) on a plane always facing the sun (DNI)	75%	Lack of monthly averages
	Monthly mean of surface air temperature	75%	Lack of monthly averages
	Mean cell elevation	Yes	
	Administrative limits	Yes	
	Land cover	Yes	
Accuracy	Limited bias, rmse < 5%	Yes	
	Limited bias, rmse < 8%	Yes	

	Limited bias, rmse < 3°C	Yes	
Space resolution	1 /250 000	Yes	
Time resolution	Monthly means averaged over several years	Yes	
Time series coverage	Last 10-years	Yes	
Product format	GIS-compatible format (KML, ArcView)	Yes	
Product availability	A few weeks after request	Yes	
Ancillary information	Title of product, geographical description, temporal description, content and units, provider, intellectual property rights, lineage.	No	Not seen

The overall rate of satisfaction was 4, as the user pointed out *“We are very satisfied of the transmitted data for product S1. Only we remark the lag of relevant metadata”*.

2.1.2 Data and other inputs used for product S1

This section provides the assessment about the usage of data for the product S1. The usage of data as it was foreseen in ENDORSE D2.1 has been fully achieved, with no changes with respect to the original plan.

Usage of data as per WP2 D2.1		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially
Data sources (non GMEs)		
Satellite	MSG-SEVIRI images, MODIS images (EUMETSAT, NASA)	Yes
Satellite-derived data	Digital Terrain Model (NASA)	Yes
Ground measurements	Irradiance data (global and diffuse on horizontal surface and direct component on surface normal to sun rays, DNI) and air temperature at 2 m from three stations in Provence managed by Armines, every 10 min, period 2009	Yes
	Irradiance data (global on horizontal surface) and other meteorological data in Provence, from the ground network of Meteo	Yes
Administrative limits	NUTS and LAU (Eurostat and Institut Géographique National de France)	Yes
Land cover	Corine Land Cover 2006 (Provider: EEA)	Yes
Other Data		Yes
	Administrative limits	Yes
	Hazardous areas, protected areas, urban areas, hydrography	Yes
	Other local information on administrative aspects and policy aspects (population, regulation, incentives rules, plans...)	Yes
GMES service(s) used		
MACC	Irradiance data (global and direct on horizontal surface), every 15 min, since 2004. This high temporal resolution data set will be combined with digital elevation model SRTM to yield shadowed areas every 15 min and correction of irradiance from MACC	Yes
	Air temperature at surface level	Yes

2.1.3 Quality control for product S1

This section provides the user's assessment about quality control for product S1. Quality control for S1 has been successfully applied.

Production Process		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially
Method	Construction of shadowed areas every 15 min in a year. Application of this map to the resampled MACC irradiance every 15 min every point. Construction of monthly means. Correction of this 1 st map with ground measurements (interpolation of differences between 1 st map and stations and addition of the resulting map of difference to the 1 st map). Computation of DNI maps using similar techniques and shadows (for which DNI is 0). Similar techniques for air temperature. The merging of layers of diverse nature will be made in the GIS of the prime-users. Thresholding irradiance values to obtain favorable sites for solar plants, masking the resulting layers with excluded areas (e.g., lakes), or power transportation lines, will be main operations.	Yes
Model	To be improved and documented. An initial version exists that was used for a precursor of this atlas.	Yes
References	None very relevant	

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially
		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially
Product	Control quality of input data. Control good termination of process. Process should issue warning to operators.	Yes
Validation	Control format by checking correct display of maps in a GIS. Control presence of metadata (manual). Control scale using the GIS and maps from IGN. The validation of the resulting high-resolution irradiance field will be performed thanks to cross-validations by keeping aside each of the ground stations, performing the process with the remaining stations, comparing the result with the unused station and repeating for each station. The ensemble of differences yields to performance indicators, such as bias, root mean square error. Similar operation for air temperature. Test on superimposition of the different layers by visual analysis in a GIS (ArcView). Test on scale.	Yes

2.1.4 Overall evaluation of product S1

The overall level of satisfaction for product S1 is high⁶, as it complies with the expressed requirements. Users expect a high level of improvement brought by S1, as regard to more efficient policies for energy planning.

⁶ 5 out of scale from 1 (not satisfied) to 5 (very satisfied)

2.2. Assessment of S2

Product S2 is a site-specific design of a CSP plant. A CSP plant uses solar energy by concentrating it to higher densities, using relatively low-cost mirrors or lenses, for the purpose of producing electric power. The solar light is concentrated and converted to high temperature heat that is used to drive a thermodynamic cycle, similar to that of ordinary thermal power plants.

The product is composed by a detailed model of each part of a CSP parabolic trough plant (with direct energy storage system) that, using near real time satellite retrieved solar radiation and air temperature values at ground level, allows to calculate every 15 minutes the expected power yield and, using a temporal integration, obtain the expected daily energy yield by a CSP plant.

This method will be used to create an operational service for active CSP plants monitoring based on the comparison between the daily energy production retrieved from satellite and the actual one measured: possible malfunctioning could be readily detected and it is possible to perform an overall plant performance analysis. Furthermore, using satellite-derived solar radiation and air temperature historical datasets, together with economical information on CSP plants, it will be provided also another service concerning CSP plants planning and possible RoI analysis.

2.2.1. Users' benchmark for product validation

This section provides the users' assessment about the product properties as presented in Deliverable 2.1 of ENDORSE. The process for developing S2 incurred in several delays, with respect to the initial scheduled timing. The results of the method developed have been tested for the ARCHIMEDE CSP plant that is currently being activated at Priolo Gargallo (Sicily, Italy) and at the moment have been only successfully verified comparing them with measured data retrieved from literature. The validation phase has not been possible yet because of a delay in the prime user's CSP plants construction program: it will be exploited as soon as the ARCHIMEDE CSP plant production data are made available by the prime user (Enel Green Power Spa). An assessment was nevertheless carried out in two steps with the prime user Enel Green Power. In the first meeting Flyby presented the development status of the S2 product and the first results were discussed. Then in the conference call in June further results achieved in the meanwhile were discussed.

The user appreciated that all the important parameters for CSP plants characterization have been calculated and only some of them should be improved by refining further the modeling. Most of them will be validated once there are some production data available, as soon as the ARCHIMEDE CSP plant becomes active. FlyBy also explored the features of the operational service that is going to be developed.

User's requirement as per WP2 D2.1		% fulfilled.	Comments about users' acceptance
Parameters	Temperature of the heat transfer fluid at the outlet of the solar field	100%	This parameter could be validated when the first Enel's CSP plant will be active. The parameter output rate (15 min) is good. The model could be improved by using also wind intensity data, but usually the CSP plants are located in low wind sites, so wind could have little impact on the heat transfer calculation.
	Energy absorbed by the heat transfer fluid through the absorber tube	100%	This parameter could be validated when the first Enel's CSP plant will be active. It would be interesting to know the simulated flow rate that would maximize the energy absorbed, in order to compare it with the actual used.
	Energy loss from the absorber tube	100%	Though it is interesting to have an estimation of this parameter, it would be hard to validate it, as no direct measure is done.
	Instantaneous efficiency of the collector field	100%	It's a really important parameter. This parameter could be validated when the first Enel's CSP plant will be active.
	Electricity output from the power cycle	100%	The turbo-generator model should be improved to permit more accurate calculation. This parameter could be validated when the first Enel's CSP plant will be active.
	Temperature of the heat transfer fluid returning to the solar field	100%	The thermal energy storage and the steam generator models could be further improved to permit more accurate calculation.

The overall rate of satisfaction was 4. All the important parameters for CSP plants characterization are calculated. Some of them should be improved by refining the modeling. Most of them (probably with only one exception) could be validated once there would be some production data available.

2.2.2. Data and other inputs used for product S2

This section provides the assessment about the usage of data for the product S2. The usage of data as it was foreseen in ENDORSE D2.1 has been substantially changed with respect to the original plan.

		% fulfilled. If a % is not	Comments about users' acceptance
Data sources (non GMEs)			
Satellite	MSG-SEVIRI images, MODIS images	Partially	No MODIS images are useful for the current version of the
Ground measurements	Flow rate sensors	No	Not applicable (user provided).
	Temperature sensors	Yes	Interpolated ground station network measurements (air
	Pressure sensors	No	Not useful (air ambient pressure)
	Pyrheliometer for DNI	No	Not possible at the moment (no access to plant).
Other Data (user provided)			
Plant data	Production data ⁷	No	Not available at the moment.
	Temperature, pressure and flow rate data ⁸	No	Not available at the moment.
GMES service(s) used			
MACC	Irradiance data (global and direct on	Yes	
	Meteorological parameters at surface level:	Partially	Air temperature data provided by University of Genova

The validation has not been possible because user's CSP plants construction program was delayed: it will be done as soon as the user will have production data available. It is also worth mentioning that in the design phase, the need for data had been somehow overestimated. As a result, some of data the usage of which had been envisaged may turned to be not necessary for developing the service.

⁷ These data are exclusive property of Enel Green Power

⁸ These data are exclusive property of Enel Green Power

2.2.3. Quality control for product S2

This section provides the user's assessment about quality control for product S2. Quality control for S1 has been successfully applied.

Production Process		% fulfilled	Comments and notes
Method/Model	The method is based on two modelling activities: one for the solar field and one for the power plant. Both activities rely on energy balance and heat transfer equations.	100%	Could be improved the models for: turbo-generator, thermal energy storage and steam generator.
References	T. Stuetzle, N. Blair, J. W. Mitchell, W. A. Beckman, "Automatic control of a 30 MWe SEGS VI parabolic trough plant", Solar Energy 76(1-3), 2004, pp. 187-193	100%	It has been used in particular for solar collector field modelling.
	M. Qu, H. Yin, D.H. Archer, "Experimental and Model Based Performance Analysis of a Linear Parabolic Trough Solar Collector in a High Temperature Solar Cooling and Heating System", Journal of Solar Energy Engineering, 2010, 132(2), pp. 021004.1-021004.12	100%	It has been used in particular for absorber pipe and HTF heat transfer modelling

Quality standards and monitoring			
		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Product	Standards for planning and coding activities will be defined	Yes	The ISO9001 quality standards regarding processes and documentation are applied. In particular the involved processes are: requirements definition, design specifications, coding, verification and validation, configuration management and control.
	Planning and coding activities will be verified	Yes	The assigned project manager, with the support of the company Quality Manager, verified all the activities in a project through dedicated milestones and verification procedures.
Validation	A number of state variables, such as temperature, pressure, and flow rate, will be measured at several locations in the solar field and feedwater/steam power plant of a CSP system operated by our user, and these data will be used to validate the solar field and the power cycle models. The air temperature values are validated in WP 3; the direct solar radiation data originate from the Core Service MACC.	Partially	There will be a complete validation only when the first Enel's CSP plant will be active. Air temperature data provided by University of Genova have been validated in WP3.

2.2.4. Overall evaluation of product S2

The product will meet user's satisfaction as soon as it can be successfully validated and exploited to monitor the new CSPS plant, which is still under construction. However, even when the CSPS plant is ready, the user would not have such a complete planning and monitoring solution, so the improvement level should be high. At the moment the user needs mostly the monitoring aspect of the product, that is the CSP operational parameters and production remote monitoring. Site assessment and CSP design optimisation could be useful in the future when new CSP plants constructions will be planned.

The (tentative) score for the overall satisfaction is 4. The main impacts the user expects from product S2 are: support to investment at the planning stage, including site assessment, CSPS design optimisation, RoI assessment and support to investment at the operational stage.

2.3. Assessment of S3

Relying on the users' requirements, as presented in D2.1 of ENDORSE, product S3 was defined as: "Forecast of direct irradiance".

The original focus was concentrating on solar power plants, with the aim to enhance existing irradiance forecast services from meteorological service providers and to support development of electricity production forecast service.

There have been variations in the product definition as users at the power plant site are interested in direct irradiances forecast and the practical handling of the service prototype mainly. A more detailed review of the assessment results has been conducted with the development team at Solar Millennium and Flagsol. This produced different statements from different groups.

2.3.1 Users' benchmark for product validation

This section provides the users' assessment about the product properties that had been defined in Task 2001 and presented in Deliverable 2.1 of ENDORSE. All the assessed product properties are 100% compliant with the expressed requirements.

<i>User's requirements as per WP2 D2.1</i>		<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance⁹</i>
Parameters	Direct normal irradiance	100%	Knowledge about the accuracy has been gained at other ground station locations than the Andasol power plant site
	Global horizontal irradiance	100%	Additional knowledge has been obtained for the parameter global irradiance
	Wind speed	100%	Is currently used from NWP. Higher temporal resolution would be appreciated

⁹ For S3 mainly dealing with increased knowledge on the fulfillment of user requirements in other regions or by other approaches

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	Temperature	100%	Is currently used from NWP
Accuracy of parameters	DNI: annual average accuracy of the DNI must be higher than the accuracy of the 2 day persistence case (next day = previous day). In 2007 this corresponds to a RMSE of less than 344.5 W/m ² at the Andasol-3 site	100%	Has been shown already
	Same for wind speed, where a RMSE of less than 3.3 m/s is required at the Andasol-3 site	100%	Has been shown already.
	Same for temperature, where a RMSE of less than 3.4 °C is required at the Andasol-3 site	100%	Has been shown already.
Space resolution	Point information for a power plant site	100%	Existing
Time resolution	Hourly resolution	100%	Existing. Higher temporal resolution would be appreciated.
Time series coverage	Due to new market conditions this requirement is not applicable anymore. Time series can be provided to the market agent at any time with any timing and length of time series. In order to provide this flexibility an up to 10 d forecast is required.		N/A
Data format	ASCII file	100%	Existing
Data availability	Due to new market conditions this requirement is not applicable anymore (see above).		N/A
	Due to new market conditions this requirement is not applicable anymore (see above).		N/A

The overall level of satisfaction of product properties is very high: 5 out of 5. As the user remarked *“We have gained additional knowledge about the forecast quality of used meteoproviders and about other regions.”*

2.3.2 Data and other inputs used for product S3

This section provides the assessment about the usage of data for the product S3.

The usage of data as it was foreseen in ENDORSE D2.1 has been fully achieved. The only exception being MACC aerosol data set, which is not implemented in the operational ECWMF Integrated Forecasting System (IFS) version. Therefore, it can't be assessed from the irradiance point of view at the moment. We rely on further MACC-2 runs.

<i>Usage of data as per WP2 D2.1</i>		<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments¹⁰</i>
Data sources (non GMEs)			
Ground measurements	Irradiance data (global on horizontal surface and direct irradiances) and other meteorological data at Plataforma Solar de Almeria, Spain; Cologne, Germany, Baseline Surface Radiation Network, Europe Hourly and daily values, period 2004-2009	Yes	Database has been extended towards BSRN measurements in Europe and Northern Africa.
	Meteorological forecasts ECMWF IFS Service	Yes	GHI forecasts have been used to derive DNI forecasts.
Other Data		Yes	
Measurements	Ground measurement of direct normal irradiance, temperature and wind speed at power plant locations	Yes	Temperature and wind speed data has been used in previous assessments for the Andasol location (outside of ENDORSE). Meteo data is not available at the BSRN sites.
Modeled data	Forecasted data as provided to SMAG from external providers for evaluation purposes	Yes	A comparison of other forecasts have been made outside of ENDORSE at the Andasol location. External provider

¹⁰ Comments about users' acceptance on increased knowledge on the fulfillment of user requirements in other regions or by other approaches

			products will be evaluated only if another system location than Andasol is under investigation in future and if there are other regional/local meteo providers existing for that region
GMES service(s) used			
Satellite	MSG-SEVIRI images	Yes	Has been used for nowcasting at Andasol. Performance assessment for other Baseline Surface Radiation Network (BSRN) stations has been made.
MACC (GMES Atmosphere service preparatory project)	Irradiance data (global and direct on horizontal surface), every 15 min, since 2005	Yes	Has been used as the input for the nowcasting scheme
	Meteorological parameters at surface level: air temperature, wind, precipitation, relative humidity, pressure	Yes	Not used so far
	Air chemistry parameters as aerosols	Aerosols have to be implemented in the operational IFS system, this is an ongoing activity in MACC-2.	Currently, the new MACC aerosol data set is not implemented in the operational ECWMF Integrated Forecasting System (IFS) version. Therefore, it can't be assessed from the irradiance point of view at the moment. We rely on further MACC-2 runs. Nevertheless, for the Andasol location an aerosol forecast is not required urgently. This will be relevant only in future if applying the FoSyS system in other regions.

2.3.3 Quality control for product S3

This section provides the user's assessment about quality control for product S3. Quality control for S3 has been successfully applied.

Production Process		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Method	Validation against ground measurements of DNI. Forecasts are validated against DNI ground measurements as provided by the prime user, by DLR at its own premises in Spain and Germany, and the WMO Baseline Surface Radiation Network (BSRN)	Yes	QC has been performed for DLR_PSA, Andasol and BSRN ground stations for 2004 to 2009

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Validation	MESOR validation standards	Yes	Has been applied as a QC for ground measurements

2.3.4 Overall evaluation of product S3

The overall level of satisfaction for product S3 is very high¹¹, as it fully complies with the expressed requirements. The product characteristics are well suited to test the prototype and to continue with the service development at Flagsol and DLR.

Coherently, the users expect a high level of improvement brought by S3. With respect to the pre-FoSYS status the improvement is very high as there was no comparable system existing before. The improvement in knowledge gained within ENDORSE is very satisfying.

The main impacts expected from product S3 are the following:

Main expected impacts	Score ¹²
Reduction of penalty payments caused by inaccurate power production programming	5
Increase power plant availability and predictability by improved operations planning in future	5
Maximise revenues of plant owner by integrated power production planning	5
Higher grid stability by increased accuracy of production planning	3 (higher if many power plants use a similar service)
Help for decision making of power plant operators about the optimum operation strategy for the upcoming hours	5

¹¹ 5 out of scale from 1 (not satisfied) to 5 (very satisfied)

¹² The score is based on a five points scale, from 1 (not important) to 5 (very important)

2.4. Assessment of S4

Product S4 is a solar energy-related TMY “Typical Meteorological Year”. A TMY is a synthesis of the meteorological situation of a past period spanning over several years, typically at least 10. It is made of observed values, and not averages for instance, which are selected according to specifications by user. The product S4 proposes a TMY generation method that enables TMYs to be representative for instance, for the median situation or for the worst situation with respect to energy production.

The product is a highly spatially-resolved Typical Meteorological Year (TMY) data set for the design and the performance assessment of complex or not, solar energy-based systems for electricity production. Two sets of meteorological parameters have been produced: one with radiation only, one with other parameters such as ambient temperature or wind speed. The targeted geographical area for these products in the initial phase has been the Provence region in France.

For product S4, the assessment was carried out with two users, Total and DC. The tables in the following sections provide the consolidated results from the two exercises.

With both users, a presentation was made of each product characteristic with preliminary results based on data obtained from ground station measures at Carpentras, France. This was followed by a fruitful point by point discussion related to the utilisation of this activity with simulation and assessment of solar photovoltaic systems, achievement of preliminary defined targets as well as possible supplementary functionality development. In addition it was discussed the manner this activity could be used for Concentrated PV.

2.4.1. Users' benchmark for product validation

This section provides the users' assessment about the product properties that had been defined in Task 2001 and presented in Deliverable 2.1 of ENDORSE. All the assessed product properties, as requested by users, have been achieved by S4.

<i>User's requirements as per WP2 D2.1</i>		<i>Yes/No/partially fulfilled</i>
Parameters	[1] Irradiance	Yes
	[2] Air temperature	Yes

	[3] Wind speed	Yes
	[4] Air humidity	Yes
Accuracy	[1] Limited bias, rmse <25%	Dependent on the source of input data
	[2] Limited bias, rmse <4 °C	Idem
	[3] Limited bias, rmse < 5 m/s	Idem
	[4] Limited bias, rmse <20%	Idem
Space resolution	2 km for all	Idem
Time resolution	Hour for all	Yes
Time series coverage	Preferably more than 15 years	Yes
Product format	Excel file, or CSV format. One line per hour. Format: date (ISO 19115) YYYY-MM-DDThh:mm:ss, followed by meteorological values. In another possible format, date will be separated in year, month, day, hour (possibly in decimal form).	Yes
Product availability	Less than 1 day after request to the Service SoDa	Yes
Ancillary information (metadata)	There is no formal requirement presently. Armines intends to provide a number of metadata, relating to title of product, geographical location of the TMY, temporal description, content and units, provider, intellectual property rights, quality, lineage.	Yes

The level of satisfaction of product properties is very high. The product is very flexible and provides all the required information. It seems to be more product/technology oriented than the other TMY concept developed, with a focus on technology specificities, which is of great interest for us.

Easiness of implementation with various solar simulation software has not been fully tested yet.

2.4.2 Data and other inputs used for product S4

This section provides the assessment about the usage of data for the product S4. The expected usage of data has been fully achieved.

<i>Usage of data as per WP2 D2.1</i>		<i>Yes/No/partially fulfilled</i>
Data sources (non GMEs)		
Satellite-derived data	Digital Terrain Model (NASA)	Yes
Ground measurements	Irradiance data (global and diffuse on horizontal surface and direct component on surface normal to sun rays, DNI) and air temperature at 2 m from three stations in Provence managed by Armines, every 10 min, period 2009	Yes
	Irradiance data (global on horizontal surface) and other meteorological data in Provence, from the ground network of Meteo-France	Yes
GMES service(s) used	MACC-HelioClim irradiance data	Yes
MACC	Irradiance data (global and direct on horizontal surface), every 15 min, since 2004	Yes
	Meteorological parameters at surface level: air temperature, wind, precipitation, relative humidity, pressure	Yes

2.4.3 Quality control for product S4

This section provides the user's assessment about quality control for product S4. Quality control for S4 has been successfully applied, although some further developments are needed for the model.

Production Process		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Method	Construction of cumulative frequencies of irradiation for a given month, for all years. For this month, selection of year whose cumulative frequencies are the closest from the sum of cumulative frequencies. Selection is performed on irradiance distribution. This year is adopted for the other parameters	Yes	
Model	Under development	90%	Includes in the method the comments made by the prime users
References	Basis is the article by Kalogirou, Renewable Energy 28 (2003) 2317–2334	Yes	

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Product	Control quality of input data. Control good termination of process. Process should issue warning to operators.	100%	
Validation	Control format and presence of metadata (manual). Compute statistics (mean, standard-deviation) of input data and of TMY and control difference between them. Difference should be small in case of median situation. If available, use a graphical tool displaying histograms. A handbook of expected differences between statistics of input data and TMY can be constructed in a preliminary stage to help operators in validation	Yes	.

2.4.4 Overall evaluation of product S4

The overall level of satisfaction and the level of improvement brought by product S4 are very high. Endorse product S4 allows users to evaluate variability of annual revenues with meteorological risks (evaluation of bad and good year revenues), which is not the case with other TMY methods. It also allows the definition of typical meteorological year taking into account the solar technology specificities with regards to sensitivity to weather parameters.

The main impacts remarked by the prime user are the following:

Main expected impacts	Score ¹³
More accurate assessment of expected profitability	4 -5

The users also pointed out the following:

- The proposed method can be used not only to generate typical meteorological year but also to generate typical meteorological data at sub-monthly base
- Yearly meteorological data can be used as input for simulation programs generally used by the prime users
- The product gives necessary inputs to evaluate a solar plant production for a typical meteorological year but also to evaluate variability of annual revenues with meteorological risks (evaluation of bad and good year revenues).

The user exposed the idea of evaluating the performance of a PV system using the proposed method of TMY generation in a daily basis by a relation with the performance ratio PV system parameter.

¹³ Score is based on a five points scale, from 1 (not important) to 5 (very important)

2.5. Assessment of S5

Product S5 is an ensemble of GIS layers for site selection for CSP plants. A web-based tool allows users to determine the energy production potential for concentrated solar power (CSP) plants and to easily discover whether a given location is suitable for such power plants.

With respect to the originally planned product, the time series have not been included.

2.5.1. Users' benchmark for product validation

This section provides the users' assessment about the product properties that had been defined in Task 2001 and presented in Deliverable 2.1 of ENDORSE. . With the exception of the time series, all the users' requirements have been met.

User's requirement as per WP2 D2.1		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially
Parameters	DNI (direct normal irradiation)	Yes
	GTI (Global Tilted irradiation)	No
Accuracy	5% for long term average	No / ~10%
Space resolution	1 km	Yes
Time resolution	Long term annual averages	Yes
	Yearly Sums	Yes
	Monthly Sums	Yes
	At least hourly Time Series	No
Time series coverage	Yes (optionally)	No
Data format	Maps in an online portal	Yes
Data availability	YES. Currently as offline production as GIS data sets but as web services in MACC become available they can be used instead.	Yes
Ancillary information	Access to infrastructure	Yes
	Land cover	Yes
	Properties	No

The level of satisfaction for product properties was ranked very high, "extraordinary", according to the user.

2.5.2 Data and other inputs used for product S5

This section provides the assessment about the usage of data for product S5.

Usage of data as per WP2 D2.1		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially
Data sources (non GMEs)		
Satellite	MSG-SEVIRI images, METOP images, MODIS images	Yes (DLR: MFG)
Ground measurements	Digital Terrain Model (NASA)	Yes
	Irradiance data (global on horizontal surface and direct irradiances) and other meteorological data at Plataforma Solar de Almeria, Spain; Cologne, Germany, Baseline Surface Radiation Network, Europe. Hourly and daily values, period 2004-2009	No (Ground measurements were used by DLR for DNI, but station data not available in WebGIS)
	Land cover maps identifying urban areas in 2005, GlobCover project	Yes
	Hazardeous areas, protected areas, hydrography, Local authorities	Yes (No local authorities)
GMES service(s) used		
MACC	Irradiance data (global and direct on horizontal surface), every 15 min, since 2005	No
GeoLand2	Land cover	Yes

Electricity GRID data, not indicated in the list, was added.

2.5.3 Quality control for product S5

This section provides the user's assessment about quality control for product S5. Quality control for S4 has been successfully applied, although some further developments are needed for validation.

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially
Product	DNI maps	
Validation	The DNI maps can be validated against ground measurements as they are available in the target region. The benchmarking standards of the IEA SHC Task 36 will used.	Yes
Product	Exclusion maps	
Validation	The derived exclusion maps from the Core-Services will be validated by comparison with existing maps which have been developed by off-line GIS applications at DLR.	Not yet (Exclusion maps can be also validated by additional map layers from providers as Google, Microsoft, OpenStreetMap)

2.5.4 Overall evaluation of product S5

The level of satisfaction was ranked high even if the tool has still minor bugs. The level of improvement, with respect to the methods previously adopted, was also ranked very high. The product provides an accessible and user friendly-tool that is unique for planning and evaluation. Uniqueness of the proposed solution is indicated as its main strength point.

2.6. Assessment of W1

Product W1 “Annual Energy Output (AEO)” of planned wind farms, is a decision-support system in on-shore wind energy policy planning and private investment.

The first version of the tool consists of a series of simulations to be analyzed by the prime-user, with a focus on the accuracy information during critical grid situations. In this first version, the user inputs this information in a template Excel file and sends it as an attachment to an email. A dedicated e-mail account has been created. A batch code runs hourly on a dedicated computer, to check if any request has been made. If it is the case, it downloads the Excel file containing the request and triggers an Excel VB macro, which processes the request, outputs the result, and sends it back to the user.

2.6.1. Users' benchmark for product validation

This section provides the users' assessment about the product properties that had been defined in Task 2001 and presented in Deliverable 2.1 of ENDORSE. The table shows that all the users' requirements have been fulfilled.

<i>User's requirement as per WP2 D2.1</i>		<i>Notes from D2.1</i>	<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance</i>
Parameters	Global and sector-wise frequency, A, k and mean wind speed of the Weibull wind speed distribution	The information provided by the tool should characterize the wind conditions at different heights and the potential energy production.	100%	
	Frequency and energy roses Annual Energy Output (P50 result)		100%	
	Wake effects		Not available in the first version of the tool. Currently under development and should be available in the final version of the tool	The first version of the tool provides results for 1 turbine without taking into account wake losses. A wake model will be introduced in the final version
Accuracy	10% on the Annual Energy Production		100%	The tool has been calibrated with regard to the expected accuracy on AEP
Space resolution	1 m (so coordinates in metric coordinates systems can be introduced)	The user should have the possibility to introduce coordinates (within different coordinate system) and the option to pick-up a location based on an aerial picture or map.	100%	The use introduces coordinates in UTM 31. The first version does not include the option of different coordinate system, either the option to locate a point on an aerial picture or map.

Time resolution		Long Term representative results	100%	The tool is currently based on 10 years for long term extrapolation of results
Time series coverage	10 years period	A 10 years period is commonly considered as Long Term representative of wind regimes	100% and will be improved!	10 years long term reference period based on MERRA data
Data format	Reporting of key results (pdf format) easy to download		100%	
Data availability	Fast access (maximum 1 day running) Confidentiality required on results and imported data	The tool should include NDA on prime-user's data Results should be sent to an e-mail address specified during the request, or accessed with login and password in case the e-mail address was not correctly filled out	100%	The user receives the results in a few minutes
Ancillary information	Option to import and use mast measurement data to realize the AEO calculation. Option to use real production data in the calculation (in order to compare or in the case of park extension cases) Option to import constraints maps in order to define suitable site according planning requirements.	Mast data as tab delimited format, containing time stamp as dd/mm/yyyy hh:mm, wind speed and direction Production data as tab delimited format containing month as mm/yyyy, power output and availability for the whole park. Constraint data as polygon shape file of excluded areas	Not available	Options Not included in the tool

3E tested the tool with different operational data sets and compared methodologies. The tool has been tested within the Wind department and received satisfied feedback (level 4, out of the applied scale from 1 –minimum- to 5 –maximum-).

EDF Luminus received the template and a temporary access to the prototype (17/02/2012), but did not start the test exercise (no feedback from EDF Luminus).

2.6.2 Data and other inputs used for product W1

This section provides information about the usage of data for product W1. As illustrated in the following table, the complex process of data exploitation was successfully carried out although some minor deviations have occurred.

Usage of data as per WP2 D2.1		Notes from D2.1	% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments about users' acceptance
Data sources (non GMEs)				
Roughness	Corine Land Cover	The several data sets will be compared according the accuracy of the final results, coverage and availability of the data	Yes	Selected input data
	Globcover 2009		NA ¹⁴	Tested but the too general land use classification based on limited classes occurs less accuracy on final results
	Data for Wind		Yes	MERRA data are used as meteorological input data
	GLCC (low spatial resolution)		NA ¹⁵	
Orography	SRTM		Yes	Selected input data
	ASTER		NA ¹⁶	
	NGI Data (local level)		NA ¹⁷	
Other Data to be provided by prime user(s)				
Characteristics of wind turbines	Power Curve		Yes	A database with the latest updated power curves is linked to the tool. The user selects the wind turbine type

¹⁴ Not used based on tests with regards to the accuracy objective

¹⁵ Not used based on tests with regards to the accuracy objective

¹⁶ Not used based on tests with regards to the accuracy objective

¹⁷ Not used based on tests with regards to the accuracy objective

	Ct (Trust Curve)		Yes	Included in the database through the power curve selection (database)
Park Layout	Introduction of coordinates of each wind turbine. The tool should allow to introduce easily coordinates in different coordinate systems, or to point locations on a map		Yes	Coordinates are introduced in UTM zone 31)
Mast measurements	Site measurements	The tool should allow the user to use mast measurement data to calculate the AEO. This data needs to be protected and not disseminated. Measurements should optimally cover a full year period, or at least complete months of measurements, so they can easily be Long Term corrected	Not available	Would increase IT development and complexity the tool with the risk of introducing errors in AEP simulation
Real production data		The user should have the possibility to import monthly production data and availability in order to apply the AEO calculation in the case of extension of wind park.	Not available	Would increase IT development and complexity the tool with the risk of introducing errors in AEP simulation
GMES service(s) used				
GEMS/MACC	Meteorological parameters at surface level: air temperature, wind, precipitation, relative humidity, pressure (1.25°x1.25° resolution)	The data provided by GMES services will be checked and the relevance to use this source will be analyzed according the required accuracy of the final results and availability of the data.	No	MERRA offers data with higher resolution (1/2° x 2/3°), is free and available on NASA's website.
Roughness	GeoLand2		Not selected, occurs unaccuracy on final results. The roughness lengths provided by this source is too general	

Functions and options with regard to addition of Ancillary information are not available in current version. The development of such functions would increase IT development and complexity of the tool, with the risk of introducing errors in AEP simulation.

Functions not included are:

- Option to import and use mast measurement data to realize the AEO calculation.
- Option to use real production data in the calculation (in order to compare or in the case of park extension cases)
- Option to import constraints maps in order to define suitable site according planning requirements

2.6.3 Quality control for product W1

This section provides the user's assessment about quality control for product W1. Some further developments are needed for the wake model, the overall achievements are nevertheless satisfactory.

Production Process		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Method	The tool will run a wind flow model and a wake model at the desired location(s), based on the necessary input data (roughness, orography, meteorological and wind turbine data), as well as (if applicable) measurement and/or production data.	75%	The first version runs well, but does not include yet a wake model
Model	Relevant wind flow and wake models to be defined will be used.	75%	Wake model is currently under development

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Product	The criteria against which the product quality will be assessed include (but is not limited to): on-line accessibility, aesthetics, ease of use, results clarity, etc.	<ul style="list-style-type: none"> on-line accessibility: 100% ease of use: 100% results clarity: 100% 	
Production	The criteria against which the product operation will be assessed include (but is not limited to): time to obtain results, reliability (all requests are processed), consistency (all requests are processed within the same timeframe), etc.	80%	The first version runs well, but does not include yet a wake model.
Validation	The results will be validated on a selection of 5 locations where EDF-Luminus has, operational data, or wind resource assessments from consultancy companies available. Different datasets, wind flow and wake models will be analyzed and tested in order to provide the required accuracy of final results (10% on AEO) compared to measurement or operational data.		No feedback from EDF Luminus

2.6.4 Overall evaluation of product W1

The prime user did not provide any comments about the level of satisfaction, the level of improvement and the expected impacts

2.7. Assessment of E1

Product E1 has been defined as “Load Balancing” and concerns solar radiation information for grid planning and grid operation.

Analysis on the influence of solar power in local grids has been done so far only with artificial grid models. Relying on ENDORSE, the detected useful areas for solar systems in the test region will be connected to the local electricity network model and the influence of the solar power will be evaluated at a quarter-hourly time step.

The evaluation on the realistic local level and the use of quarter-hourly solar radiation values on the local level has not been done so far. Within ENDORSE the detailed expectation of the users and the tools and standards in the grid management will be analyzed and the lessons learned will be adapted to the design of this service.

2.7.1. Users' benchmark for product validation

This section provides the users' assessment about the product properties that had been defined in Task 2001 and presented in Deliverable 2.1 of ENDORSE. The users' requirements for product E1 have been met, with the exception of snow coverage.

<i>User's requirement as per WP2 D2.1</i>		<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance</i>
Parameters	[1] Irradiance	100%	
	[2] Ambient temperature	100%	
	[3] Wind speed	100%	
	[4] Snow cover	0%	
Accuracy parameters of	[1] tbd	-	Will be a result of the project
Space resolution	[1] Area of low voltage transformer	100%	
	[2] 1 km x 1 km	consultation DLR	

Time resolution	[1] 15 minutes	100%	
	[2] 5 minutes	100%	
	[3] 30 seconds	80%	Only validation data available, simulation not yet
Time series coverage	Grid area	100%	9 months of validation and meteorological data available
Data format	CSV, XML, tbd	100%	CSV data format

The level of satisfaction as for product properties was marked 4-5.

2.7.2 Data and other inputs used for product E1

This section provides the assessment about the usage of data for the product E1. The foreseen goals have been fulfilled, with two exceptions: ground measurement data for snow coverage and SWU data about potential areas for solar roofs: roof potential analysis was delayed.

Usage of data as per WP2 D2.1		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments about users' acceptance
Data sources (non GMEs)			
Satellite	MSG-SEVIRI images, METOP images, MODIS images	100%	
Ground measurements	Irradiance data (global on horizontal surface and direct irradiances) and other meteorological data at Ulm, Baseline Surface Radiation Network, Europe Hourly and daily values	100%	
	Air temperature, wind speed and snow cover from local weather station	80%	Snow cover is missing
Other Data			
SWU	Structure and characteristic of distribution grid	100%	
	Detailed load curves of the distribution grid	100%	Standard load profiles
	Actual status of photovoltaic systems installed and power output within the test period	100%	
	Potential areas for solar roofs	50%	Delayed
Modeled data	Power factory grid simulation	100%	Working prototype, have to be improved
Reference	Measurements at low voltage transformers	100%	
GMES service(s) used			
MACC	Irradiance data (global and direct on horizontal surface), every 15 min, since 2005	100%	

2.7.3 Quality control for product E1

This section provides the user's assessment about quality control for product E1. All the foreseen steps for quality control have been successfully applied.

Production Process		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Method	Comparison of measured and calculated parameters	80%	Overlay medium voltage grid necessary

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Product	Power and voltage	100%	
Validation	Grid measurement	100%	

2.7.4 Overall evaluation of product E1

The overall level of satisfaction was scored very high (4-5). This is a new product in research framework, bringing high improvement as no previous systems is actually comparable in usage.

The main expected impacts expected from product E1 are reported in the following table. The mainly refer to operation efficiency n grid management

Main expected impacts	Score ¹⁸
Increase knowledge about the investment needed for the grid planning, due to rising decentralized energy input	4
Reduce error of load forecast, increase accuracy of local day ahead solar power forecast	3
Improve accurate planning	4
Reduce operational risk	3
Increase return on Investment	3
Improve efficiency of grid planning and grid management processes	4
Improve predictability of grid operation	3

¹⁸ The score is based on a five points scale, from 1 (not important) to 5 (very important)

2.8. Assessment of B1

Product B1 is "Mapping biomass potentials".

It was originally defined as a regular investigation of forest biomass increment for Brandenburg forests with a spatial resolution of about 1 km x 1 km. Due to a technical problem in the post-processing the foreseen resolution of 1km x 1km was slightly changed. The problem is now identified and fixed and will not occur in the second version of the product.

2.8.1. Users' benchmark for product validation

The users' requirements have been addressed in a fairly satisfactory way, although improvements are expected for space and time resolution, as well as for time series coverage.

<i>User's requirement as per WP2 D2.1</i>		<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance</i>
Parameters	Above Ground Biomass increment	Yes	
Accuracy	+/- 20%	Yes	The accuracy of the product should be improved.
Space resolution	1 km x 1 km	Yes	The spatial resolution of the product's second version should be increased. MERIS-FR (300 m x 300 m) should be considered to be used.
Time resolution	Annual	Yes	Data of annual above ground biomass increments are appropriate. A higher temporal resolution is not needed
Time series coverage	2000 to 2007	Yes	A change of the time period to e.g. more recent years would be appreciated.
Data format	GeoTIFF	Yes	
Data availability	The products will be available via FTP.	Yes	The products were sent via e-mail.
Ancillary information	The map projection is defined as ETRS89, GRS80 Zone 3	Yes	

The product was rated 3. In principle it is usable but could be improved by:

- Incensement of the spatial resolution (e.g. 300 m x 300 m or higher)
- Improvement of the accuracy

2.8.2 Data and other inputs used for product B1

This section provides the usage of data for the product B1. Overall, the foreseen goals have been met, the major deviations are indicated in the following table. The second release of the product will include additional datasets.

<i>Usage of data as per WP2 D2.1</i>		<i>Notes from D 2.1.</i>	<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance</i>
Data sources (non GMEs)				
Satellite: Terra Sensor: MODIS Provider NASA	Land cover map giving information about the fraction of tree cover per pixel	A possible GMES product pendant could be the Fraction of Vegetation Cover (FCOVER) derived from SPOT VEGETATION data.	Yes	Will not be included in the second version, due to too high uncertainties in the MODIS-VCF product.
Provider: FAO	Map that provides information about the main soil type		Yes	
Spaceborne: Space Shuttle Endeavour Mission: SRTM Provider: NASA	Digital elevation model		Yes	
Possible additional Datasets:				
Satellite: Envisat Sensor: MERIS Provider: ESA	Land cover map identifying forested areas (needle leafed, deciduous and mixed forest) in 2006.	Ready and free available	No	Foreseen to be introduced to the second iteration of the product.
Satellite: Envisat Sensor: MERIS	10 Day composites of fAPAR	Dataset needs to be	No	Foreseen to be introduced to the second iteration of

ENDORSE. D5.1- Prime Users' Assessment of Products

Provider: DLR		preprocessed, before usage is possible. (risk)		the product.
GMES service(s) used				
Satellite: SPOT 4 or SPOT 5 Sensor: VEGETATION Provider: POSTEL	LAI time-series 10-day composites	The LAI time series will be harmonized using special software to identify outliers and gaps. The biomass model needs gap-free, time-series as input. The LAI time series will become fully available in the Land GMES service BioPAR developed in the geoland 2 project.	Yes	
Satellite: SPOT 4 SENSOR: VEGETATION Provider: JRC	Land cover map identifying forested areas (needle leafed, deciduous and mixed forest) in 2000.	More actual land cover maps are welcome, if available in the GMES Land Service EUROLAND	Yes	

2.8.3 Quality control for product B1

This section provides the user's assessment about quality control for product B1. The validation process still needs to be further addressed in order to meet the expected quality standards.

Production Process		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Method	Modeling	Yes	
Model	BETHY/DLR	Yes	
References	Wisskirchen K. Modellierung der regionalen CO2-Aufnahme durch Vegetation [PhD Thesis]. Meteorologisches Institut der Rhein. Friedrich – Wilhelm – Universität, Bonn; 2005. Knorr W. Satellite Remote Sensing and Modelling of the Global CO2 Exchange of Land Vegetation: A Synthesis Study [PhD Thesis]. Max-Planck-Institut für Meteorologie, Hamburg; 1997.	Yes	
Post Processing	Assessing above ground biomass increase using scaling factors	Yes	
Validation	Use of measured above ground biomass increase for defined areas within the Brandenburg state forest	20%	A first validation exercise on state level was carried out. Further validation is needed to be performed.

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Validation	<p>The prime user will provide data about the increase of above ground biomass as well as standing biomass for the period of investigation (2000 to 2007) for selected test areas within the state forest of Brandenburg. This data will directly be compared with the increase of above ground biomass, which will be estimated from the modeled Net Primary Productivity by BETHY/DLR.</p> <p>After this first stage of validation the model will be improved with e.g. higher resolution input data and a second model run and validation will be performed.</p> <p>Secondly the input data as e.g. meteorological time series could be compared with ground measurements in order to estimate the accuracy.</p>	Partially	<p>The growth potential was calculated for each stock in a model area. For this, the data from the DSW2 and the valid yield tables were used.</p> <p>To illustrate the growth for the period from 2000 to 2007 tree-ring series of beech and pine were created.</p>

2.8.4 Overall evaluation of product B1

The level of satisfaction was rated 3 while there was no rate for the level of improvement because this question cannot be answered until a second version is available.

The main impacts the user expects from product are:

Main expected impacts	Score ¹⁹
More efficient tool for public consultation	5
Compliance with environmental-friendly policies	3
Time and money savings compared to field measurements	5

The growth estimate for forest stands with terrestrial methods is paired with a heavy workload. The savings potential from the use of remote sensing products like B1 appears high.

¹⁹ The score is based on a five points scale, from 1 (not important) to 5 (very important)

2.9. Assessment of B2

Product B2 is defined as “Certification of sustainable bioenergy use”. It consists of remote sensing images and maps showing the region of interest (ROI) for certification with a resolution of 300m x 300m. The images and maps of the ROI’s cover different times of observation (at least two) in order to identify land cover change (legal or illegal) or continuity of land use. The products support the service for certifying the sustainable production of bioenergy products.

2.9.1. Users’ benchmark for product validation

This section provides the users’ assessment about the product properties that had been defined in Task 2001 and presented in Deliverable 2.1 of ENDORSE. The users requirements have been fully met.

<i>User’s requirement as per WP2 D2.1</i>		<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users’ acceptance</i>
Parameters	RGB	Yes	
	CIR	Yes	
	RMSE	Yes	
Accuracy	No accuracy can be defined, only for visual inspection	Yes	
	No accuracy can be defined, only for visual inspection	Yes	
	Less than 50% cloud cover	Yes	
Space resolution	300m x 300m	Yes	In general, images with higher spatial resolution would improve the land over change analysis and the final decision process.
	300m x 300m	Yes	
	300 m x 300 m	Yes	
Time resolution	Comparison of two maps at least, defined by user requirements and cloud cover,	Yes	For the certification a comparison

			of land cover / land use before January 1 st , 2008 is mandatory. Time resolution depends on the availability of cloud free satellite data.
	Comparison of two maps at least, defined by user requirements and cloud cover,	Yes	
	Comparison of two maps at least, defined by user requirements and cloud cover,	Yes	
Time series coverage	2007 for comparison of the land cover / land use and after 1.1.2008 for documenting sustainable land use	Yes	
Data format	GeoTiff and kmz	Yes	
Data availability	The data will be available via ftp transfer	Yes	The product prototype was delivered via mails. This was sufficient.
Ancillary information	Land cover information based on MERIS-FRS (GLOBCOVER)	Yes	If higher spatial resolution can be achieved in the future, a more detailed land cover / land use information is needed.

The score of the overall level of satisfaction is high (4).

Higher spatial resolution might improve the analysis of land cover / land use change in the future.

2.9.2 Data and other inputs used for product B2

This section provides the assessment about the usage of data for product B2. Data have been exploited as it had been originally foreseen.

<i>Usage of data as per WP2 D2.1</i>		<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance</i>
Data sources (non GMEs)			
Spaceborne: Space Shuttle Endeavour Mission: SRTM Provider: NASA	Land-sea-mask for the region from 60°N to 60°S	Yes	All relevant water bodies in the scenes under investigation are masked, using the SRTM data.
Satellite: Envisat Sensor: MERIS Provider: ESA	Land cover maps identifying forested areas (needle leafed, deciduous and mixed forest) in 2005 Provider: GlobCover project	Yes	For identifying forests the GLOBCOVER map is used as additional layer.
GMES service(s) used			
Satellite: Envisat Sensor: MERIS-FRS Provider: ESA	L1b data are needed (GMES heterogeneous mission accessibility (HMA))	Yes	

2.9.3 Quality control for product B2

This section provides the user's assessment about quality control for product B2. As it indicated in the following table, the quality control process adopted for product B2 could only be partially appreciated by the prime user.

Production Process		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Method	For producing the RMSE maps a thorough pre-processing is needed. Therefore, cloud, haze and snow masking, as well as identifying dark objects as shadow and water is of great importance. New algorithms are developed at DLR for cloud, haze and snow masking using the bright and flat feature for snow and clouds. Precise geo-location is mandatory which is mainly fulfilled for MERIS-FRS data, 3 rd re-processing.	Yes	For the prime user it is difficult to assess the different pre-processing steps. The prime user can only assess the final product. In the final products, it was observed that sometimes cloud shadows are not identified correctly. During the visual inspection this misclassification can be identified but for automatic interpretation, cloud shadow should be masked with high reliability.
Model	Not applicable		
References	Description of the pre-processing is under development.		

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Product	For producing the RMSE maps the quality flags delivered by ESA will be taken into account. In addition, cloud, snow and haze maps will be produced as probability layer. If clouds are identified for sure the probability is set to 1, if no cloud is identified for sure the probability is set to 0. If the masking algorithm cannot identify a cloud, the probability is set to 0.5.	Yes	Quality flags are not used by the prime user for the interpretation of land cover / land use changes..
Production	The algorithms and the production flow applied will be documented.		
Validation	Validation will be performed in close co-operation with the prime user. Full data exchange will be provided.		A rigorous validation was not performed by the prime user.

2.9.4 Overall evaluation of product B2

As a first approach, the delivered products were rated as satisfactory (score 4). The potential to perform a risk analysis and to define the next steps for a more efficient auditing is identified. The need to higher spatial resolution products for better site specific analysis is also identified on the one hand. On the other hand the applicability of the method on a global scale is mandatory for the prime user. These two conflicting interests were discussed without finding a solution.

The level of improvement brought by product is high (Score 4).

The improved risk analysis and the definition of the next steps based on the delivered products make the auditing process more efficient.

The main impacts for the product are presented in the following table

Main expected impacts	Score ²⁰
Fast and reliable supply of remote sensing products	5
Reduce the effort to investigate land cover change manually	%
Support to better management practices for certifying bodies and bio-energy trading companies.	5

²⁰ The score is based on a five points scale, from 1 (not important) to 5 (very important)

2.10. Assessment of D1

Product D1 is a toolbox, which computes the annual energy consumption used for lighting a room in which blinds and lights are controlled by daylight to satisfy visual comfort and performance. For this, every 15 min the product computes, for one year or more, the light distribution inside the room for all possible shading situations, using the light available outside from the sky and from the sun.

The toolbox is based on “Phanie”: the light simulation engine developed for climate based daylight modeling by researchers at CSTB-France (Centre Scientifique et Technique du Bâtiment).

2.10.1. Users' benchmark for product validation

This section provides the users' assessment about the product properties that had been defined in Task 2001 and presented in Deliverable 2.1 of ENDORSE. The users' requirements have been satisfactorily met.

<i>User's requirement as per WP2 D2.1</i>		<i>Notes</i>	<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance</i>
Parameters	[1] Indoor global illuminances on the work plane due to skylight and sun, all year, every 15 min.	Indoor illuminances due to daylight depend on the outdoor sky luminances and on the blind position chosen to satisfy visual comfort requirements.	100%	This is a real progress compared to our product DIAL+ which does not compute instant illuminances and thus cannot take into account shading control strategies.
	[2] Blind up/down or position.	Information on how and how often blinds are used.	100%	This is new information which should be of interest to companies like Somfy which produces and sells motors and controls for shades.
	[3] Artificial light energy consumption.	With control, artificial light is used to complement the indoor illuminance due to daylight so that it reaches the level required for the user activity. This is the basis for the computation of the lighting energy consumption.	100%	This is important information for comparing daylight/artificial light control products and strategies and computing the return on investment based on energy savings.
Accuracy	[5] MBE<5%, RMSE<25%	The accuracy is obtained over the length of time used for the	100%	Results from the Nantes validation indicate that the accuracy is reached.

	[6] Position + or - 15°	simulation (preferably a year).	No	The Nantes validation did not include shade control. So this could not be checked.
	[7] MBE<5%, RMSE<10%		Partially	The Nantes experiment could not include artificial light: the illuminance sensors would not be able to make the difference between the contribution from daylight and the contribution from artificial light. We consider however that this is not a problem because the accuracy of the lighting energy consumption computed by the product depends entirely on the accuracy of the computed indoor illuminances (parameter [1]). The accuracy of this parameter is reached.
Space resolution	Site specific	Any site in Europe or elsewhere for the commercial use of the product.	100%	Thanks to the access to the MACC-Helioclim database, the service will deliver information over Europe.
Time resolution	At least 15 min	Every 5 min would be better to take appropriately into account the dynamic of daylight for the control of blinds and artificial light.	100%	15 min is perfectly acceptable. This is in line with the climatic data available. This is better than the hour interval used in energy simulation programs. When implemented as a service, the product could go down to a 5 mn resolution through interpolation of the 15 mn data. This will depend on how acceptable the increase in computation time is.
Time series coverage	At least 10 years.	To take into account long term trend for energy savings.	100%	The 15 min MACC-Helioclim database delivers data since February 2004. One month after the end of the project, in February 2014, there will be 10 years of data.
Data format	ASCII values		100%	The product delivers all the raw information needed (parameters [1], [2], [3]).
Data availability	Tables and figures		Partially (content defined, programming needed)	The raw information needs to be processed to produce meaningful statistical information presented in figures and tables. This was discussed at the December meeting and finalized in February. The autonomy of daylight, the number of hours of use of artificial light, the lighting energy consumption will be computed and presented on a monthly basis.

Ancillary information	Statistics on the use of the blind		Partially (content defined, programming needed)	The raw information is there. The format was discussed at the December meeting and finalized in February. Statistics will be computed and presented on a monthly basis.
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Score is 4.5. The ENDORSE product delivers information which is not available in DIAL+ software. The climate based daylight modeling toolbox is powerful and validated thanks to the experimental setup in Nantes. The service based upon it should open a great deal of business opportunities, targeting not only engineering offices working on low energy buildings, but also companies selling products for daylighting such as Saint-Gobain, Velux or Somfy. CSTB will use the tool to improve the simplified calculations used in energy regulations to take into account the benefits of controlling artificial lights by daylight while controlling shades for the visual comfort of the occupants.

2.10.2 Data and other inputs used for product D1

This section provides the usage of data for the product D1 as presented in Deliverable 2.1 of ENDORSE. The usage of data as it was originally foreseen has been fully achieved.

<i>Usage of data as per WP2 D2.1</i>		<i>Notes from D2.1</i>	<i>% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially</i>	<i>Comments about users' acceptance</i>
Data sources (non GMEs)				
Specific experimentations	Indoor global illuminances in a room located in Nantes, at CSTB. Simultaneous outdoor global, diffuse horizontal illuminances and sky luminances seen by the window.	These measurements will be used for the validation of the results provided by the Phanie light simulation engine.	100%	This dataset is unique due to the sky luminance maps measured in parallel to the indoor illuminances. It covers 6 months with a wide range of sky conditions and sun altitudes.
Other Data to be provided by prime user(s)				
References	Typical values for glazing and surface properties. Control strategies.	The prime user has already defined such a database in its software. It is working with Saint Gobain and Velux to make sure that the database adequately represents their products.	100%	We have given to ENTPE the list of glazing products extracted from the Saint-Gobain database. For the prototype, the shading control strategy will be based on the luminance of the window as

				seen from the inside.
GMES service(s) used				
MACC	[1] Global horizontal irradiance	Irradiances are absolutely needed to compute illuminances and sky luminance distributions. Surface air temperatures are not absolutely needed; they could be useful in defining blind control strategy according to outdoor conditions.	100%	Irradiances are available from the MACC-Helioclim database. We understand that surface air temperature could later be available from another ENDORSE service. It would enhance the definition of the shading control strategy by allowing it to take into account warm outdoor situations.
	[2] Direct normal irradiance		100%	
	[3] Surface air temperature		Not yet	
	15min time step in Nantes for 2010 and 2011.		100%	

2.10.3 Quality control for product D1

This section provides the steps planned for quality control for the product D1, as presented in Deliverable 2.1 of ENDORSE. The main deviation with respect to the planned production process has been the development of the web interface, which has not been implemented yet.

Production Process		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Method: The Phanie light simulation package uses text files for input and output. The web interfaces will be used to produce the text input file needed by Phanie then exploit the output from Phanie to present results to the users in a meaningful way.	Implementation of the Phanie light simulation package on the server.	100%	The implementation was needed for the experimental validation procedure.
	Check Phanie implementation with reference simulations from CSTB.	100%	This was the quality control procedure of the implementation.
	Development of the web interface needed to describe the room geometry, the surface properties, the shades, the luminaires, the control strategy...	10%	The content of the interface has been discussed. At the December meeting, ENTPE has shown examples of web services for architecture. There are very few. We noticed particularly one called spacedesigner3D developed by Asynth in Paris: nice user interface and open source version. We agreed that ENTPE would use the open source version of this service. The technology used is FLASH from Adobe. The development environment is Flex Builder.
	Implementation of the interface needed to obtain irradiance data from MACC.	100%	This was required for the validation procedure.

	Implementation of the models needed to produce illuminances and sky luminances from irradiances.	100%	The models have been developed in C++ and incorporated to Phanie. Results have been compared to previous implementations in java for the SATEL-LIGHT server (ENTPE).
	Development of the web interface displaying the output to the user.	5%	The type of information produced as an output of the service has been discussed; the whole interface has not been implemented yet.
Model	Perez CIE-ASRC Sky luminance model	100%	Incorporated to Phanie.
	Perez luminous efficacy model	100%	Incorporated to Phanie.
	Phanie light simulation package	100%	A new sky subdivision for climate based modeling has been defined and implemented in Phanie. The model has been validated experimentally using measurements in Nantes.

Quality standards and monitoring		% fulfilled. If a % is not applicable or not available please indicate Yes/No/partially	Comments and notes
Validation	Indoor illuminances (parameter [1])	100%	The Phanie light simulation engine has been validated on the basis of the indoor illuminances measured in Nantes during the product development.
	Use of blinds [2] Lighting energy consumption [3]	0%	The validity of these parameters will be checked on specific days during the year (different sun paths), with modeled clear sky and cloudy sky conditions for which control decisions on the use of blinds and artificial light can be checked easily.
Usability of the service	Service interface interpretation and ease of use. Representativity of the technical solutions available from the service. Adequateness of the output reports.	0%	ESTIA has asked ENTPE to access the service during its development. This way, it will be able to check and make comments as progress is going on.

2.10.4 Overall evaluation of product D1

The overall level of satisfaction as for product D1 is high (score 4-5).

The Phanie light simulation engine can now be used for climate based daylight modeling. This capability has been validated using data from a robust experimental setup. Thanks to the access to the Helioclim database, Phanie can produce results for any site in Europe and Africa. For the time being, the input and the output of the Phanie are just text files. This implies that the product can only be used by trained users. The development of a web service around it will make its use much easier. Once as a service, D1 seems to us very promising.

The level of improvement brought by product D1 is very high.

D1 is a real progress compared to our product DIAL+ that does not compute instant illuminances and thus cannot take into account shading or artificial light control strategies. Another point is that DIAL+ has only access to climatic information for less than 10 cities in most European countries. So the access of D1 to the Helioclim database (with an average resolution of 5 km) is also an enormous progress in taking into account local daylight climate information.

The main impacts from product D1 are illustrated in the following table.

Main expected impacts	Score ²¹
<p>ROI assessment. Investing into control systems for shades and artificial lighting has to be justified on the basis of realistic energy savings and improved comfort for the occupants, both part of the evaluation of the return on investment. Realistic computation of ROI is becoming possible thanks to service D1</p>	4
<p>More energy efficient building design or retrofiting. Great progresses have been made on the thermal performance of buildings; more are to be done now on lighting, which can now reach more than 50% of the energy consumption in the service industry. This is possible by using more efficient lighting solutions as well as control systems reducing lighting power according to daylight. D1 is a tool which will be very useful to compute the amount of lighting energy saved using control systems, for new or “to be retrofitted” buildings</p>	4
<p>Support to energy regulation policy planning. Energy regulation policies now require computing the energy consumption of buildings. The algorithms used for that are simplified ones. Those used to evaluate the lighting energy that can be saved by an optimized use of daylight are rather crude. CSTB which is involved in defining French energy regulation policies is interested in using D1 for improving the formulae currently used in the French RT2012</p>	4

²¹ The score is based on a five points scale, from 1 (not important) to 5 (very important)

3. Main conclusions from the assessment of the ENDORSE products

Involvement of prime users

The assessment of the products developed within ENDORSE was carried out as it had been planned in the DoW. With respect to the panel involved in the collection of requirements (presented in D2.1), there has been one major change: Flagsol GmbH replaced Solar Millennium AG as prime user for product S3.

The ENDORSE beneficiaries succeeded in involving the prime users in the assessment exercise that took place in form of interviews, focus groups and tests, mostly relying on the usage of prototype. The applied approach and methodologies proved to be flexible enough to serve a variety of products and organization. At the same time, the common approach and the consistent tools ensure comparability of the results.

The assessment sessions took place in the period January-May 2012, with a slight delay with respect to the original plan. This delay was mainly due to organizational reasons.

Validation of users' benchmark

Task 5001 was carried out by relying on the benchmarks for validating the products that had been defined in Task 2001 of ENDORSE.

As illustrated in D2.1., the ENDORSE partners and the users defined the products properties, including parameters, accuracy, resolution, coverage, data formats and availability. The ENDORSE products were developed accordingly and the assessment exercise basically consisted in checking whether and to which extent these requirement had been met.

The results presented in Chapter 2 show that overall the defined benchmarks for product properties have been satisfactorily met, with only minor exceptions and deviations. This can be considered as an achieved milestone within ENDORSE, as the presence of the requested parameters and the compliance with the requirements are the basic condition for acceptance.

Usage of data for developing the ENDORSE products

The exploitation of data for product development was carried out as planned in D2.1., with only minor deviations. The ENDORSE products rely on a large variety of data sources, as shown in the following exhibits.

Exhibit 3. Data sources (non GMES) for ENDORSE products: satellite, satellite derived, space borne

Satellite, satellite derived, space borne	Provider	ENDORSE products
MSG-SEVIRI images, MODIS images	EUMETSAT, NASA	S1, S3, S5, E1
MERIS-FR- Land cover map	ESA	B2
Digital Terrain Model	NASA	S1, S4, S5,
Land cover map (tree coverage)	NASA	B1
Digital elevation model (NASA)	NASA	B1
Land cover map (forested areas)	ESA	B1
Land cover map	GlobCover	B2, S5
10 days composite of fAPAR	DLR	B1
Land-sea-mask for the region from 60N to 60S (ESA)	NASA	B2

Solar-related products largely rely on the exploitation of EUMETSAT and NASA based services. Products B1 and B2 (biomass) rely on specific maps providing data for land covering. D1 mainly relies on specific experimentations.

Exhibit 4. Data sources (non GMES) for ENDORSE products: ground measurements

Ground measurements	Provider	ENDORSE products
Irradiance data (global and diffuse on horizontal surface)	Armines, Meteo France	S1, S4
Irradiance data (global on horizontal surface)	Meteo France	S1, S4
Irradiance data (global and diffuse on horizontal surface and direct irradiances)	DLR	S3, E1
Other ground measurements		E1

Exhibit 5. Other data sources for ENDORSE products

Other data	Sources	ENDORSE products
Roughness/land cover	Corine Land Cover	S1, W1
	Globcover 2009	W1
	Data for Wind	W1
	GLCC (low spatial resolution)	W1
Orography	SRTM	W1
	ASTER	W1
	NGI Data (local level)	W1
Meteorological forecasts	ECMWF IFS Service	S3
Hazardeous areas, protected areas, hydrography	Local authorities	S1, S5
Soil type map	FAO	B1

W1 relies on specific sources, related to roughness and orography.

Exhibit 6. Data sources for ENDORSE products: GMES source and core services

GMES core services	ENDORSE products
Irradiance data (global and direct on horizontal surface), every 15 min, since 2004 (MACC)	S1,S3, S4, S5, E1, D1
Meteorological parameters at surface level (MACC)	S1, S3, S4, W1
Air chemistry parameters	S3
GeoLand2 roughness	W1
GeoLand2 land cover	S5
LAI time-series 10-day composites	B1
Land cover map identifying forested areas	B1

The table illustrates the extent at which the ENDORSE products are exploiting the GMES core services. The worldwide coverage of GMES ensure the possibility to extend the potential areas of application of the products and, in terms of quality, it allows to compare the accuracy of the final results obtained with different sets of data sources coming from local/national data sources.

Quality control

Quality control has been a common practice in the assessment of the ENDORSE products. The procedures for assessing the quality of methods, models and references have been extensively applied and no major weaknesses have been detected. In some case (W1, B2) feedback from users was limited. For D1, further steps are needed in order to fully check the validity of the product. In the case of S2, the actual validation process still has to take place.

Overall satisfaction and impacts of the ENDORSE products

The following exhibit summarises the level of satisfaction recorded for the various ENDORSE products, and the level of improvement that the users expect in comparison with the previously adopted methods. Coherently with the assessment expressed on the single aspects, the overall evaluation is equally very satisfactory.

	Level of satisfaction for product properties, from 1=not satisfied to 5= very satisfied	Overall level of satisfaction of the product, from 1=not satisfied to 5= very satisfied	Overall level of improvement brought by the product with respect to the methods previously adopted (from 1= no improvement to 5 very high improvement).
S1	4	4	4
S2	4	4	4
S3	5	5	4
S4	4-5	4-5	4-5
S5	5	4	4-5
W1	4	N.A.	N.A
E1	4-5	4-5	4-5
B1	3	3	N.A
B2	4	4	4
D1	4-5	4-5	5