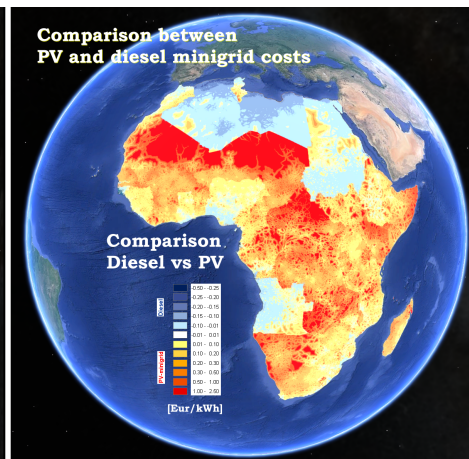
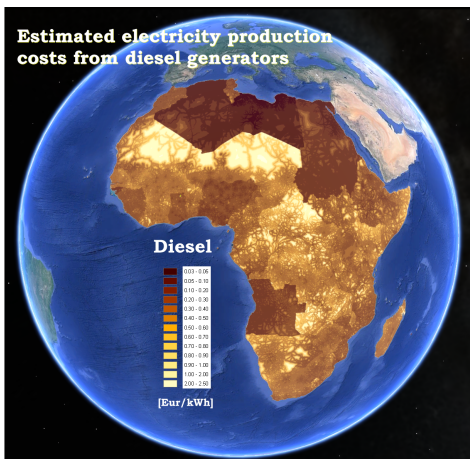
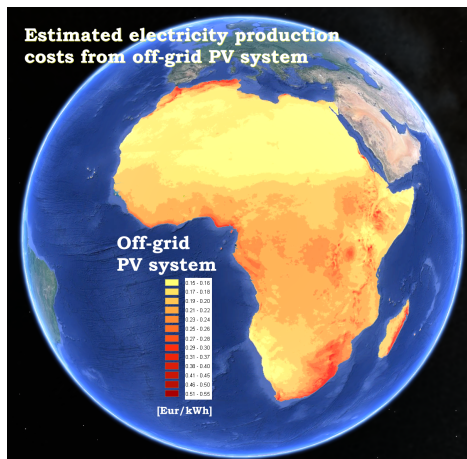




European
Commission



J R C T E C H N I C A L R E P O R T S

Metadata

Geospatial data layers provided for the Global Atlas of the International Renewable Energy Agency (IRENA)

Katalin Bódis

November 2013

European Commission
Joint Research Centre
Institute for Energy and Transport

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1 Introduction

The International Renewable Energy Agency (IRENA) Global Atlas aims to provide access to a set of geographical information layers, which enables users to highlight areas of opportunity for developing renewable energy projects. The Renewable Energy Unit of the Institute for Energy and Transport (IET) of the European Commission Joint Research Centre (JRC) provided thematic data layers to the publically available geoserver of IRENA. The data layers were resulted by research on renewable energy and rural electrification options in Africa. The research has been done within the framework of the 'Renewable Energy Mapping and Monitoring in Europe and Africa' action (REMEA) and the research program of the African Renewable Energy Technology Platform (AFRETEP).

2 Description

The target geoserver, inventory and geodata catalogue were capable of integrate all GIS standards. The provided geospatial layers have been prepared and delivered in ESRI binary and ascii grid formats including the data layers, the definition of applied reference system as well as classification and graphical information regarding the legends for thematic mapping. ESRI ArcMap Document and the related layer files (.lyr) assisted the mapserver experts on visualisation the data as the authors had designed. Metadata in harmony with ISO standards (ISO 19115:2003/19139) and Inspire requirements have been compiled in XML and document formats (Annex I) interpreted by ESRI ArcCatalog XML metadata reader. The metadata should provide information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data. ISO 19139 provides the XML implementation schema for ISO 19115 specifying the metadata record format which has been followed to edit the XML code describing the geospatial metadata.

The data transfer has been completed by using the anonymous ftp-site of the Renewable Energy Unit of the Institute for Energy and Transport having the archived and compressed data files temporarily available (<http://re.jrc.ec.europa.eu/download/afretep/irena>).

The first public layers are available from the IRENA Global Atlas geoserver (Annex II) using the following address: <http://irena.masdar.ac.ae:8080/geoserver/JRC/wms>

Detailed description on the complex analysis and modelling approach is published in the papers listed in the chapter on 'Related publications'.

3 Related publications

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, *Renewable and Sustainable Energy Reviews*, 28 (2013) 500-509. URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Huld, T., Szabó, S., Bódis, K., Moner-Girona, M., Jäger-Waldau, A., 2013, Solar resources and their exploitation. Climate and technological changes compared. In: *The availability of renewable energies in a changing Africa. Assessing climate and non-climate effects*, (Ed. F. Monforti), European Commission, Directorate-General Joint Research Centre, Institute for Energy and Transport, Institute for Environment and Sustainability, Ispra, Italy, p. 110. EUR 25980 EN, pp. 17-26.

URL: <http://iet.jrc.ec.europa.eu/remea/availability-renewable-energies-changing-africa>

Huld, T., Müller, R., Gambardella, A., 2012, A new solar radiation database for estimating PV performance in Europe and Africa. *Solar Energy*, 86, 1803-1815.

URL: <http://dx.doi.org/10.1016/j.solener.2012.03.006>

Wagner, A., Becker, D., Dicke, B., S. Ebert, S., Ragab, A., 2012, International Fuel Prices 2010/2011, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Sector Project "Transport Policy Advisory Services", Division 44 - Water, Energy, Transport.

URL: <http://www.giz.de/Themen/en/dokumente/giz-en-IFP2010.pdf>

Belward, A., Bisselink, B., Bódis, K., Brink, A., Dallemand, J.-F., de Roo, A., Huld, T., Kayitakire, F., Mayaux, P., Moner-Girona, M., Ossenbrink, H., Pinedo, I., Sint, H., Thielen, J., Szabó, S., Tromboni, U., Willemen, L., 2011, *Renewable energies in Africa - current knowledge* (Ed. F. Monforti), European Commission, Directorate-General Joint Research Centre, Institute for Energy and Transport, Institute for Environment and Sustainability, Ispra, Italy, p. 60. EUR 25108 EN.

URL: <http://iet.jrc.ec.europa.eu/remea/renewable-energies-africa-current-knowledge>

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2011, Energy solutions in rural Africa: mapping electrification costs of distributed solar and diesel generation versus grid extension, *Environmental Research Letters*, Volume 6, Issue 3, July 2011, Article number: 034002, DOI: 10.1088/1748-9326/6/3/034002.

URL: <http://iopscience.iop.org/1748-9326/6/3/034002>

Nelson, A., 2008, Estimated travel time to the nearest city of 50,000 or more people in year 2000. Global Environment Monitoring Unit, Joint Research Centre of the European Commission (Ispra, Italy), URL: <http://bioval.jrc.ec.europa.eu/products/gam/index.htm>

United Nations University, 2007, The Significance of Transport Costs in Africa Policy Brief n.5. URL: <http://archive.unu.edu/publications/briefs/policy-briefs/2007/pb05-07.pdf>

Huld, T., Suri, M., Dunlop, E., Albuissou, M. Wald, L., 2005, Integration of HelioClim-1 database into PVGIS to estimate solar electricity potential in Africa PVGIS: Proceedings of the 20th European Photovoltaic Solar Energy Conference and Exhibition (Barcelona, June 2005). URL: <http://re.jrc.ec.europa.eu/pvgis>

Acknowledgement

The research producing the results in the published information and papers had been conducted by Sándor Szabó (EC JRC AFRETEP) and Fabio Monforti (EC JRC REMEA). In addition to the contributing authors of the publications, Thomas Huld (EC JRC IET) assured the extra space and access to the FTP server. Gábor Barton (Scottish Natural Heritage) helped with guidelines solving standardisation and XML coding problems.

The REMEA team would like to thank Nicolas Fichaux (International Renewable Energy Agency) and Jacinto Estima (Research Center for Renewable Energy Mapping and Assessment) for their great work helping to publish the data in IRENA Geoserver.

Annex I. - Metadata

Estimated costs of electricity (Euro/kWh) delivered by a (15 kWp) off-grid PV system

Data format(s): ESRI ASCII GRID, ESRI BINARY GRID

Coordinate system: ETRS89_LAEA, EPSG:3035

Location(s): <http://re.jrc.ec.europa.eu/pvgis>, <http://www.sciencedirect.com/science/article/pii/S1364032113005844>

Abstract: PV electricity production depends primarily on the amount of solar radiation available. For grid-connected systems, the energy output can be approximated, being proportional to the total solar irradiation impinging on the PV modules. For off-grid systems energy output fundamentally depends on the installed capacity size of the RE resource conversion technology (i.e. PV, small hydro, wind etc). The energy output will also depend on the size of the battery storage and on the consumption patterns. For the latter, it becomes useful to perform a simulation based on detailed time series of satellite solar irradiation data. The data contains the cell-based Estimated costs of electricity (Euro/kWh) delivered by a (15 kWp) off-grid PV system. This calculation was made using the photovoltaic geographic information system (PVGIS) database, which in turn is based on solar radiation data from HelioClim-1.

Relevant publications:

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, *Renewable and Sustainable Energy Reviews*, 28 (2013) 500-509.

URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Huld, T., Szabó, S., Bódis, K., Moner-Girona, M., Jäger-Waldau, A., 2013, Solar resources and their exploitation. Climate and technological changes compared. In: *The availability of renewable energies in a changing Africa. Assessing climate and non-climate effects*, (Ed. F. Monforti), European Commission, Directorate-General Joint Research Centre, Institute for Energy and Transport, Institute for Environment and Sustainability, Ispra, Italy, p. 110. EUR 25980 EN, pp. 17-26. URL: <http://iet.jrc.ec.europa.eu/remea/availability-renewable-energies-changing-africa>

Huld, T., Müller, R., Gambardella, A., 2012, A new solar radiation database for estimating PV performance in Europe and Africa. *Solar Energy*, 86, 1803-1815. URL: <http://dx.doi.org/10.1016/j.solener.2012.03.006>

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2011, Energy solutions in rural Africa: mapping electrification costs of distributed solar and diesel generation versus grid extension, *Environmental Research Letters*, Volume 6, Issue 3, July 2011, Article number 034002, DOI: 10.1088/1748-9326/6/3/034002.

URL: <http://iopscience.iop.org/1748-9326/6/3/034002/>

Huld, T., Suri, M., Dunlop, E., Albuissou, M. Wald, L., 2005, Integration of HelioClim-1 database into PVGIS to estimate solar electricity potential in Africa PVGIS: Proc. 20th European Photovoltaic Solar Energy Conf. and Exhibition (Barcelona, June 2005). URL: <http://re.jrc.ec.europa.eu/pvgis>

ISO 19115:2003/19139 Metadata:

Metadata Information:

Metadata language: English

Last update: 2013-11-21

Metadata contact - pointOfContact:

Individual's name: Katalin Bodis

Organization's name: European Commission Joint Research Centre

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Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

Scope of the data described by the metadata: dataset

Metadata identifier: 51271A0E-861B-4CAE-A054-9EA7F59ED8B6

Resource Identification Information:

Citation:

Title: Estimated costs of electricity (Euro/kWh) delivered by a (15 kWp) off-grid PV system.
Reference date - publication: 2013-03-05

Themes or categories of the resource: economy

Descriptive keywords: Renewable technologies, Rural electrification, Off-grid systems, Photovoltaic systems

Keywords: Energy resources

Citation:

Title: GEMET - INSPIRE themes, version 1.0

Reference date - publication: 2008-06-01

Descriptive keywords: Renewable technologies, Rural electrification, Off-grid systems, Photovoltaic system

Keywords: Renewable energy, Solar energy

Citation:

Title: Integrated Public Sector Vocabulary, version 2.00

Reference date - publication: 2006-05-23

Dataset language: eng

Maintenance:

Update frequency: irregular

Resource constraints:

Legal constraints:

Access constraints: otherRestrictions,

Use constraints: no constraints

Limitations of use: intellectual property, Szabo et al. 2013.

Resource constraints:

Constraints:

Limitations of use: no conditions apply

Spatial representation type: grid

Spatial resolution:

Ground sample distance: 1000

Extent:

Geographic extent:

Bounding rectangle:

EPSG:3857 "Google Mercator"	EPSG:4326 "WGS84"	ETRS89_LAEA_N00_E18
West longitude: -31.873	Xmin = -31.873	Xmin = -270000.000
East longitude: 61.863	Xmax = 61.863	Xmax = 8369000.000
North latitude: 37.829	Ymin = -35.271	Ymin = -655000.000
South latitude: -35.271	Ymax = 37.829	Ymax = 7345000.000

Temporal extent: 2010-01-01 2010-12-31

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Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

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Contact's position: Scientific officer

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Country: Italy

E-mail address: thomas.huld@jrc.ec.europa.eu

Online resource:

Online location: <http://re.jrc.ec.europa.eu/pvgis>

Description: European Commission Joint Research Centre PVGIS portal

Reference System Information:

Reference system identifier: ETRS89_LAEA, EPSG:3035

Value: +proj=laea +lat_0=0 +lon_0=18 +x_0=4321000 +y_0=3210000 +ellps=GRS80 +units=m +no_defs

Data Quality Information:

Scope of quality information:

Level of the data: dataset

Lineage:

Lineage statement:

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, Renewable and Sustainable Energy Reviews, 28 (2013) 500-509. URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Distribution Information:

Format:

Format name: ESRI ASCII GRID, ESRI BINARY GRID

Format version: from 7.x

Transfer options:

Online resource:

Online location: <http://irena.masdar.ac.ae:8080/geoserver/JRC/wms>

Function performed: unknown

File identifier: eurpvkwh2012.asc

Character set: UTF8: 8-bit variable size UCS Transfer Format, based on ISO/IEC 10646

Hierarchy level: Dataset: Information applies to the dataset

Date stamp: 2013-11-21 T10:54:04

Metadata standard name: ISO 19115:2003/19139

Metadata standard version: 1.0

Estimated costs of electricity (Euro/kWh) delivered by a diesel generator using the diesel price for each country and taking into account the cost of diesel transportation

Data format(s): ESRI ASCII GRID, ESRI BINARY GRID

Coordinate system: ETRS89_LAEA, EPSG:3035

Location(s): <http://www.sciencedirect.com/science/article/pii/S1364032113005844>

Abstract: Diesel generators have been the traditional solution to decentralized electrification needs. For off-grid applications, they present lower up-front capital costs per kilowatt installed; however, the dramatic increase of fuel costs in recent years and the cost of transport to remote areas greatly diminish the low capital cost advantage of the diesel option. In Africa the transport infrastructure is underdeveloped which has a severe consequence: the transport costs faced by African countries are almost twice as high as the world average. A global map of accessibility developed by the JRC formed this second component for the genset electricity cost calculations. To estimate the location specific operating costs for diesel gensets, the country-based diesel prices have been combined with the travel time data (derived from the accessibility map) integrating the transport costs.

Relevant publications:

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, *Renewable and Sustainable Energy Reviews*, 28 (2013) 500-509.

URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2011, Energy solutions in rural Africa: mapping electrification costs of distributed solar and diesel generation versus grid extension, *Environmental Research Letters*, Volume 6, Issue 3, July 2011, Article number 034002, DOI: 10.1088/1748-9326/6/3/034002.

URL: <http://iopscience.iop.org/1748-9326/6/3/034002/>

Wagner, A., Becker, D., Dicke, B., S. Ebert, S., Ragab, A., International Fuel Prices 2010/2011, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Sector Project "Transport Policy Advisory Services", Division 44 - Water, Energy, Transport, (2012). URL: <http://www.giz.de/Themen/en/dokumente/giz-en-IFP2010.pdf>

Ebert, S., Metschies, D. G. P., Schmid, D., Wagner, A., 2009, International Fuel Prices 2009, In: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (Ed.), Federal Ministry for Economic Cooperation and Development (BMZ), Eschborn, Germany, 2009.

Nelson, A., 2008, Estimated travel time to the nearest city of 50,000 or more people in year 2000. Global Environment Monitoring Unit, Joint Research Centre of the European Commission (Ispra, Italy),

URL: <http://bioval.jrc.ec.europa.eu/products/gam/index.htm>

United Nations University, 2007, The Significance of Transport Costs in Africa Policy Brief n.5

URL: <http://archive.unu.edu/publications/briefs/policy-briefs/2007/pb05-07.pdf>

ISO 19115:2003/19139 Metadata:

Metadata Information:

Metadata language: English

Last update: 2013-11-21

Metadata contact - pointOfContact:

Individual's name: Katalin Bodis

Organization's name: European Commission Joint Research Centre

Contact's position: Senior GIS analyst

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Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

Scope of the data described by the metadata: dataset

Metadata identifier: 51271A0E-861B-4CAE-A054-9EA7F57AB5C5

Resource Identification Information:

Citation:

Title: Estimated costs of electricity (Euro/kWh) delivered by a diesel generator using the diesel price for each country and taking into account the cost of diesel transportation

Reference date - publication: 2013-03-05

Themes or categories of the resource: economy

Descriptive keywords: Optimisation, Rural electrification, Off-grid systems, Diesel generator

Keywords: Energy resources

Citation:

Title: GEMET - INSPIRE themes, version 1.0

Reference date - publication: 2008-06-01

Descriptive keywords: Optimisation, Rural electrification, Off-grid systems, Diesel generator

Keywords:

Citation:

Title:

Reference date - publication:

Dataset language: eng

Maintenance:

Update frequency: irregular

Resource constraints:

Legal constraints:

Access constraints: otherRestrictions,

Use constraints: no constraints

Limitations of use: intellectual property, Szabo et al. 2013.

Resource constraints:

Constraints:

Limitations of use: no conditions apply

Spatial representation type: grid

Spatial resolution:

Ground sample distance: 1000

Extent:

Geographic extent:

Bounding rectangle:

EPSG: 3857 "Google Mercator"	EPSG: 4326 "WGS84"	ETRS89_LAEA_N00_E18
West longitude: -31.873	Xmin = -31.873	Xmin = -270000.000
East longitude: 61.863	Xmax = 61.863	Xmax = 8369000.000
North latitude: 37.829	Ymin = -35.271	Ymin = -655000.000
South latitude: -35.271	Ymax = 37.829	Ymax = 7345000.000

Temporal extent: 2010-01-01 2010-12-31

Point of contact - Processor:

Individual's name: Katalin Bodis

Organization's name: European Commission Joint Research Centre

Contact's position: Senior GIS Analyst

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Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

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Postal code: 21027

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E-mail address: sandor.szabo@ec.europa.eu

Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

Reference System Information:

Reference system identifier: ETRS89_LAEA, EPSG:3035

Value: +proj=laea +lat_0=0 +lon_0=18 +x_0=4321000 +y_0=3210000 +ellps=GRS80 +units=m +no_defs

Data Quality Information:

Scope of quality information:

Level of the data: dataset

Lineage:

Lineage statement:

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, Renewable and Sustainable Energy Reviews, 28 (2013) 500-509.

URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2011, Energy solutions in rural Africa: mapping electrification costs of distributed solar and diesel generation versus grid extension, Environmental Research Letters, Volume 6, Issue 3, July 2011, Article number034002, DOI: 10.1088/1748-9326/6/3/034002.

URL: <http://iopscience.iop.org/1748-9326/6/3/034002/>

Distribution Information:

Format:

Format name: ESRI ASCII GRID, ESRI BINARY GRID

Format version: from 7.x

Transfer options:

Online resource:

Online location: <http://irena.masdar.ac.ae:8080/geoserver/JRC/wms>

Function performed: unknown

File identifier: eurdikwh2012.asc

Character set: UTF8: 8-bit variable size UCS Transfer Format, based on ISO/IEC 10646

Hierarchy level: Dataset: Information applies to the dataset

Date stamp: 2013-11-21 T12:11:23

Metadata standard name: ISO 19115:2003/19139

Metadata standard version: 1.0

Comparison between estimated PV and diesel minigrid costs (Euro/kWh)

Data format(s): ESRI ASCII GRID, ESRI BINARY GRID

Coordinate system: ETRS89_LAEA, EPSG:3035

Location(s): <http://re.jrc.ec.europa.eu/pvgis>, <http://www.sciencedirect.com/science/article/pii/S1364032113005844>

Abstract: The map/data illustrates an economic comparison of the two off-grid options (diesel generator or PV). Negative values indicate the location where diesel is more economically advantageous, while positive values indicate where PV options are cheaper. The different policies prevailing in the various African countries on the fuel taxation/fuel subsidies are remarkable. The diesel versus PV map/data reveals that the effects of fuel subsidies play a crucial role: they change the picture of the most economically viable option dramatically.

Relevant publications:

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, *Renewable and Sustainable Energy Reviews*, 28 (2013) 500-509.

URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Huld, T., Müller, R., Gambardella, A., 2012, A new solar radiation database for estimating PV performance in Europe and Africa. *Solar Energy*, 86, 1803-1815. URL: <http://dx.doi.org/10.1016/j.solener.2012.03.006>

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2011, Energy solutions in rural Africa: mapping electrification costs of distributed solar and diesel generation versus grid extension, *Environmental Research Letters*, Volume 6, Issue 3, July 2011, Article number 034002, DOI: 10.1088/1748-9326/6/3/034002.

URL: <http://iopscience.iop.org/1748-9326/6/3/034002/>

Wagner, A., Becker, D., Dicke, B., S. Ebert, S., Ragab, A., International Fuel Prices 2010/2011, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Sector Project "Transport Policy Advisory Services", Division 44 - Water, Energy, Transport, (2012). URL: <http://www.giz.de/Themen/en/dokumente/giz-en-IFP2010.pdf>

Nelson, A., 2008, Estimated travel time to the nearest city of 50,000 or more people in year 2000. Global Environment Monitoring Unit, Joint Research Centre of the European Commission (Ispra, Italy),

URL: <http://bioval.jrc.ec.europa.eu/products/qam/index.htm>

ISO 19115:2003/19139 Metadata:

Metadata Information:

Metadata language: English

Last update: 2013-11-21

Metadata contact - pointOfContact:

Individual's name: Katalin Bodis

Organization's name: European Commission Joint Research Centre

Contact's position: Senior GIS analyst

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Administrative area: (VA)

Postal code: 21027

Country: Italy

E-mail address: katalin.bodis@jrc.ec.europa.eu

Online resource:

Online location: <http://iet.jrc.ec.europa.eu/renea/>

Description: European Commission Joint Research Centre website

Scope of the data described by the metadata: dataset

Metadata identifier: 51271A0E-861B-4CAE-A054-8BC5F44BG7C8

Resource Identification Information:

Citation:

Title: Comparison between estimated PV and diesel minigrid costs (Euro/kWh)

Reference date - publication: 2013-03-05

Themes or categories of the resource: economy

Descriptive keywords: Optimisation, Rural electrification, Off-grid systems, Photovoltaics, Diesel generator

Keywords: Energy resources

Citation:

Title: GEMET - INSPIRE themes, version 1.0

Reference date - publication: 2008-06-01

Descriptive keywords: Renewable technologies, Rural electrification, Off-grid systems, Photovoltaic system

Keywords: Renewable energy, Solar energy

Citation:

Title: Integrated Public Sector Vocabulary, version 2.00

Reference date - publication: 2006-05-23

Dataset language: eng

Maintenance:

Update frequency: irregular

Resource constraints:

Legal constraints:

Access constraints: otherRestrictions,

Use constraints: no constraints

Limitations of use: intellectual property, Szabo et al. 2013.

Resource constraints:

Constraints:

Limitations of use: no conditions apply

Spatial representation type: grid

Spatial resolution:

Ground sample distance: 1000

Extent:

Geographic extent:

Bounding rectangle:

EPSG:3857 "Google Mercator"	EPSG:4326 "WGS84"	ETRS89_LAEA_N00_E18
West longitude: -31.873	Xmin = -31.873	Xmin = -270000.000
East longitude: 61.863	Xmax = 61.863	Xmax = 8369000.000
North latitude: 37.829	Ymin = -35.271	Ymin = -655000.000
South latitude: -35.271	Ymax = 37.829	Ymax = 7345000.000

Temporal extent: 2010-01-01 2010-12-31

Point of contact - Processor:

Individual's name: Katalin Bodis

Organization's name: European Commission Joint Research Centre

Contact's position: Senior GIS Analyst

Contact information:

Address:

Delivery point: Renewable Energy Unit, Institute for Energy and Transport, Via E. Fermi 2749, TP 450.

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Administrative area: (VA)

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Country: Italy

E-mail address: katalin.bodis@jrc.ec.europa.eu

Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

Point of contact – Principal Investigator:

Individual's name: Sandor Szabo

Organization's name: European Commission Joint Research Centre

Contact's position: Scientific officer

Contact information:

Address:

Delivery point: Renewable Energy Unit, Institute for Energy and Transport, Via E. Fermi 2749, TP 450.

City: Ispra

Administrative area: (VA)

Postal code: 21027

Country: Italy

E-mail address: sandor.szabo@ec.europa.eu

Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

Reference System Information:

Reference system identifier: ETRS89_LAEA, EPSG:3035

Value: +proj=laea +lat_0=0 +lon_0=18 +x_0=4321000 +y_0=3210000 +ellps=GRS80 +units=m +no_defs

Data Quality Information:

Scope of quality information:

Level of the data: dataset

Lineage:

Lineage statement:

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, Renewable and Sustainable Energy Reviews, 28 (2013) 500-509. URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2011, Energy solutions in rural Africa: mapping electrification costs of distributed solar and diesel generation versus grid extension, Environmental Research Letters, Volume 6, Issue 3, July 2011, Article number 034002, DOI: 10.1088/1748-9326/6/3/034002. URL: <http://iopscience.iop.org/1748-9326/6/3/034002/>

Distribution Information:

Format:

Format name: ESRI ASCII GRID, ESRI BINARY GRID

Format version: from 7.x

Transfer options:

Online resource:

Online location: <http://irena.masdar.ac.ae:8080/geoserver/JRC/wms>

Function performed: unknown

File identifier: diffdipv2012.asc

Character set: UTF8: 8-bit variable size UCS Transfer Format, based on ISO/IEC 10646

Hierarchy level: Dataset: Information applies to the dataset

Date stamp: 2013-11-21 T09:35:17

Metadata standard name: ISO 19115:2003/19139

Metadata standard version: 1.0

Modelled most economic rural electrification option (off-grid PV system, grid extension, mini-hydro, diesel generator)

Data format(s): ESRI ASCII GRID, ESRI BINARY GRID

Coordinate system: ETRS89_LAEA, EPSG:3035

Location(s): <http://www.sciencedirect.com/science/article/pii/S1364032113005844>

Abstract: The cost of electricity delivered has been computed for each pixel of the African continent for four options: extension of the grid from the closest existing network, hydropower including the extension of a local grid from the closest permanent river section, off-grid PV system and stand-alone diesel generator. Based on the power generation costs belonging to each energy source the minimum price can be defined for each geographic location. The map/data on modelled most economic rural electrification option shows regions where off-grid PV system (value 1), grid extension (value 2), mini-hydro (value 3) or diesel generator (value 4) may prove to be the most economic electricity option.

Relevant publications:

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, *Renewable and Sustainable Energy Reviews*, 28 (2013) 500-509.

URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Huld, T., Müller, R., Gambardella, A., 2012, A new solar radiation database for estimating PV performance in Europe and Africa. *Solar Energy*, 86, 1803-1815. URL: <http://dx.doi.org/10.1016/j.solener.2012.03.006>

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2011, Energy solutions in rural Africa: mapping electrification costs of distributed solar and diesel generation versus grid extension, *Environmental Research Letters*, Volume 6, Issue 3, July 2011, Article number 034002, DOI: 10.1088/1748-9326/6/3/034002.

URL: <http://iopscience.iop.org/1748-9326/6/3/034002/>

Wagner, A., Becker, D., Dicke, B., S. Ebert, S., Ragab, A., International Fuel Prices 2010/2011, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Sector Project "Transport Policy Advisory Services", Division 44 - Water, Energy, Transport, (2012). URL: <http://www.qiz.de/Themen/en/dokumente/qiz-en-IFP2010.pdf>

Parshall, L., Pillai, D., Mohan, S., Sanoh, A., Modi, V., 2009, National electricity planning in settings with low pre-existing grid coverage: development of a spatial model and case study of Kenya, *Energy Policy*, 37. 2395-410.

Nguyen, K. Q., 2007, Alternatives to grid extension for rural electrification: decentralized renewable energy technologies in Vietnam, *Energy Policy*, 35. 2579-89.

ISO 19115:2003/19139 Metadata:

Metadata Information:

Metadata language: English

Last update: 2013-11-21

Metadata contact - pointOfContact:

Individual's name: Katalin Bodis

Organization's name: European Commission Joint Research Centre

Contact's position: Senior GIS analyst

Contact information:

Address:

Delivery point: Renewable Energy Unit, Institute for Energy and Transport, Via E. Fermi 2749, TP 450.

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Administrative area: (VA)

Postal code: 21027

Country: Italy

E-mail address: katalin.bodis@jrc.ec.europa.eu

Online resource:

Online location: <http://iet.jrc.ec.europa.eu/renea/>

Description: European Commission Joint Research Centre website

Scope of the data described by the metadata: dataset

Metadata identifier: 51271A0E-861B-4CAE-A054-5AB6F89RH4A1

Resource Identification Information:

Citation:

Title: Modelled most economic rural electrification option (off-grid PV system, grid extension, mini-hydro, diesel generator)

Reference date - publication: 2013-03-05

Themes or categories of the resource: economy

Descriptive keywords: Optimisation, Renewable technologies, Rural electrification, Off-grid systems

Keywords: Energy resources

Citation:

Title: GEMET - INSPIRE themes, version 1.0

Reference date - publication: 2008-06-01

Descriptive keywords: Renewable technologies, Rural electrification, Off-grid systems, Photovoltaic system

Keywords: Renewable energy, Solar energy

Citation:

Title: Integrated Public Sector Vocabulary, version 2.00

Reference date - publication: 2006-05-23

Dataset language: eng

Maintenance:

Update frequency: irregular

Resource constraints:

Legal constraints:

Access constraints: otherRestrictions,

Use constraints: no constraints

Limitations of use: intellectual property, Szabo et al. 2013.

Resource constraints:

Constraints:

Limitations of use: no conditions apply

Spatial representation type: grid

Spatial resolution:

Ground sample distance: 1000

Extent:

Geographic extent:

Bounding rectangle:

EPSG: 3857 "Google Mercator"	EPSG: 4326 "WGS84"	ETRS89_LAEA_N00_E18
West longitude: -31.873	Xmin = -31.873	Xmin = -270000.000
East longitude: 61.863	Xmax = 61.863	Xmax = 8369000.000
North latitude: 37.829	Ymin = -35.271	Ymin = -655000.000
South latitude: -35.271	Ymax = 37.829	Ymax = 7345000.000

Temporal extent: 2010-01-01 2010-12-31

Point of contact - Processor:

Individual's name: Katalin Bodis

Organization's name: European Commission Joint Research Centre

Contact's position: Senior GIS Analyst

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Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

Point of contact – Principal Investigator:

Individual's name: Sandor Szabo

Organization's name: European Commission Joint Research Centre

Contact's position: Scientific officer

Contact information:

Address:

Delivery point: Renewable Energy Unit, Institute for Energy and Transport, Via E. Fermi 2749, TP 450.

City: Ispra

Administrative area: (VA)

Postal code: 21027

Country: Italy

E-mail address: sandor.szabo@ec.europa.eu

Online resource:

Online location: <http://iet.jrc.ec.europa.eu/remea/>

Description: European Commission Joint Research Centre website

Reference System Information:

Reference system identifier: ETRS89_LAEA, EPSG:3035

Value: +proj=laea +lat_0=0 +lon_0=18 +x_0=4321000 +y_0=3210000 +ellps=GRS80 +units=m +no_defs

Data Quality Information:

Scope of quality information:

Level of the data: dataset

Lineage:

Lineage statement:

Szabó, S., Bódis, K., Huld, T., Moner-Girona, M., 2013, Sustainable energy planning: Leapfrogging the energy poverty gap in Africa, Renewable and Sustainable Energy Reviews, 28 (2013) 500-509. URL: <http://dx.doi.org/10.1016/j.rser.2013.08.044>

Distribution Information:

Format:

Format name: ESRI ASCII GRID, ESRI BINARY GRID

Format version: from 7.x

Transfer options:

Online resource:

Online location: <http://irena.masdar.ac.ae:8080/geoserver/JRC/wms>

Function performed: unknown

File identifier: opentype2012.asc

Character set: UTF8: 8-bit variable size UCS Transfer Format, based on ISO/IEC 10646

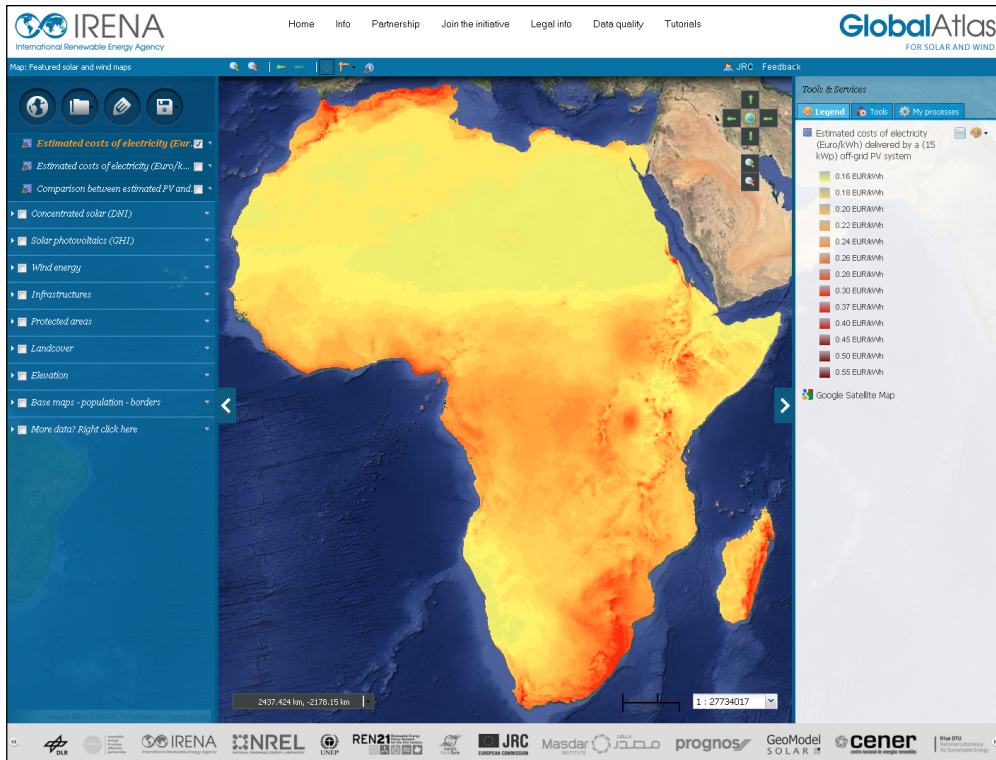
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Date stamp: 2013-11-21 T15:44:03

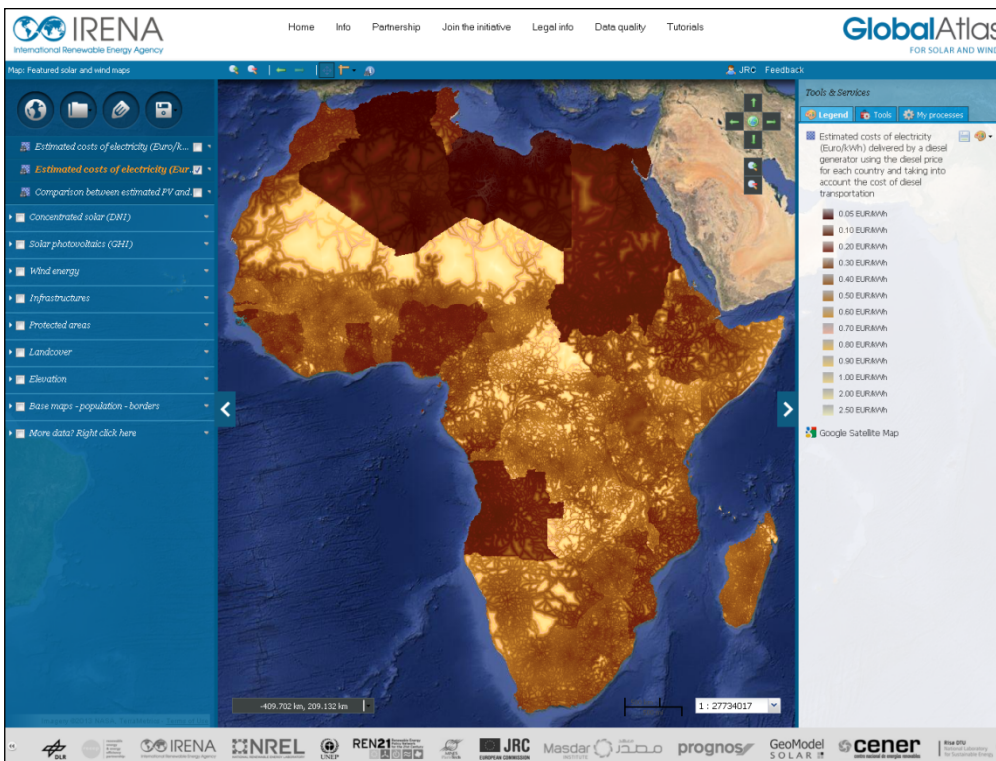
Metadata standard name: ISO 19115:2003/19139

Metadata standard version: 1.0

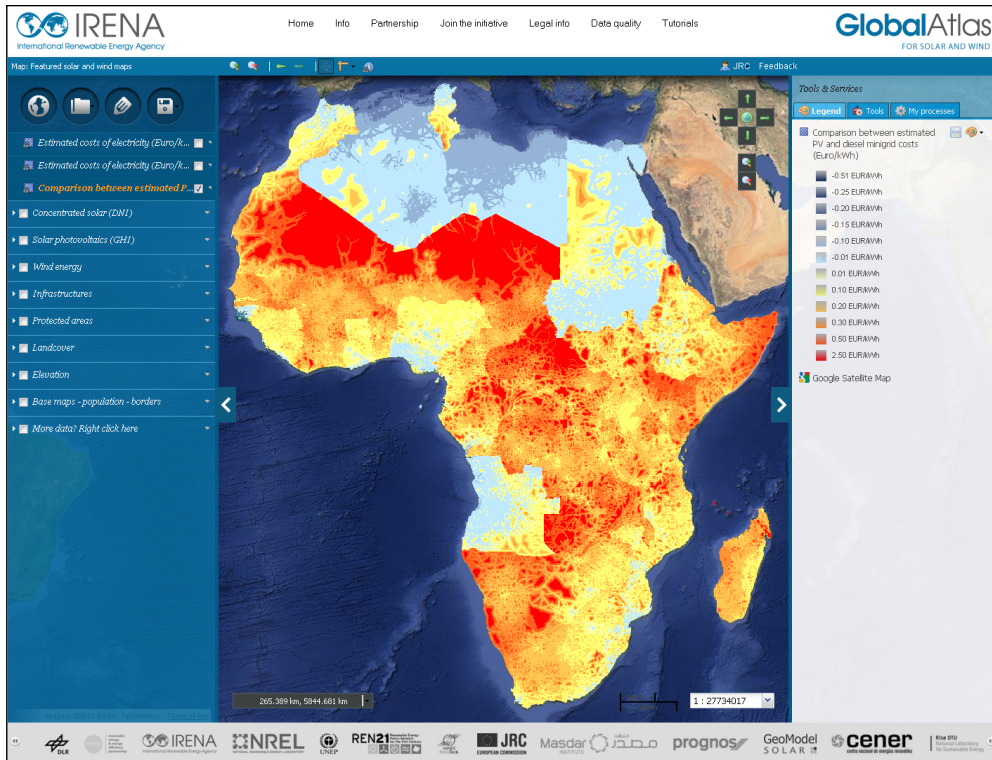
Annex II. - IRENA Geoserver View



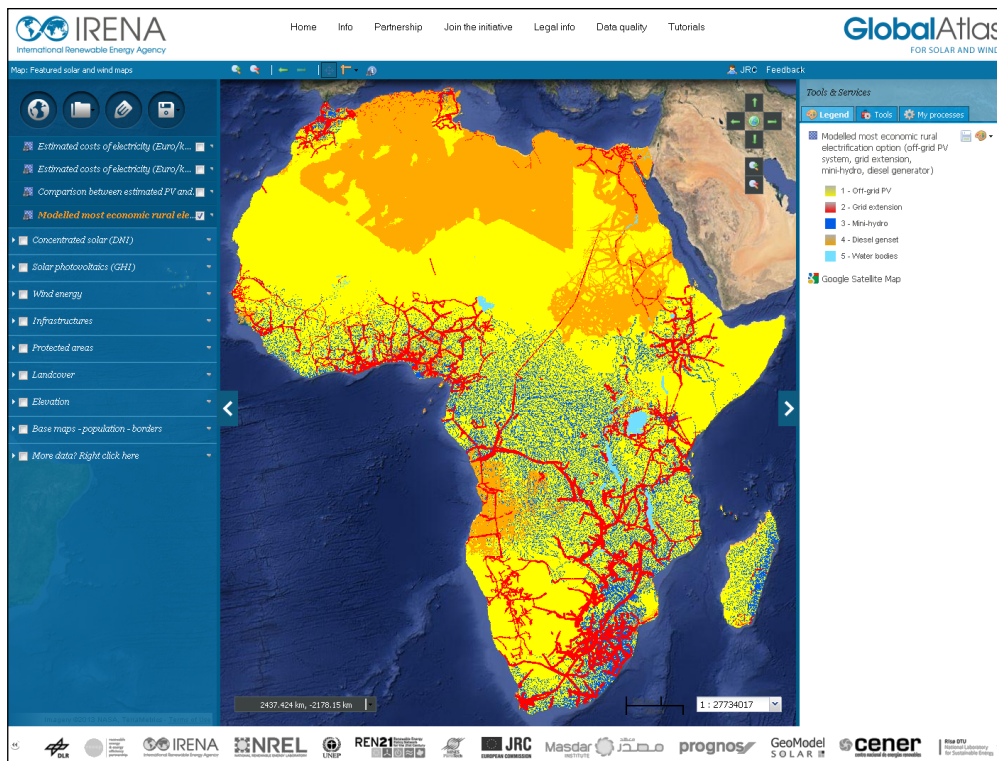
Estimated costs of electricity (Euro/kWh) delivered by a (15 kWp) off-grid PV system



Estimated costs of electricity (Euro/kWh) delivered by a diesel generator using the diesel price for each country and taking into account the cost of diesel transportation



Comparison between estimated PV and diesel minigrad costs (Euro/kWh)



Modelled most economic rural electrification option (off-grid PV system, grid extension, mini-hydro, diesel generator)

European Commission
EUR 26482 – Joint Research Centre – Institute for Energy and Transport

Title: Metadata - Geospatial data layers provided for the Global Atlas of the International Renewable Energy Agency (IRENA)

Author(s): Katalin Bódis

Luxembourg: Publications Office of the European Union

2013 – 28 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424 (online), ISSN 1018-5593 (print)

ISBN 978-92-79-35406-9 (pdf)

ISBN 978-92-79-35407-6 (print)

doi:10.2790/14129

Abstract

The International Renewable Energy Agency (IRENA) Global Atlas aims to provide access to a set of geographical information layers, which enables users to highlight areas of opportunity for developing renewable energy projects. The Renewable Energy Unit of the Institute for Energy and Transport (IET) of the European Commission Joint Research Centre (JRC) provided thematic data layers to the publically available geoserver of IRENA. The data layers were resulted by research on renewable energy and rural electrification options in Africa. The research has been done within the framework of the ‘Renewable Energy Mapping and Monitoring in Europe and Africa’ action (REMEA) and the research program of the African Renewable Energy Technology Platform (AFRETEP).

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

