

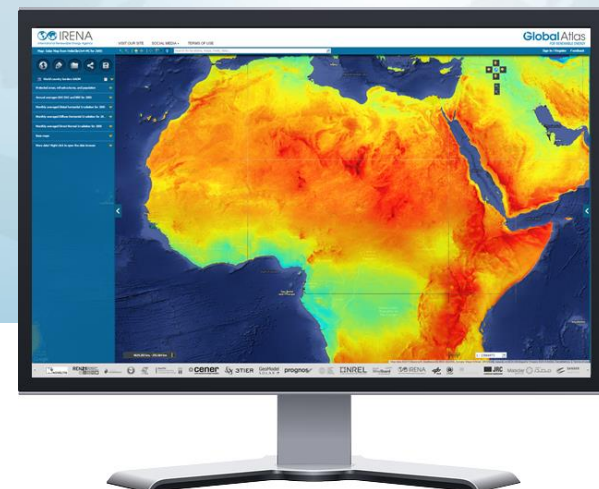
# The IRENA Global Atlas for Renewable Energy

## OGC Energy & Utilities Summit

Harnessing the Power of Geospatial Information for  
Smart Energy Communities and Utilities

St. Johns, NL, Canada  
June 28<sup>th</sup>, 2017

Jacinto Estima, PhD  
Programme Officer – GIS & Information Systems  
International Renewable Energy Agency (IRENA)



## “IRENA’s Renewable Energy Prospector”

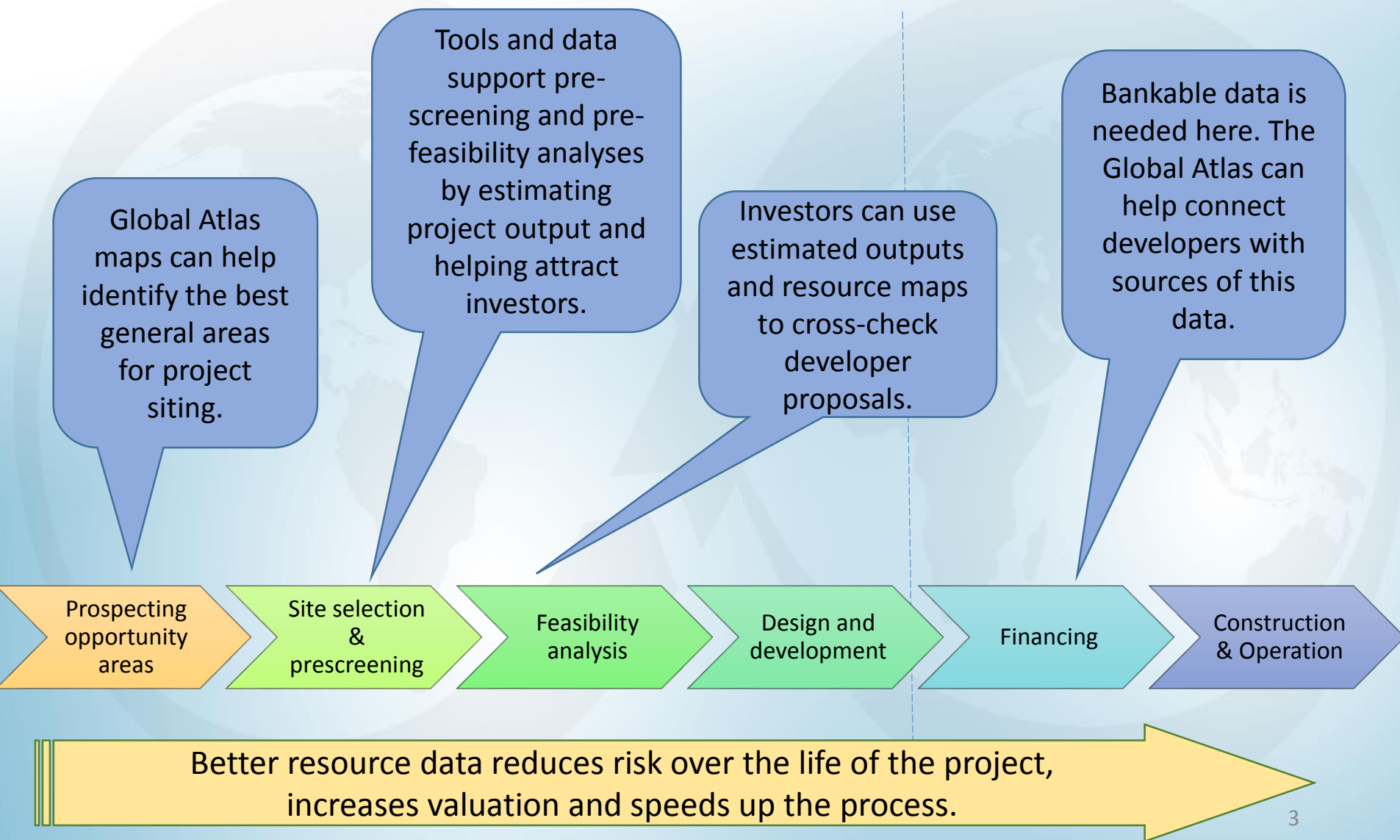
The Global Atlas facilitates access to renewable resource data, analysis and methods in order to accelerate the initiation and development of a broader range of renewable energy projects.



Support  
SDG  
goals

- Provide free resource data for all
- Shorten the project life cycle
- Optimize development and cut costs

# When is the Global Atlas used?



# Who Uses the Global Atlas?

Policymakers and  
Governments



*How big?*

City and energy planners  
& land administrators



*Where?*

Developers and  
business leaders



*How much?*

Modelers and analysts



*Where is the data?*

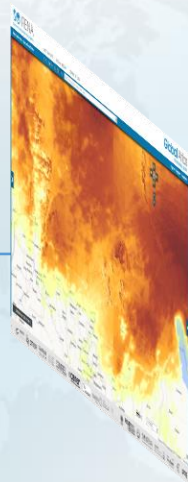
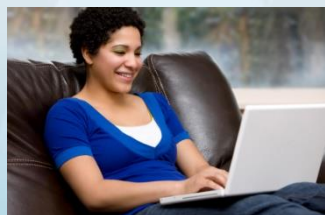
Educators



*How can I learn?*

# How the Global Atlas Works

What you see



What is happening



Who's making it happen



Partner Countries



Over 2000 datasets available!



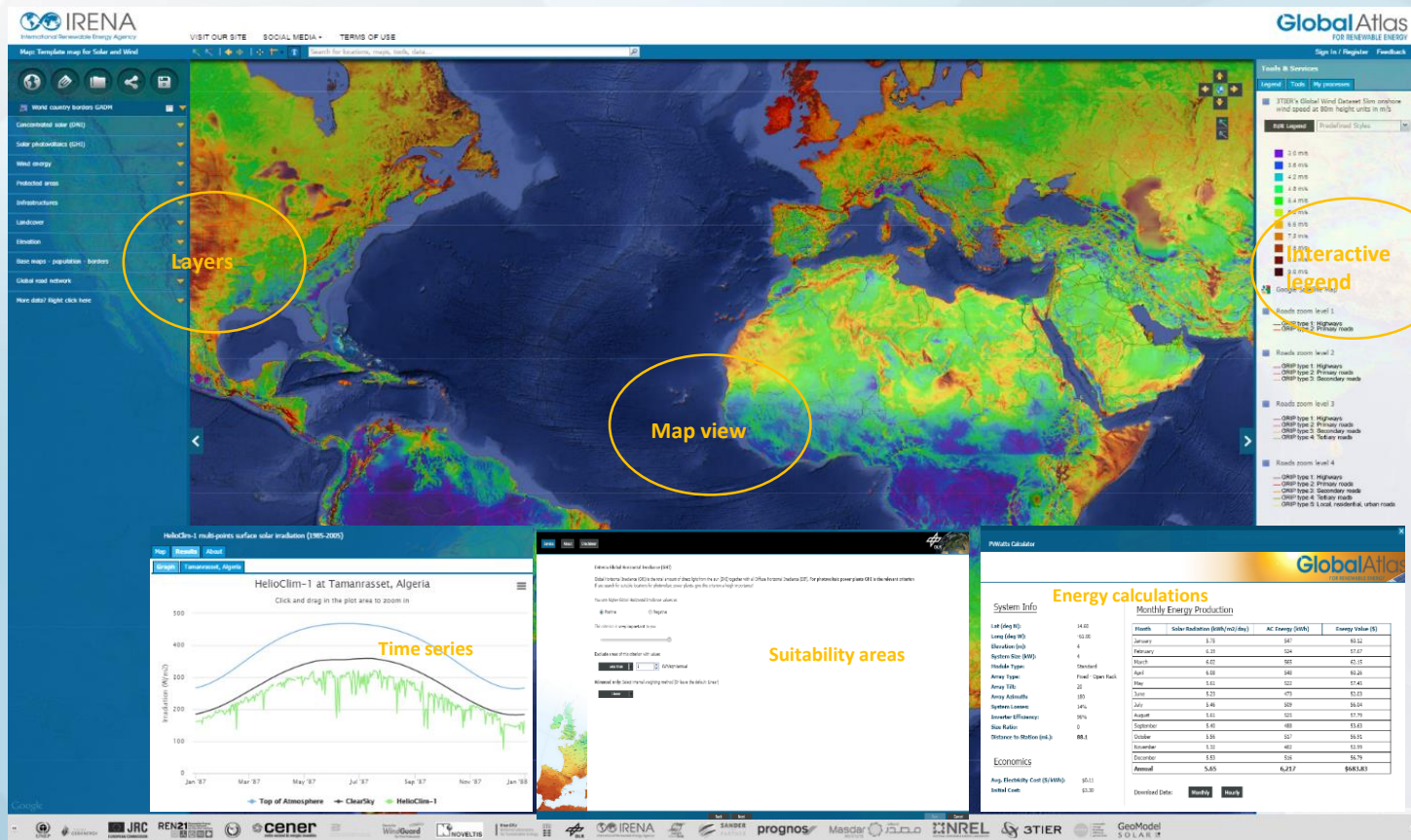
# How the Global Atlas Works



Figure 1. Global Renewable Energy Atlas architecture

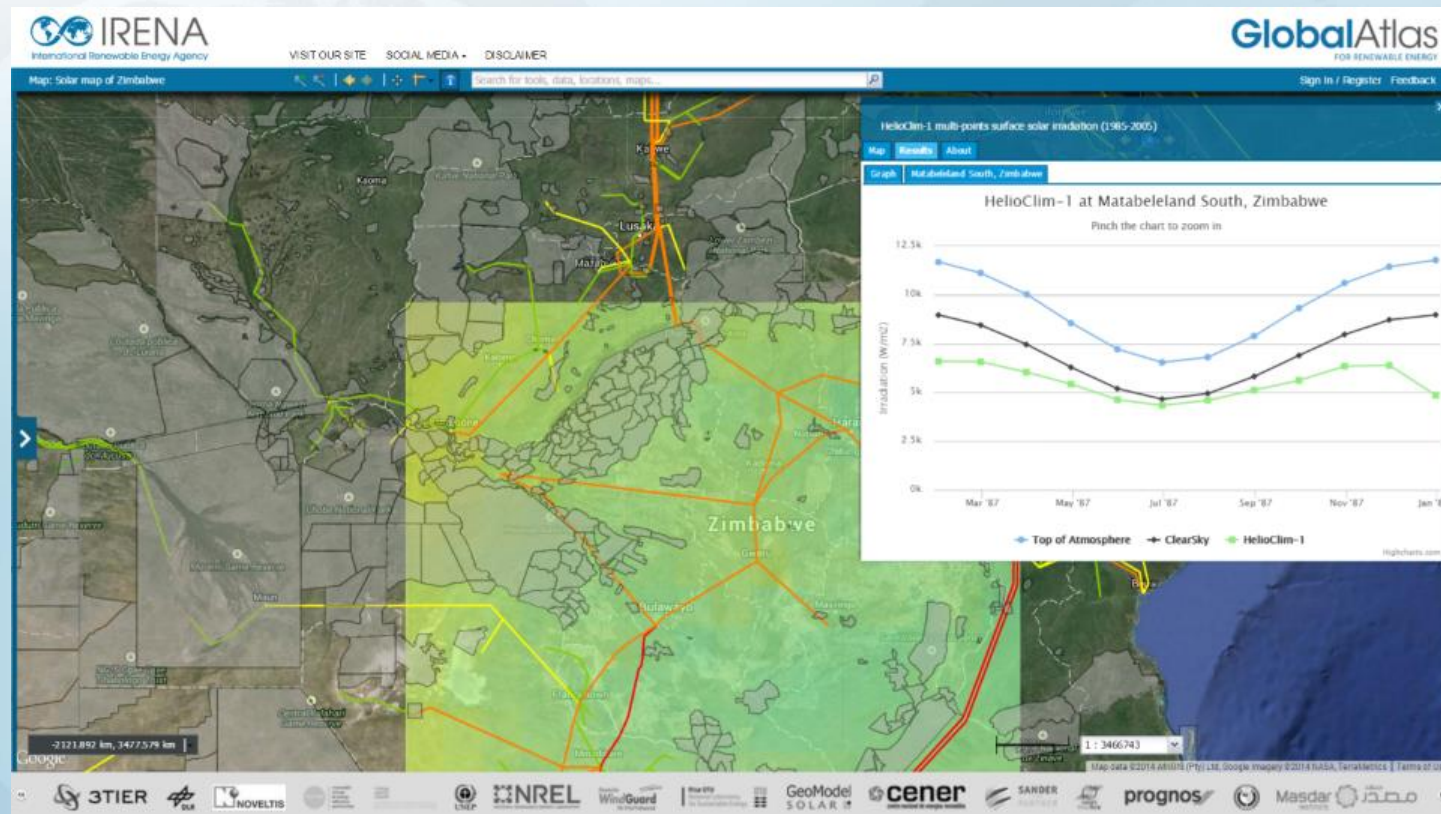
# Where does the data come from?

Data layers, visualization and analytical tools, in one platform



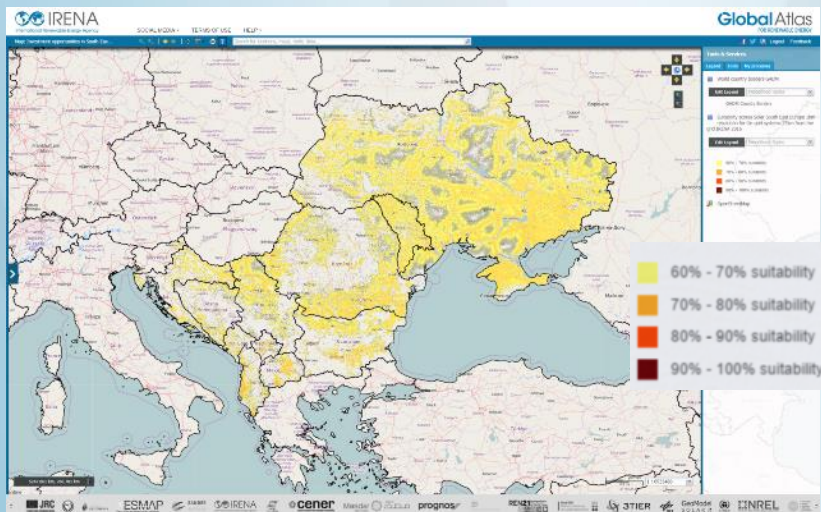
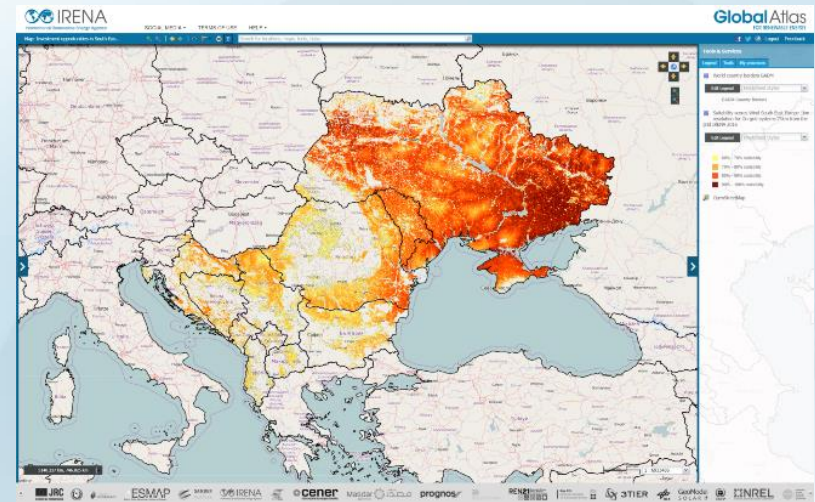
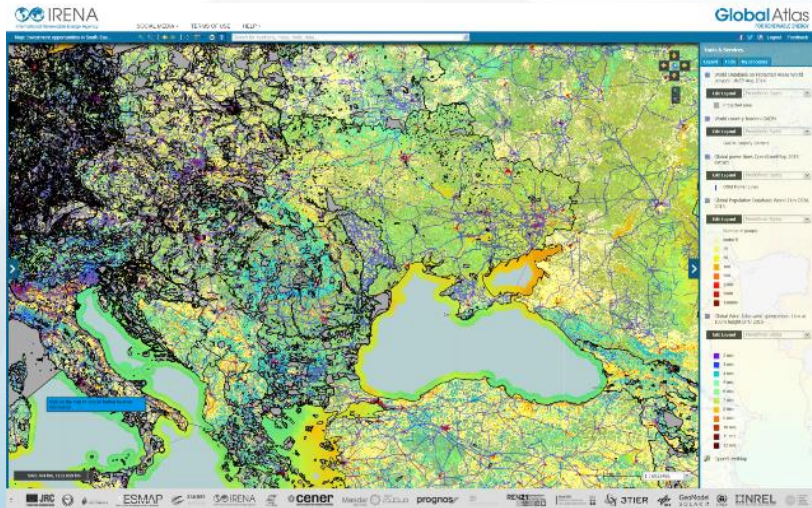
# Where does the data come from?

## Online prospection of RE opportunities



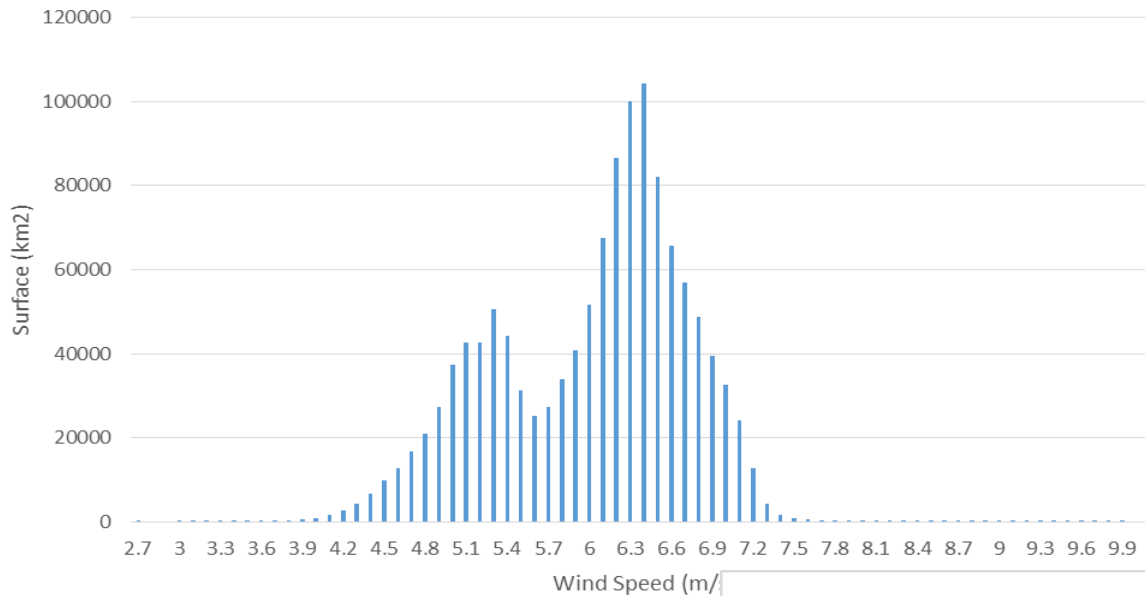


# Dealing with complexity to help decision making

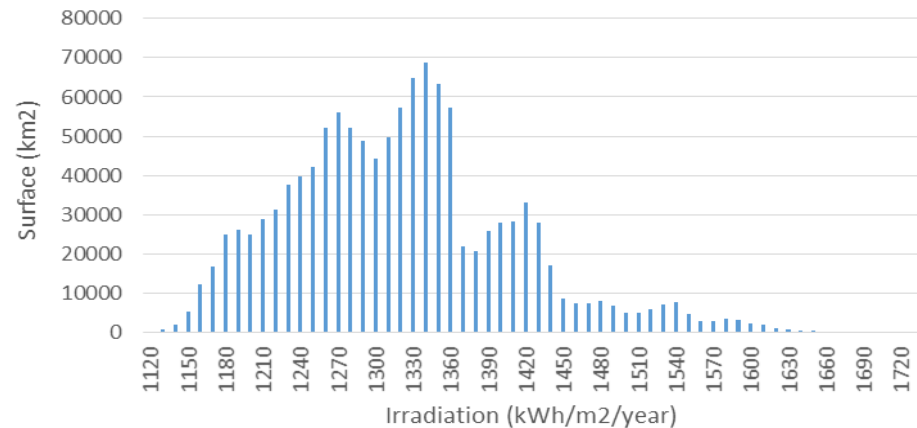


# Derivative output: potentials in numbers

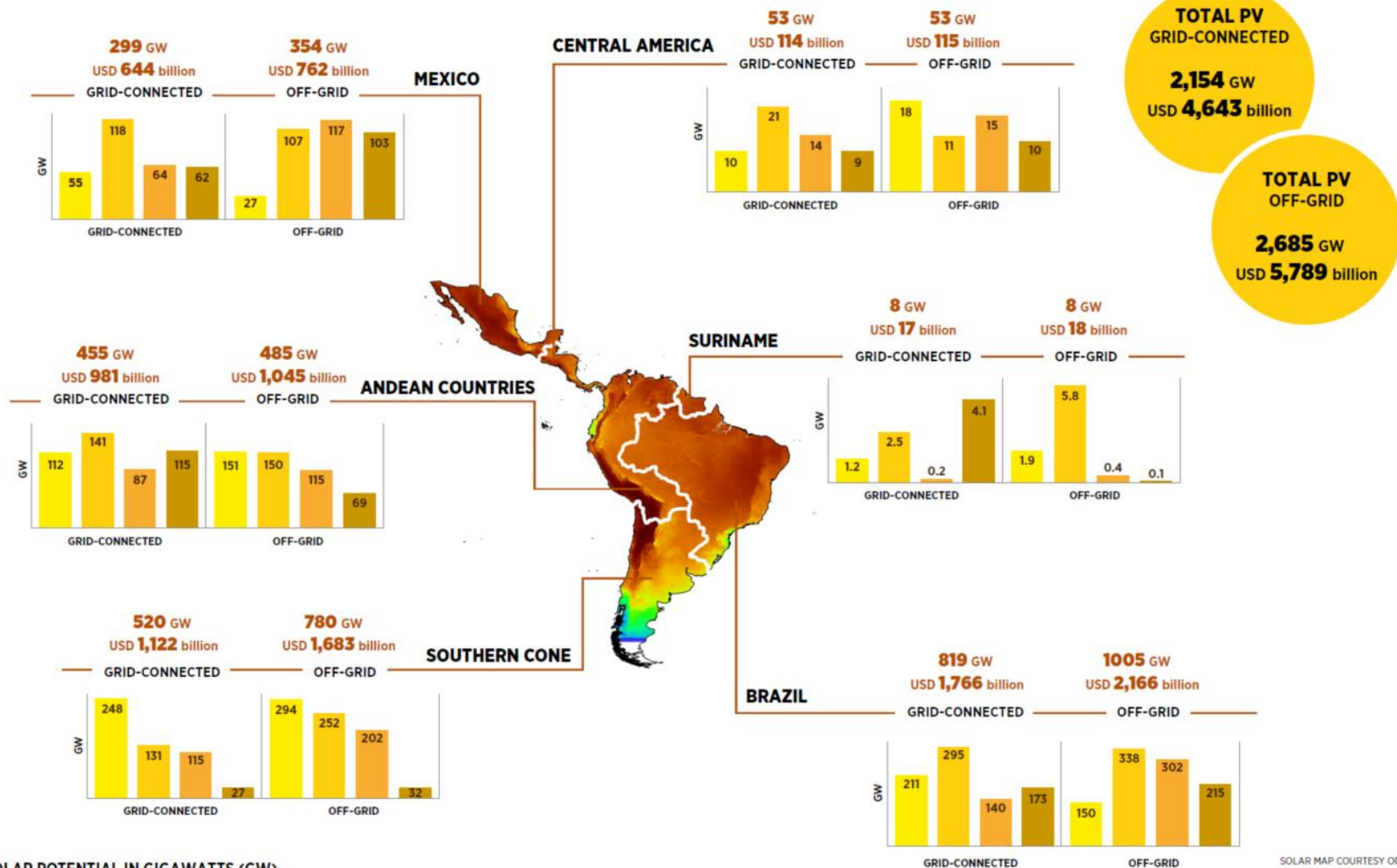
Wind On-grid - suitability above 60%



Solar On-grid - suitability above 60%



# Derivative output: technical potentials



Estimated potential for grid-connected and utility-scale off-grid solar PV across Latin America by sub-region, expressed in gigawatts (GW) and United States dollars (USD). The suitability threshold is 60%, with output indicated for a grid distance of 75 km.



# Esmap – world bank solar map

# GlobalAtlas

FOR RENEWABLE ENERGY

GlobalAtlas  
FOR RENEWABLE ENERGY



SOCIAL MEDIA ▾ TERMS OF USE HELP ▾

Map: Global Solar Atlas - ESMAP



Search for locations, maps, tools, data...

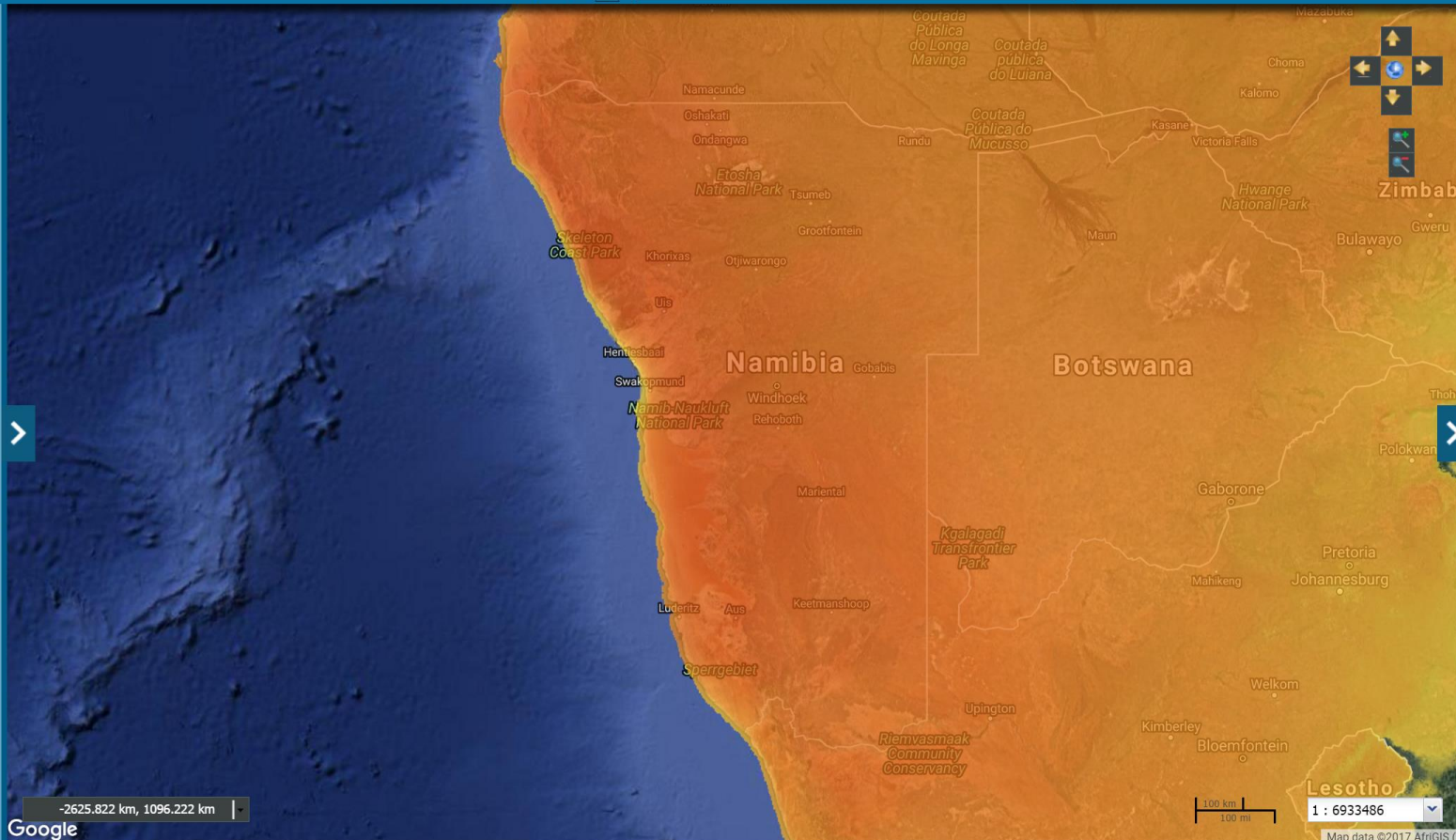
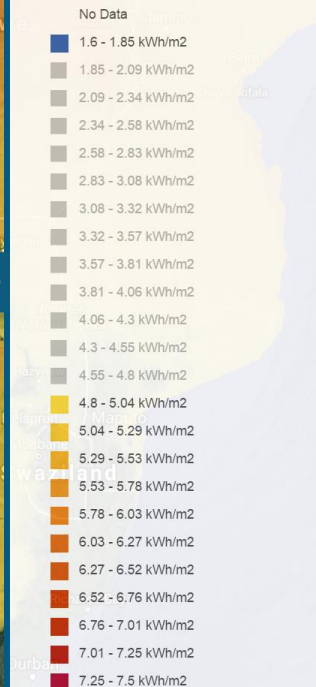
Sign In / Register Feedback

Tools & Services

Legend Tools My processes

☒ Global Horizontal Irradiation kWh/m2  
World 1km 1994/1999/2007-2015 WBG

Edit Legend Predefined Styles ▾



Google

Map data ©2017 AtrnGIS (P)



[www.irena.org/globalatlas](http://www.irena.org/globalatlas)

IRENA  
International Renewable Energy Agency



# DTU – global wind map

# GlobalAtlas

FOR RENEWABLE ENERGY

GlobalAtlas  
FOR RENEWABLE ENERGY



SOCIAL MEDIA ▾ TERMS OF USE HELP ▾

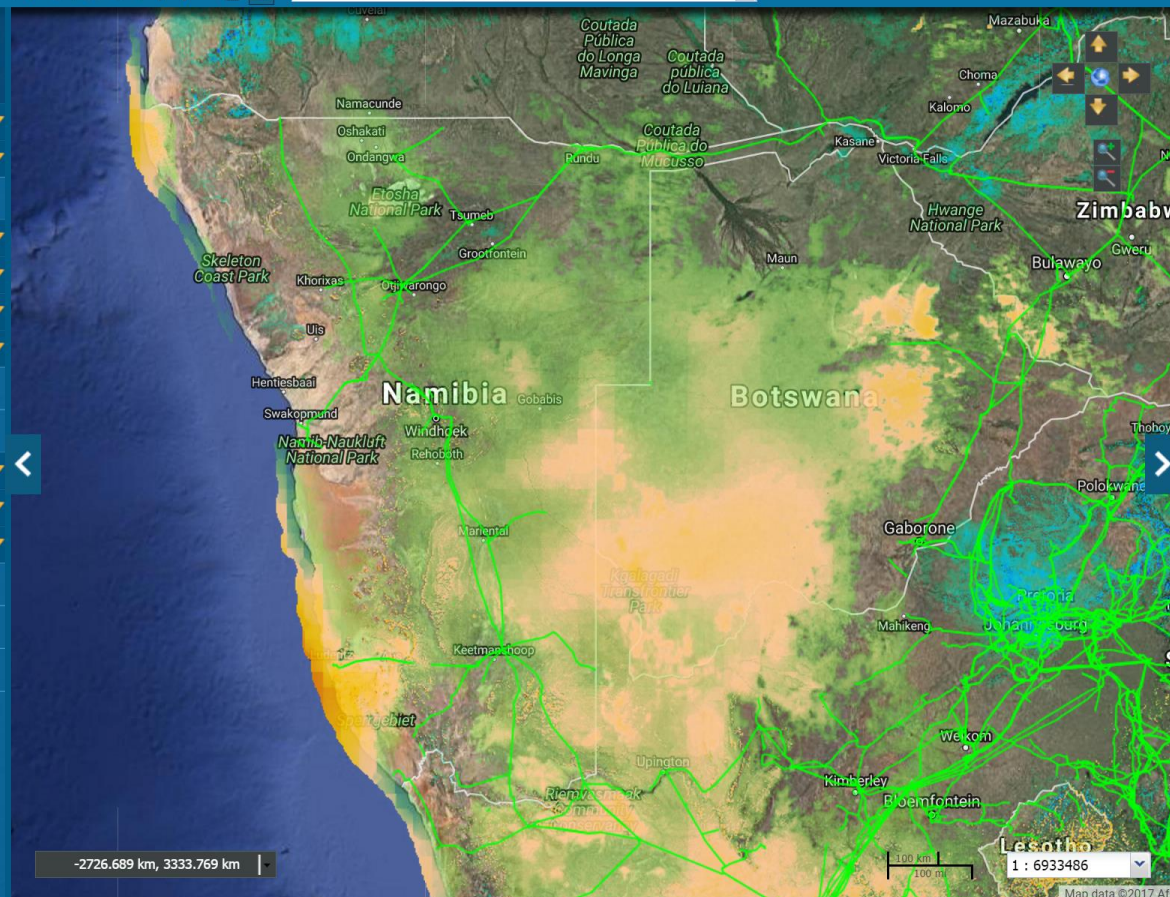
Map: DTU Global Wind Atlas 1km resolution

Search for locations, maps, tools, data...

Sign In / Register Feedback



- Wind power plants April 2016
- World Database on Protected Areas World polygon
- Power lines and substations
  - Africa Transmission Lines Existing Polygons AIC
  - Global power lines OpenStreetMap 2015
  - Global Power Generators OpenStreetMap 2015
  - Global sub stations OpenStreetMap 2015 extra
- Roads
- DTU Global Wind Atlas - Wind speed (WS) maps
  - Average WS 1km at 200m height DTU 2015
  - Average WS 1km at 100m height DTU 2015
  - Average WS 1km at 50m height DTU 2015
- DTU Global Wind Atlas - Power density (PD) maps
- DTU Global Wind Atlas - Confidence intervals Wind Spe...
- Context maps - Population density, topography, landcov...
- Base maps - World countries and borders



Tools & Services

Legend Tools My processes

Global power lines OpenStreetMap 2015 extract

Edit Legend Predefined Styles

OSM Power Lines

Average WS 1km at 100m height DTU 2015

Edit Legend Predefined Styles

2 m/s  
3 m/s  
4 m/s  
5 m/s  
6 m/s  
7 m/s  
8 m/s  
9 m/s  
10 m/s  
11 m/s  
12 m/s

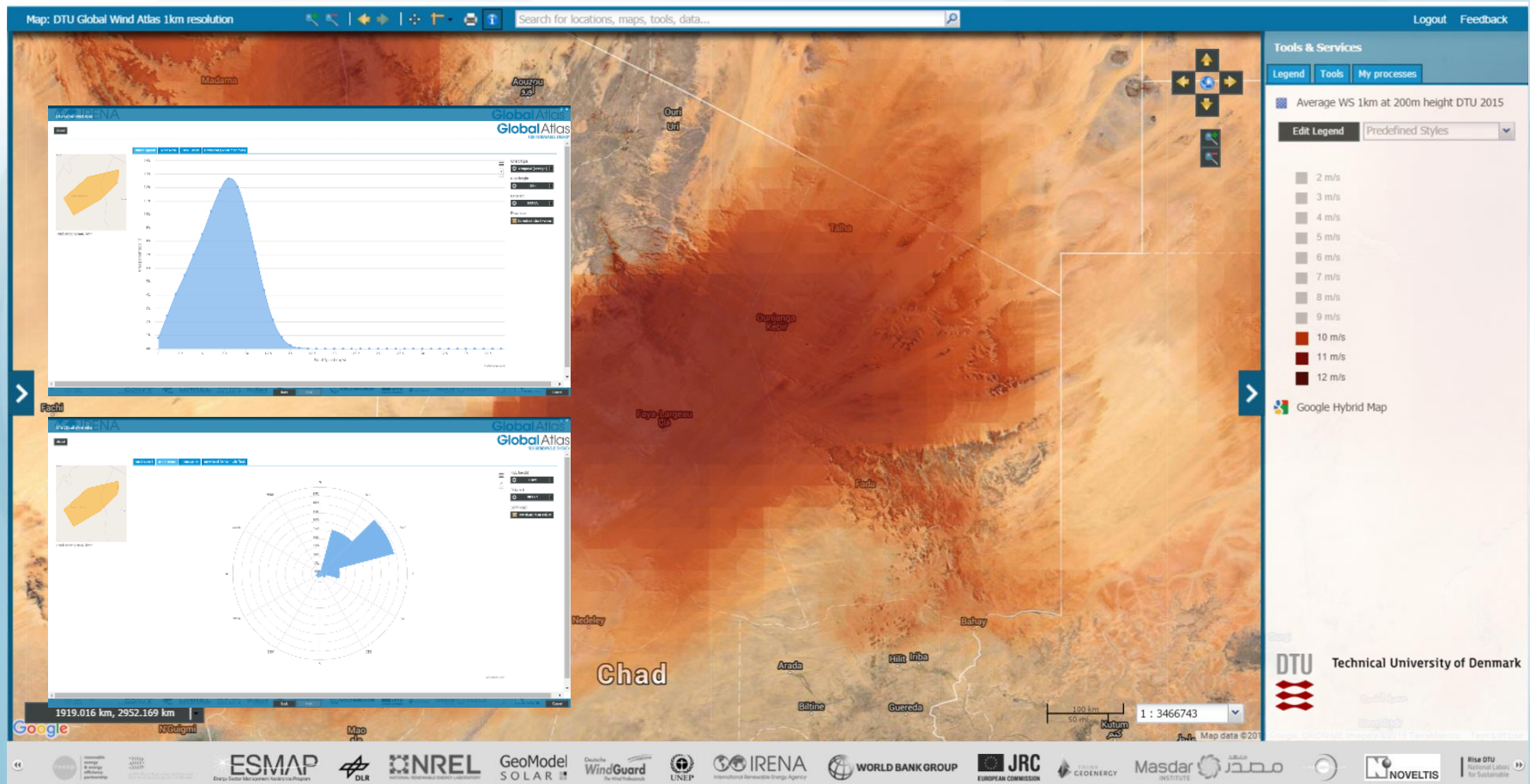
Google Hybrid Map



www.irena.org/globalatlas



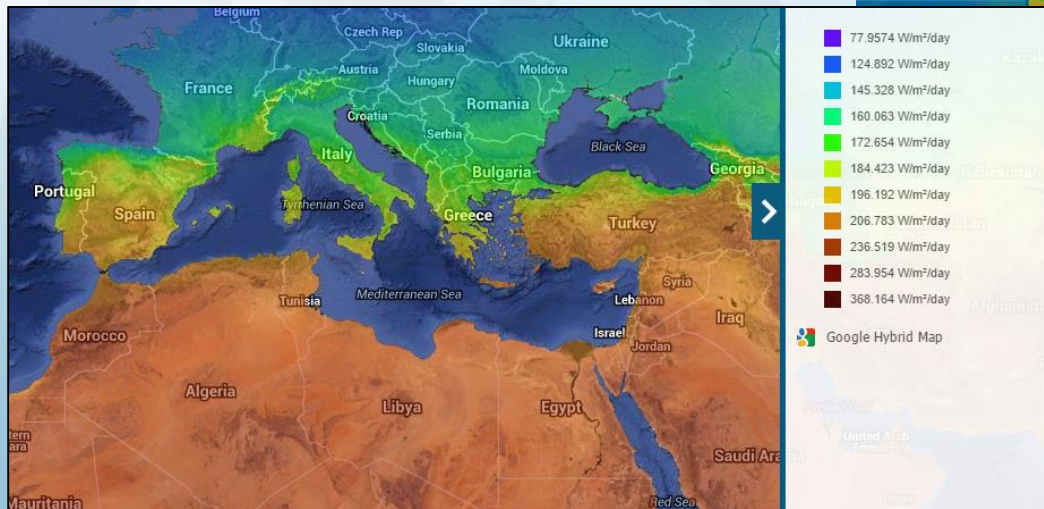
## Advanced wind analysis tools



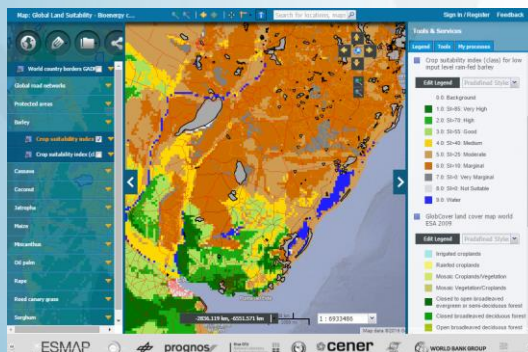


# Which Map Should I Use?

## Global Technology Maps

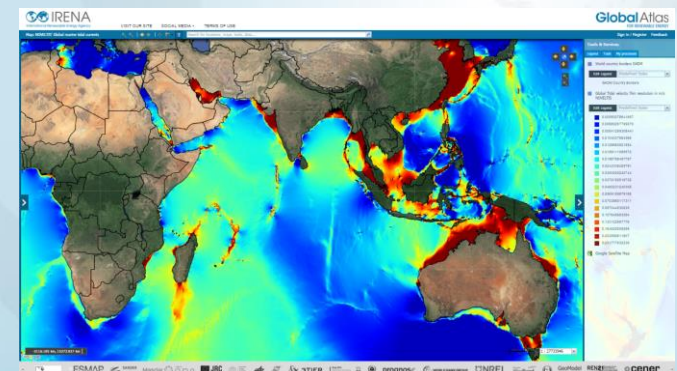
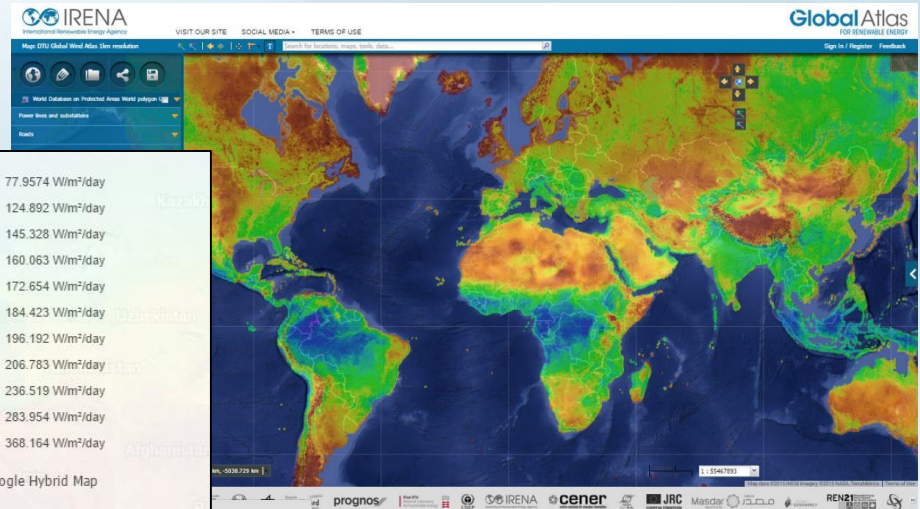


3TIER/Vaisala Solar Map



Bioenergy

## Global Wind Atlas



Tidal currents

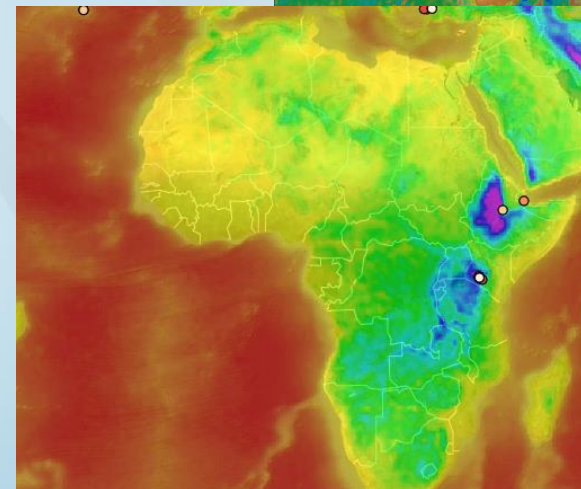
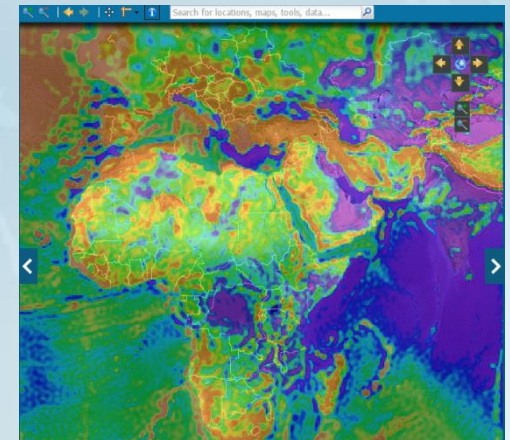
# Which Map Should I Use?

## Geothermal Maps



Heat Flow data

Gravity  
Disturbance

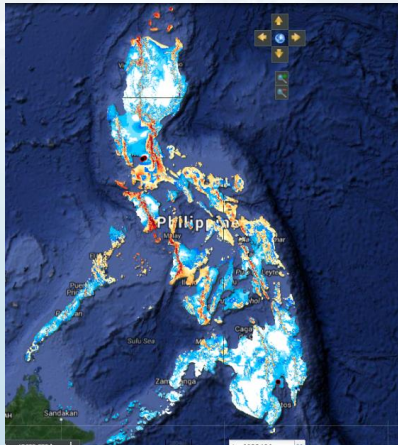


Bouguer  
Anomaly

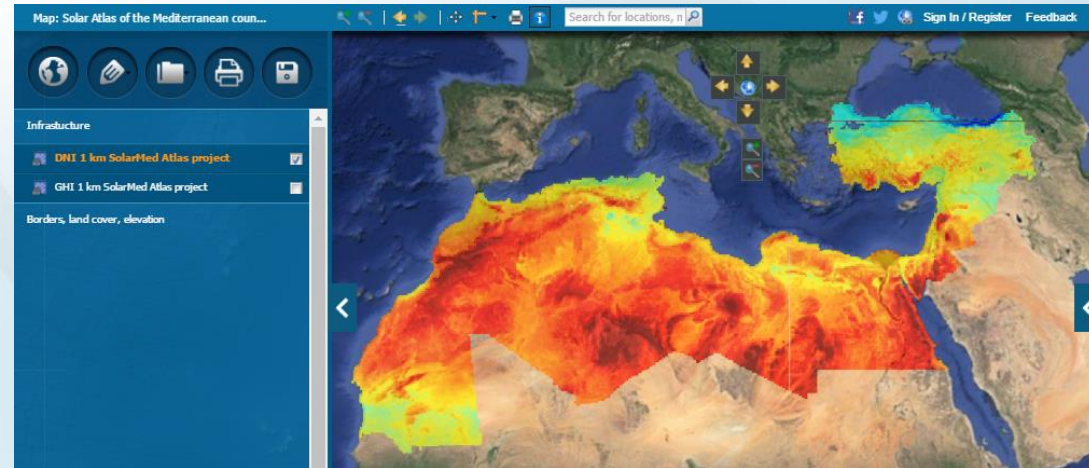


# Which Map Should I Use?

## Regional and Country Maps



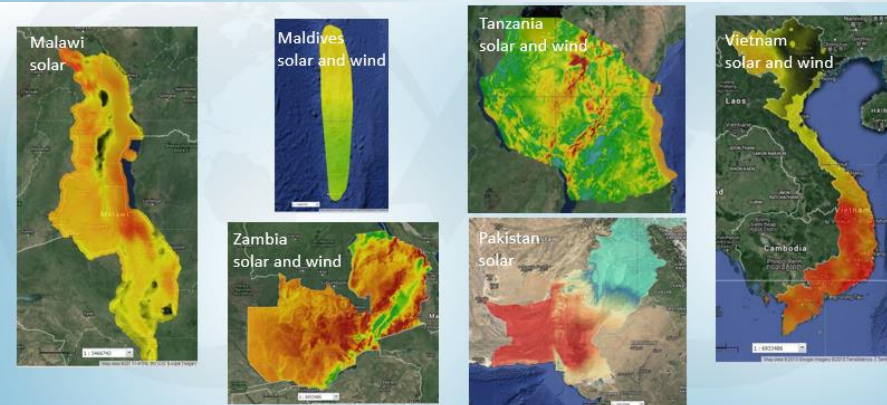
Wind map of the Philippines



Solar Med Atlas – Middle East and North Africa



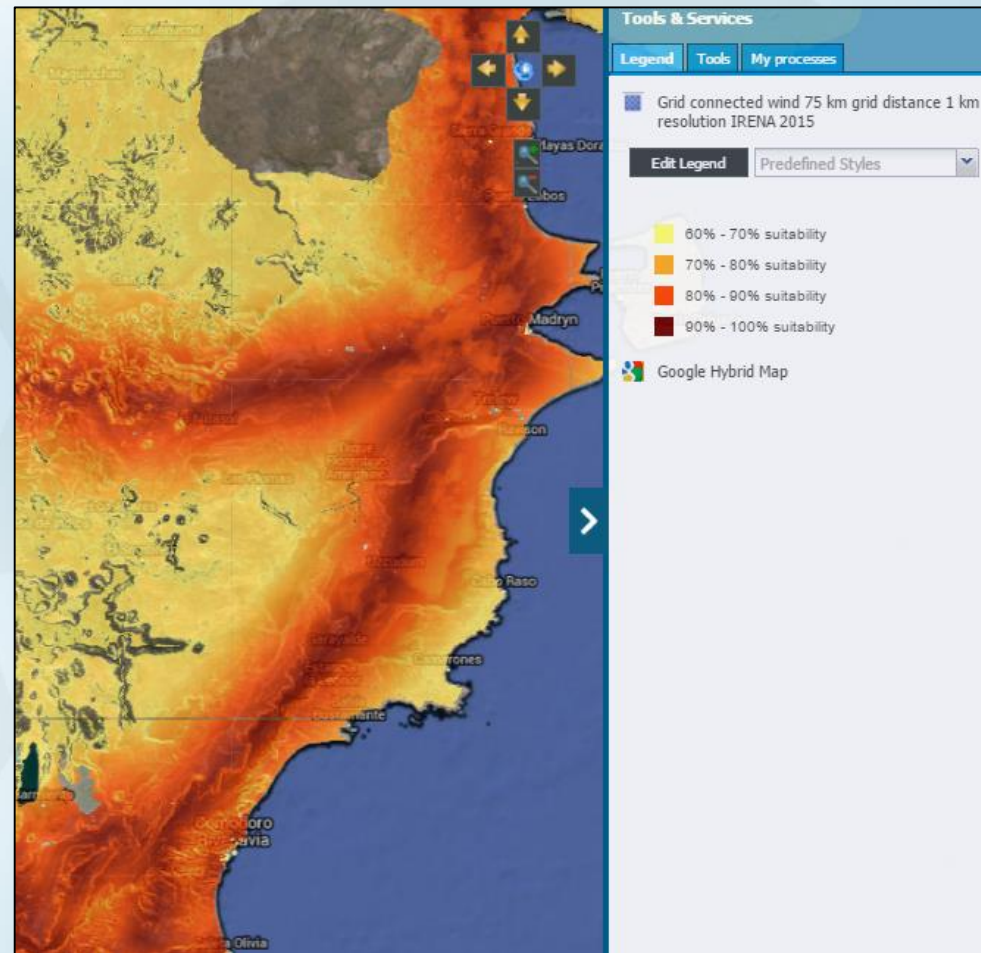
West Africa Solar and Wind



ESMAP Country Maps

# Suitability Studies

- Pre-packaged analysis for high-level users
- Each square km is scored based on:
  - Resource strength
  - Grid distance
  - Population density
  - Topography
  - Land cover
  - Protected Areas
- Three regions completed to date
  - Latin America
    - [Investment Opportunities report](#)
    - [Map # 2012](#)
  - GCC
    - [Investment Opportunities report](#)
    - [Map #2146](#)
  - Southeast Europe
    - [Map #2411](#)





# Global Atlas 3.0 – New map gallery

Portugal ✕

[Add more countries](#)



Maps



Tools



Wind



Solar



Geothermal



Biomass



Ocean

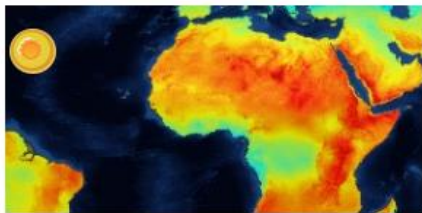


Hydro



Advanced search

## PUBLISHED MAPS



**Solar irradiation across Africa, Europe and Latin America in 2005**

**Best use:** Policy, Potential

0 Comments  0

[► Preview](#)

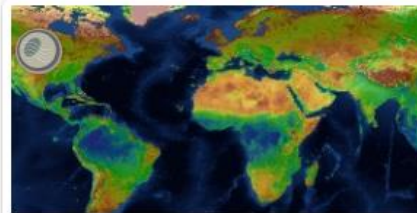


**NOVELTIS' Global marine tidal currents**

**Best use:** Policy

0 Comments  0

[► Preview](#)

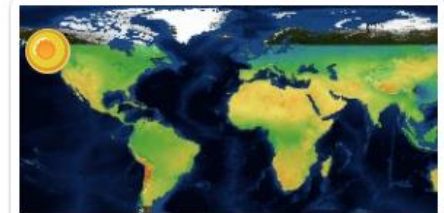


**DTU Global Wind Atlas 1km resolution**

**Best use:** Business, Policy

0 Comments  1

[► Preview](#)



**Global Solar Atlas - ESMAP**

**Best use:** Business, Potential

0 Comments  0

[► Preview](#)

## PUBLISHED TOOLS



**Solar-Med-Atlas: PV System Calculator**



**Concentrated Solar Power (CSP)  
Potential Calculator for Morocco**



**IRENA Wind Data Viewer**



**Multi Point Solar Irradiation Data  
Extractor (Heliodim 4, 1985-2005)**

# Bioenergy Simulator



A tool for bioenergy simulation [More](#)

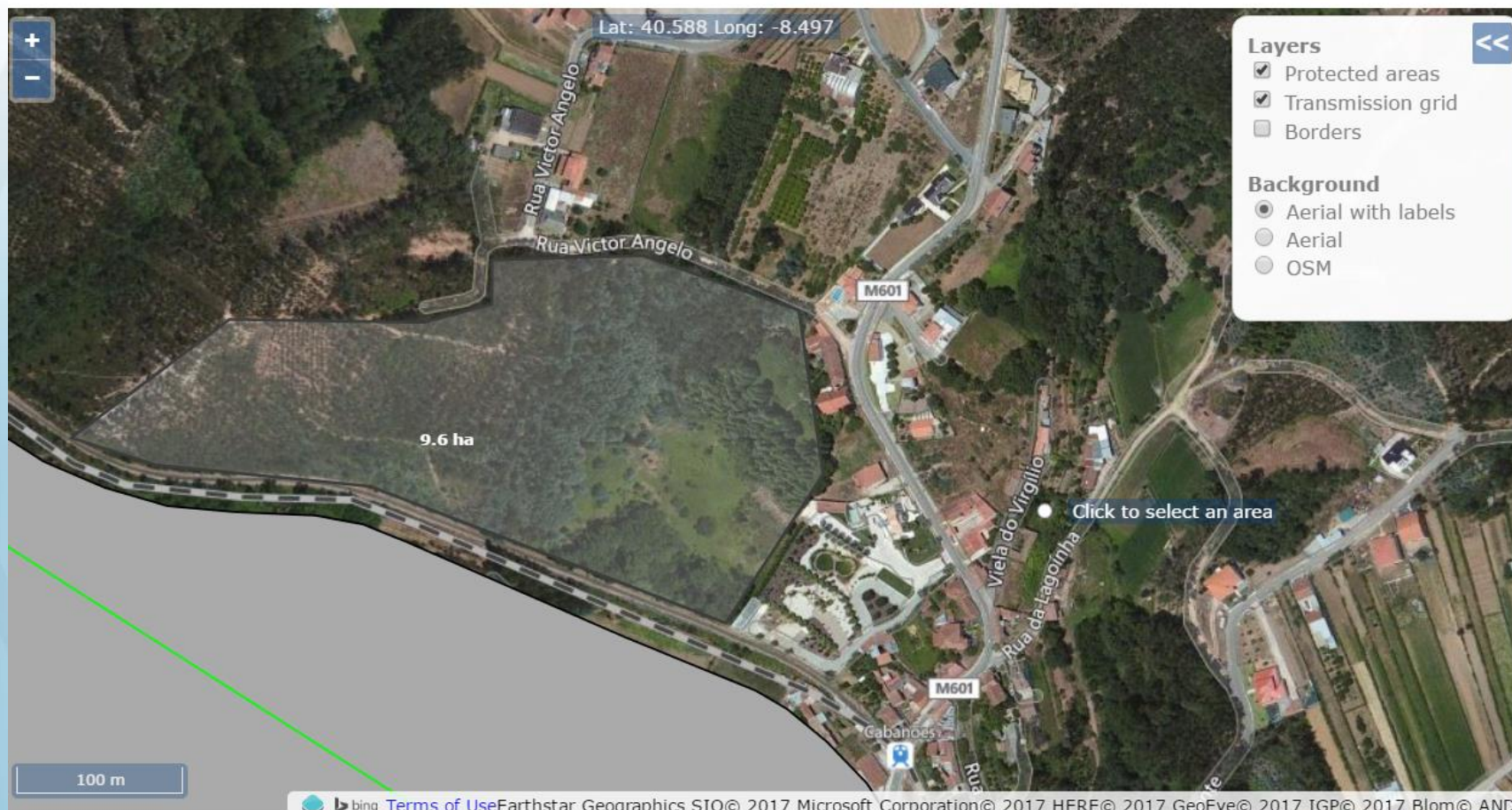


In partnership with:





# Bioenergy Simulator



# Bioenergy Simulator

## CROP DATA

### Selected Area (ha)

10



### Crop

Sunflower

**Harvested product** (Please select a crop from above)

### Seed

#### Average crop yield (t/ha)

Select a value: Default - Rain-fed cor

- |                                     |                |     |
|-------------------------------------|----------------|-----|
| <input type="checkbox"/>            | High inputs    | 1.4 |
| <input checked="" type="checkbox"/> | Intermediat... | 0.9 |
| <input type="checkbox"/>            | Low inputs     | 0.4 |

#### Moisture content (%)

Default: ☒ 0

#### Oil content (%)

Default: ☒ 44

The selected area does not contain any Protected or Water Stress areas

### Information

The selected area contains

- Maximum value of population density of 127 people per km<sup>2</sup>  
(LandScan 2014 Global Population Database - Oak Ridge National Laboratory)

## TECHNOLOGY

Bioenergy and use

## TECHNOLOGY INFORMATION

# Bioenergy Simulator

## TECHNOLOGY

### Bioenergy end-use

Electricity

### Bioenergy conversion technology

Biodiesel - engine

### Overall energy efficiency of the selected technology

Oil extraction efficiency (%)

Default:



85

Overall electrical efficiency

Default:



0.35

Overall thermal efficiency

Default:



N/A

## TECHNOLOGY INFORMATION

### Biofuel used

Biodiesel is primarily a mixture of Fatty Acid Methyl Esters (FAME) made from vegetable oils, animal fats or recycled greases. It is produced mainly through a chemical process called transesterification, in which fat/oil is reacted with an alcohol in the presence of a strong base catalyst. The resulting products are biodiesel and glycerol. Oil extraction efficiency is assumed to be at 85% of the total oil content of seeds. However, users can edit this parameter using their own values.

### Bioenergy conversion technology

An internal combustion engine (ICE) is a heat engine where the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber. An ICE can be fed with fossil fuels such as gasoline, diesel, natural gas or with renewable energy sources such as biodiesel, bioethanol, biomethane and vegetable oils.

## PROCESS SCHEME





# Bioenergy Simulator

## SUMMARY OF THE SELECTED BIOENERGY SUPPLY CHAIN

**Type of crop** Sunflower

**Biomass feedstock** Sunflower seed

**Biofuel produced** Biodiesel

**Bioenergy conversion technology** Biodiesel - engine

**Bioenergy end-use** Electricity

## RESULTS

**Land area** 10 ha

**Crop average yield** 0.9 t/ha

**Total crop production** 9 t

**Biodiesel yield:** 382.5 L/ha

**Biodiesel total production:** 3,825 L

**Bioenergy yield** 13.005 GJ/ha

**Total bioenergy production** 130.05 GJ

**Gross electricity production** 12.745 MWh

**Gross heat production** N/A

## POSSIBLE APPLICATION OF THE POTENTIAL BIOENERGY PRODUCTION

Considering that the average annual electricity consumption in Portugal is 4.8 MWh per capita ([The World Bank, 2010 - 2013](#)), the estimated electricity production could supply n. 3 person(s)/year.

Feedback

Export Results



PREVIOUS

NEXT



Start

Crops

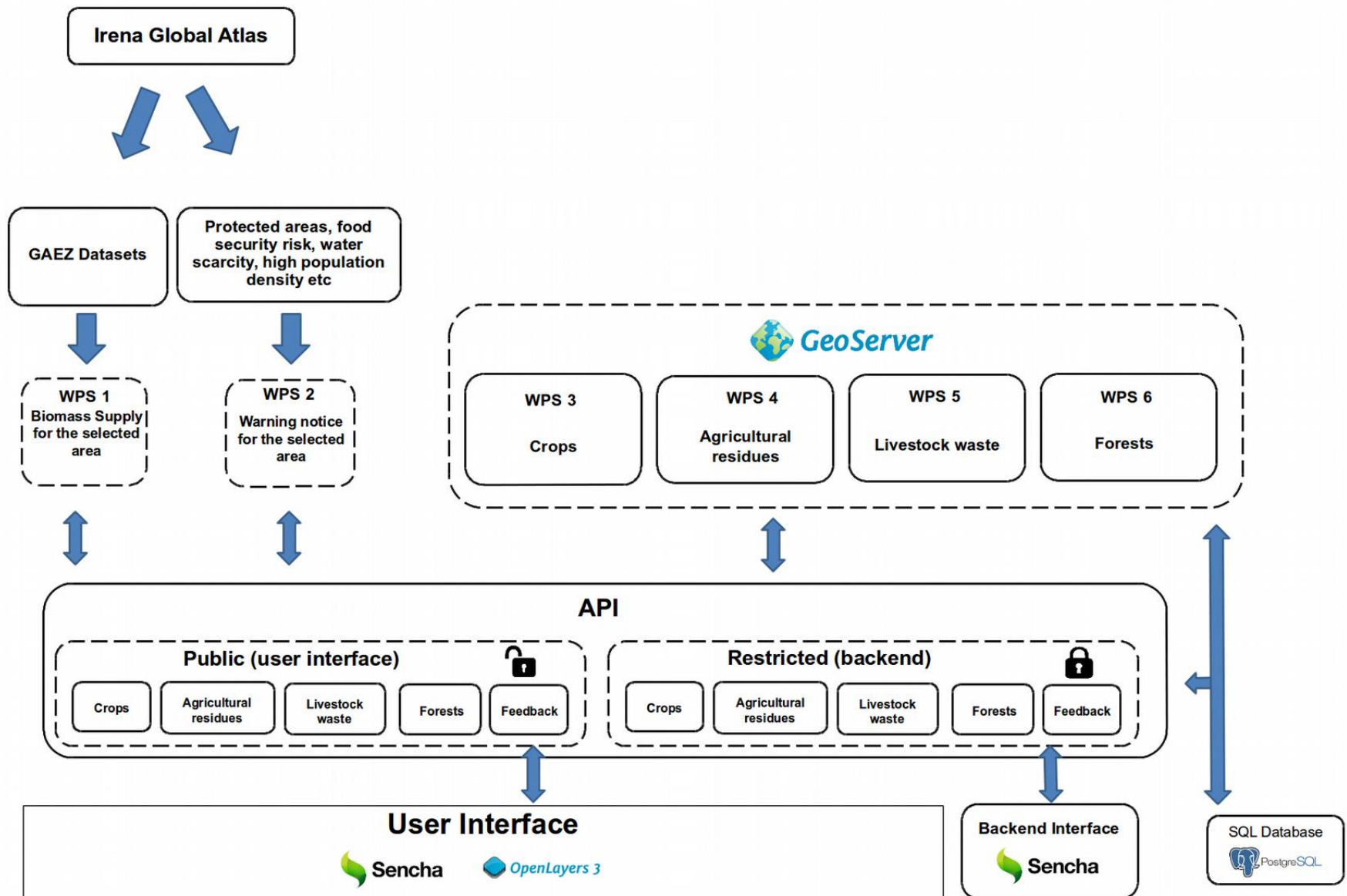
Agricultural  
Residues

Livestock  
Waste

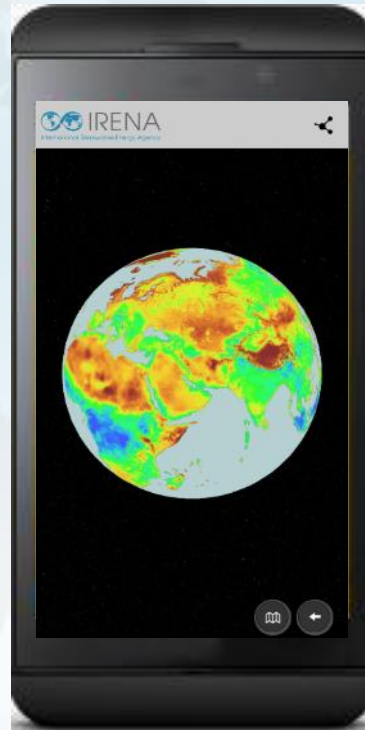
Forest  
Plantations



# Bioenergy Simulator - architecture



# Global Atlas Mobile App!



GlobalAtlas *pocket*  
Mobile App



Available on the  
**App Store**



ANDROID APP ON

**Google play**

Available on  
**Blackberry** and  
other Smartphones

