MENA Renewable Energy Source Mapping Via Nano-Satellite Mission

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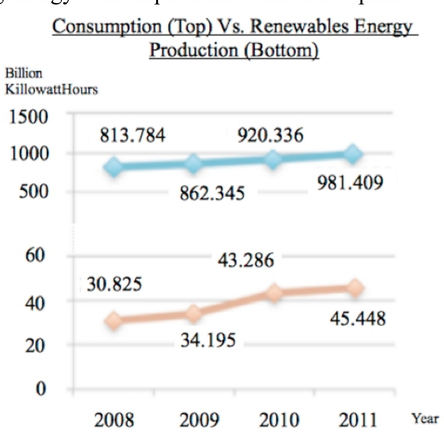
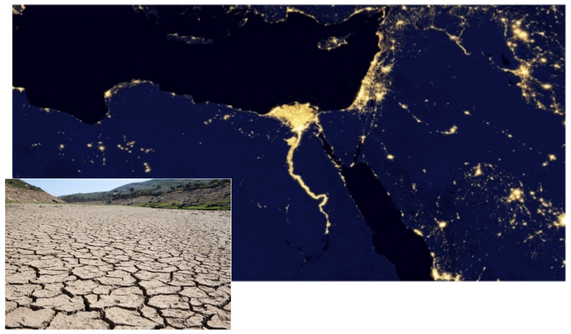
Problem Definition & Mission Idea

- Rising energy consumption and carbon footprint



- Vast unoccupied lands and population concentration in main cities, as well as water scarcity and river share dispute.



- Available Satellite systems are either large ones or do not in particular target renewable energy mapping

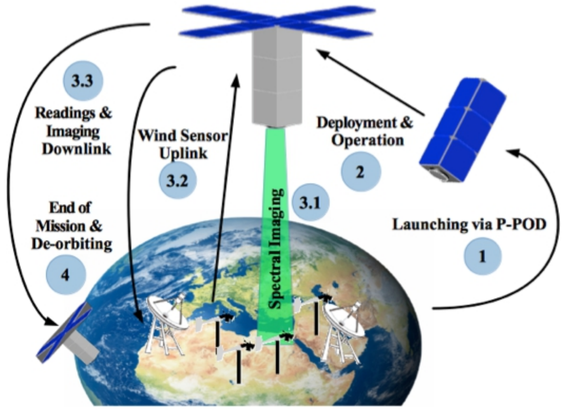
Thus, a small satellite mission with ground sensors is proposed to create a mapping of renewable energy sources in terms of location and output throughout the year.

Energy sources to map:
- Solar
- Geothermal
- Wind

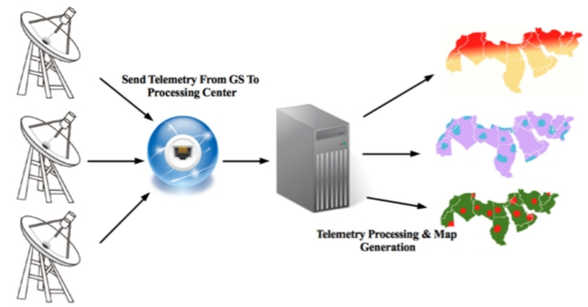
A small satellite mission is efficient and cost effective to:
- Detect energy outputs covering vast amounts of lands
- Covering locations currently inaccessible to GSM networks

Concept of Operations

- Obtaining solar and geothermal data through IR imaging payload, and wind data via ground sensors that uplink to the satellite.

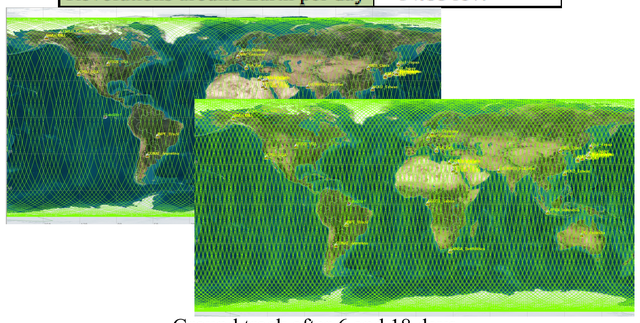


- Consolidating received data for processing and maps generation.



Orbital Parameters

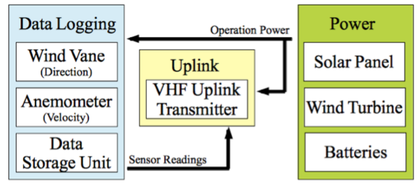
Altitude	604.5 Km
Eccentricity	0
RA	Launching Position
Inclination	98.43 degree
Argument of Perigee	None
Ground Track Revisit Time	~ 6 days
Maximum orbit speed	~ 7.56 Km/sec.
Orbit Period	~ 96.78 min.
Revolutions around Earth per day	~ 14.88 rev.



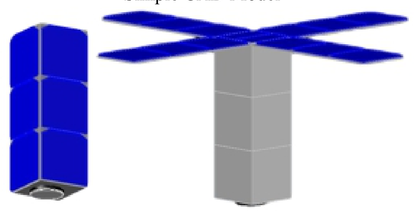
Ground track after 6 and 18 days

System Structure & Performance Parameters

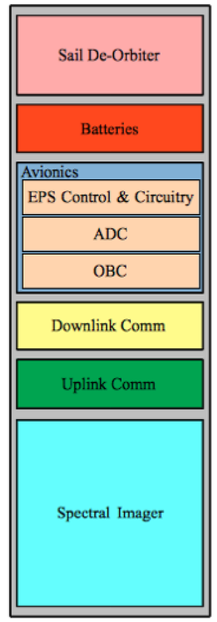
Ground sensor design for wind measurement



Simple CAD Model



Performance Parameters:
- LWIR Camera of 8-14μm range is needed to obtain solar and geothermal data
- Wind sensors should be at least 10m high and use self-cleaning solar panels
- S-Band transmitter for downlink to prevent data carry-over scenarios



Tentative internal structure and specifications table

Mass	~2 Kg
Peak Power Consumption	11.58 W
Solar Power Generation	25 W
Payloads	**LWIR Camera** Spectral Range: 8-14 μm Focal Length: 18 mm f/1 Resolution: 640x480 pixels GSD: ~0.94 km Power Consumption: 2.5 W Dimensions: 49x49x76 mm^3 Mass: 250gm **VHF uplink receiver** at 1200 bps
ADCS	**Determination:** • Magnetometer • Gyroscope • Sun sensor • GPS **Control** by magnetorquer
OBC	• ARM-based computer • Scheduling and multi-tasking • Storage unit for telemetry
Communications	• S-Band downlink transmitter at 1 mbps • VHF uplink receiver at 1200 bps • Deployable 4-way monopoles antenna
EPS	• Deployable solar arrays • Power distribution • Chargeable batteries
De-orbiting	Air drag sail de-orbiter

Project Organization & Implementation

A **consortium of participating countries** is to be formed to participate in the actuation of the mission and benefiting from the data for the regional development. The following are the breakdown of key players and detailed implementation phases.

Design	Manufacture	Deploy & Operate	Process & Distribute	Use
• Proposal Team • Academia • Space Agency	• Space Agency • Mass Producer • COTS Providers	• Launching Agent • Space Agencies • Proposal Team	• Space Agencies • Business Startup	• Consortium Members • Governments • Energy & Estate Agencies

Phase	Involved Peers (Not limited to)	Known Costs (M$)
Invitation to Renewable Energy Mapping Consortium & Planning	• Governments • Energy Agencies • Satellite Agencies	
Satellite & Wind Sensor Design	• Proposal Team & Space Agency(s)	
Satellite & Wind Sensor Manufacturing, Assembly & Test	• Mass Producer • Proposal Team & Space Agency(s)	2.9 – for satellite (Shared cost) 0.0004/Sensor
Wind Sensor Delivery & Deployment	• Mass Producer • Governments	
Ground Station Deployment	• Governments • Regional Space Agencies	0.5/ground station development (If not present)
Satellite Launch	• Satellite Launching Agent	4 – to place on desired orbit
Mission Operation	• Space Agencies • Processing Center	0.2/year – for a ground station 1/year – for telemetry processing
Annual Map Publishing	• Processing Center • Governments • Energy Agencies	

Project Risks:

Due to the Arab spring, political turmoil and reform in a given country may delay joining the consortium or even obstruct development and deployment of systems.

Though a country's membership is not a requirement at project initiation, delays in joining may cause this country not obtaining 5 years (Mission's lifetime) worth of telemetry.

Possible delays in importing needed materials for manufacturing and assembly of systems.