Green Energy Park

Solar R&D and testing

Soiling effect

PV Days 2017

October 25th 2017,
Halle

IRESEN
Institut de Recherche en Energie
Solaire et en Energies Nouvelles

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The African context

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0.03 $ / kWh !

The African context

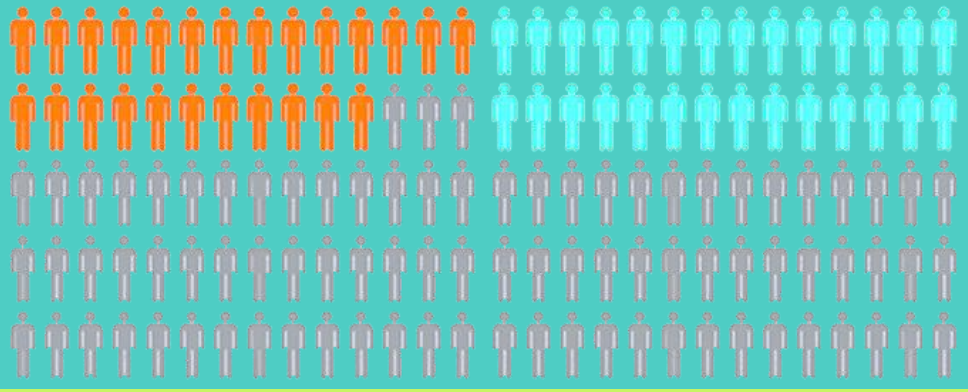
of the
7 Billion people
on Earth today,

legend
= 100 Million

2.5 Billion
have unreliable or no access to electricity
Source: IEA, 2012

2.8 Billion
live in areas of high water stress
Source: WWAP, 2012

Highest percentage live in Africa!



African emerging economies must bring reliable electricity

634* mio. people who currently lack access

Renewable energies are an adequate solution, especially distributed PV (high potential of job creation)

Source: *AIE 2017

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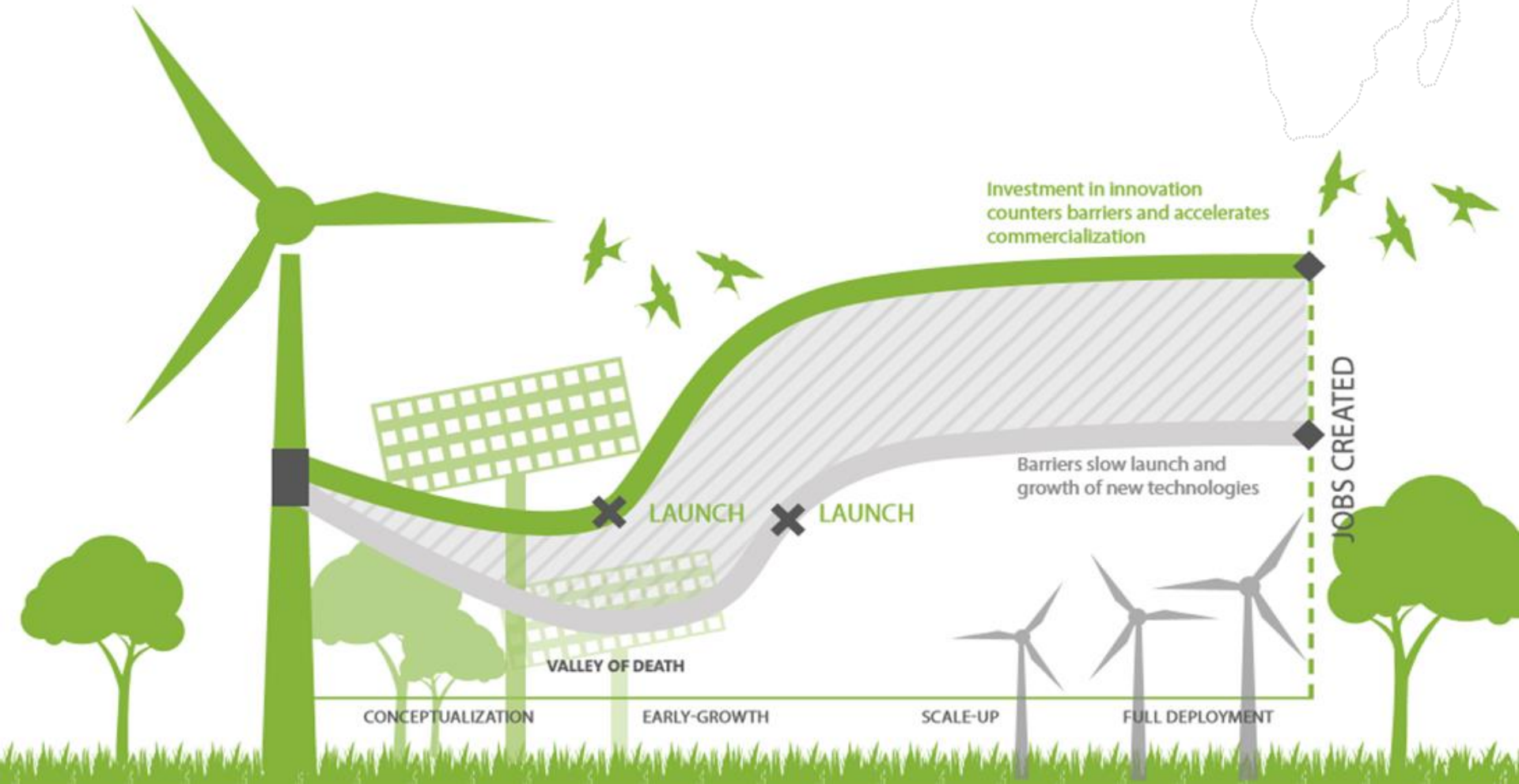
technology cooperation

Technology transfer



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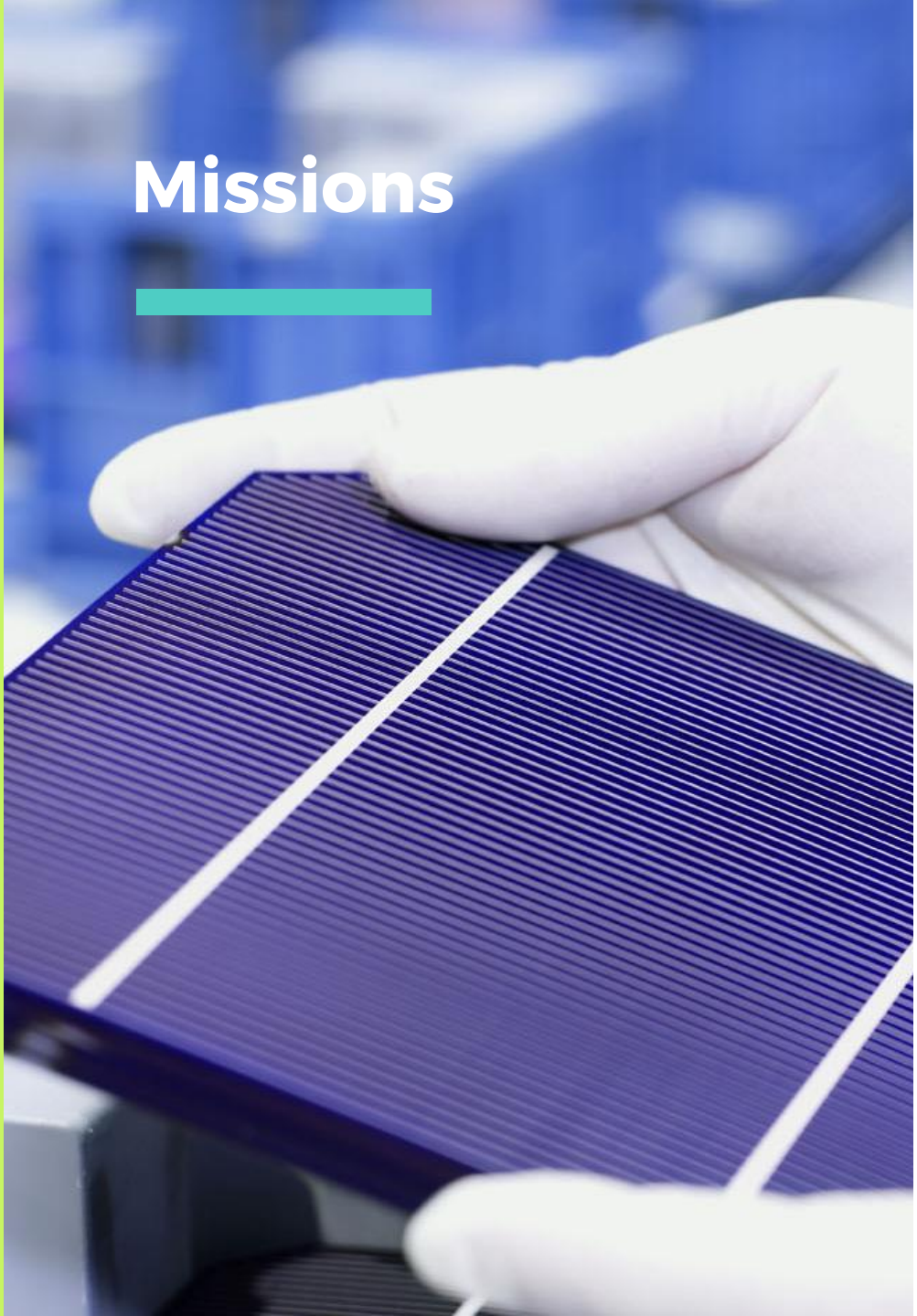
1.

IRESEN Introduction

IRESEN at a glance



Missions

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Institut de Recherche en Energie Solaire et en Energies Nouvelles

Created in 2011, the Research Institute for Solar Energy and New Energies (IRESEN) is at the heart of the **national energy strategy** in The Kingdom of Morocco, by its position in the fields of **applied research and innovation**.

FUNDING AGENCY

Financing of collaborative Innovative Projects

RESEARCH CENTER

Development of applied Research facilities

www.iresen.org

Roadmap

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I Identify appropriate solar technologies

II Developing next solar technologies, suitable to the local conditions

III Protecting the local market: standardisation, certification

www.iresen.org

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Funding Agency

40 M€

2011-2017

Dedicated to support R&D & Innovation

2017-2023

80 M€

More Than 540

Researchers and PhD students supported

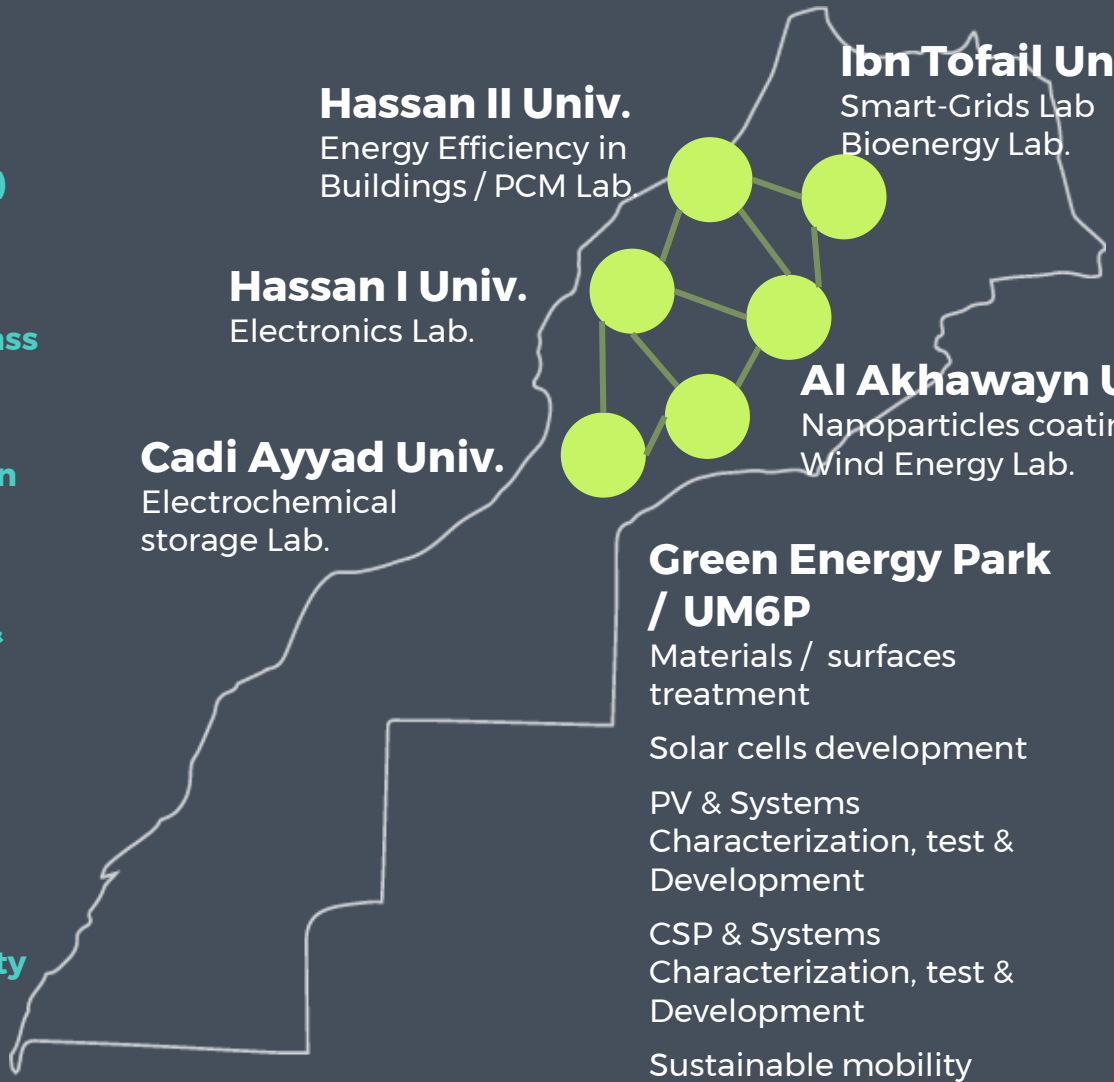
12 Laboratories

Created across Morocco

Labs created across Morocco

IRESEN
Institut de Recherche en Energie Solaire et en Energies Nouvelles

- **Solar (Thermal, PV)**
- **Bio energy & Biomass**
- **Smart Grids & Green Cities**
- **Energy Efficiency & Storage**
- **Wind**
- **Sustainable Mobility**



Ibn Tofail Univ.
Smart-Grids Lab
Bioenergy Lab.

Hassan II Univ.
Energy Efficiency in Buildings / PCM Lab.

Hassan I Univ.
Electronics Lab.

Al Akhawayn Univ.
Nanoparticles coating Lab.
Wind Energy Lab.

Cadi Ayyad Univ.
Electrochemical storage Lab.

Green Energy Park / UM6P
Materials / surfaces treatment

Solar cells development

PV & Systems Characterization, test & Development

CSP & Systems Characterization, test & Development

Sustainable mobility

R&D Projects

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- Solar (Thermal, PV)
- Bio energy & Biomass
- Smart Grids & Green Cities
- Energy Efficiency & Storage
- Wind
- Sustainable Mobility

Solar heating of bitumen

Smart & sustainable Mobility

Synthesis of batteries based on local resources

Solar Cooling for chicken farm

New cleaning solutions for PV modules

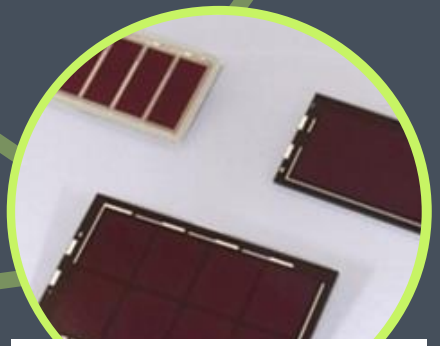
Solar Drying of phosphates

Solar food dryer

Pilot digester coupled with solar energy

Remote village Smart-Grid using Renewable Energies

Traditional public bath using solar and biomass



First Moroccan triple junction solar cell

Success Stories

First Moroccan Fresnel Concentrator → solar air conditioning → solar drying system for vegetables → Creation of a startup for the African market

Solar Motorcycle fridge → prep. phase for the creation of a startup to address the African continent

Modular and mobile solar desalination system (distillation & inverses osmosis → Creation of a startup

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OCP

Every once in a while, a new technology, an old problem, and a big idea turn into an innovation

Dean KAMEN

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MOHAMMED VI POLYTECHNIC UNIVERSITY

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MOHAMMED VI POLYTECHNIC UNIVERSITY

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2.

The Green Technologies Parks

R2I2M

Park green energy

dans l'écosystème de
L'UNIVERSITÉ MOHAMMED VI POLYTECHNIQUE

The identity

RESEARCH to INNOVATION to MARKET
R2I2M

TECHPARK

جامعة محمد السادس متعددة التخصصات التقنية
MOHAMMED VI POLYTECHNIC UNIVERSITY

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Institut de Recherche en Energie Solaire et en Energies Nouvelles

MOHAMMED VI POLYTECHNIC UNIVERSITY

other Universities

GREEN Technology PARKS

- Green Energy Park
- Green & Smart Building Park
- Bio Energy & Storage Park
- EWA Park
- new platform
- new platform

Green INNOVATION BOOSTERS

GREENSMEs & R&D units

Knowledge creation & dissemination → **Know-how creation & transfer** → **Technology development & validation** → **Start-Up Creation** → **Fully integrated technologies into African Market**

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other Universities

GREEN Technology **PARKS**

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- Green & Smart Building Park
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- EWA Park
- new platform
- new platform

Green INNOVATION **BOOSTERS**

GREEN**SMEs & R&D** units

INNO project call
R&D

INNO booster call
Startups

Venture capital

GREEN TECHNOLOGY **PARKS**

Research 2 Innovation Network

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GREEN Tech **PARKS**

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Bio Energy Park
Bio energies & Storage

Green Energy Park
Solar Energies

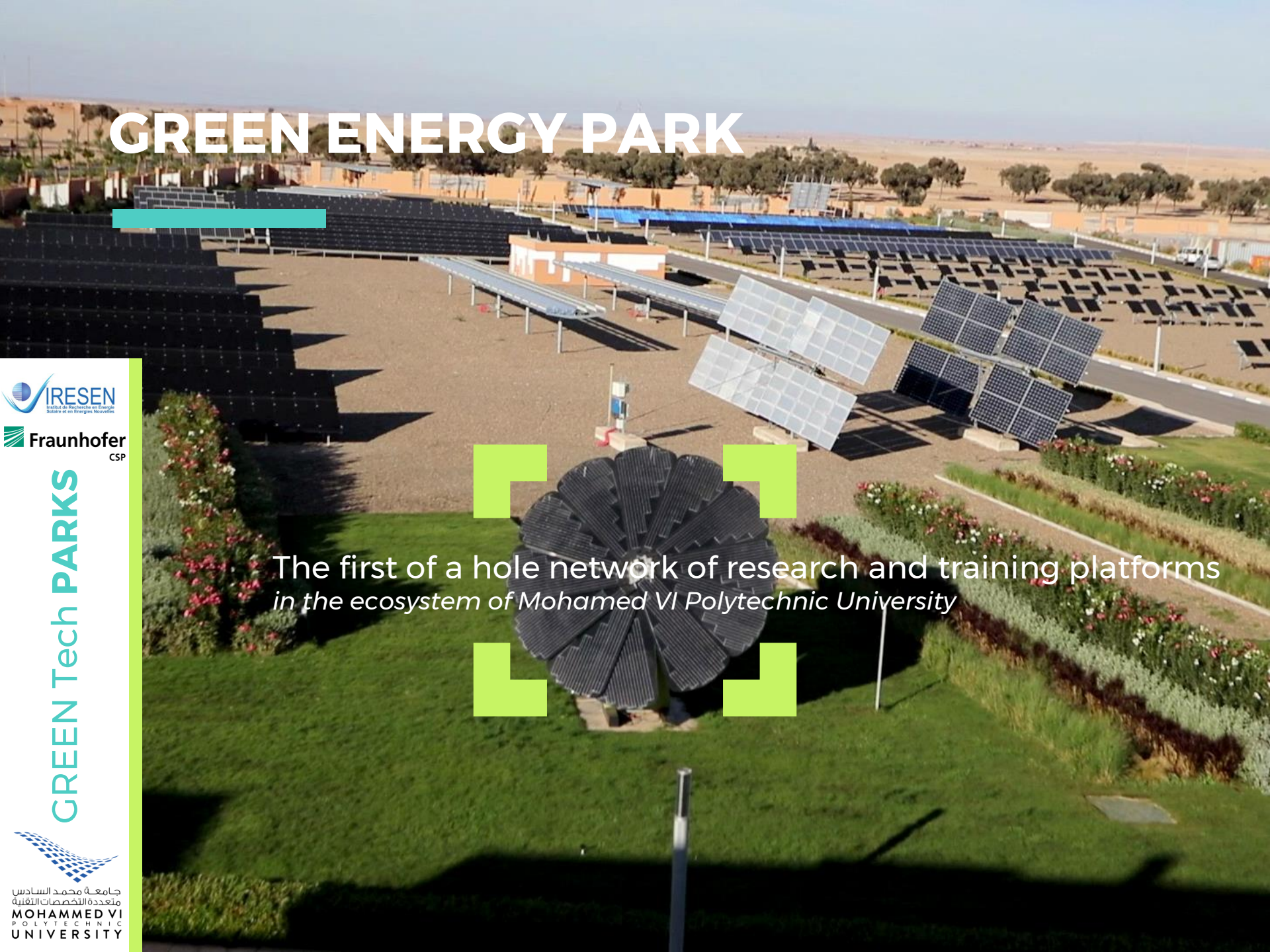
Green & Smart Building Park
Energy Efficiency & Smart Grids

Green Mining Park
Mining industry

Green Industry Park
Industry 4.0

EWA Park
Nexus Water-Energy Agriculture

GREEN ENERGY PARK



The first of a hole network of research and training platforms
in the ecosystem of Mohamed VI Polytechnic University

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Fraunhofer CSP

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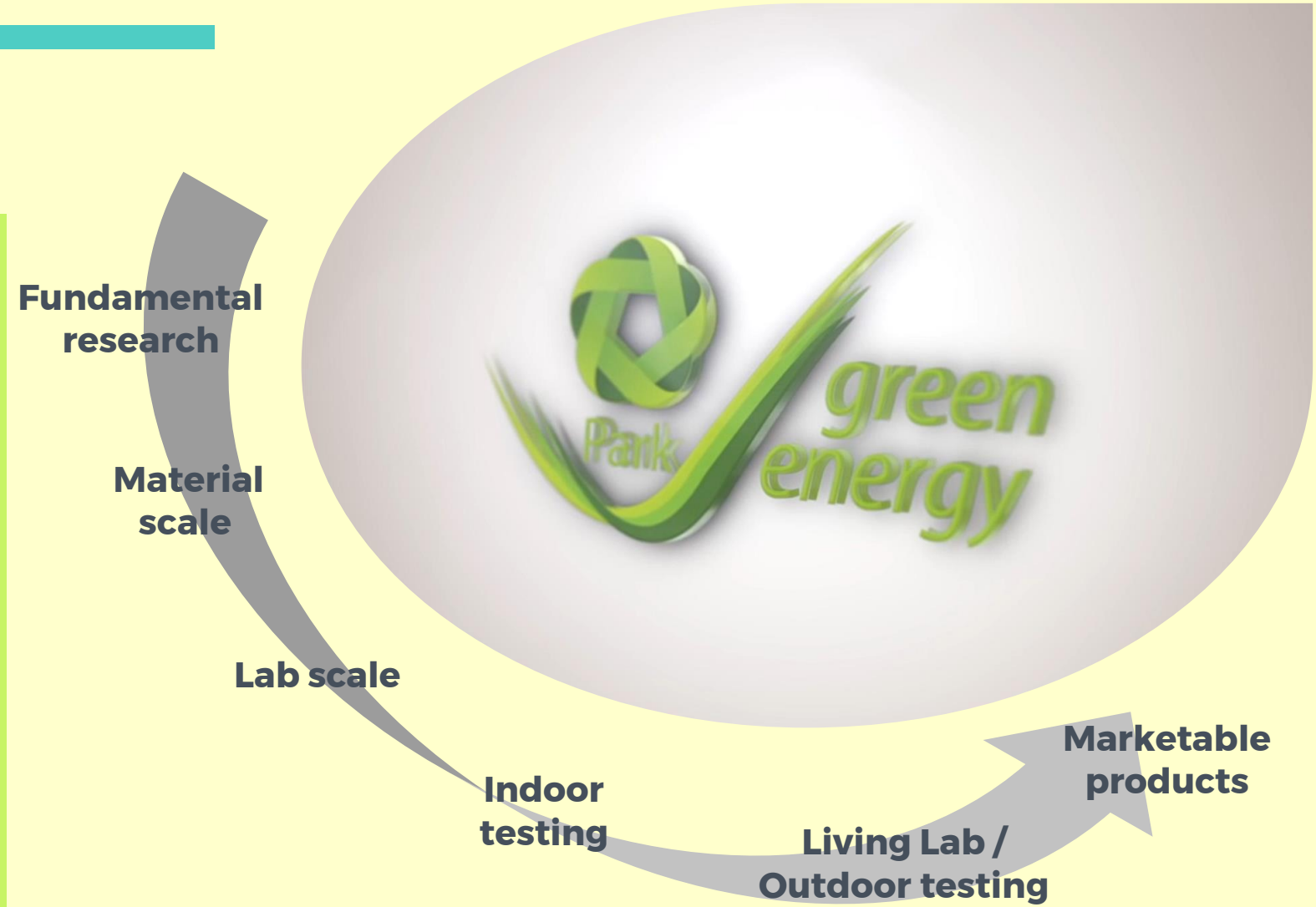
MOHAMMED VI POLYTECHNIC UNIVERSITY

Research to Innovation platform model



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Research to Innovation platform model

Joint PV outdoor test platform, combining a multitude of test-set-ups, in order to evaluate, characterize and validate PV modules in harsh weather conditions (First Solar, DSM, HQcells,..) -> assessment of PV technologies and development of **new adapted technologies for Africa** (**desert modules**)

GREEN Tech PARKS

MOHAMMED VI POLYTECHNIC UNIVERSITY

Soiling effect on the PV systems

- From May the 2th to the 31st the soiling impact on two PV systems (Monocrystalline & Amorphous) has been investigated.

Type of technology	Amorphous	polycrystalline
Number of modules in series/string	8	23
The modules nominal power	135 Wp	240 Wp
Number of string	2	2
The open circuit voltage Voc	61,3 V	37,3 V
The short circuit current Isc	3,41 A	8,3 A
The maximum voltage V_{mpp}	47 V	30,1 V
The maximum courant I_{mpp}	2,88 A	7,9 A

- Both system are composed with two strings each.
- For the experiment period and for each technology, one string was cleaned twice a week and the other left without cleaning.
- The soiling impact can be visualized by calculating the difference between the energy produced from the clean and the soiled string: $\Delta E = E_{clean} - E_{soiled}$

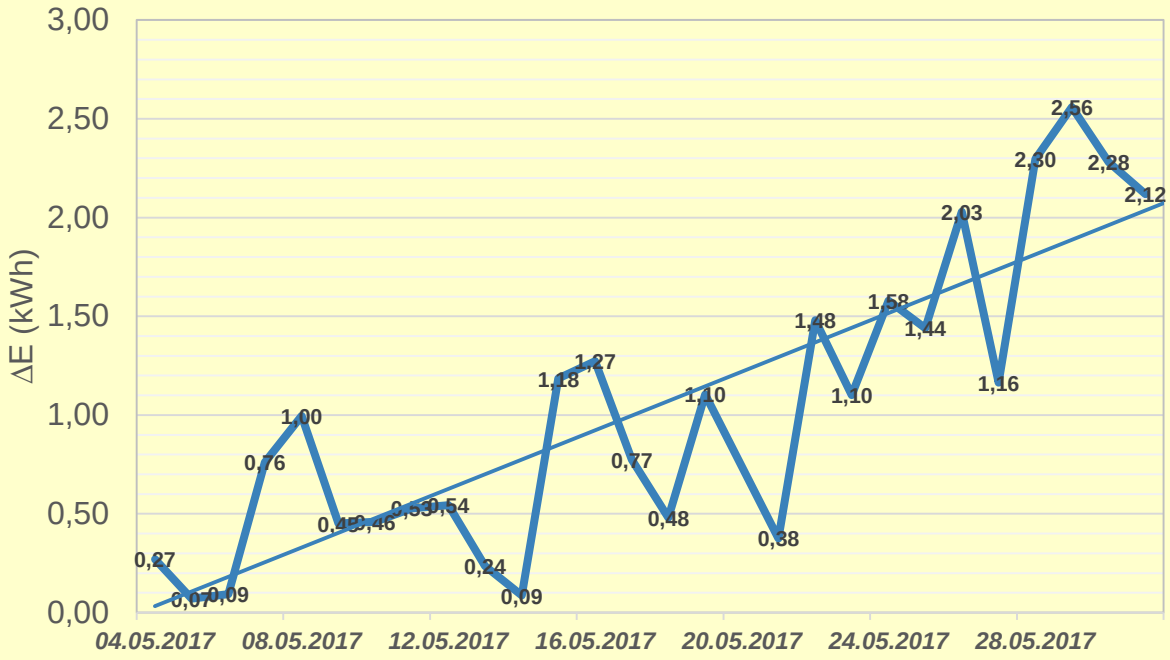
GREEN Tech PARKS

Soiling effect on the PV systems

- From May the 2th to the 31st the soiling impact on two PV systems (**Monocrystalline** & Amorphous) has been investigated.

- For the **monocrystalline system**, the difference in energy (ΔE) between the cleaned and the soiled strings keep increasing with time.

- During the **29th of May** the energy loosed due to soiling reaches **~ 2.5kWh which is the equivalent to 41% loss** from the system's production.



- The **average energy drop due to soiling was of 1.03kWh during the whole exposition period**. Which is the equivalent of **18.6%** loss from the system's production.

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GREEN Tech PARKS
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Soiling effect on the PV systems

- From May the 2th to the 31st the soiling impact on two PV systems (Monocrystalline & **Amorphous**) has been investigated.

- For the **Amorphous system**, the difference in energy between the two strings is increasing with time, but it's not so high (~0.5kWh).

- For the 27th the 28th and the **29th of May** the energy loosed due to soiling reaches **~ 0.57kWh. This is equivalent to 9.1%** of the system's production.

- The **average energy loss during the whole exposition period was of 0.29kWh due to soiling.** This is equivalent to **4.9%** of the system's production.

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Soiling effect on the PV systems

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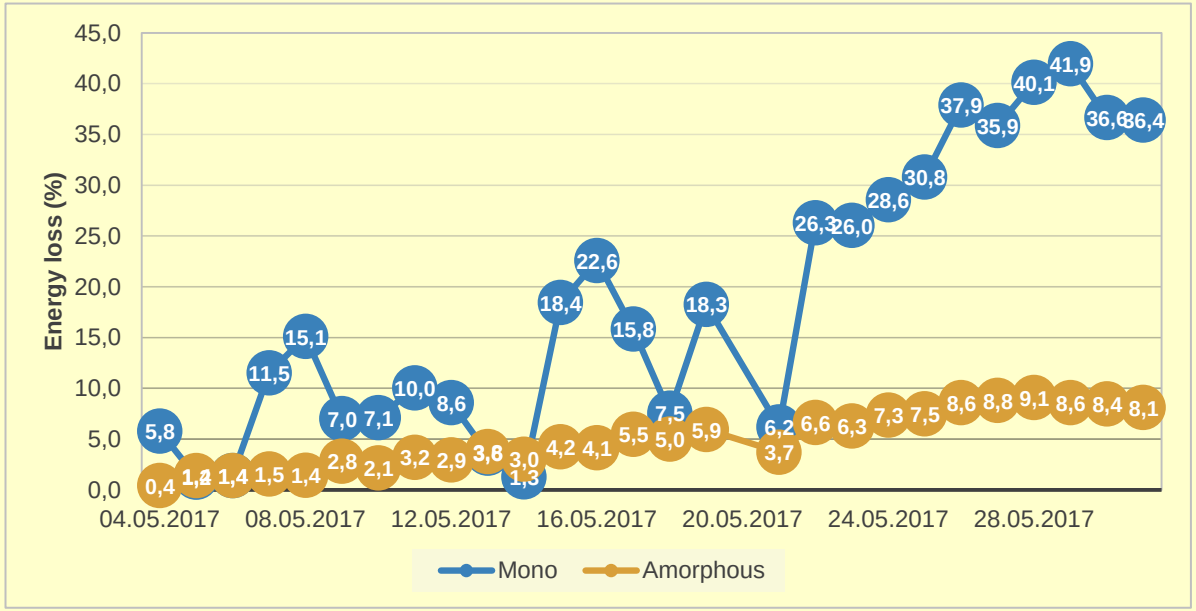
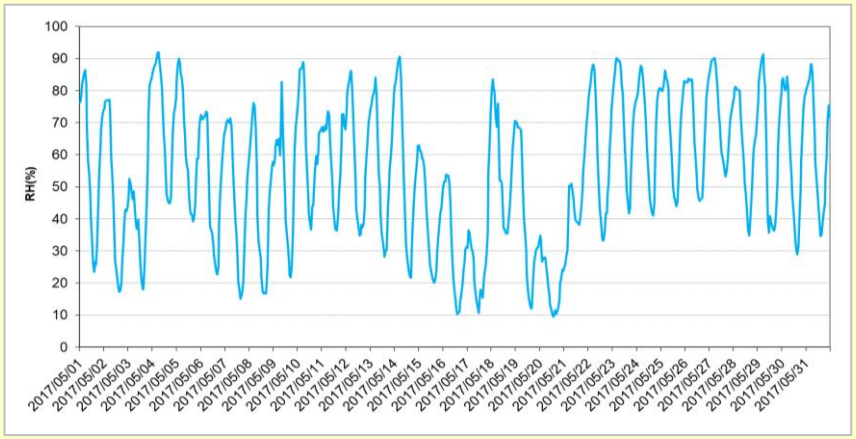
Soiling effect on the PV systems

- The difference in the energy losses between the technologies can be explained by the humidity variation between the day and the night, and the modules temperature.
- The Monocrystalline modules are sensible to the temperature, which contribute to the evaporation of the dewdrops on the surface. This causes an agglomeration and cementation of the dust on the surface, thus a high energy loses.





Technology	Mono	Amorph
Max. energy loss	41.9%	9.1%
Average energy loss	18.6%	4.9%

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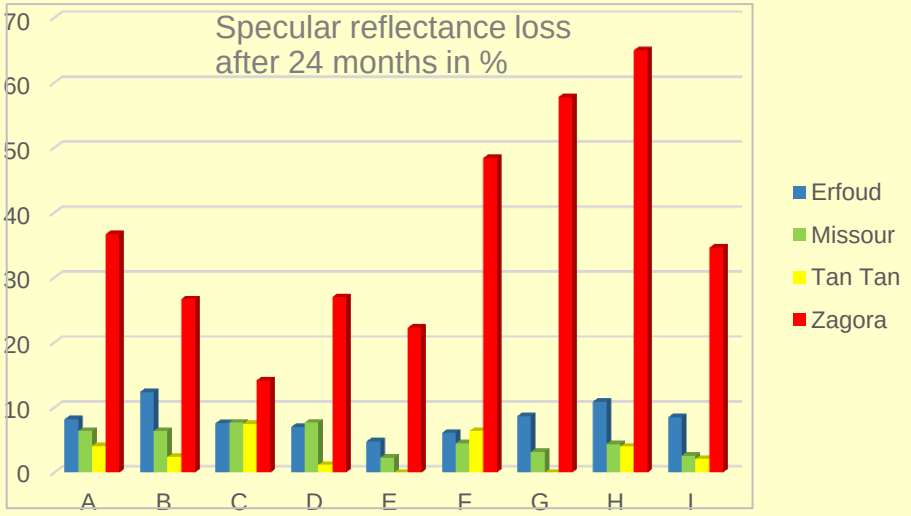
Outdoor Exposure- Moroccan & African Sites



Location	Latitude	Longitude	Max Temperature [°C]	Min Temperature [°C]	Mean Temperature [°C]	Yearly sum solar irradiance GHI [kWh/m²]	Mean wind speed [m/s]	Mean relative humidity [%]
Missour	32,86°N	-4,11°E	40,6	-1,8	18	2023	3,6	48,1
Erfoud	31,49°N	-4,22°E	44	-3,1	22,2	2044	3,1	30,1
Zagora	30,27°N	-5,85°E	45,3	-0,6	23,9	2174	3,8	23,4
Tan Tan	28,5°N	-11,32°E	32	9,2	18,8	1856	4,4	82,9
Yamoussoukro	6,798°N	-5,275°E	39,44	13,07	26,20	1652	2,4	75,5

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GREEN & SMART BUILDING PARK

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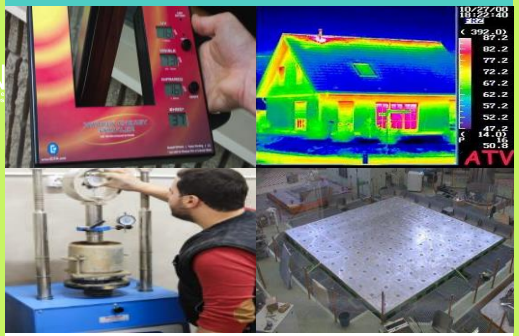
Testing, training and research platform is dedicated to research and development in the field of green buildings, energy efficiency, Smart grids and electrical mobility.

What Does a Smart African City Look Like?

Green & Smart Building Park

GREEN Tech PARKS

Laboratories



Materials characterization and development Lab

Eco-energy design Lab

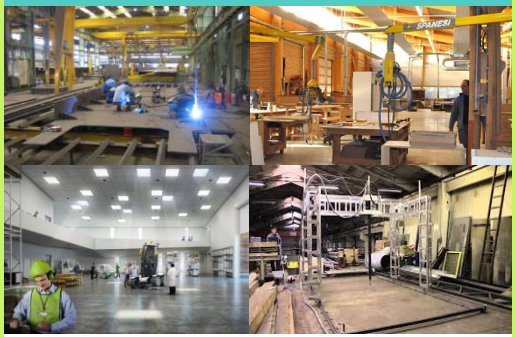
Fablab 5x12m

Seismology Lab

Thermal / acoustic Lab

Smart Grid Lab

Training workshops

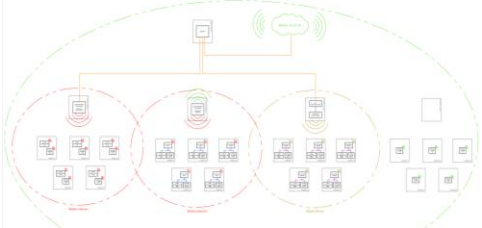


Specialized trainings

Practical workshops

(welding, ironworks, carpentry,..)

Green construction



Smart Campus

25 different student houses (**architecture, materials, BIPV**,..)

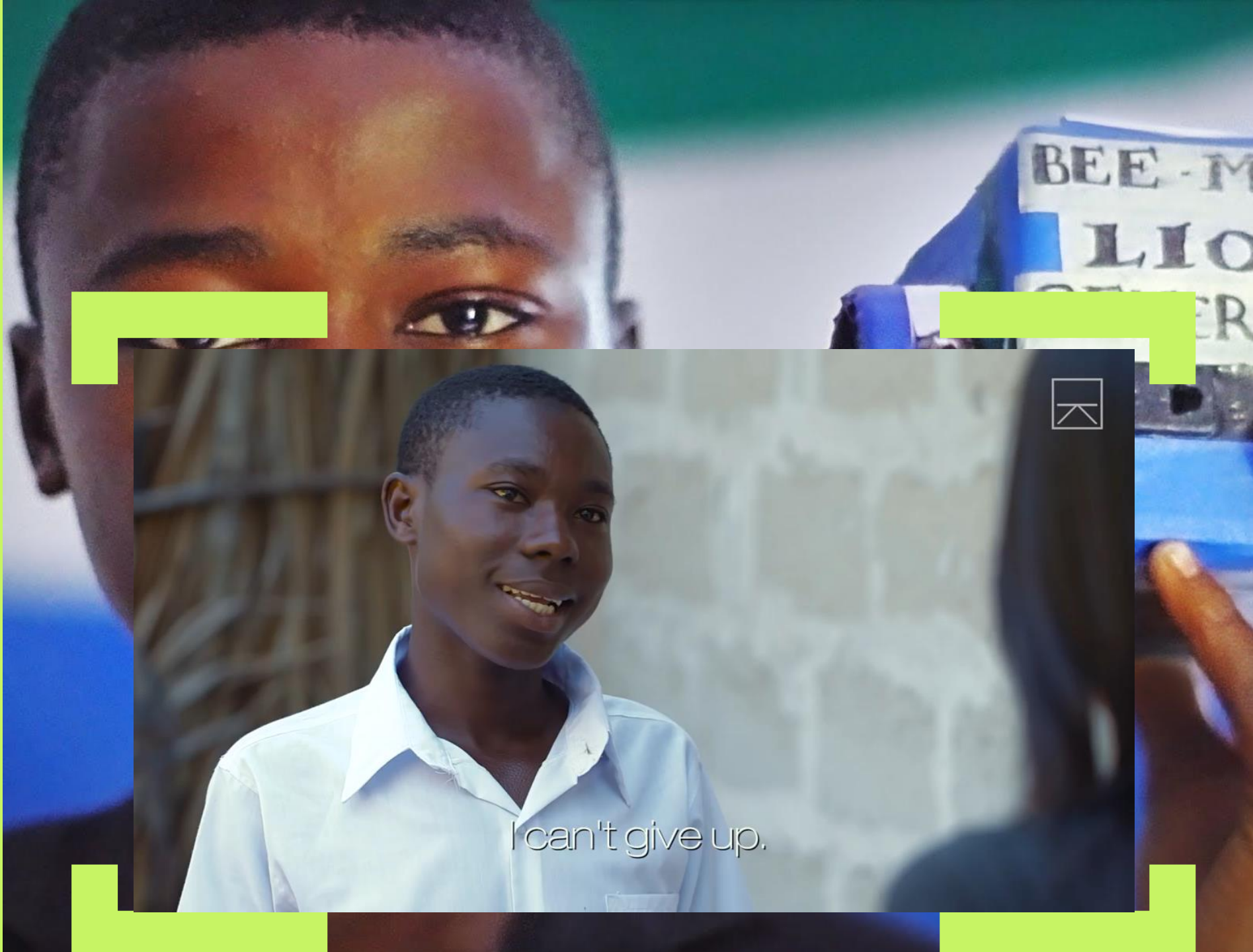
Comparing materials and technologies

5 autonomous smart grids

sustainable mobility

Architecture & handcrafts Museum


TECHPARK
THE GREEN INNOVATION NETWORK
Developing adapted green technologies to help the African Dream happen


I can't give up.

ikken@iresen.org

Thank you

Developing adapted green solutions for the wealth of the future Africa

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