Initiative de Recherche
Accès Universel à l'Energie

1. Accueil par Gilles Vermot Desroches Senior Vice-Président Schneider Electric Sustainability & Inclusive Business
2. Interventions de Anna Creti (Chaire CEC) et Jean-Pierre Ponssard (Chaire EP)
3. Présentation de Arthur Contejean (AIE)
4. Présentation de Ahmed Tritah responsable du programme de recherche
5. Discussion sur des enjeux prioritaires de la recherche

World Energy Outlook 2018

Toward universal access to energy: current landscape and challenges

Arthur Contejean

25 Janvier 2019

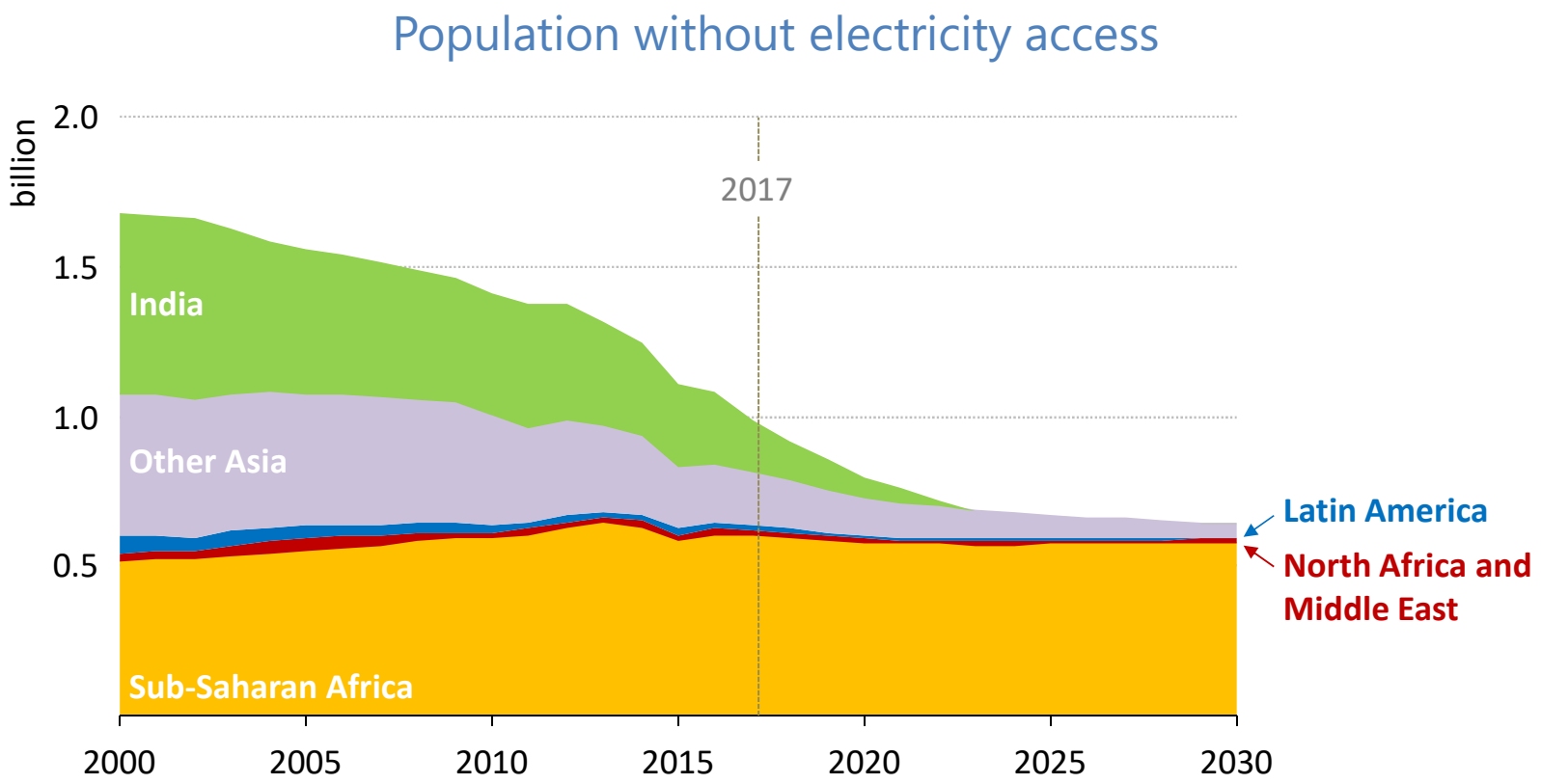
Context

World Energy Outlook 2018

- The 2015 Sustainable Development Goals recognise energy access as the "golden thread" that weaves together human development, economic growth & sustainability
- Yet, IEA finds that in 2017, fewer than 1 billion people lacked access to electricity & 2.7 billion people did not have access to clean cooking
- The declining costs of renewables and digital technologies are transforming the electricity access landscape
- But is this new political momentum & technology progress enough to bring universal access to modern energy?

Progress in electricity access is seen in all world regions, but sub-Saharan Africa lags behind

World Energy Outlook 2018



The world population without electricity access fell below 1 billion in 2017, led by India; but despite recent progress, efforts in sub-Saharan Africa need to redouble

An integrated strategy for energy & sustainable development

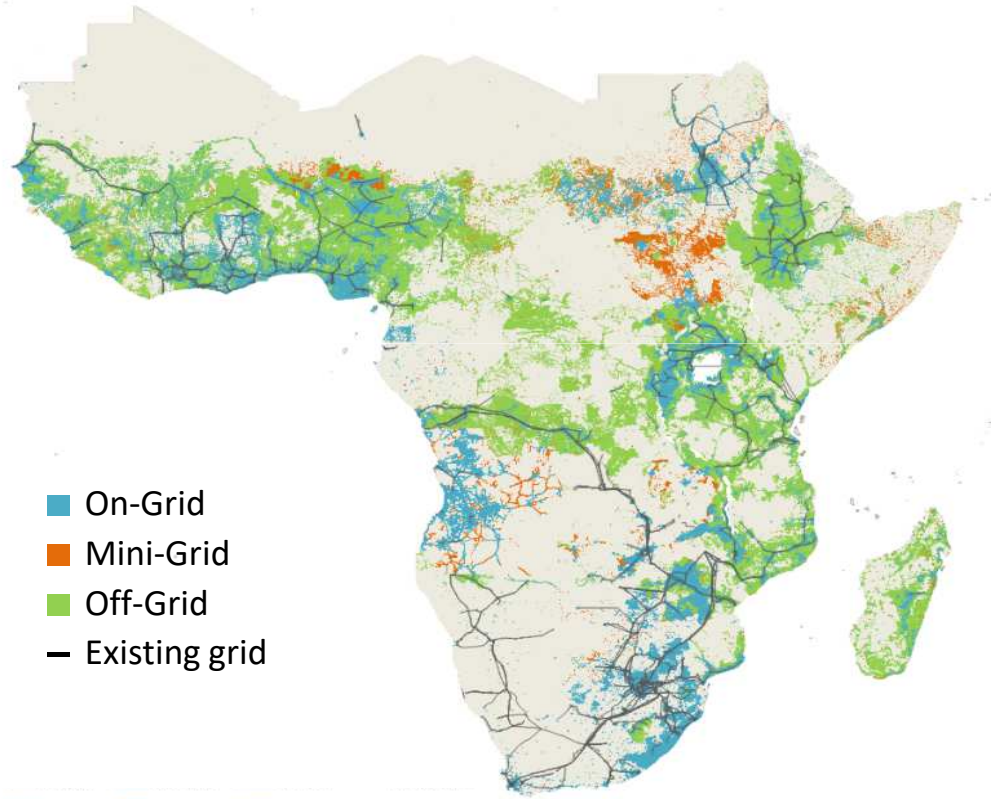
World Energy Outlook 2018

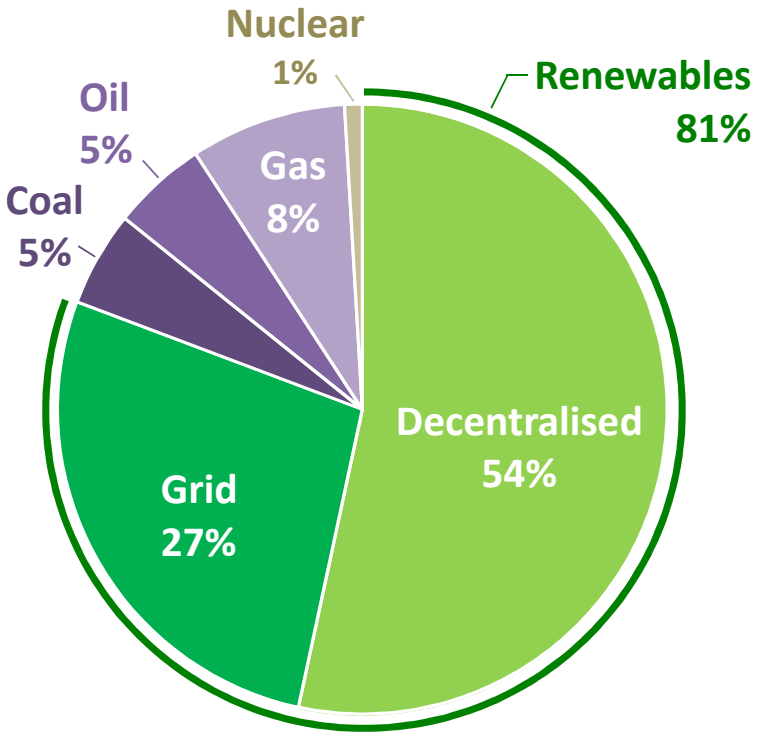
The Sustainable Development Scenario reduces CO_2 emissions while also tackling air pollution, achieving universal energy access

Renewables will be central for providing access

World Energy Outlook 2018

Population gaining access to electricity by source in the Sustainable Development Scenario, 2018-2030



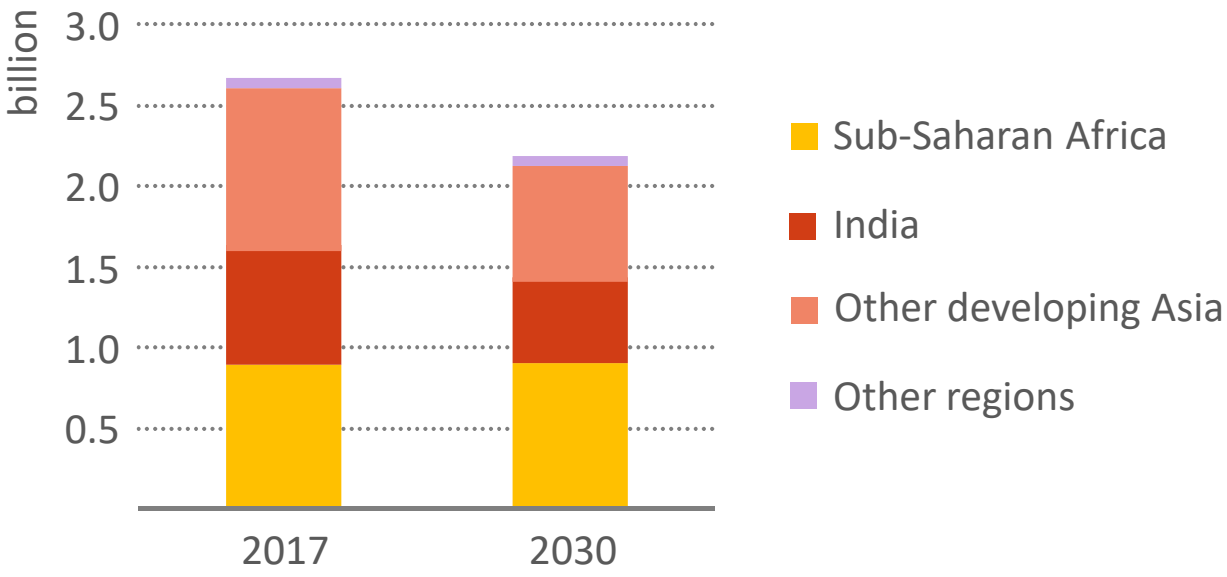


Renewables will play a major role in delivering electricity access, in particular decentralized systems; reaching universal access requires to push them further

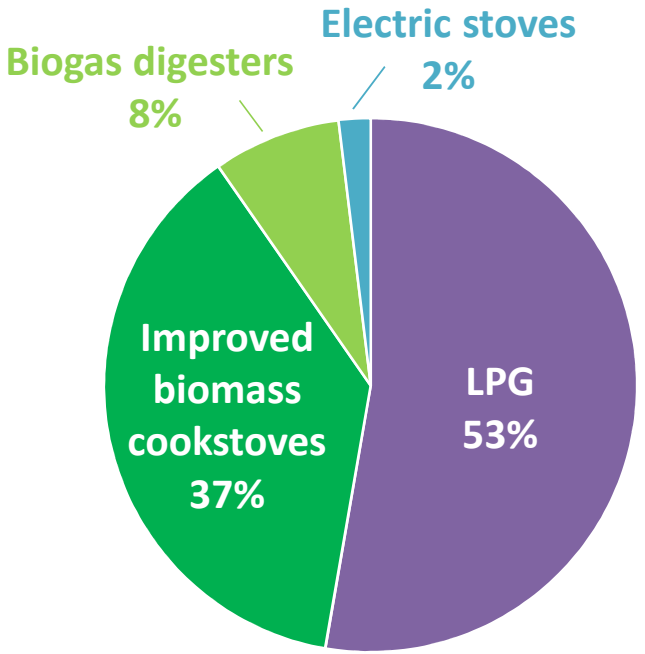
Clean cooking for all: what will it take?

World Energy Outlook 2018

Number of people without access to clean cooking in 2017 and 2030 in the New Policies Scenario



People gaining access by source in the Sustainable Development Scenario, 2018-2030

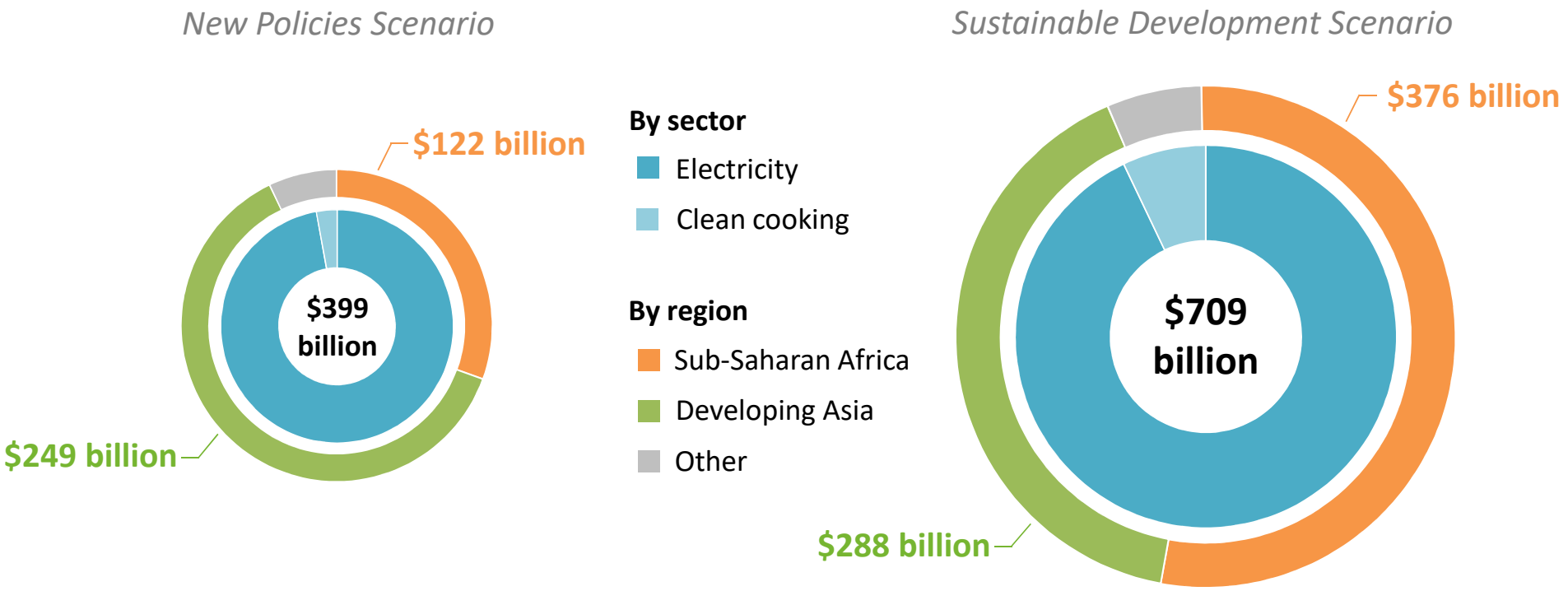


Much more efforts are needed in Asia and Africa to reach universal access to clean cooking by 2030; LPG and improved biomass cookstoves are key options for advancing this goal.

Much more effort should be directed to sub-Saharan Africa to reach universal access by 2030

World Energy Outlook 2018

Total investment in energy access, 2018-2030

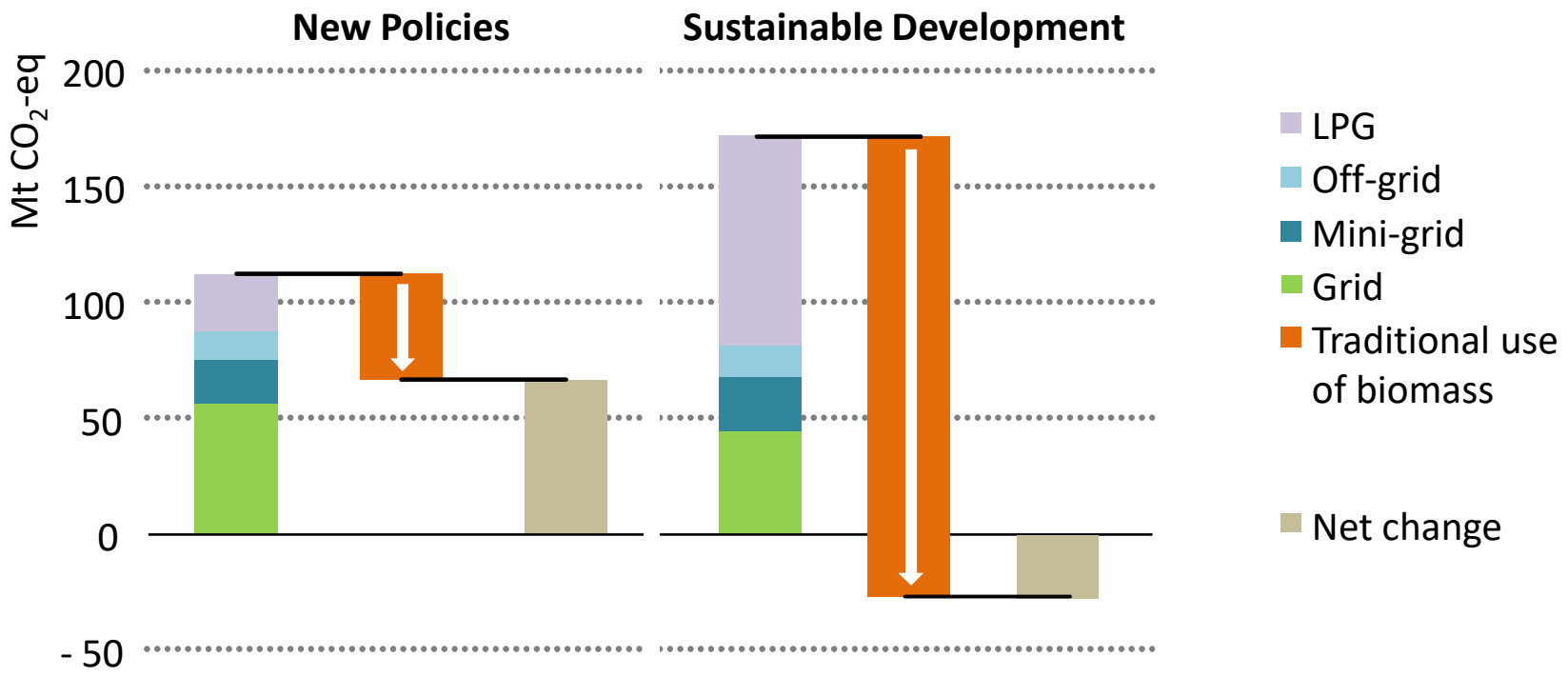


Reaching universal access would require almost double the investment, and 82% of additional investments should go to sub-Saharan Africa

Synergies between energy access and GHG mitigation

World Energy Outlook 2018

Energy access-related GHG emissions in 2030 compared to today by scenario



Higher CO_2 emissions from increased fossil fuel consumption for access are more than offset by a reduction in other GHGs from avoided traditional use of biomass

Conclusions

World Energy Outlook 2018

- **Universal access to both electricity and clean cooking cannot be achieved unless it is elevated on the political agenda, and succeeds to attract more investments, in particular in Sub-Saharan Africa.**

- **Reaching universal access to is essential for achieving the Sustainable Development Goals, especially for improving livelihoods, health, gender equality and education.**

- **Cost declines and innovations in solar and energy efficiency open new and viable rural electrification strategies to "leave no one behind".**

- **The IEA will continue to lead in providing data, analysis and policy guidance to support governments & the international community : our focus for the WEO-2019 will be on Africa.**

Chaire Énergie et Prospérité

DAUPHINE UNIVERSITÉ PARIS
CHAIRE ECONOMIE DU CLIMAT

Joint Research Initiative

"Universal Access to Energy"

Ahmed Tritah, Le Mans Université

Presentation at Schneider Electric

January 25th, 2019

Research scope & motivation

The two challenges of « Universal access to energy »

The economic challenge

1. High growth of the sector is necessary in decades to come to sustained current development dynamics
2. Structural transformation of the economy
3. No stand-alone solution due to a large share of rural/remote and poor populations

The sustainability challenge

1. High reliance on biomass and fossil fuel despite abundance of low carbon energy sources
2. New opportunities to leapfrog from “dirty-energy”
3. Risk of lock-in effects

Research agenda

Three complementary axes

1. **What are the economic, behavioral, financial and regulatory barriers to access?**
   a) Barriers in the supply side of energy
   b) Barriers at the demand side : households and firms
2. **How to leverage the development potential of energy?**
   a) Transmission channels from energy to development (complementary policies, infrastructures and institutions)
   b) Feedback from energy access to resources and emissions
3. **Assessing the validity of business models and public policies taking into account:**
   a) global considerations: new cost-saving technologies, new international actors (China)
   b) local considerations: rural vs urban needs; segmentation of usage, financial capabilities

An excerpt of four advanced current projects

1. Anna Creti and Mamadou Barry : **What are the determinants of off-grid solar technology adoption at the household level?**
2. Emile Tenezakis and Ahmed Tritah: **Electricity access as a vehicle to women and children empowerment in Africa**
3. Nicolas Plain : **Optimisation of microgrids configuration in Africa & Blockchain Technology**
4. Akyl Amiraly : **Leapfrogging services involving information technologies**

Determinants of off-grid solution adoption at the household level: a case study

Anna Creti (U. Paris Dauphine, CEC) and Mamadou Barry (U. Paris Dauphine, CEC)

Data sources

- Pay-As-You-Go service prodiver database in Benin
- Socioeconomic information on consumers collected on facebook account to complete the dataset

Methodology

- Adoption is defined as costumers that have already finished paying the solar panel
- We rely on a binary model to model the determinants of solar panel adoption

Main Results

- Education and Income are keys determinants
- Financial inclusion also increases the probability of adoption
- Geographical patterns in adoption (likely to be adopted by rural population)

Ongoing and future work

•Determinants of off-grid solution adoption at the household level in Tanzania (ongoing)

•The economic costs of power shortages at the firm level (future)

•The welfare effects of access to electricty on children below 5 (future)

Power to empower

Emile Tenezakis (PSE) and Ahmed Tritah (Le Mans Université, Chaire Energie & Prospérité)

- Promoting access to electricity: a current priority of public policies
- Underlying hypothesis: universal access promotes economic development

Is this always the case?

NO

- Electricity consumption is an induced demand : depends on demand of productive assets
- Key issue: in a context of; what is the causal effect of access to electricity on the accumulation of human capital and the work of women and children?
- Why considering these two groups?
  - Under-representation of women in market activities
  - Over-representation of children in production at the expense of educational investments

Power to empower

Emile Tenezakis and Ahmed Tritah

- **The problem of causal inference**: double selection - double treatment
  - Spatial selection of electrified zones / villages: more dynamic zones, better endowed with infrastructures benefit the first ones from electrification programs
  - Same for the selection of households in electrified zones
- **Our contribution**

1. provide control for both levels of selection
2. Account the double treatment:
   a) Electricity benefits connected households: direct effects
   b) Electricity benefits local non-connected people: spillover effects

Data and empirical strategy

- **Data**: 2013-2014 household living conditions surveys in Rwanda,> 26000 individuals, 6824 households in 1013 villages
- **Facts**: No electrified assets in connected areas except for light
- **Theoretical hypothesis**

  light = shock of staffing in time

  productivity shock in domestic production (better daily time management)
- **Empirical evaluation**: econometric methods of impact evaluation (matching + IV)

Results – implications – future research

- **Allocation of domestic time:** less time on household chores (e.g. less time collecting wood)
- **Women**

  connected households: increases women's employment - intensive effect

  spillover effects: female employment in out-of-home households increase
- **Children**

  Positive effect on children's employment, despite less school failure: no trade-off between work and studying!

  No spillover effects
- **Prospect**

  Need to use (Quasi-) experimental approaches for more robust causal inferences (e.g. KivuWatt current project)

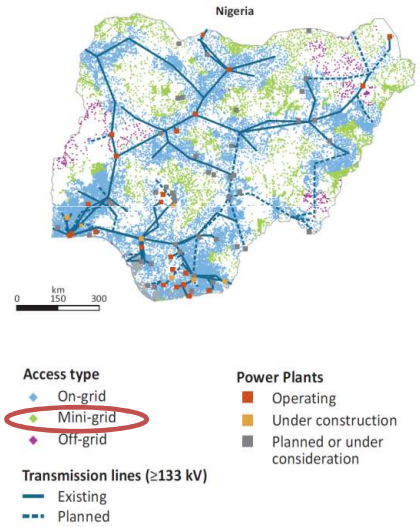
  What public policies to stimulate complementarities between access to energy, the labor market and education?

RENEWABLE ISOLATED MICROGRIDS (MG) FOR RURAL ELECTRIFICATION IN SUB-SAHARAN AFRICA

-

THE QUESTIONS WE ARE INTERESTED IN AS PART OF THE RESEARCH WORK

MG: one of the solutions for access to electricity



World Energy Outlook 2014

How to develop high quality and cost effective MG ?

1. How better:

- Standardize MG projects to reduce costs and accelerate the rate of electrification?
- Integrate the productive uses of electricity (high load factor and in time adequacy with solar production)?

2. Method:

- Knowing the solar resource available throughout the continent
- Define several typical configurations of rural villages in sub-Saharan Africa with associated domestic and productive uses
- Create typical MG configurations [solar panels / batteries / diesel generators] suitable for these villages

How to optimize these typical MG configurations ?

- For each typical MG configuration, what is the optimization of the kWh cost and the ideal quality of service with
  - Number of solar panels
  - Battery capacity
  - Power of the diesel generator
- Depending on the solar resource available, can we consider 100% solar / batteries MG while having a good quality of service and a low cost per kWh?
- What other means can reduce the cost of these configurations?

RENEWABLE ISOLATED MICROGRIDS (MG) FOR RURAL ELECTRIFICATION IN SUB-SAHARAN AFRICA

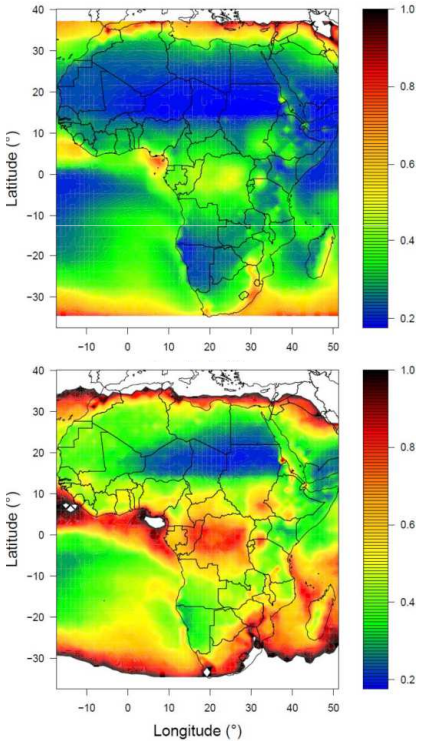
-

THE 3 RESEARCH ARTICLES

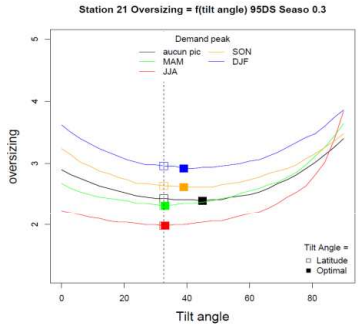
Accounting for low solar resource days to size 100% solar MG power systems in Africa

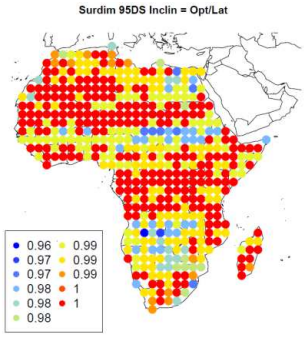
Peak power of solar PV panels (in kWp) needed to achieve a 95% (left) (resp. 99% (right)) quality service level for a 1 kWh daily demand in a 100% solar microgrid power system

(Plain et al. 2019)



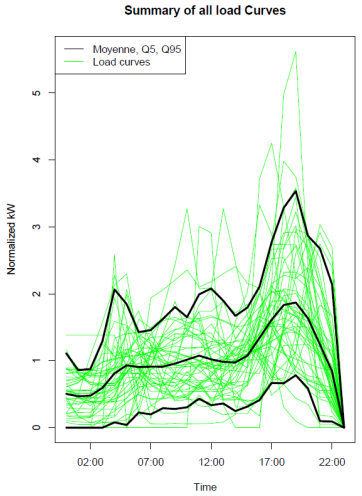
Cost of seasonality for 100% solar MG in Africa & the interest for optimal tilt of PV arrays





Temporal variability of load curves for different configuration of rural villages in Africa

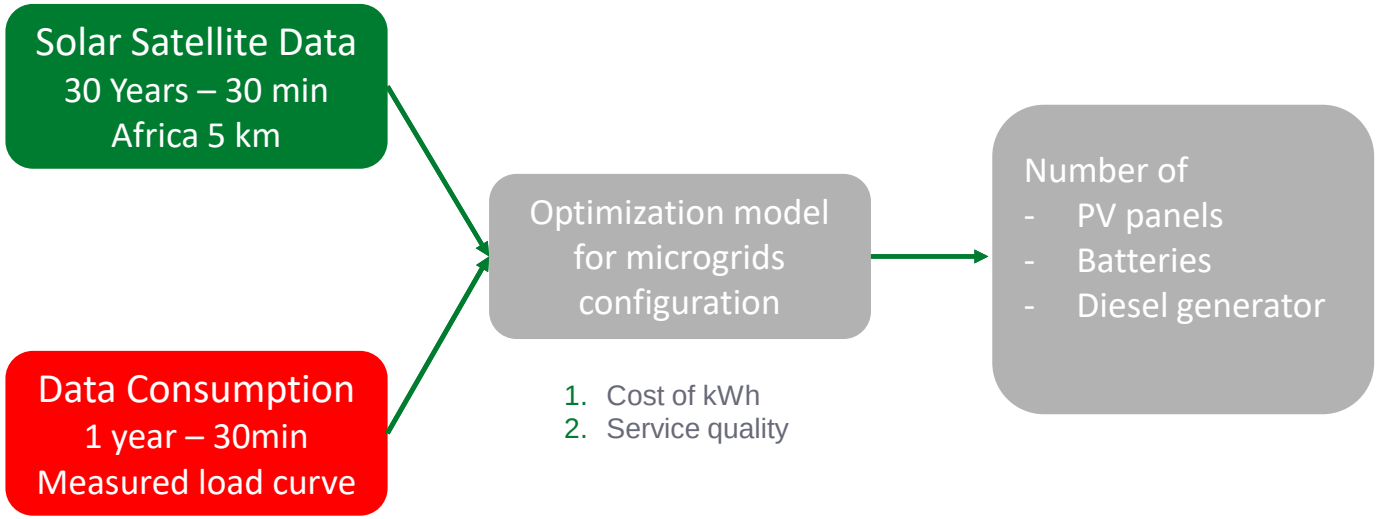
- Inventory of different uses of electricity and associated load curves
- Recovery of load curve data measured in the field



RENEWABLE ISOLATED MICROGRIDS (MG) FOR RURAL ELECTRIFICATION IN SUB-SAHARAN AFRICA

-

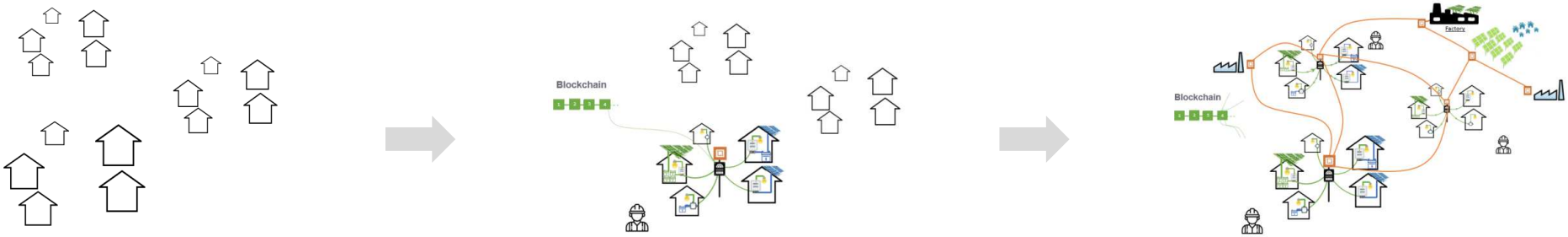
OUR OPTIMIZATION MODEL FOR TYPICAL MICROGRIDS CONFIGURATION



RENEWABLE ISOLATED MICROGRIDS (MG) FOR RURAL ELECTRIFICATION IN SUB-SAHARAN AFRICA

-

OUR WORK ON BLOCKCHAIN TECHNOLOGY



Leapfrogging services involving Information technologies for a better access to Electricity, Delivery and Mobility services in cities of India and East-Africa

Akil Amiraly,
Ecole polytechnique, France
Management Research Centre

Leapfrogging services involving Information technologies
for a better access to Electricity, Delivery and Mobility services
in cities of India and East-Africa:

Entry Point: Information based innovation for Electricity / Mobility services

FOCUS

- **Innovations under study**

  Payment models : prepayment, pay as you go / and Tools :mobile money

  Devices associated with digital platforms (sensors and IoT) and Renewable energies

  Business models : digital market place, market at the doorstep, and new Consumption patterns

Purpose: Assessing the emergence of digital technologies for Electricity/Mobility services

- **Core objective**
  1. **Assessing the development of digital leapfrogging technologies + frugal payment models for access and delivery of essential services**
  2. **Assessing the potential development of electric mobility services**

- **Case studies in 3 sectors:**

  Electricity services : net metering, prepaid metering, second-life batteries use

  Digital platform services

  Doorstep Mobility and Delivery services models

- **3 sub-objectives**

  Identifiying the tools and services harnessing the potential of IT

  Deciphering the logics of action, business models, the sustainability of the projects

  Analyzing the impacts of the payments models on users' consumption practices and income

Leapfrogging services involving Information technologies
for a better access to Electricity, Delivery and Mobility services
in cities of India and East-Africa:

Services identified based on on-going **projects in 3 sectors:**

FOCUS

- **Electricity services (Bangalore, Stone Town)**
  Net-metering involving electricity from the grid and solar energy (Bangalore);
  Prepayment of electricity by end-users based on mobile money (Stone Town);

- **Digital Platform services (Bangalore, Delhi, Nairobi) > Digital Market place**
  Last mile Connectivity with IoT devices for basic service (water tanker: Bangalore);
  Last mile Connectivity for emergency service (fire tanker, ambulance: Delhi, Nairobi).

- **Mobility services (Kigali, Stone Town) Delivery services (Bangalore, Delhi)**
  Last meter Mobility services with mobile money (bus: Kigali; moto-taxi: Stone Town);
  Last meter Delivery with E-rickshaws at the doorstep (Bangalore, Delhi);

Services analyzed from **two angles:**

- **Service providers' angle**:
  Business sustainability /Risks management / Data collection & mgt.

- **Users' angle**:
  Impact of the service on households' Budget and Consumption patterns.

SOLAR
& OFF-GRID
RENEWABLES
AFRICA: EAC & SADC

Leapfrogging services involving Information technologies
for a better access to Electricity, Delivery and Mobility services
in cities of India and East-Africa:

FOCUS

- **Question**
- What are the conditions that make the prepayment system, a model of financial inclusion for a better access to essential services?
- How new forms of payment help to give access to basic services?
- Does it allow people who formerly did not have access to basic services to have access to these services?

- **Refined Questions**
- **Financial inclusion: Definition and operationalization**
- **Business model behind financial inclusion**
- **Trust issue (in relation with the lockouts issue)**
- **Lockouts situation**
- **Paying for product /services beyond essential services**

Overview of on-going projects

1. “The Economic Benefit and Environmental Costs of India’s Coal-Fired Power Plants “ (Geoffrey Barrows)
2. “Socio-Economic Impact of Electricity in Rwanda: quasi-experimental evidence from KivuWatt power-plant” (Ahmed Tritah)
3. Electricity Access, Resilience and Inequality: The case of Tanzania (Ahmed Tritah, Quentin Hounyonou)
4. Is Ethnic Diversity a Tragedy for Public Good Provision in Africa? (Gwen-Jiro Clochard and Guillaume Hollard)
5. “Can CSR Initiatives be Successfully Implemented as Business Opportunities? The case of BoP” (Thomas André and Jean-Pierre Ponssard)
6. Facilitating the access to basic services to middle and low-income groups in Indian cities: The challenges of the financial inclusion and the lockout situation (Akyl Amiraly)

Open discussion

1. interaction on ongoing research and on other unidentified issues
2. internships, expertise
3. conferences, workshops, public events