Food and Agriculture Organization of the United Nations

INTERNATIONAL WORKSHOP
SESSION 1

INVESTING IN ENERGY SUSTAINABLE TECHNOLOGIES IN THE AGRIFOOD SECTOR (INVESTA)

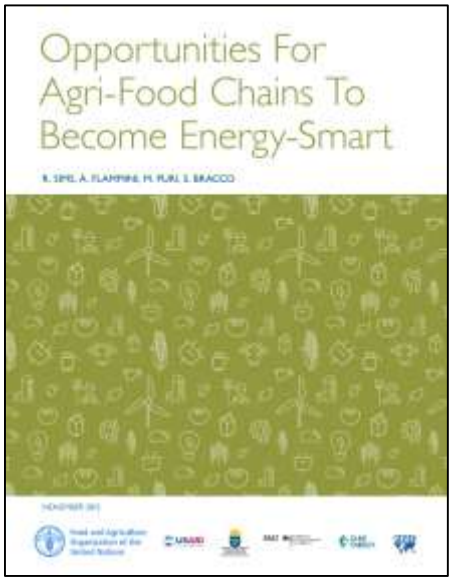
FAO Headquarters, 23-24 November 2017

Stefania Bracco, Expert in Energy-Smart Agrifood Value Chains
Alessandro Flammini, Natural Resources Officer
Jeanette Cooke, Gender expert

PROJECT BACKGROUND

- FAO project, funded by GIZ as a contribution to the Powering Agriculture: An Energy Grand Challenge initiative

- It stems from a previous study which highlighted opportunities for energy interventions in the MILK, VEGETABLE and RICE value chains



AIM OF THE PROJECT

- To provide policy-makers, private investors and financial institutions with an estimation of ‘real’ costs and benefits associated with energy interventions

- Identification of ecosystem conditions (policies, regulations) to promote investments in energy technologies in food chains

- Insights on the appropriate delivery models and financial instruments

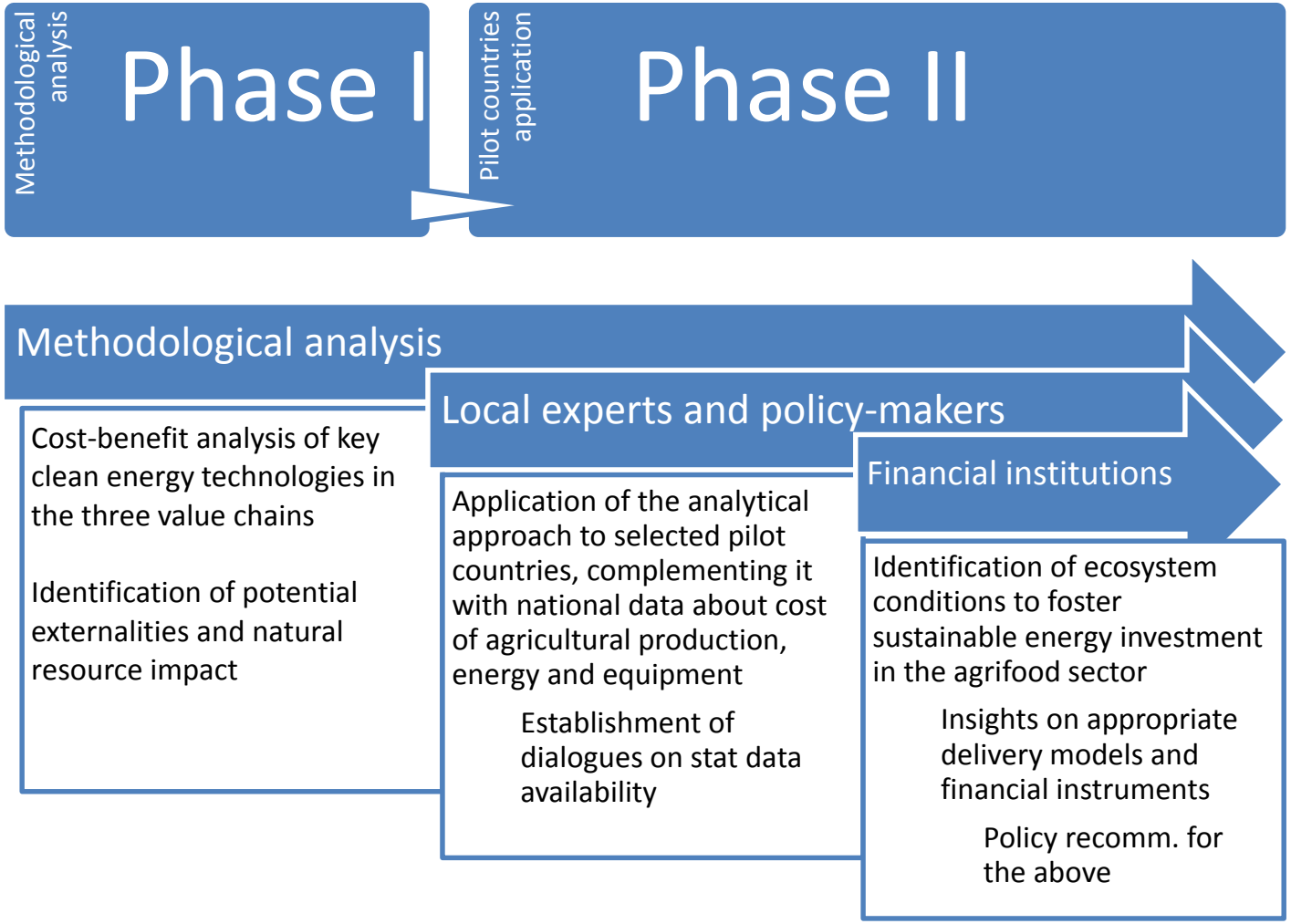
IT INCLUDES

- Methodology to assess financial and economic costs and benefits of energy interventions, including social and environmental impacts, at micro and national level

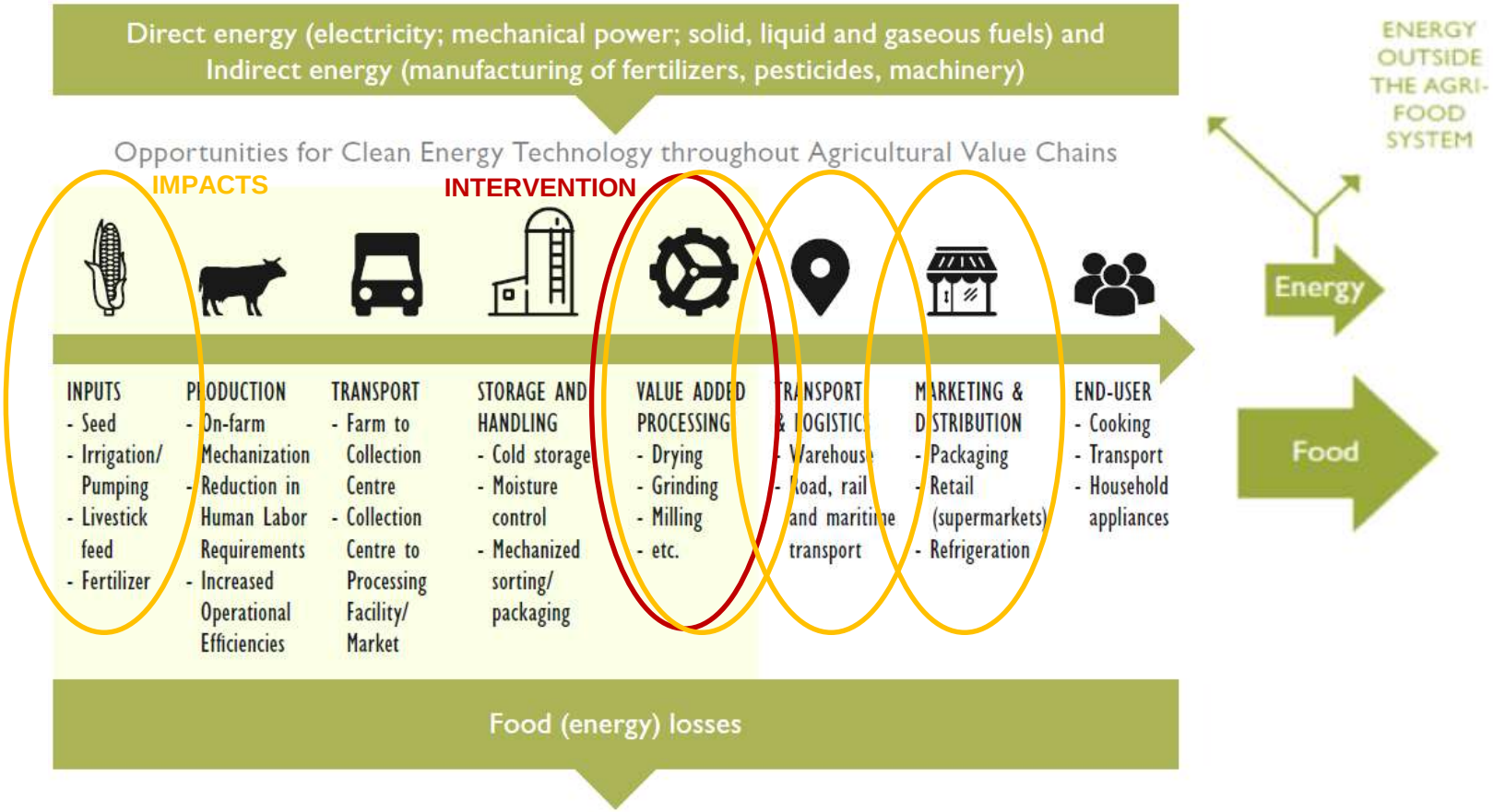
- Country case studies:
  - Kenya, Tanzania and Tunisia for MILK
  - Kenya for VEGETABLES
  - Philippines for RICE

- One national stakeholder meeting in each country (above 200 national stakeholders interviewed; around 90 participated in national discussions)

TWO PHASES


Methodological analysis
Phase I
Pilot countries application
Phase II
Methodological analysis
Cost-benefit analysis of key clean energy technologies in the three value chains
Identification of potential externalities and natural resource impact
Local experts and policy-makers
Application of the analytical approach to selected pilot countries, complementing it with national data about cost of agricultural production, energy and equipment
Establishment of dialogues on stat data availability
Financial institutions
Identification of ecosystem conditions to foster sustainable energy investment in the agrifood sector
Insights on appropriate delivery models and financial instruments
Policy recomm. for the above

VALUE CHAIN APPROACH



METHODOLOGY FOR THE COST-BENEFIT ANALYSIS (CBA) OF ENERGY INTERVENTIONS

Feasibility analysis

Financial CBA

Economic CBA

Sensitivity analysis

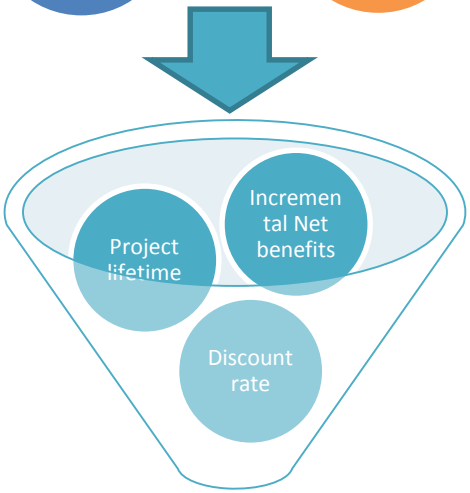
2. FINANCIAL COST-BENEFIT ANALYSIS

"With" - Project scenario

Annual benefits (positive, inflows) + Annual costs (negative, outflows) = Annual net benefit

"Without" - Benchmark scenario

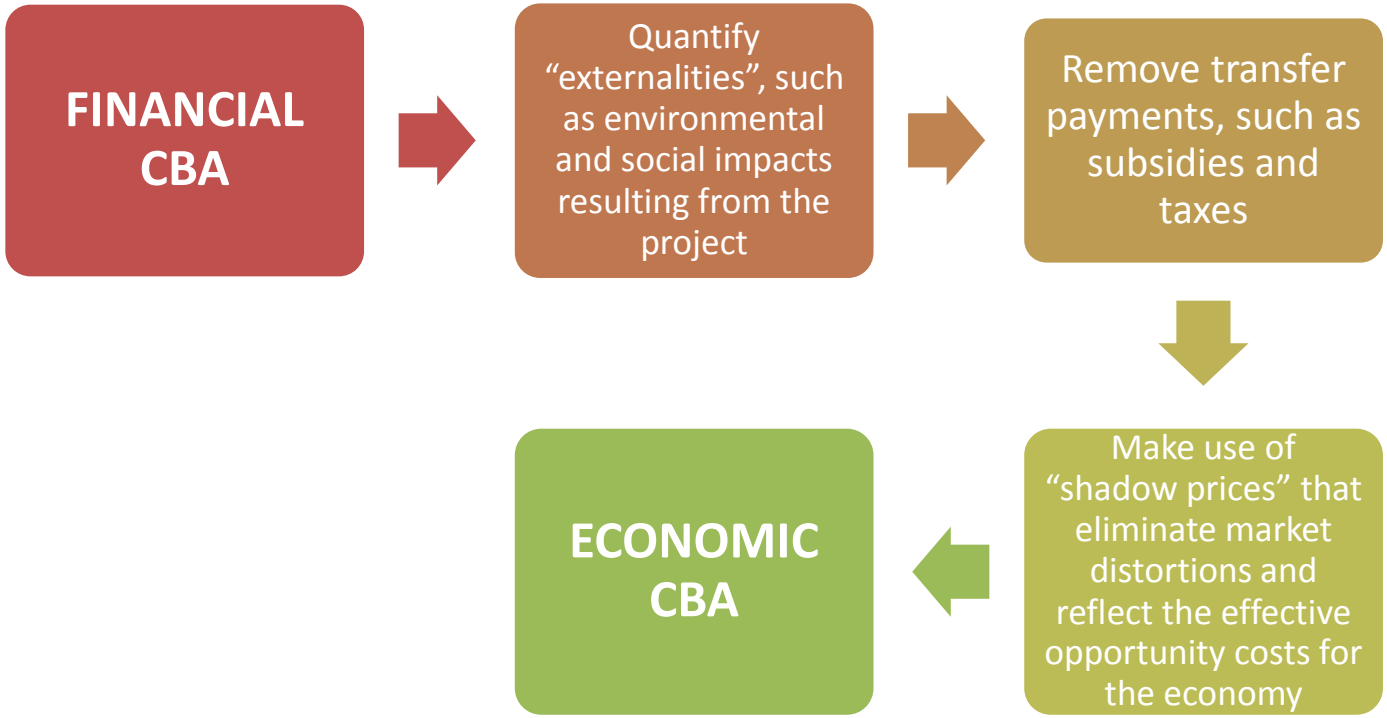
Annual net benefit = Annual costs (negative, outflows) + Annual benefits (positive, inflows)



Profitability indicators

- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Payback time (PBT)

3. FROM FINANCIAL TO ECONOMIC CBA



EXTERNALITIES AND CO-BENEFITS

	Indicators for intervention-level assessment	Indicators for national-level assessment
Environmental impacts	Soil quality	-
	Fertilizer use and efficiency	Fertilizer use
	Indoor air pollution	-
	Water use and efficiency	Water use and efficiency
	Water quality	-
	Food loss	Food loss
	Land requirement	Land requirement
	GHG emissions	GHG emissions
	-	Health risk due to indoor air pollution
	-	Fossil fuel consumption
Socio-economic impacts	Access to energy	Access to energy
	Household income	Household income
	Time saving	Time saving
	Employment	Employment

METHODOLOGY FOR THE COST-BENEFIT ANALYSIS (CBA) AT NATIONAL LEVEL

Technical potential assessment (How many systems can potentially be introduced in the Country?)

Cost-benefits analysis

Data availability (Which data have been used and where do they come from?)

Barriers to market development

TECHNOLOGIES ASSESSED IN THE **MILK** VALUE CHAIN

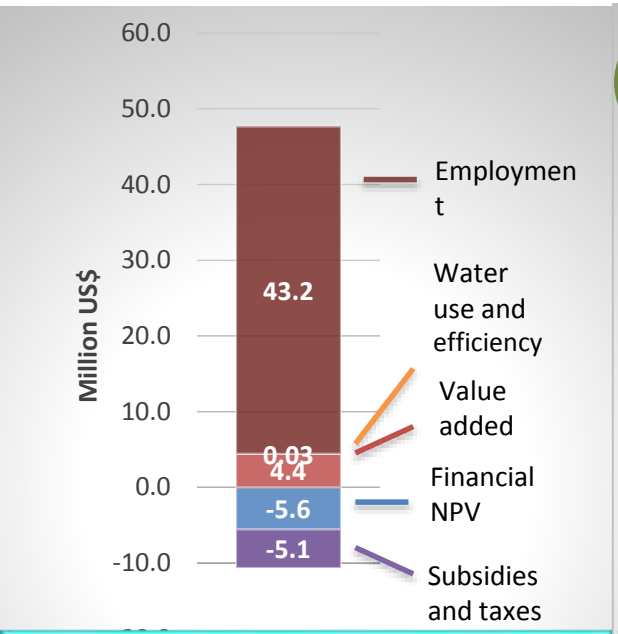
Biogas for power generation from dairy cattle	Biogas-powered domestic milk chiller	Solar milk cooler
• 650 m^3 anaerobic digester and uses cattle manure mixed with crop residues as feedstock • 150 kW_{el} nominal power capacity • Capital cost: around US$ 500,000	• It can only cool up to 20 l of milk per day • Benefits for the farmer arise from increased milk revenues, application of digestate slurry/manure on the farm as a fertiliser, and from using some biogas as a fuel for clean cook-stoves • Capital cost: US$ 1,600 • Lifespan: 20 years digester, 10 years milk chiller	• It can chill and store 500 - 2,000 l of milk per day relying just on solar power • Assumed capacity: 600 l • The system is a compound unit • Capital cost: US$ 40,000

SOLAR MILK COOLER

Cost-benefit Analysis

Tunisia

intermediate step between small farmer groups and MCCs



INITIAL INVESTMENT OVER 20 YEARS:

US$ 23 M for 580 systems

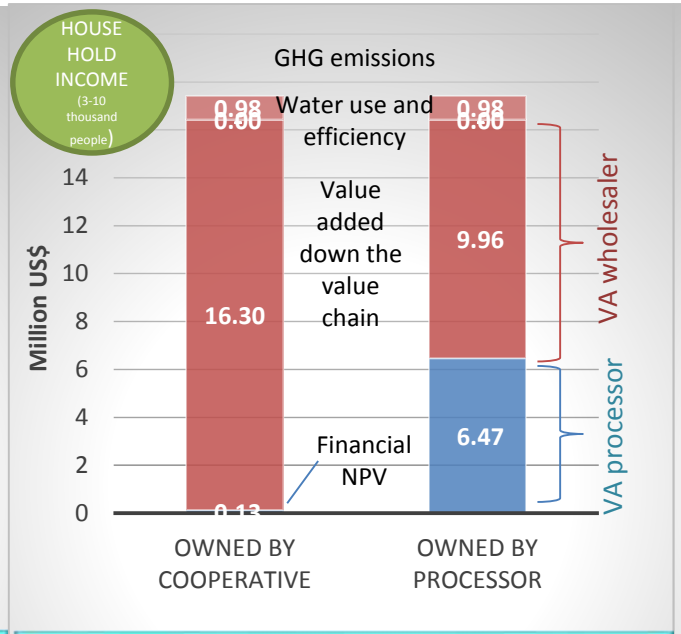
FINANCIAL IRR: 5%

FINANCIAL NPV: US$ -6 million

ECONOMIC NPV: US$ 37 million

Tanzania

for milk off-grid existing milk collection centres (MCCs)



INITIAL INVESTMENT OVER 20 YEARS:

US$ 5 M for 128 systems

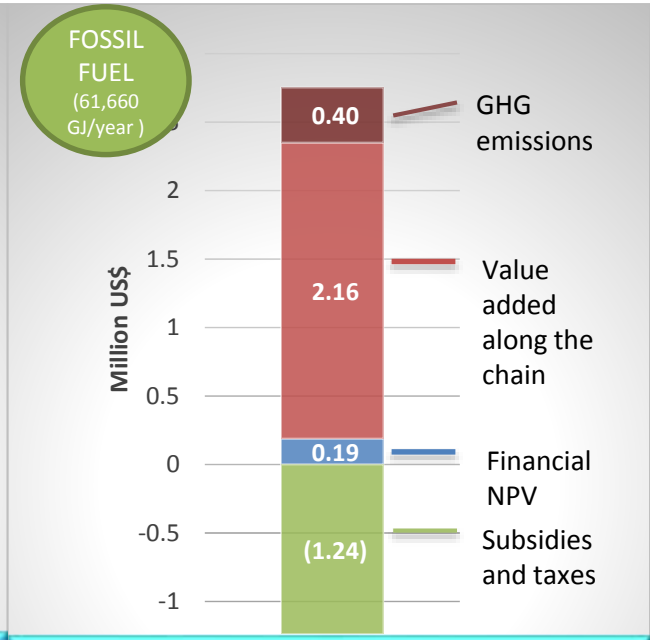
FINANCIAL IRR: 16% / 38%

FINANCIAL NPV: US$ 0.1 million / 6.5 million

ECONOMIC NPV: US$ 17 million

Kenya

replacing 10 kW diesel generator + DX cooler



INITIAL INVESTMENT OVER 20 YEARS:

US$ 5 M for 125 systems

FINANCIAL IRR: 12%

FINANCIAL NPV: US$ 188 thousand

ECONOMIC NPV: US$ 1.5 million

TECHNOLOGIES ASSESSED IN THE **RICE** VALUE CHAIN

Rice husk gasification (RHG)	Solar-powered domestic rice processing
• 100 kW_{el} rice husk gasifier connected to a rice mill (with dry ash removal and dry gas filter technology) • The system consumes up to 120 kg of biomass per hour • Capital costs: about US$56 thousand • Lifetime of the system: 10 years	• Solar-powered domestic-scale rice processing and milling equipment for up to 120 kg/day • The technology also improves rice quality if compared to old diesel-powered millers due to lower damage of grains • Capital cost (including huller, polisher, PV modules and modules' holder, battery, electrical cables and accessories, charge controller): US$4,850 • Lifetime: 20 years

RICE HUSK GASIFICATION
Cost-benefit analysis

FOSSIL FUEL (150 thousand TJ/year)

FERTILIZER USE

INITIAL INVESTMENT
OVER 10 YEARS
US$ 4 M
For 75 systems

	1 shift (8h/day)	2 shifts (16h/day)	2 shifts with SAGR
FINANCIAL IRR	0%	24%	25%
FINANCIAL NPV	US$ -6.5 Million	US$ -7.7 Million	US$ 8.6 Million
ECONOMIC NPV	US$ -1.1 Million	US$ 3 Million	US$ 3.2 Million

TECHNOLOGIES ASSESSED IN THE **VEGETABLE** VALUE CHAIN

Solar cold storage for vegetables	Solar-powered water pumping for vegetables
• 25 m^3 refrigerated cold storage system, designed for tomatoes and green beans and powered by electricity from a 11 kW_p solar PV array. • The system is built in a 20 feet container • Capital cost: around US$ 115 thousand	• The water pump used for the case study is equipped with a 80 W_p panel for pumping up to 1,200 l / day from a maximum depth of 8 m and suitable for irrigating 0.2 ha • Capital cost: US$ 650 (incl. 2 years services + maintenance) • Lifetime: 10 years

Tomato is the second leading vegetable in Kenya and has a very perishable nature -> high losses from over-packing and transport
Green beans are less perishable but are typically directed to the export market and therefore have to meet high quality requirements

MAIN POLICY AND REGULATORY AREAS

- For each technology assessed and type of technology (renewable heat and electricity generation at the commercial scale, medium-scale systems for small enterprises or farmer cooperatives, domestic-scale systems), the main policy and intervention areas were identified on the basis of the national stakeholder discussions

Target setting	"Sticks": Regulatory schemes	"Carrots": Financial incentive schemes	"Guidance" Knowledge and education schemes
e.g. Overall or sector-specific targets	Standards and mandates; Tax impositions; Emissions trading schemes	e.g. Capital grants; Operating grants; Soft loans and loan guarantees; Tax credits and planning cost reductions; Tax reductions	Information and promotion; Training

- Most of them are linked to the need to **develop and enforce quality standards, environmental safeguards**, put **REs on a level playing field** with FF, and develop a **market for co-products**

BUSINESS MODELS AND RISK MITIGATION

- For each case study, the business model options and intervention areas were presented along with their pros and cons: a very diverse combination of ownership (farmer, farmer group, community, processor, JV..) and models (own use, service fee, ESCO model,…)

- Financing instruments to hedge risks presented and discussed:
  - guarantee instruments;
  - currency risk mitigation instruments; and
  - liquidity risk mitigation instruments.

A SPECIAL FOCUS ON GENDER

Gender-sensitive approach

- ***Why*?** For inclusive, equitable and sustainable development
  - In agriculture / value chains / the energy sector
  - It makes business sense
- **Benefits** for women, her family and community
  - Time saving / Better health, nutrition, wellbeing / Increased income / More influence in decision-making / Greater resilience
- **Risk**
  - Gender blind investment ≠ gender neutral outcomes

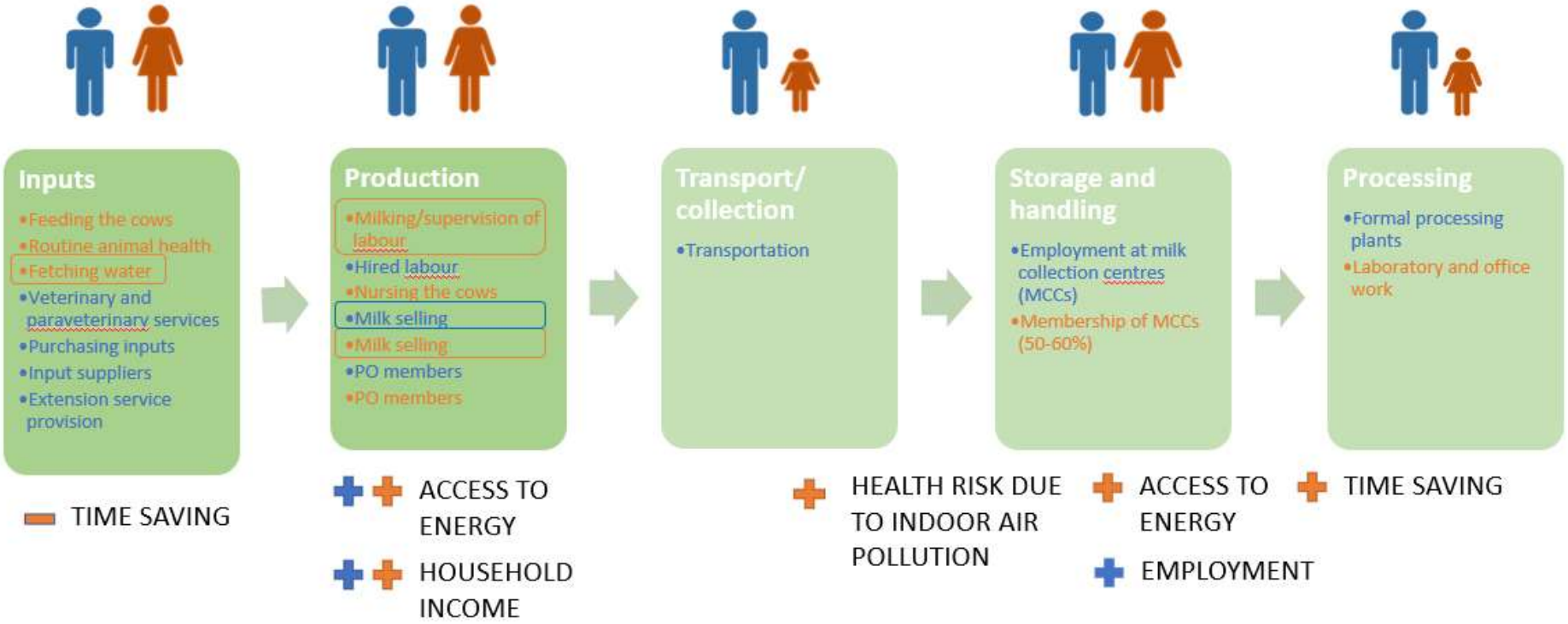
Methodology

Dimensions of women's economic empowerment

- Access to productive resources, including assets, agricultural services and financial services
- Power and agency concerns capabilities, self-confidence and decision-making power

Limitations

EXAMPLE: Gender-sensitive value chain mapping and analysis of Biogas domestic milk chiller, Kenya



Barriers and policy recommendations

to promote gender equality and women's empowerment (1)

BARRIERS	POLICY RESPONSE
• Lack of country-level information for gender analysis	• Facilitate collection of sex-disaggregated data
• Technologies can be unresponsive to women's needs • Inequitable access to information	• Mainstream gender considerations throughout innovation cycle and marketing
• High investment costs for women-headed households and women in male-headed households	• Improve women's secure access to land • Support financial and business literacy • Develop gender responsive financial services

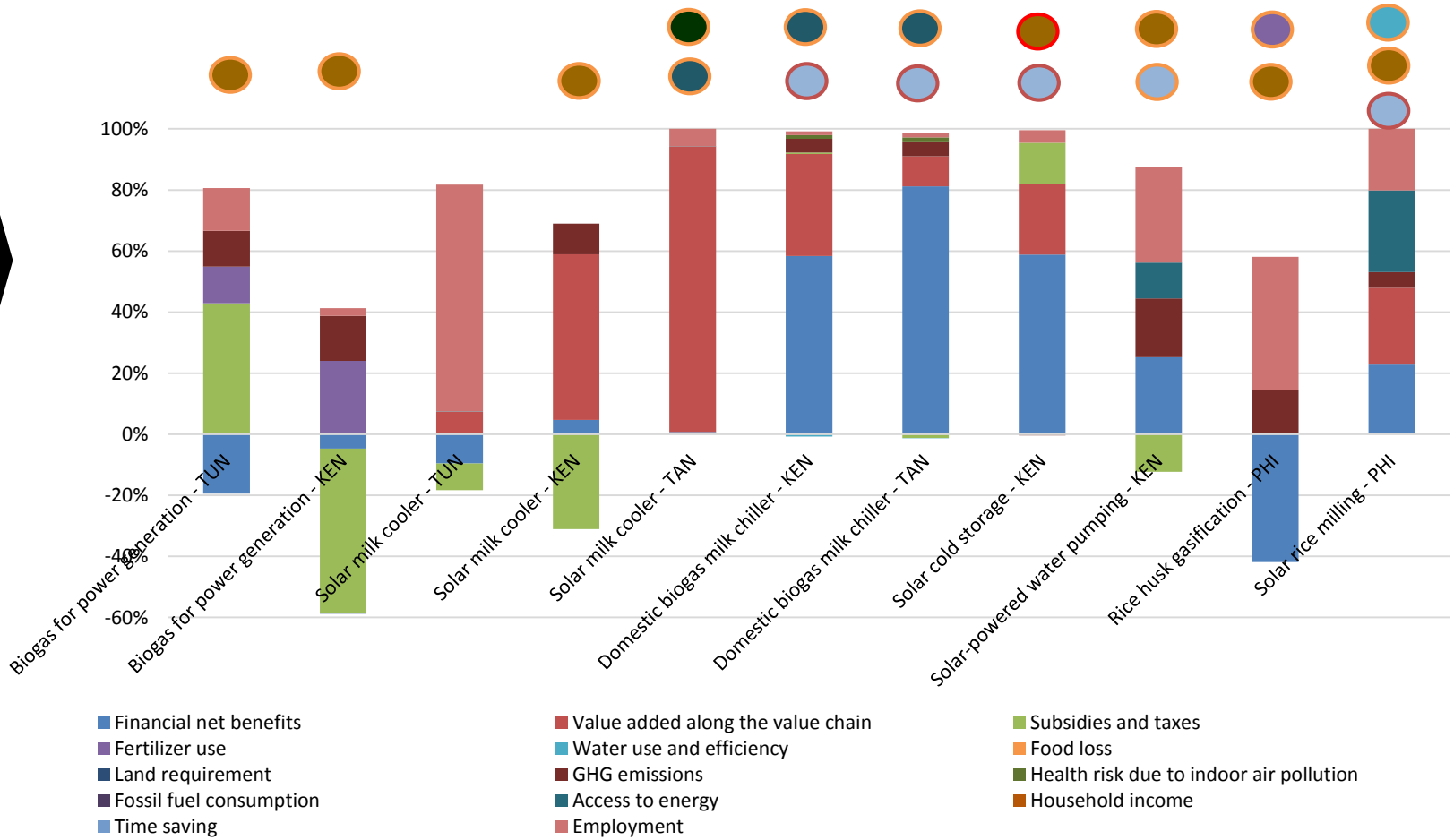
Barriers and policy recommendations

to promote gender equality and women's empowerment (2)

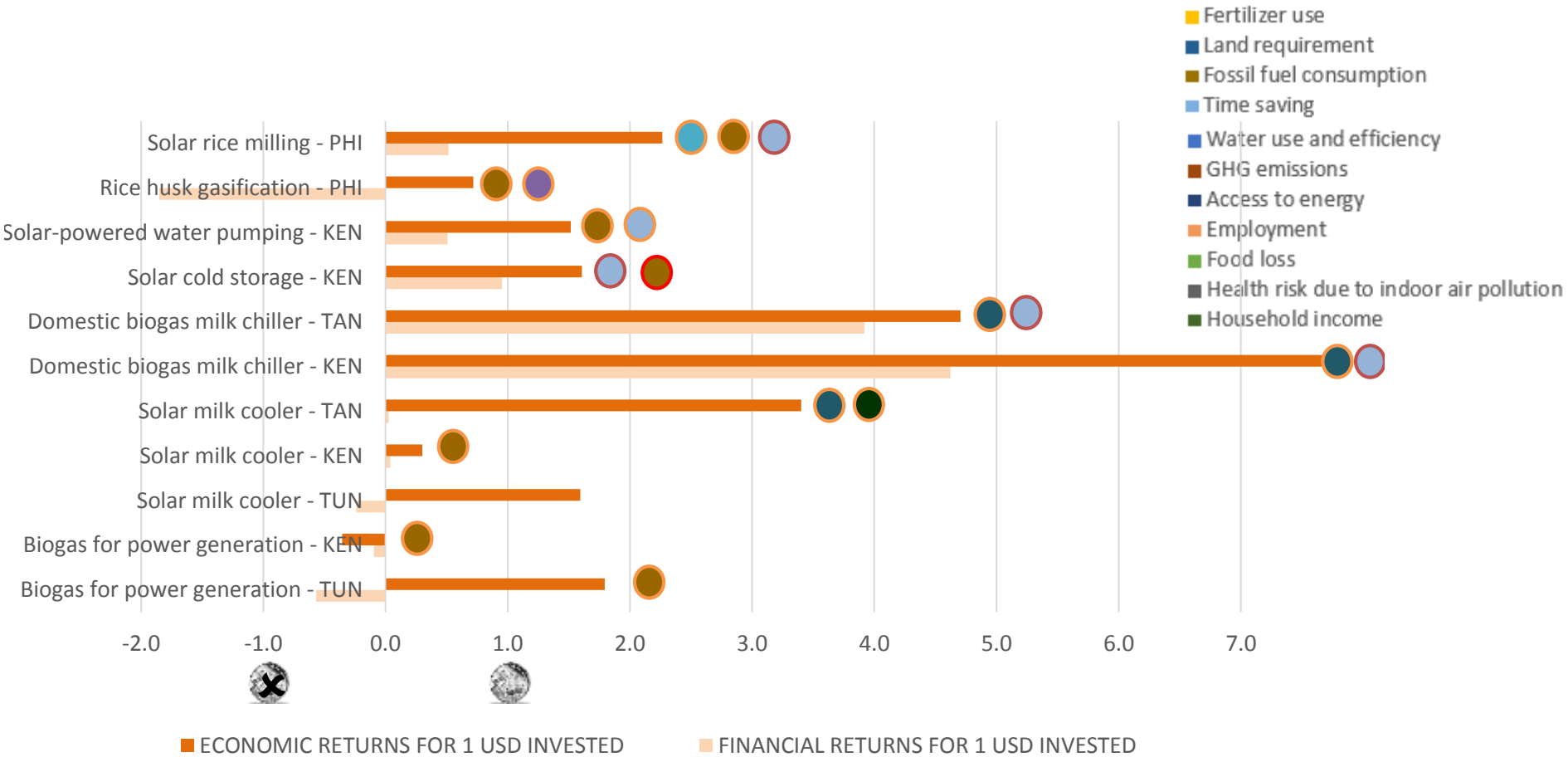
BARRIERS	POLICY RESPONSE
• Inequitable access to cooperatives between men and women	• Facilitate gender equitable and single-sex cooperatives
• Shortage of managers and skilled technicians in rural areas. Those available are often men.	• Build the capacity of men and women to hold these roles. Promote girls and boys education in STEM fields. • Develop support services and supply chains that are accessible, affordable and operated by men and women

BENEFITS DISTRIBUTION

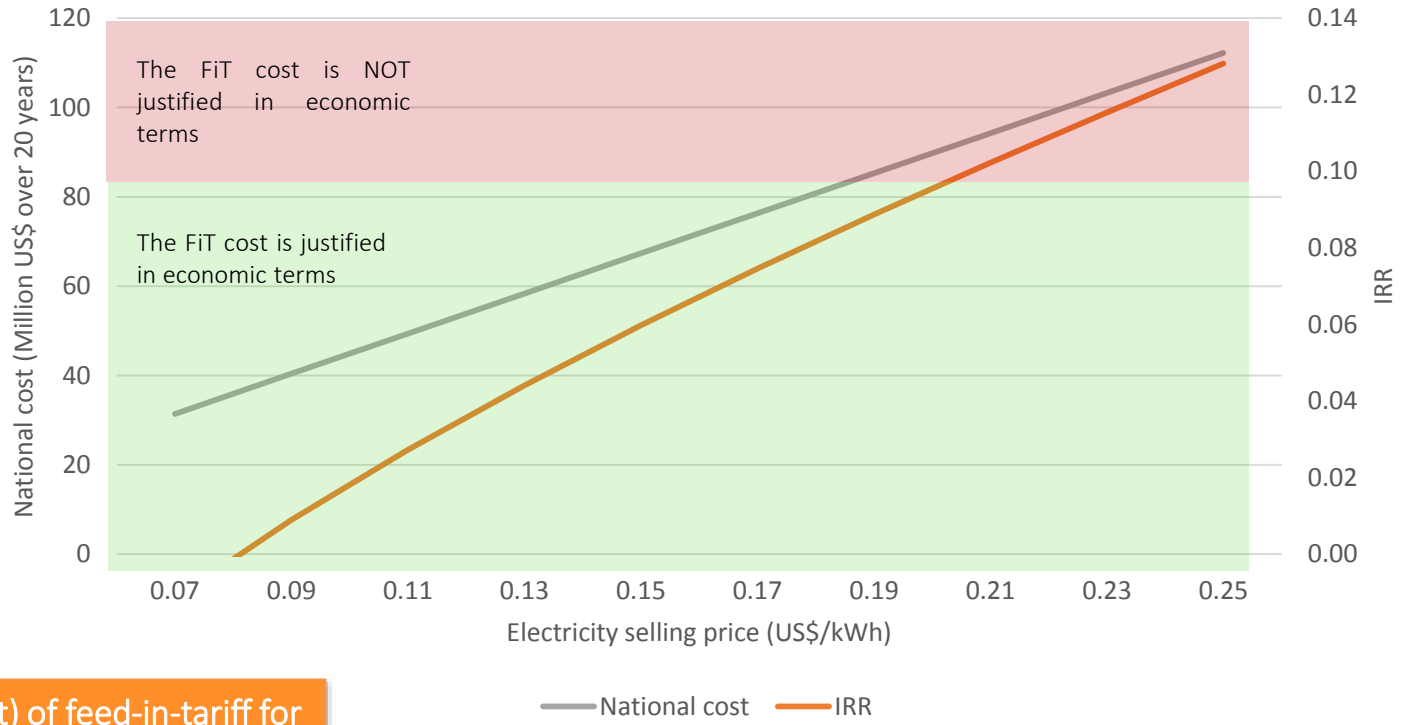
- What share of my grant will have an impact on…. employment creation? What kind of employment? Typically women jobs?



ECONOMIC VS FINANCIAL BENEFITS



SUPPORT LEADING TO POSITIVE ECONOMIC RETURNS

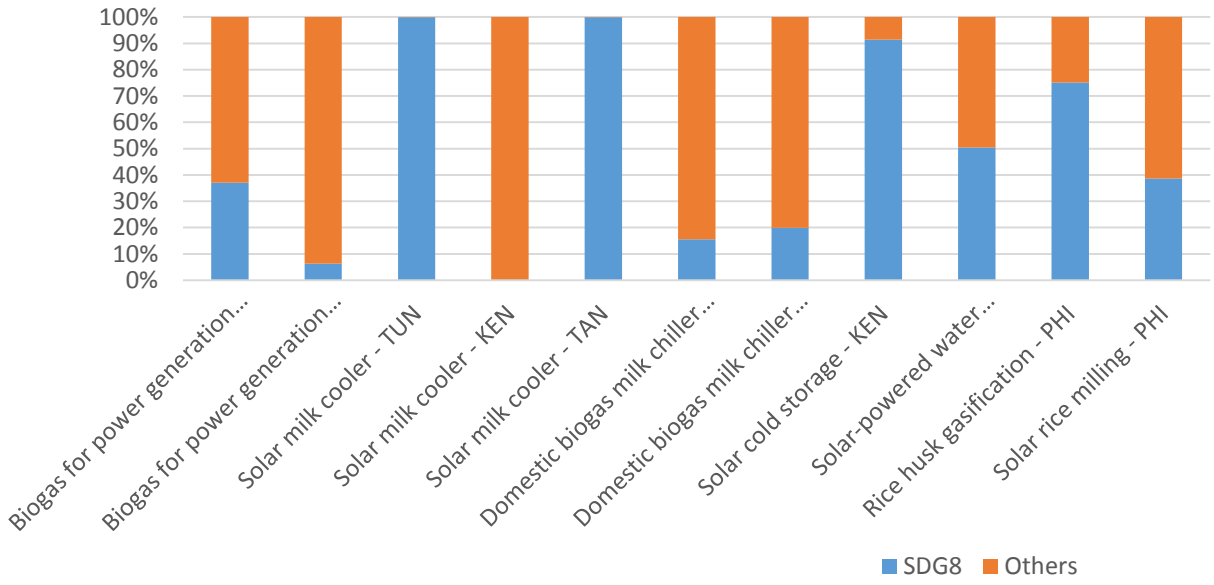


National cost (left) of feed-in-tariff for 'biogas for power from dairy cattle manure' in Tunisia (assuming 73 systems) and financial IRR (right)

CONTRIBUTION TO SPECIFIC THEMATIC PRIORITIES OR SDGs

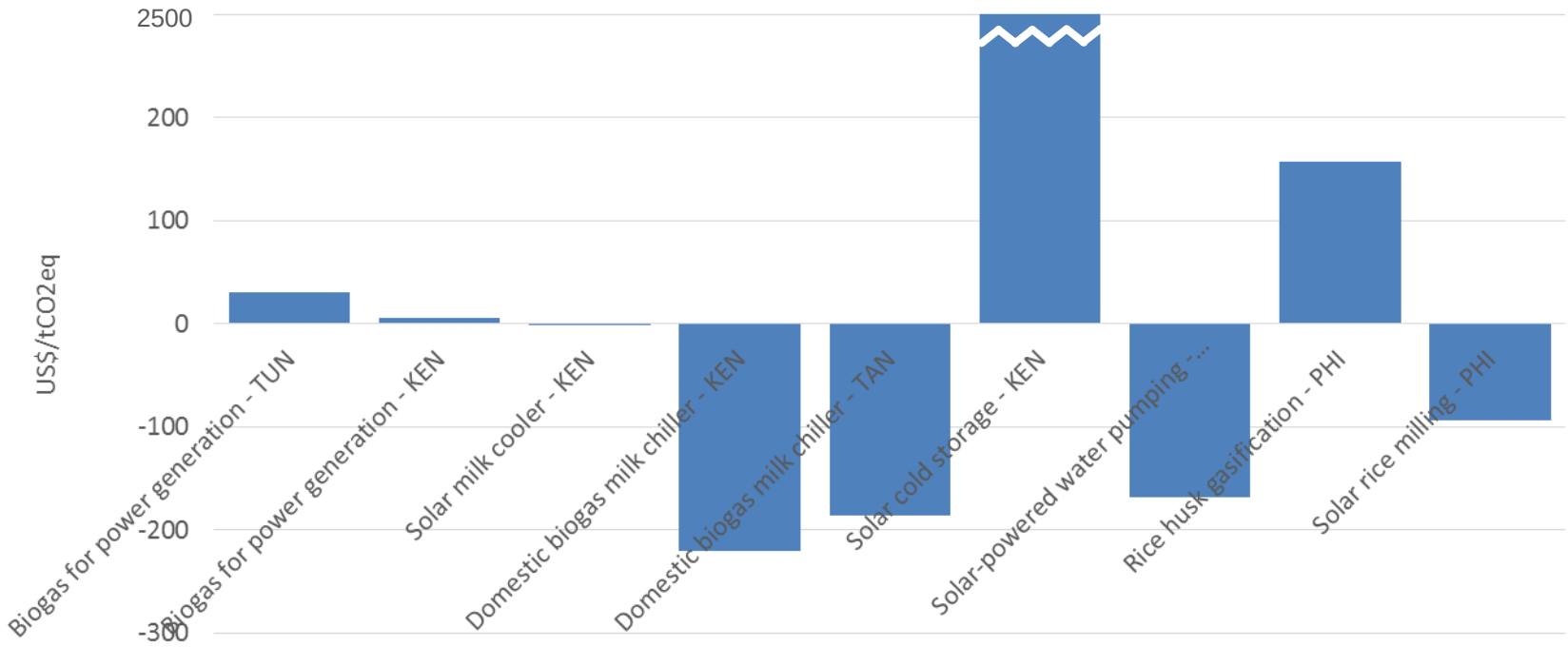
- What share of initial investment will have an impact (positive or negative) on… SDG8 (Decent Work and Economic Growth) ?

ENERGY INTERVENTIONS ⟷ INDICATORS ⟷ SDGs/Targets



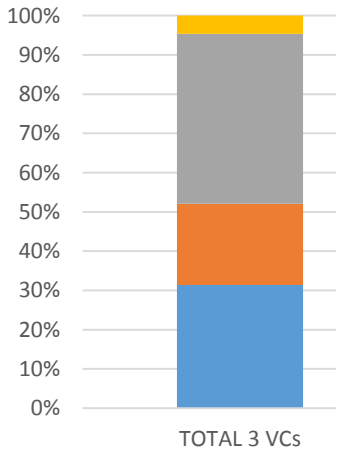
- FINANCIAL NPV
- V.A. FOOD CHAIN
- SOIL QUALITY
- ACCESS TO ENERGY
- HOUSEHOLD INCOME
- TIME SAVING
- EMPLOYMENT

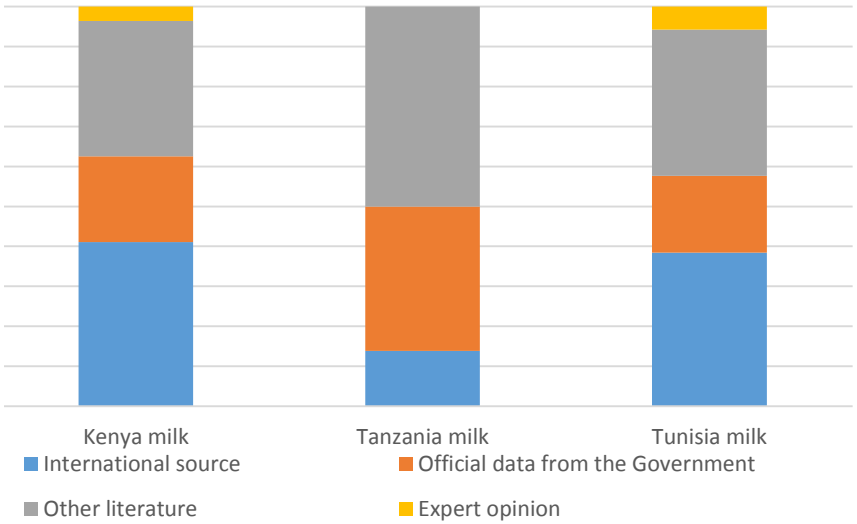
..OR MITIGATION COST



DATA AVAILABILITY

- About half of the country-specific data needed for the 11 CBAs come from international databases or official data





FOR FINANCING INSTITUTIONS

- It ensures that support leveraged by projects gives equal recognition to financial attractiveness (to the investor) and other sustainable development benefits (non-financial returns)

- The effort has a value *per se*, since it incentivizes project developers to think differently (Capacity building)

- Improved accountability for improved Result Based Management, to maximise the effectiveness of financial support to contribute to donor objectives, SDGs, other env and soc targets

FOR POLICY-MAKERS/REGULATORS

- Options are screened/prioritized on the basis of the ‘real’ returns – from the ‘public’ perspective
- Insights on the main barriers hindering the adoption of energy-smart food technologies and policy options to overcome them
- The recommendations provide scope for further cooperation with international organizations such as FAO, GIZ, PAEGC partners and financing institutions

FINDINGS AND RECOMMENDATIONS

- 23 general recommendations for national policy-makers and regulators covering:
  - Financial versus economic returns
  - Regulatory framework
  - Mechanisms to foster investments
  - Gender equality
  - Data gaps

- Most of them are linked to the need to **develop and enforce quality standards, environmental safeguards**, put **REs on a level playing field** with FF, and develop a **market for co-products**

THEY WILL BE DISCUSSED IN MORE DETAIL DURING THE WORKSHOP

POWERING TUNISIAN AGRICULTURE WITH RENEWEBALES ENERGIES

AFEF BEN REJEB

DEPUTY DIRECTOR

MINISTRY OF AGRICULTURE WATER RESOURCES AND FISHERIES

TOWARDS THE EXPANSION OF RE IN TUNISIAN AGRICULTURE SECTOR…

- WHY TRANSITION TO RENEWABLE ENERGY ?
- WHAT ARE THE OPPORTUNITIES FOR THE USE OF RES AND THE ISSUES THAT HINDER THEIR DEVELOPMENT ?
- PILOTS PROJECTS
- WEAKNESSES AND STRENGTHES
- RECOMMANDATIONS

TUNISIAN DAIRY SECTOR

AT THE SOCIAL LEVEL

- 40% OF WORKING DAYS IN THE AGRICULTURAL SECTOR
- STABILIZATION OF BREEDERS IN PRODUCTION AREAS (112 THOUSAND BREEDERS, REPRESENTING 30% OF BREEDERS)
- ENSURE FOOD SECURITY
- SOURCE OF RAW MATERIALS FOR FOOD INDUSTRIES

AT THE ECONOMIC LEVEL

- 11 % OF THE VALUE OF AGRICULTURAL PRODUCTION
- 25% OF THE VALUE OF ANIMAL PRODUCTION
- 7% OF THE VALUE OF FOOD INDUSTRIES

⇨ TOTAL ELECTRICITY CONSUMPTION OF THE AGRICULTURAL AND AGRI-FOOD SECTOR : **2882 GWh**

⇨ TOTAL PHOTOVOLTAIC POTENTIAL IN THE AGRICULTURAL AND AGRI-FOOD INDUSTRIES

- POTENTIEL BRUT (MWC) : **1100**
- POTENTIEL EXPLOITABLE (MWC) : **315**

WHY TRANSITION TO RENEWABLE ENERGY ?

✓ **REASONS**

- CONTINUOUS AND SIGNIFICANT INCREASE IN ENERGY CONSUMPTION AND COSTS DUE TO RISING STANDARD OF LIVING AND DEVALUATION OF THE LOCAL CURRENCY
- CONTINUOUS DEPLETION OF LOCAL FOSSIL RESOURCES
- DEPENDENCY ON IMPORTS WITH A RATE OF AROUND 60%
- SIGNIFICANT POLLUTION CONTRIBUTING TO CLIMATE CHANGE

✓ **GOALS:**

- IN ADDITION TO REDUCING ENVIRONMENTAL POLLUTION AND STRENGTHENING THE SECURITY OF SUPPLY, SUSTAINABLE ENERGIES ARE EXPECTED TO CONTRIBUTE TO:
  - ENERGY SECURITY;
  - REDUCE THE NATIONAL NEGATIVE ENERGY BALANCE;
  - INCREASED LOCAL ADDED VALUE AND JOBS CREATION
  - PRODUCTION COSTS REDUCTION

WHAT ARE THE OPPORTUNITIES FOR THE USE OF REs AND THE ISSUES THAT HINDER THEIR DEVELOPMENT ?

✓OPPORTUNITIES:

- TUNISIA SET UP, FROM THE MIDDLE OF THE YEARS 1980, A POLICY OF ENERGY CONTROL. THE IMPLEMENTATION OF THIS POLICY IS BASED ON FOUR INSTRUMENTS: INSTITUTIONAL, REGULATORY, FINANCIAL AND TAX:
  - THE LAW OF DECEMBER 2015 WHICH PAVED THE WAY FOR THE LIBERALIZATION OF THE EXPLOITATION OF RENEWABLE ENERGIES BY PRIVATE INVESTORS, TUNISIANS AND FOREIGNERS
  - IMPLEMENTING DECREES THAT PROVIDED CLARIFICATIONS AND CLARIFICATIONS HAVE BEEN PUBLISHED (DECREE NO. 2016-1123 / AUGUST 2016 =)
  - THE STRATEGY FOR THE PROMOTION OF GREEN ENERGIES BY 2030 WAS ADOPTED IN NOVEMBER 2016
- FOR THE AGRICULTURAL SECTOR, ADOPTION OF THE NEW INVESTMENT CODE BENEFITS AND INCENTIVES FOR INVESTING IN RENEWABLE ENERGIES.
- TUNISIA ENJOYS A VERY ATTRACTIVE SUNSHINE RATE FOR SOLAR ENERGY PV.

✓CONSTRAINTS:

OUR COUNTRY IS LAGGING FAR BEHIND IN RENEWABLE ENERGIES DUE TO:

- LACK OF INVESTOR AWARENESS OF THE MAJOR CHALLENGE OF THIS STRATEGIC SECTOR IN THE FUTURE
- LACK OF KNOW-HOW, ESPECIALLY ON A TECHNICAL LEVEL
- POOR COMMUNICATION ON THE BENEFITS ATTRIBUTED TO INVESTMENTS IN RES
- VERY HEAVY INVESTMENT ESPECIALLY FOR THE ACTORS OF AGRICULTURAL VALUE CHAINS WHICH ARE CHARACTERIZED BY THEIR SMALL SIZE AND THEIR VERY LIMITED FINANCIAL MEANS.
- LACK OF EXTENSION OF THESE TECHNOLOGIES AMONG FARMERS.

WEAKNESSES & STRENGTHES

- **WEAKNESSES**
  - FARMERS ARE NOT AWARE OF NEW TECHNOLOGIES
  - FARMERS DO NOT HERE THE MEANS TO COVER CAPITAL COST ASSOCIATED WITH RES
  - LIMITED ACCESS TO FUNDING
  - LACK OF DISSEMINATION OF GOOD PRACTICES
  - LOW MEMBERSHIP OF FARMERS IN PROFESSIONAL ORGANIZATIONS
  - WEAK COLLABORATION BETWEEN THE DIFFERENT ACTORS IN THE VALUE CHAIN

- **STRENGTHES**
  - TUNISIA ENGAGEMENT AT INTERNATIONAL LEVEL (UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE COP23, ODD2030, …)
  - COMMITMENT OF DONORS TO FUND AND SUPPORT THE RES USE
  - OPPORTUNITIES TO IMPLEMENT PRIVATE PUBLIC PARTNERSHIPS IN ORDER TO DEVELOP THE USE OF RES
  - ENHANCE RESEARCH RESULTS IN DEVELOPMENT PROJECTS

EXPERIENCE WITH REFERENCE TO THE FINDINGS AND RECOMMENDATIONS OF THE INVESTA PROJECT

- KNOWLEDGE, EDUCATION , TRAINING , EXTENSION OF RE USES AMONG PRIVATE AND PUBLIC ACTORS
- SIMPLIFY THE ADMINISTRATIVE PROCEDURES FOR COLLECTING SUBSIDIES
- INITIATE THE REVISON OF PRICING AND SUPPORT POLICIES THROUGH ANALYSIS AND STUDIES
- ANY POLICY CHANGE SHOULD BE PROGRESSIVE AND THERE MUST BE PREREQUISITES SUCH AS RISE PUBLIC AWARENESS
- SHOWING HOW RE USE HAS COMPETITIVE ADVANTAGE
- ESTABLISHMENTS OF CONTRACTUEL RELATION BETWEEN VALUE CHAIN'S ACTORS AND PROMOTE THE SYNERGY BETWEN THEM.
- STRENGTHEN CONTROLS AND FINES AGAINST ILLEGAL MILK COMMERCIALIZATION AND TRANSFORMATION

EXAMPLES OF SUCCESSFUL POLICIES

- SOLIDARITY FUNDING SYSTEM BASED ON THE BUSINESS RELATION BETWEEN MILK VALUE CHAIN ACTORS
- LINK THE VETERINARY HEALTH AGREEMENT WITH THE IMPLEMENTATION OF BIOGAS UNIT
- VALUATION OF THE NEW INVESTMENT LAW, WHICH ENCOURAGES INVESTMENT IN EQUIPMENT AND MODERN MEANS OF PRODUCTION, INCLUDING RENEWABLE ENERGY IN ADDITION TO THE LAW OF 2016 ABOUT THE LIBERALIZATION OF THE EXPLOITATION OF RENEWABLE ENERGIES BY PRIVATE INVESTORS

RECOMMANDATIONS

- ADAPT INVESTA RESULTS TO TUNISIAN REALITIES: CONTEXTUALIZATION OF THE STUDY TO THE SPECIFICITIES OF THE TUNISIAN AGRICULTURAL SECTOR
- CAPITALIZATION OF THE RESULTS OF THE VARIOUS PILOT PROJECTS TO GENERALIZE THEM
- CAPACITY BUILDING OF INSTITUTIONS INVOLVED IN THE MILK SECTOR IN THE USE OF RENEWABLE ENERGIES
- NEED OF AN INTEGRATED NEXUS APPROACH
- ENCOURAGE THE CREATION OF AN INTERNATIONAL NETWORK ON THE USE OF RENEWABLE ENERGY IN THE AGRICULTURAL SECTOR TO FACILITATE TRADE

THANK YOU FOR YOUR ATTENTION … 🙂

ben.afef@yahoo.com

sana.zitouni1@gmail.com

chirazlouk@yahoo.fr

UNITED REPUBLIC OF TANZANIA

The Milk Cold Chain Technologies in Tanzania

Nelson Kilongozi
Tanzania Dairy Board
P.O BOX 38456
Dar es Salaam

INTRODUCTION

Basic information of the Tanzania Dairy Industry

- Approximately 37% of the 1.68 million households inTanzania own cattle and approximately 60% of rural households derive 22% of their income from livestock. .
- About 70% of the milk produced comes from the traditional herd (indigenous cattle) kept in rural areas, 30% comes from improved cattle mainly kept by smallholder producers.
- Dairy value chain studies have revealed that generally 10% of raw milk produced reaches both formal and informal markets, of this only 3% is formally traded and enters the processing industries.
- This low traded volumes are due to losses in milk that arise from poor access to markets and poor milk handling practices resulting in spoilage and spillage

- Spoilage can be partly attributed to non cooling of milk since most households do not refrigerate milk on farm.

- In the rural setting of Tanzania, raw milk cannot be cooled at dairy farms due to lack of access to (reliable) electricity. About 11% of small-holder farmers have access to grid electricity in rural areas

- This compromises in particular the quality of evening milk. Quality of (evening) milk is lost because it doesn't survive the heat overnight.

- Low quality (evening) milk is rejected by collection centers. Current estimates of post-harvest milk losses at farm level in Tanzania are estimated at 30-40% creating a lost income opportunity for farmers and a growing gap between milk supply and milk demand.

Milk cooling technologies in Tanzania

Milk cooling Technologies in Tanzania include:

- SimGas biogas milk chillers**. Simgas' idea was to create a user-friendly, affordable household milk chiller that runs off-grid, using biogas. Tested in small-scale farms in Tanzania, and through interviews carried out by SNV staff with dairy cooperative representatives and their members
- Production of biogas from sisal waste by Katani Ltd in Tanga
- TDDP Biogas project funded by a Food For Progress grant from the United States (dairy cold chain in 85 milk collection and processing facilities (biogas).
- Off grid Solar milk coolers by Mueller

(** SimGas in collaboration with SNV, Mueller, and BoP Inc)

BARRIERS TO INVESTMENT IN ENRGY TECHNOLOGIES

Barriers (negative influence) to energy technology uptake include:

- Lack of Quality Based Payment System (premium prices to quality milk). Clean cooling technologies can improve milk quality and add value along the milk value chain, but farmers have little incentives to improve milk quality and hygiene, as there is no price premium).
- High initial investment costs versus volumes cooled (20 lts plants) and maximum about 600l which is too small for a collection centre
- Drudgery in manure collection
- Knowledge gap (issues of gas emissions etc)

Successful policies that facilitate investments in energy sector in Tanzania:

- **The National Energy Policy (2003)** focuses on market mechanisms and means to have affordable and reliable energy supplies in the whole country (allows ▪

- Promotes the development and utilization of indigenous and renewable energy sources and technologies
- The 2009 Electricity Act opened the Tanzanian electricity sector for private companies and ended 40 year monopoly held by TANESCO in the national power sector. Independent power producers (IPP) penetration so far has been limited, but is steadily increasing

Food security policy

- Its goal is to accelerate Tanzania's adoption of more effective policies and programs to drive broad-based agricultural sector growth, improve household food security and nutrition, and reduce poverty
- **National Livestock Policy**
- This is a blue print that guides the development and commercialization of the livestock industry in Tanzania. In Dairy it asserts the will of government to promote investment in dairy production, processing and marketing

As regards to INVESTA findings

As regards to INVESTA findings, Tanzania Dairy Board believes that:

- There is strong case for public sector to support renewable energy initiatives (Govt, WB) in form of subsidies where financial net benefits may be significantly be different from economic net benefits
- Adoption of these initiatives will depend on **reliability** and **affordability of the technology**
- These initiatives contribute towards reduction of the emission of greenhouse gases and the climate change
- The initiatives lessen the vulnerability of energy dependence and the financial burden of oil imports.
- There is increased competitiveness

THE END

MWISHO .....

Thank you for listening
Ahsanteni sana
KWA KUNISIKILIZA

International Workshop

INVESTING IN SUSTAINABLE ENERGY TECHNOLOGIES IN THE AGRIFOOD SECTOR

23-24 November, 2017. Roma

How does the future of food supply match with reducing greenhouse gas emissions under the Paris Agreement?

Professor Ralph Sims

STAP Panel member for the Global Environment Facility

Massey University, New Zealand R.E.Sims@massey.ac.nz

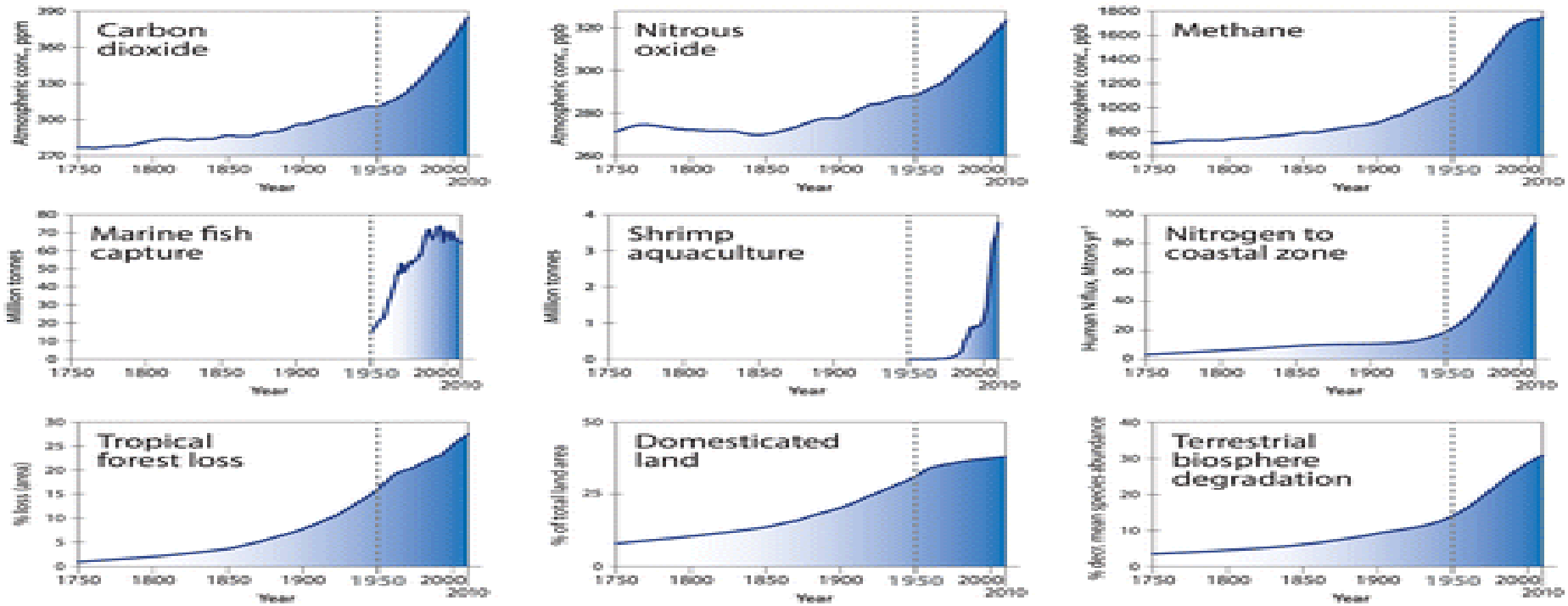
Welcome to the Anthropocene age

as driven by the "Great Acceleration"

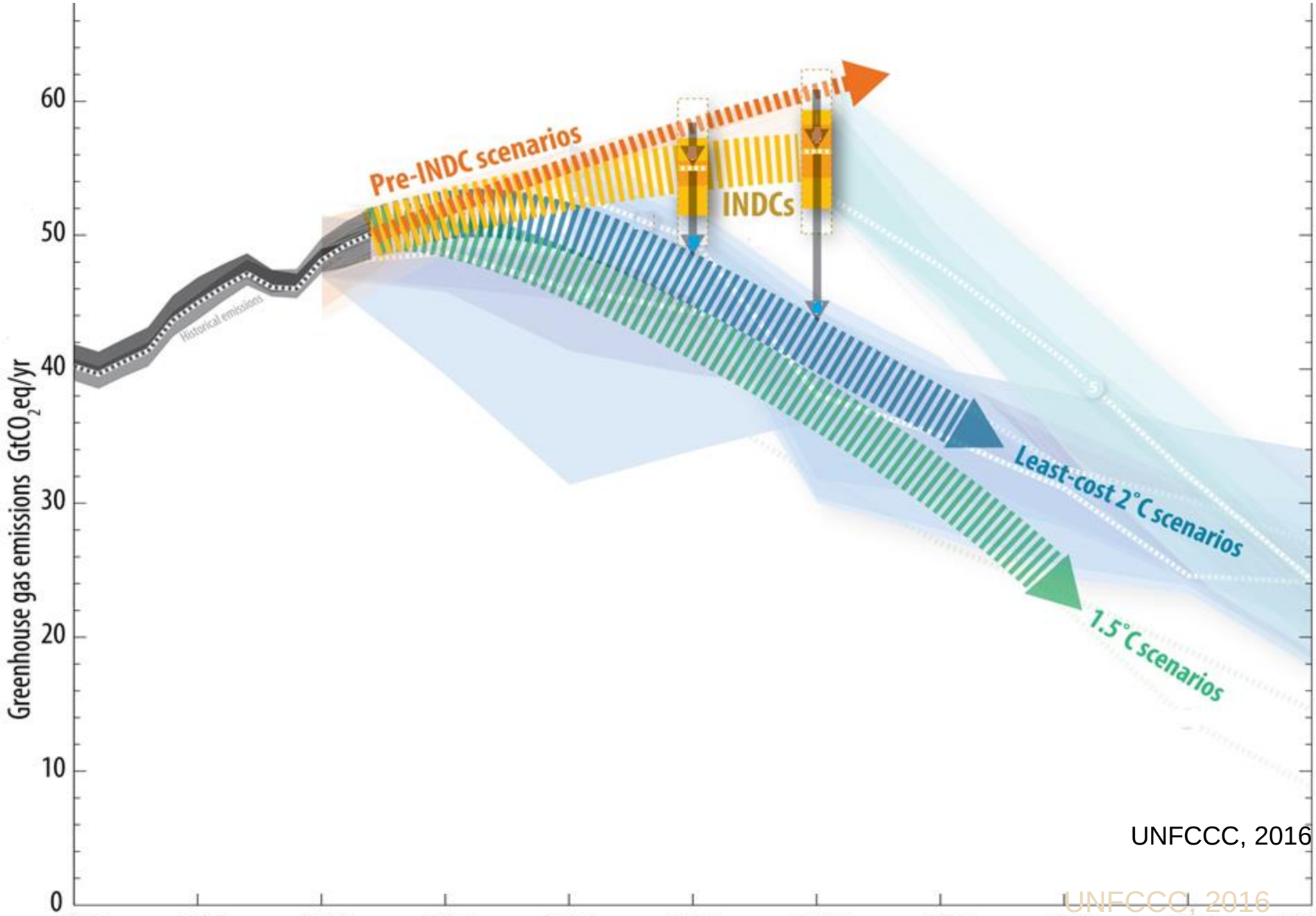
Socio-economic trends

We cannot continue along these exponential pathways, so innovative solutions are urgently required to protect the Global Commons.

Earth system trends



The Paris pledges are totally inadequate



UNFCCC, 2016

UNFCCC, 2016

"As well as energy, climate change discussions should focus more on food production and cutting food waste, but a lack of knowledge is fueling public resistance".

"All these things can help us ensure that, in producing the food that we need to feed the billions of people on this planet, we're not destroying the planet in the process".

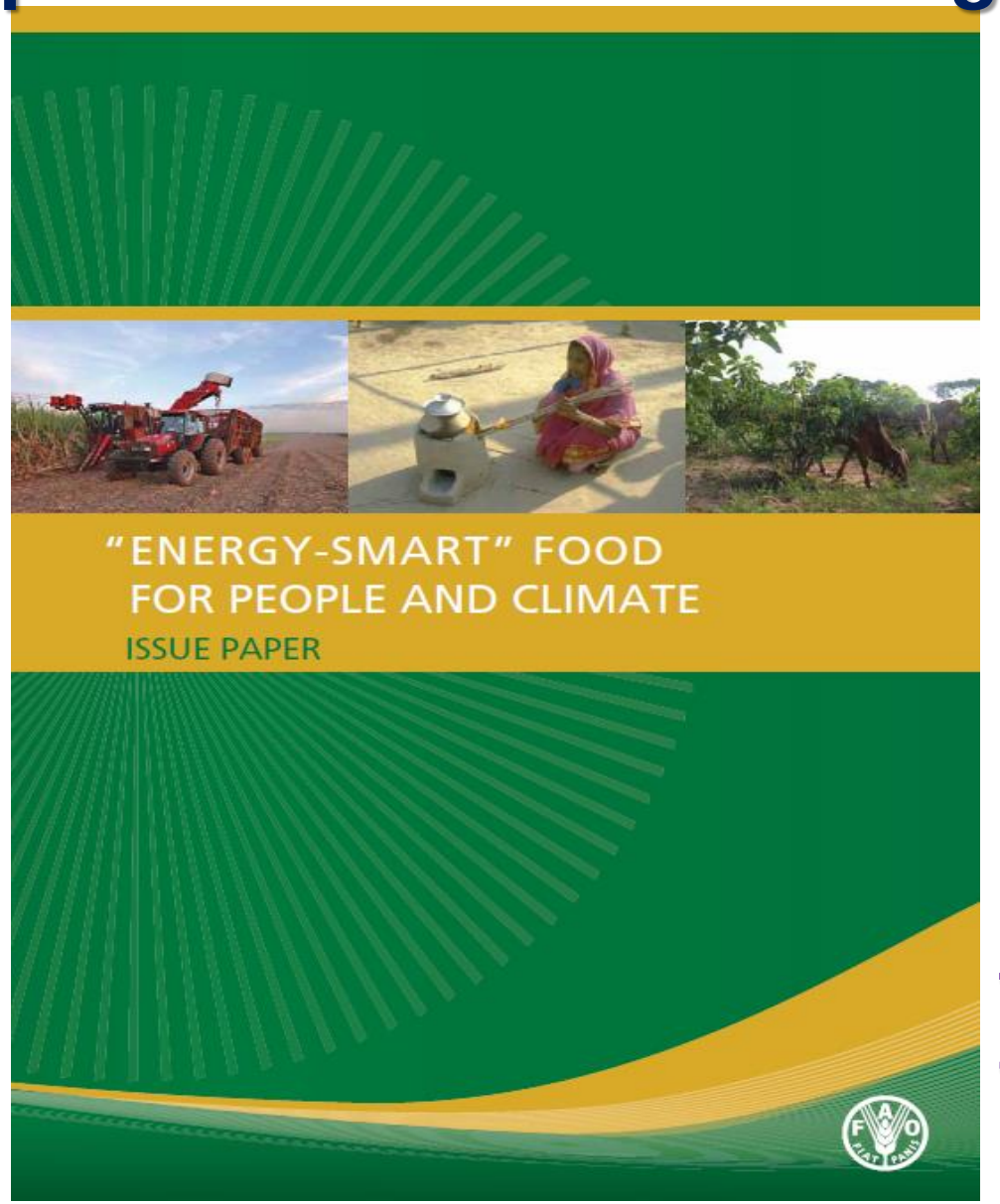
Barack Obama. 26 May, 2017

Thomson Reuters Foundation.

Climate change talks should focus on food, despite resistance.

http://news.trust.org/item/20170526132835-rjekn/

Producing *Energy-Smart Food* has to become part of the climate change mitigation solution



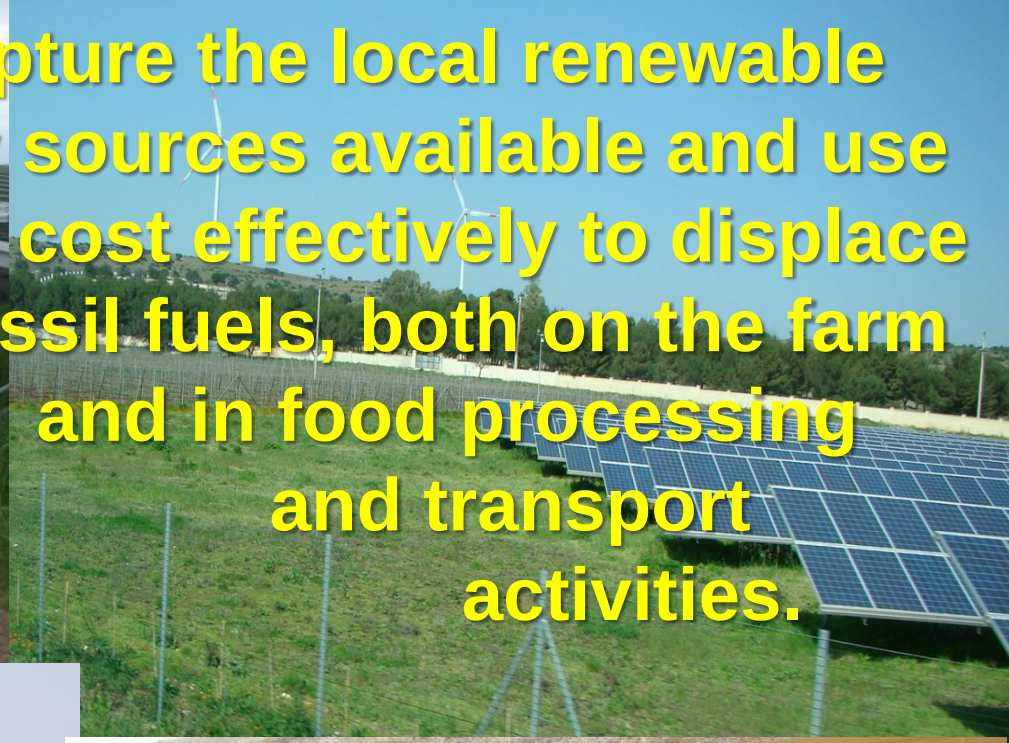
Key messages from 2011:

Global agri-food supply uses ~32% of end-use energy per year and produces ~22% of GHG emissions.

Renewable energy and energy efficiency can be integrated throughout the agri-food supply chain.

http://www.fao.org/docrep/014/i2454e/i2454e00.pdf

Aim to capture the local renewable energy sources available and use them cost effectively to displace fossil fuels, both on the farm and in food processing and transport activities.



Why are conventional agri-food systems environmentally unsustainable?

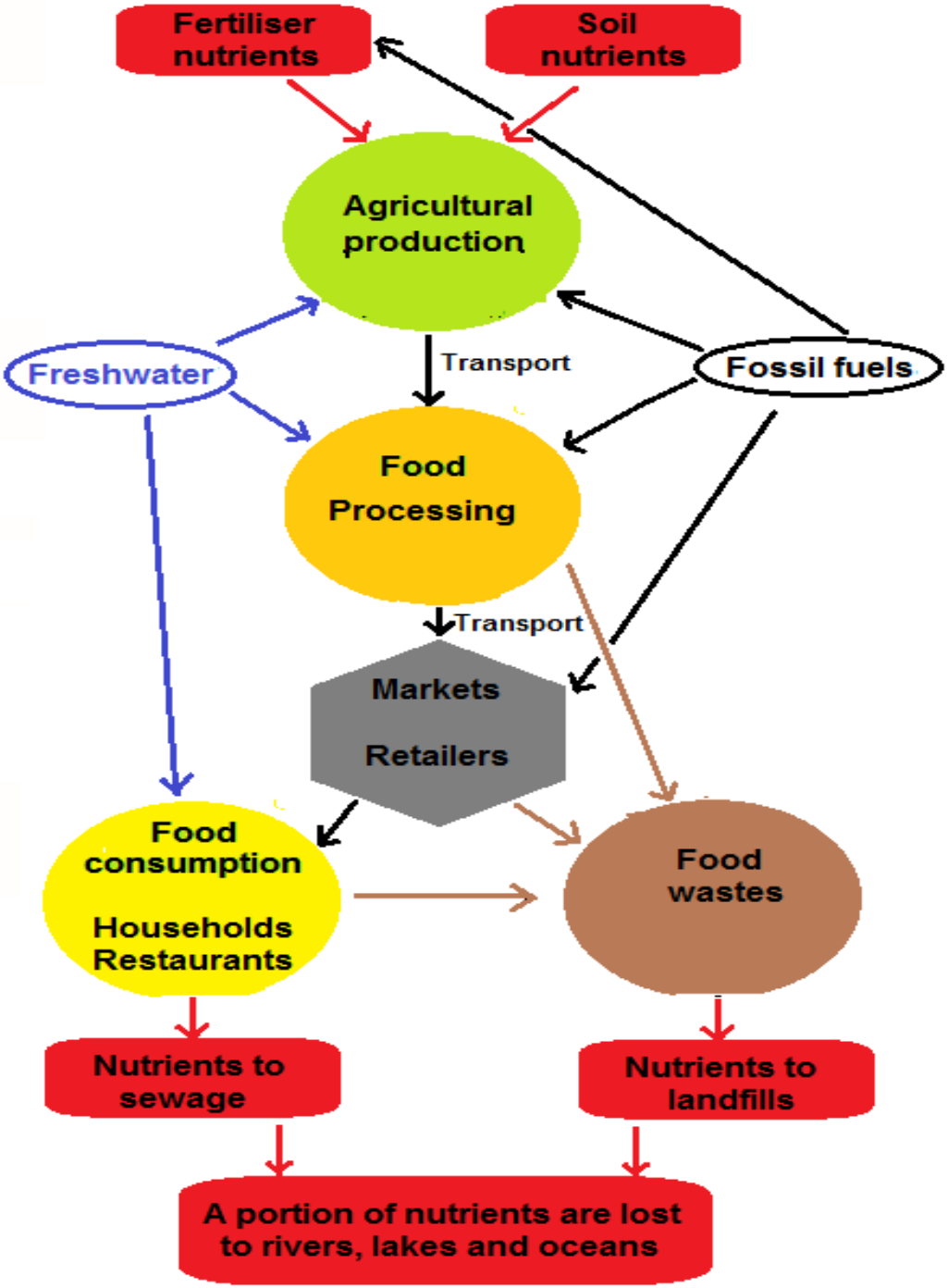
- Heavy reliance on fossil fuel inputs;
- Abatement of GHG emissions is limited;
- Intensive farming can degrade soils;
- Livestock wastes and chemicals degrade waterways;
- Climate impacts may reduce productivity;
- Present food supply is a linear, "take-make-waste" system.

1. Extract natural resources and materials then process

2. Add energy and water inputs.

3. Consume the product.

4. Dispose of wastes.

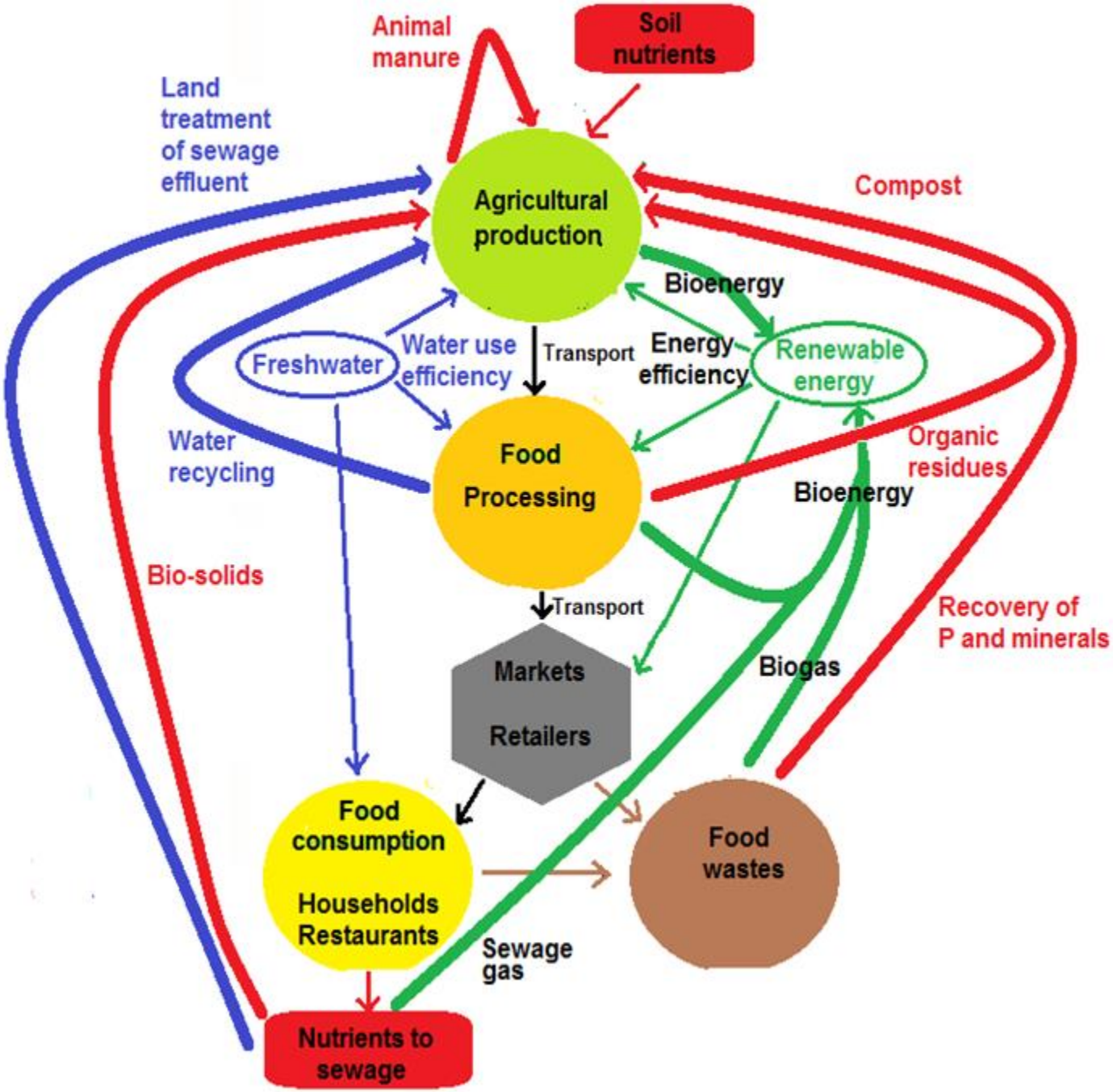


How can we improve resource use efficiency based on the Circular Economy?

- deploy low-carbon energy technologies;
- use organic wastes / residues for bioenergy;
- improve freshwater use efficiency to reduce demand;
- recycle water where feasible;
- use precision application techniques for fertilisers and agri-chemicals;
- change fertiliser manufacturing processes;
- close the nutrient cycle.

The Circular Economy

Fossil fuels displaced by renewable electricity and heat as well as for transport fuels.



IN ADDITION:

- 19% of the global warming to date has resulted from GHG emissions from livestock.
- If our planet is to stay below 2ºC temperature rise above pre-industrial levels, human demand for animal proteins will have to be reduced.
- Becoming a “Reductarian” is the trend by eating less meat and milk products.
- Synthetic meat and milk products are evolving and starting to gain market shares:

INDEPENDENT

News InFact Politics Voices Indy/Life Business

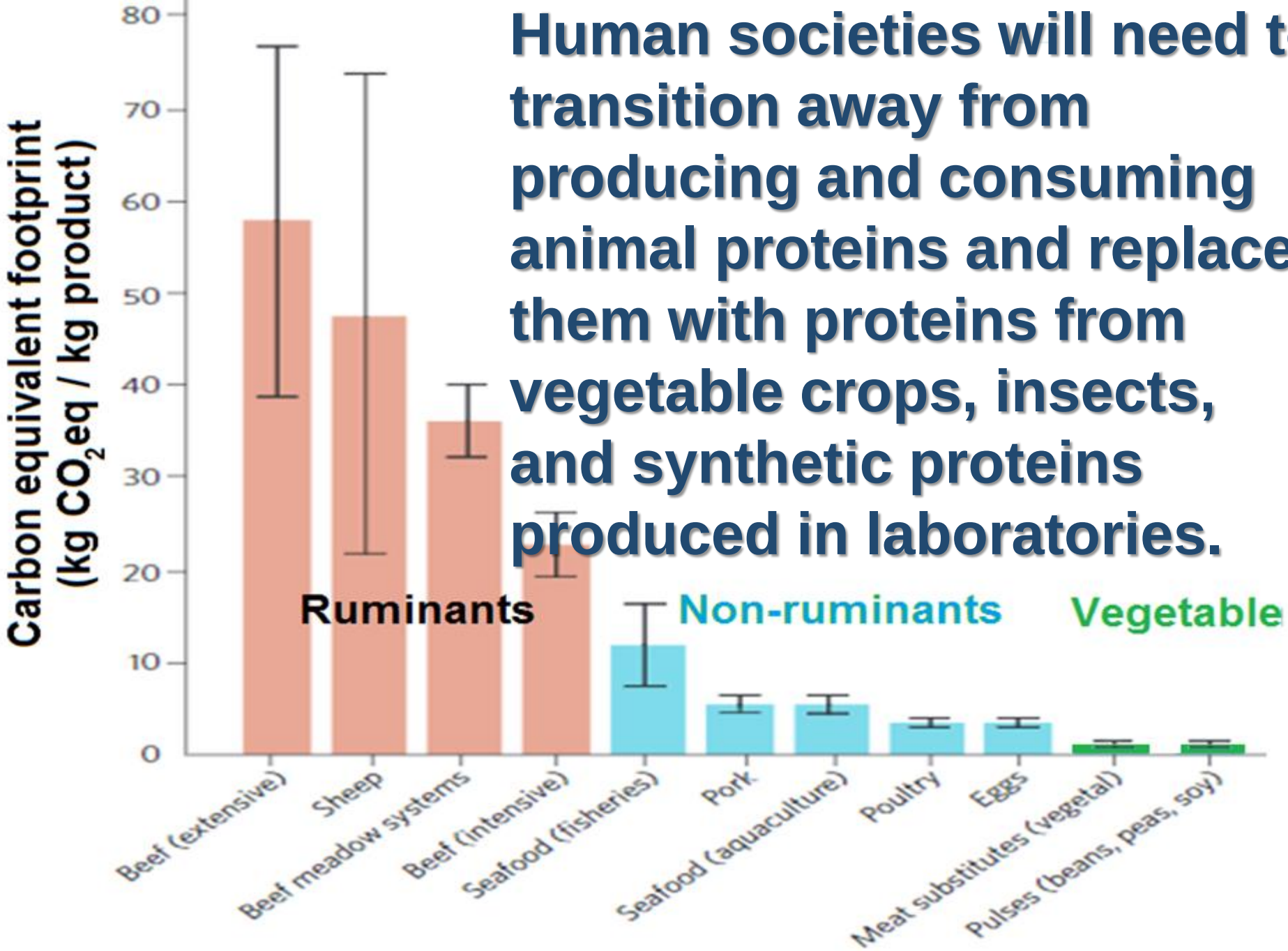
Rachel Roberts | Saturday 16 September 2017 17:32 BST |

News › World › Asia

China signs $300m deal to buy lab-grown meat from Israel in move welcomed by vegans

For many environmental and animal rights groups, lab meat is seen as a positive move

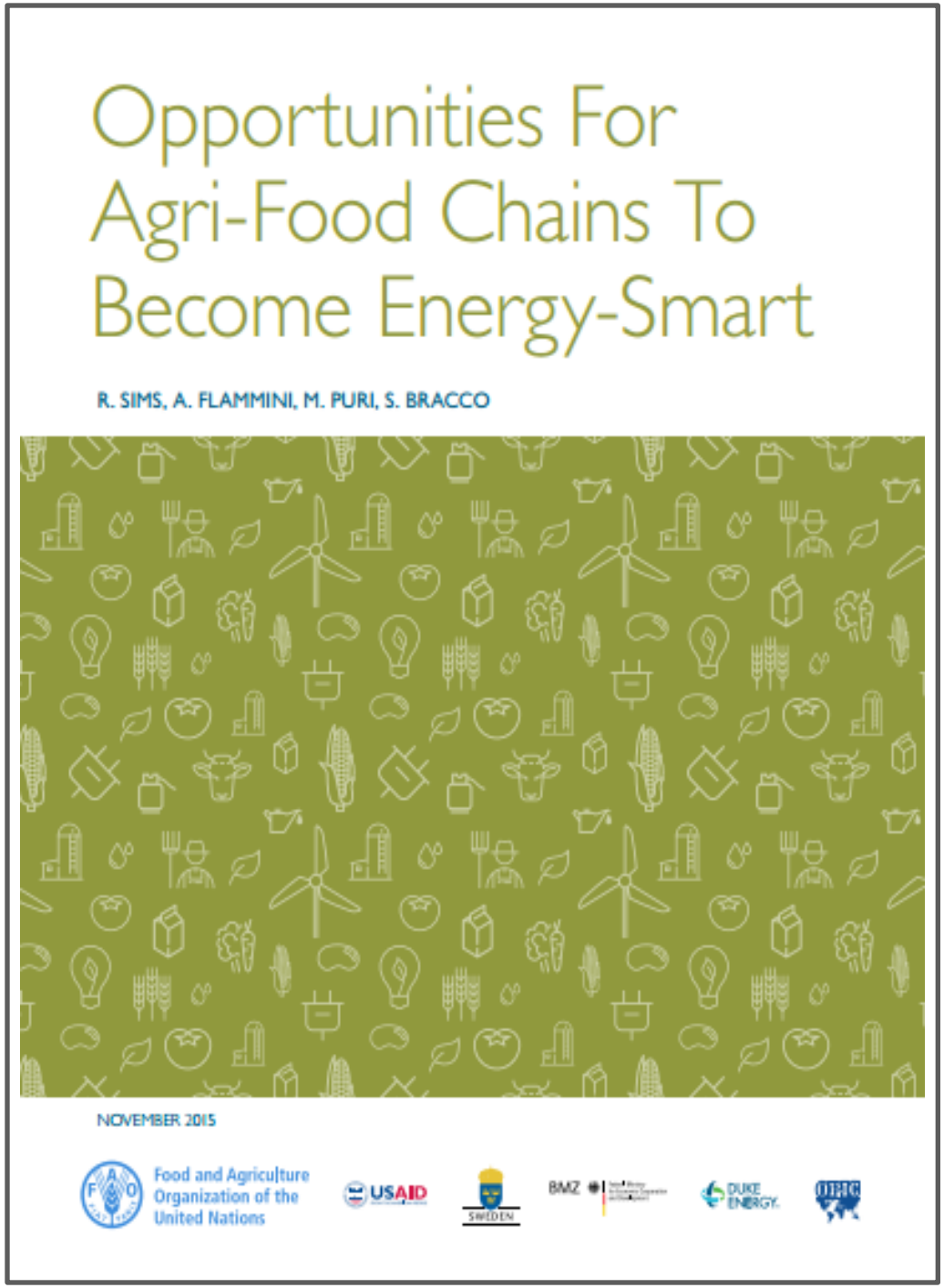
Human societies will need to transition away from producing and consuming animal proteins and replace them with proteins from vegetable crops, insects, and synthetic proteins produced in laboratories.



Ripple *et al.*, 2014. *Ruminants, climate change and climate policy,* Nature Climate Change 4(1), 2-5.

In summary:

- We currently have a materialistic, urban-based, throw-away society (including wasting one third of the food we produce).
- A future Circular Economy could well provide greater food supply security and reduce emissions and environmental impacts. But how quickly we can actually achieve this is uncertain.
- Reducing demand for animal protein has already started and could accelerate.
- Providing adequate food and freshwater supplies under the Sustainable Development Goals, as well as mobility and energy access for all, will reduce greenhouse gas emissions and also lessen the risks of future conflicts.



This report analysed milk, vegetables and rice as examples of agri-food supply chains.

Renewable energy and energy efficiency opportunities exist at all scales. GHG emissions per unit of production are decreased as a result.

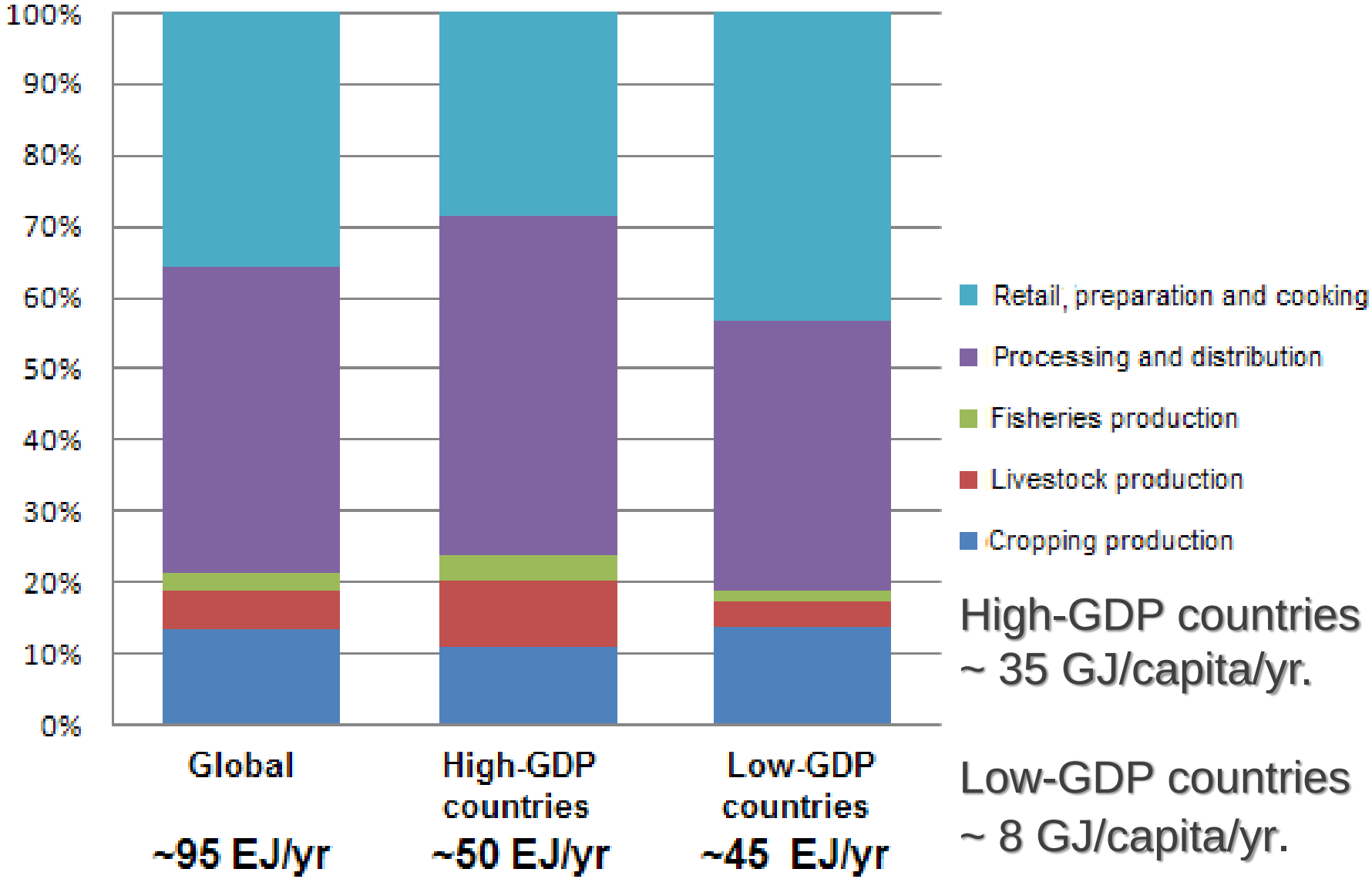
The cost of implementing clean energy systems varies with the location, local resources and price of carbon, but is often cost-effective.

http://www.fao.org/3/a-i5125e.pdf

Why is the problem complex?

- **All agri-food systems depend upon energy inputs regardless of scale.**
- **Scales of an agri-food system range from**
  - **subsistence farmers growing food or fishing for their own consumption,**
  - **family units supplying local markets,**
  - **small businesses employing a few staff,**
  - **large corporate companies supplying huge supermarket chains across the world.**
- **They each have different energy use priorities, but both low- and high-energy systems can also use renewable energy.**

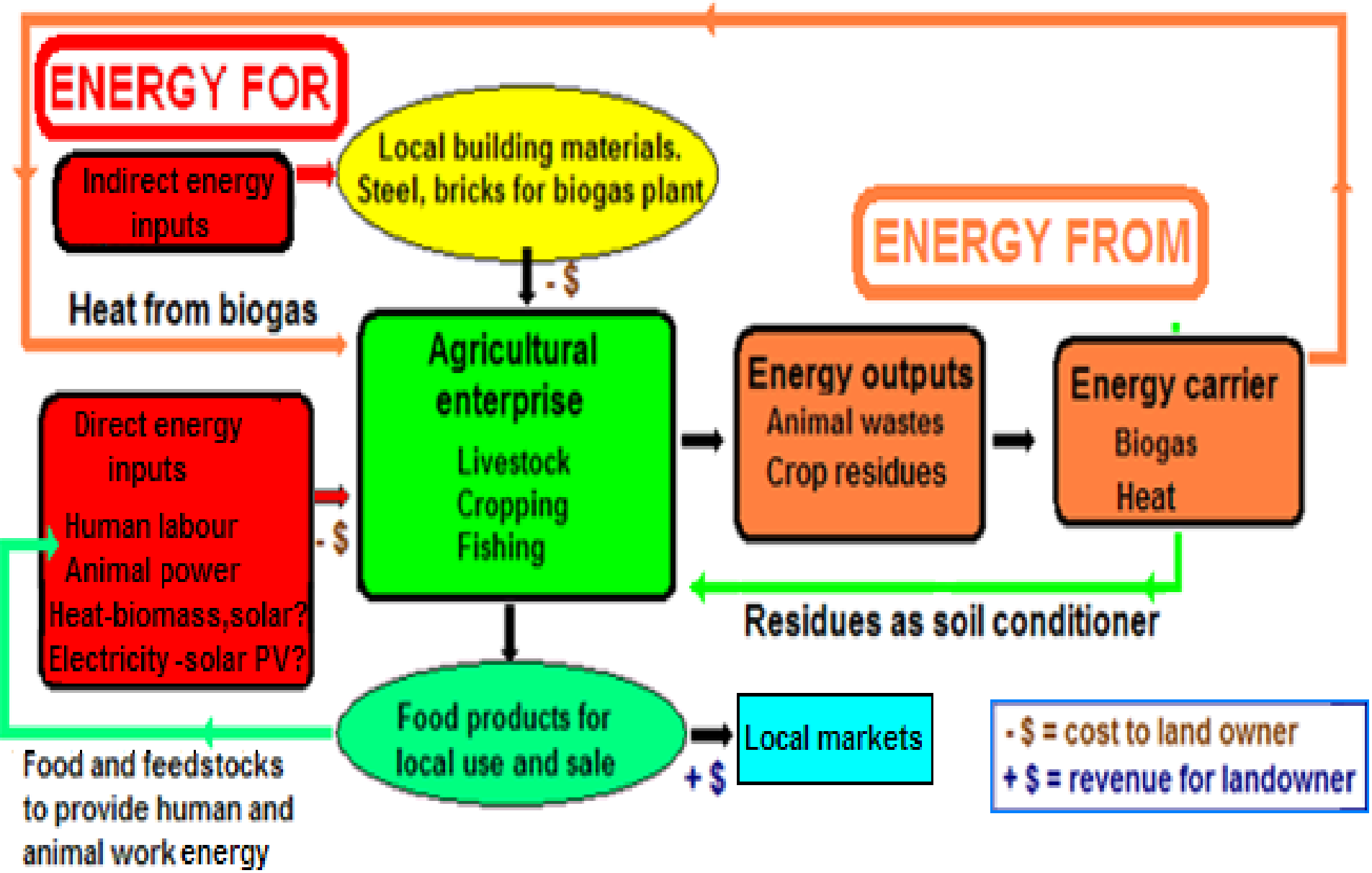
Around 32% of total global end-use energy demand of ~300 EJ/yr is used in agri-food supply chains.



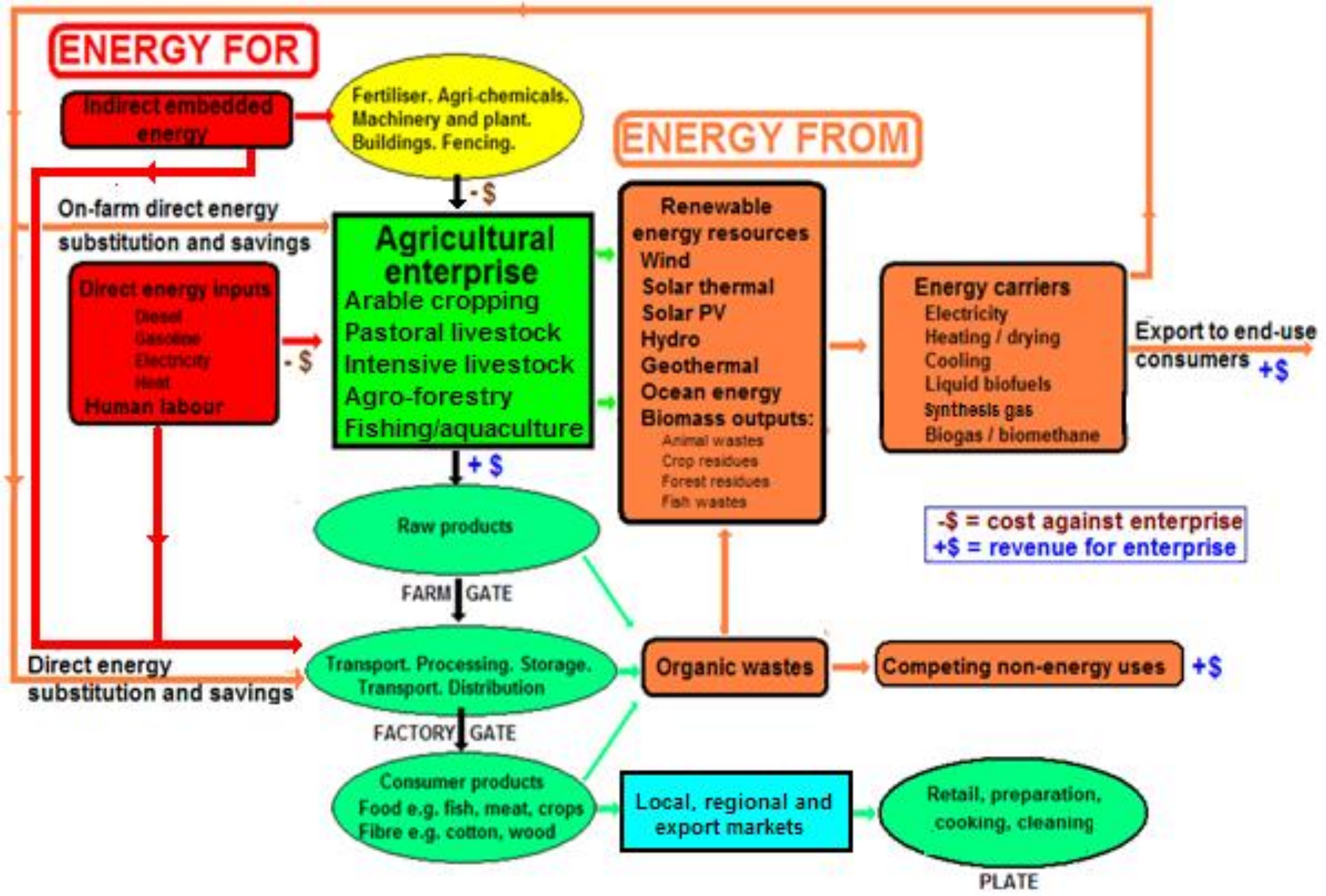
High-GDP countries ~ 35 GJ/capita/yr.

Low-GDP countries ~ 8 GJ/capita/yr.

A *low input* agri-food /energy



A *high input* agri-food/energy



In summary

- The global agri-food supply chain must be decoupled from its dependency on fossil fuels in order to meet future food demands.
- Energy efficiency and renewable energy technologies can help improve energy access, food security, price fluctuations and climate change impacts.
- Policy development to drive the transition to climate-Smart food needs a long-term vision.
- Reducing demand for animal protein has already begun but will not prove easy.

FULL ADVANTAGE PHILS INTERNATIONAL, INC.

BERNARDO D. TADEO, PhD

President & CEO

From Advocates to Active Developers!

FULL ADVANTAGE
Sustainable Energy and Environment Solutions

Experience the Full Advantage of...

COMPETENT SERVICE AT ITS BEST

Host and Affiliate of: WADE

Recipient of: CTI Climate Technology Initiative — Clean Energy Financing Award 2009

Hosted by: Thailand Science Park

Your business partner and solutions provider in the field of sustainable energy and environment

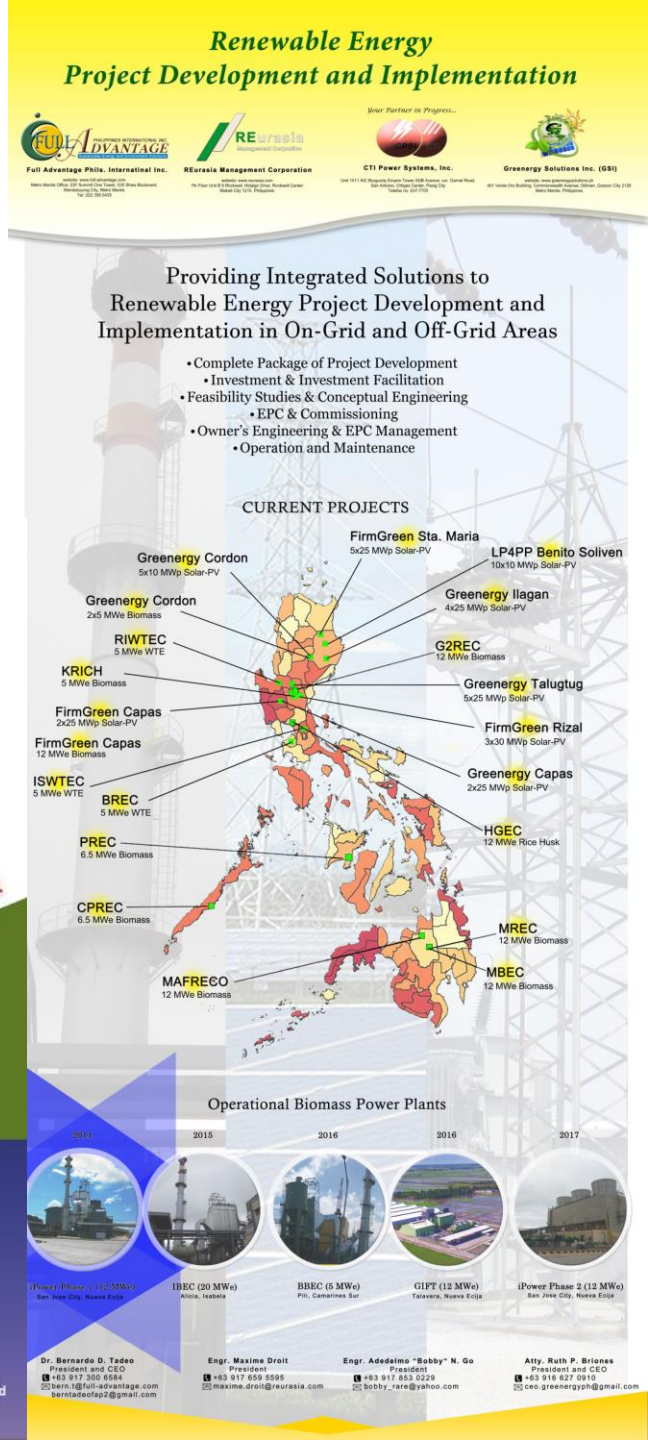
- Advisory and Consulting
- Business/Project Development
- Climate Change Activities

Sub-sectors:

- *Renewable energy and rural electrification*
- *Cogeneration and decentralized energy systems*
- *Biogas production and energy recovery from wastewater, landfill and MSW*
- *Energy efficiency*
- *Biofuels*
- *Climate Change and Greenhouse Gas (GHG) mitigation activities*

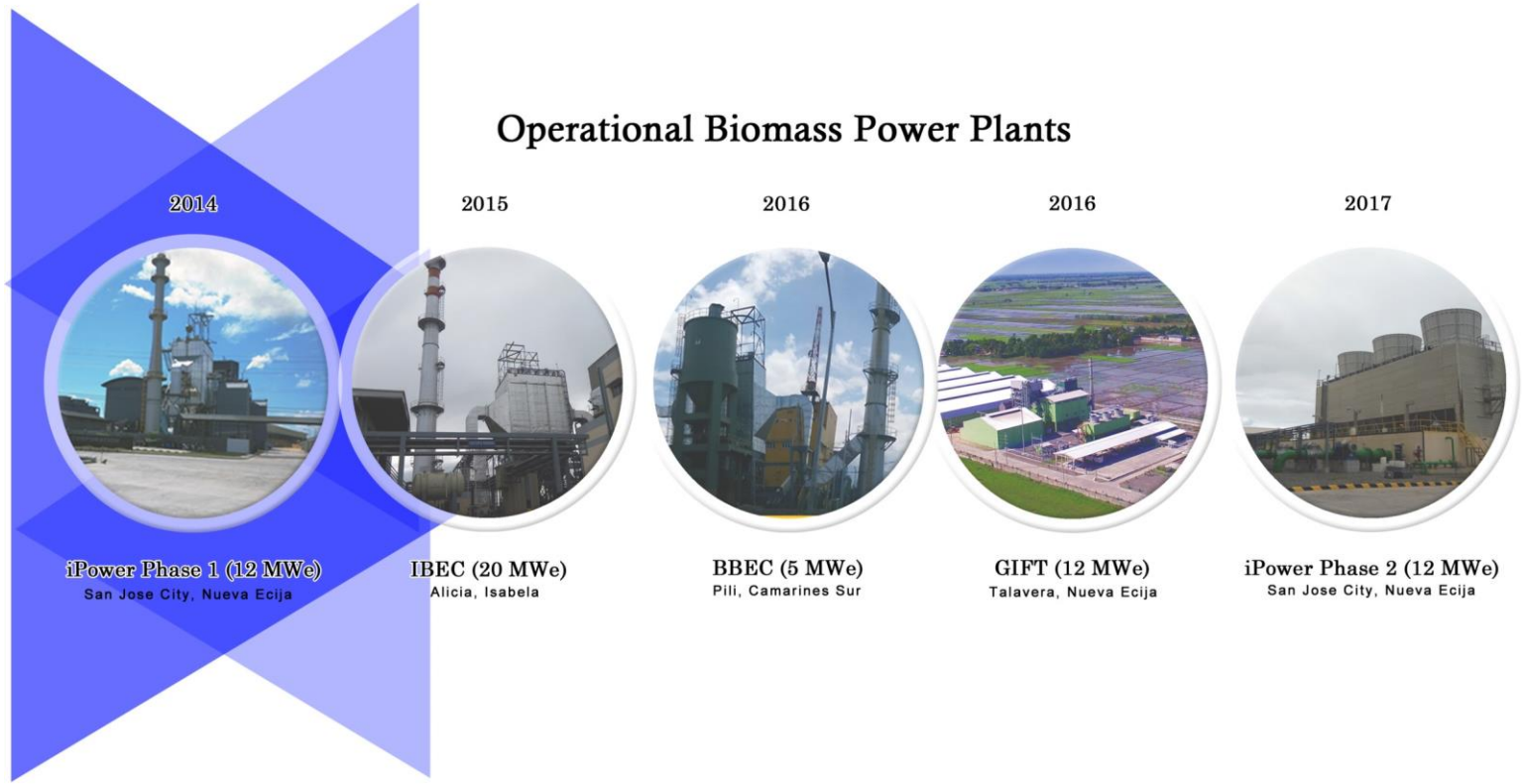
Our Service, Your Advantage.

Full Advantage Co., Ltd. , Room 201, Innovation Cluster I Bldg. , 131 Thailand Science Park, Paholyothin Rd., Klong 1, Klong Luang, Pathumtani 12120 Thailand
Tel: +662 5647923, Fax: +662 5647924, Website: http://full-advantage.com, Email: ExecutiveDirector@full-advantage.com



Examples of Successful Biomass to Energy Projects (on-grid) under the Renewable Energy Law (Republic Act No. 9513)

12 years after the EC-ASEAN Energy Facility Program with PhilRice…



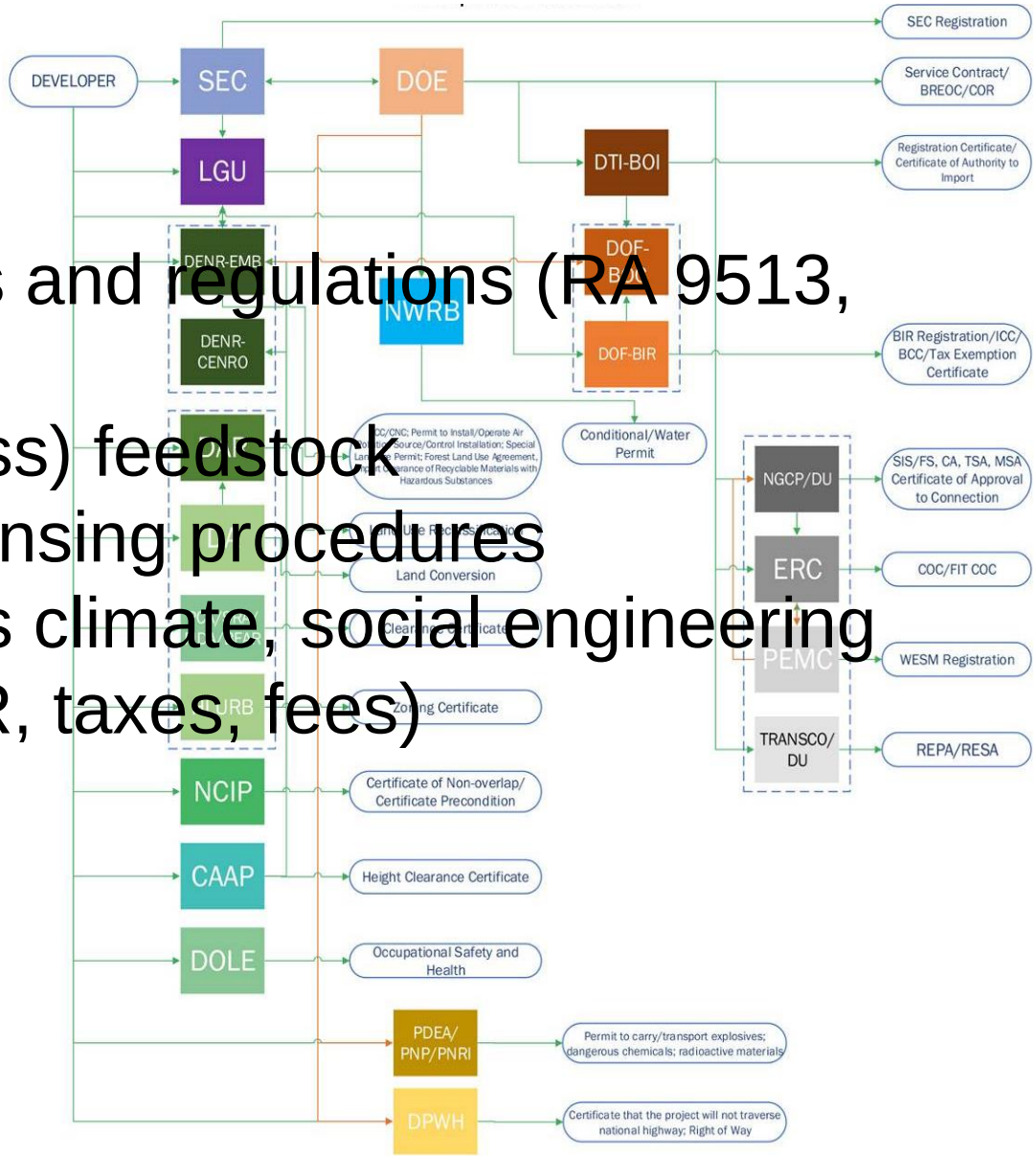
However, RA 9513 and other laws, rules and regulations are biased against off-grid areas (no business case, unfavorable political conditions, logistics issues, etc.)

Barriers/Challenges Faced by Developers	Measures to Overcome Barriers/Challenges	Barriers/Challenges Faced by Investors/Banks
•Lack of guarantees/ collaterals for loans	**Security of payment of debt** • Acceptance of the following security arrangements in lieu of collaterals: - Mortgage of the project's assets to the investor/bank providing the equity/loan - Assignment of off-take agreements - Assignment of agreement on carbon credit revenues, *e.g. Japan-JCM* •Provision of partial/full guarantee from entities such as IFC, PhilEXIM, LGUCC, Quedancor or small scale risk guarantees •Partnering with a sponsor who: - has a strong reputation and creditworthiness - can provide partial or full collaterals/guarantee	•Reputation and participation of sponsors
•Inability of financing institutions to provide loans on project finance basis •Lack of experience by financing institutions to evaluate biomass energy projects	**Building capacity of Investors/Banks** • Development of their capacity to evaluate cash flow of projects (inflow-outflow) • Building of in-house capacity to evaluate biomass energy projects • Hiring of competent third-party consultants to assist in different aspects of evaluation	•Commercial and technical feasibility of the project
•Inability of financing institutions to provide loans on project finance basis	**Building capacity of project developers** •Development of capacity of project developers to secure all key project elements of the project and address the risks, including: - fuel/feedstock supply - product (electricity) off-take - technology selection and supply - technical and commercial viability - permits and consents	•Security of fuel supply •Security of electricity off-take •Technology issues •Permitting, legal and contractual issues •Commercial and technical feasibility of the project
•Lack of successful examples of similar installations	**Visits to successful installations** •Organization of site visits to reference sites •Organization of study tours to relevant sites and entities	•Technology issues
•Long and tedious approval process	**Credit documentation and procedures** •Preparation of a robust and good quality project documentation •Disclosure by investors/banks of a transparent evaluation and approval process	•Quality of documentation
	Access to low-cost interest •Support to buy down interest rate	

Drivers of Successful
iomass to Energy Development: Developers Perspectiv

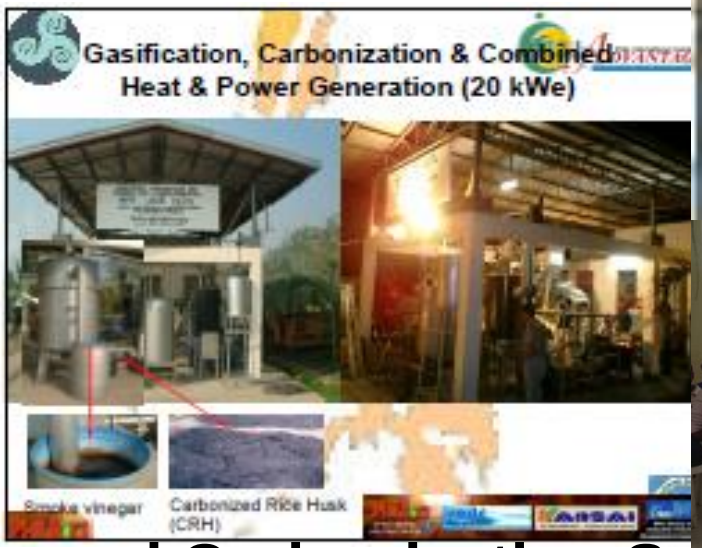
(P6F)

1. **POLICY**, laws, rules and regulations (RA 9513, 9367)
2. **PRICING** of (biomass) feedstock
3. **PERMITTING** & licensing procedures
4. **POLITICS**, business climate, social engineering
5. **PROFIT** for all (CSR, taxes, fees)
6. **PATIENCE** capital
7. **FAITH**



Market for High Value Co-Products: Priority to increase the Economic CBA

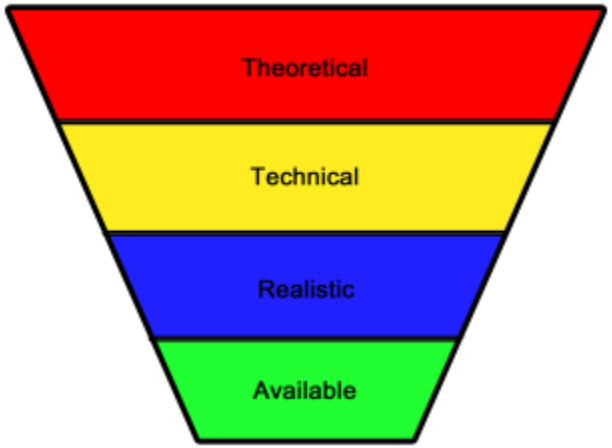
1. Silica – high value product industry & manufacturing
2. Biochar – organic fertilizer
3. Activated Carbon – wat



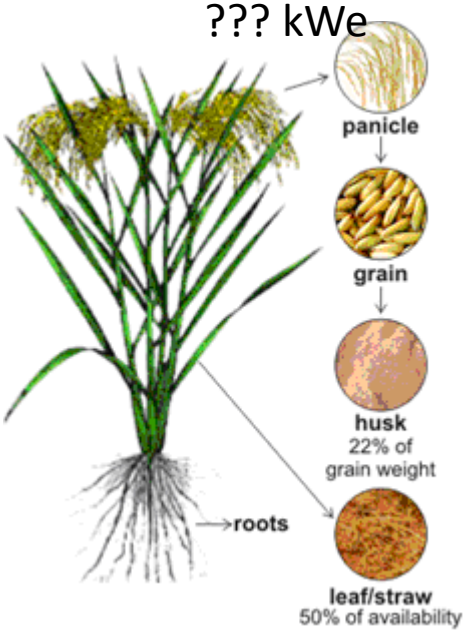
Gasification and Carbonization System:
≤100 kWe proof of concept

Main Challenge in connecting agriculture (biomass) to energy system:

Biomass Consolidation in Highly Dispersed Islands



??? kWe



Based on INVESTA
Specific Policy Recommendations:

1. **Financial vs Economic Returns**
   - **Trust and Confidence of Investors to Developers/Owners/Sponsors**
   - **Viability of the project**
   - **Demand driven technologies**
   - **Integrated holistic analyses**
2. **Regulatory framework**
   - Ease of doing business: less permitting and licensing procedures,
3. **Mechanisms to foster investments**
   - more transparent laws, rules and regulations (national and local)
   - Ethical investors, Religious, NGO, civil societies
   - Green climate fund (hard to access), - G2G recognition of non-monetary incentives, incentivize over punitive
   - CSR when no business case
4. **Gender equality**
   - descent green jobs accounting
5. **Data Gaps**
   - common data sources: national, regional, provincial

Maraming Salamat po!

Presentation by:

JUHUDI KILIMO

Who are we?

JUHUDI KILIMO

- **We are Juhudi Kilimo**

A for-profit MFI that provides loans to SHFs for acquisition of productive agricultural assets such as dairy cow, poultry, water pump and greenhouses.

- **JK reduces Lending risk**

By using social group guarantee and collateralizing the financed asset.

- **Our loan products**

Are coupled with insurance, technical assistance, linkages so that they can derive maximum benefits from the financed assets.

- **Today**

Juhudi's 41,296 active farmer clients (Est. OLB of $12 million) are served by 250 employees spread across 24 field branches in 13 counties in Kenya.

High-level Project Overview

- **Juhudi** partnered with Futurepump in 2014
- **Futurepump** received a capital investment from JK and Village Capital to test and refine its product prototype
- The final product was **Sunflower pump** - a solar-powered water pump designed ideally to irrigate small farms.
- **Winrock** International partnered with JK and Futurepump and provided resources for testing the new pump in the market
- Despite generating a huge buzz during initial tests held at farmers focus groups, the pump saw little actual demand during the 3 months **pilot** period (JK financed only $2,750 worth of sunflower pumps).
- The pilot was concluded (not scaled up) and no unit has been sold since then. 1 client defaulted the loan due to her dissatisfaction with the product.

JUHUDI KILIMO

Benefits of the product

Can lift up to 13K Litres of Water per day

Works to a pumping depth of up to 7M

Suitable for small farms (1-5 acres)

No Fuel Cost

Low maintenance

High quality & Durable

JUHUDI KILIMO

Demerits of the product

More expensive than alternative solutions

Requires bundling with other assets (water tanks, irrigation kits)

Limited pumping depth (especially during dry seasons when water levels are low)

Lack variety in the market

Low power in the morning, evening & on cloudy days

Lessons: Solar Pump Pilot

- **What did we learn?**
  - The solar pump concept generates a lot of interest among SHF
  - Match the Solar pump technical specs to farmer needs
  - Not a stand alone solution (bundle with storage, irrigation kit)
  - Price is a critical factor when making a choice
- **Some of the key factors for success**
  - Customer education
  - Product awareness
  - Access to Capital
- **Challenges in developing / implementing**
  - Need for variety/alternatives
  - Price versus pump technical specifications
  - Depth/Distance to water source e.g. during drought
  - Opening credit lines
- **How we will solve these challenges**
  - Explore more partners/products
  - Explore an appropriate bundle irrigation kit
  - Invest in Training
  - Robust Marketing

UNIVERSITÄT HOHENHEIM

Field experience implementing a small solar milk cooling solution in Tunisia and Kenya

Institute of Agricultural Engineering in the Tropics and Subtropics
University of Hohenheim in Stuttgart – Germany

Victor Torres-Toledo
Ana Salvatierra-Rojas
Farah Mrabet
Florian Männer
Prof. Dr. Joachim Müller

In cooperation with:

german cooperation
DEUTSCHE ZUSAMMENARBEIT

POWERING AGRICULTURE: AN ENERGY GRAND CHALLENGE FOR DEVELOPMENT

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Hohenheim Solution for milk cooling

- Commercial DC-freezer converted to run as a smart ice-maker
- Insulated milk-cans with ice-compartment
- Preserve morning or evening milk up to 16 hours
- Cooling on-farm, during collection at farmer groups and transport

On-field assessments

- 2016 Tunisia
  10 Systems

ICARDA Science for Better Livelihoods in Dry Areas
INRAT
ITAACC Project giz

- 2016 Kenya
  3 Systems

PARI
zef Center for Development Research University of Bonn
german cooperation DEUTSCHE ZUSAMMENARBEIT

↑ Piloting Technology + Potential to preserve milk quality

↓ Piloting Business opportunities + local commercialisation

- 2018 Kenya
  2 Systems

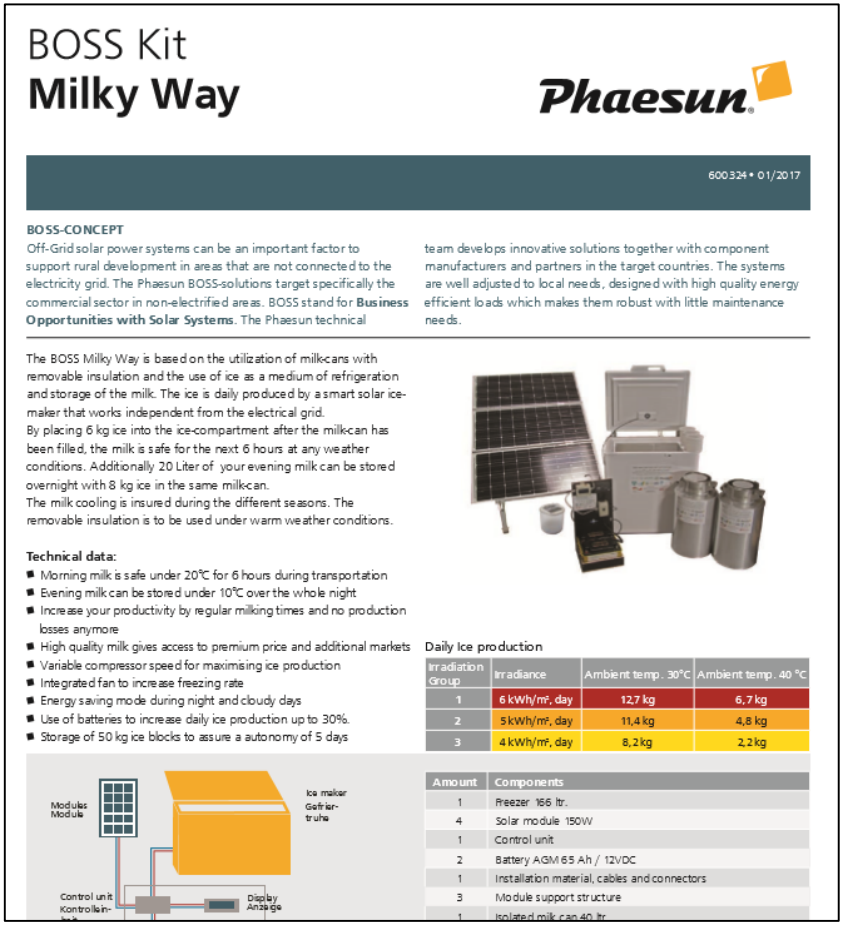
POWERING AGRICULTURE
giz
BBV-Landfrauen Internationale Zusammenarbeit GmbH

- 2018 Columbia
  3 Systems

POWERING AGRICULTURE
giz

Cooperation with the private sector

- Available on the market in cooperation with Phaesun GmbH (Germany)



BOSS Kit
Milky Way

Phaesun

600324 • 01/2017

BOSS-CONCEPT

Off-Grid solar power systems can be an important factor to support rural development in areas that are not connected to the electricity grid. The Phaesun BOSS-solutions target specifically the commercial sector in non-electrified areas. BOSS stand for **Business Opportunities with Solar Systems**. The Phaesun technical team develops innovative solutions together with component manufacturers and partners in the target countries. The systems are well adjusted to local needs, designed with high quality energy efficient loads which makes them robust with little maintenance needs.

The BOSS Milky Way is based on the utilization of milk-cans with removable insulation and the use of ice as a medium of refrigeration and storage of the milk. The ice is daily produced by a smart solar ice-maker that works independent from the electrical grid.
By placing 6 kg ice into the ice-compartment after the milk-can has been filled, the milk is safe for the next 6 hours at any weather conditions. Additionally 20 Liter of your evening milk can be stored overnight with 8 kg ice in the same milk-can.
The milk cooling is insured during the different seasons. The removable insulation is to be used under warm weather conditions.

Technical data:

- Morning milk is safe under 20°C for 6 hours during transportation
- Evening milk can be stored under 10°C over the whole night
- Increase your productivity by regular milking times and no production losses anymore
- High quality milk gives access to premium price and additional markets
- Variable compressor speed for maximising ice production
- Integrated fan to increase freezing rate
- Energy saving mode during night and cloudy days
- Use of batteries to increase daily ice production up to 30%.
- Storage of 50 kg ice blocks to assure a autonomy of 5 days

Daily Ice production

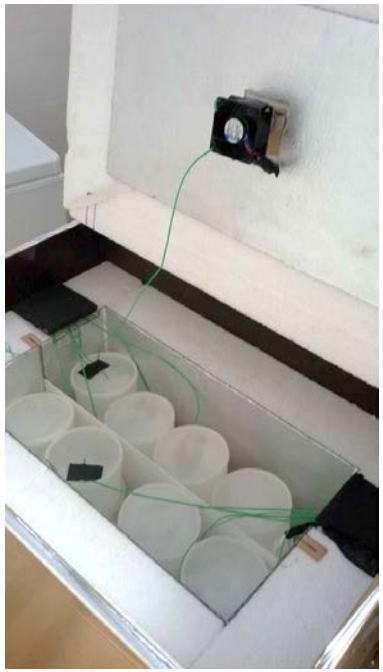
Irradiation Group	Irradiance	Ambient temp. 30°C	Ambient temp. 40 °C
1	6 kWh/m², day	12,7 kg	6,7 kg
2	5 kWh/m², day	11,4 kg	4,8 kg
3	4 kWh/m², day	8,2 kg	2,2 kg

Modules
Module
Ice maker
Gefrier-
truhe
Control unit
Kontrolleinheit
Display
Anzeige

Amount	Components
1	Freezer 166 ltr.
4	Solar module 150W
1	Control unit
2	Battery AGM 65 Ah / 12VDC
1	Installation material, cables and connectors
3	Module support structure
1	Isolated milk can 40 ltr.

- Cooperation with Kenian company Davis & Shirtliff to simplify the system and explore possibilities for local production

D&S DAVIS & SHIRTLIFF



Which barriers exist today to investments in solar milk cooling?

- Low awareness of which actors have a higher potential/need to adopt milk cooling. (Lack of selection criteria for demo projects)
- Lack of quality milk price premiums.
- Milk rejection occurs for the whole collection of several farmers and often not based on objective quality parameters. (Lack of transparency for farmers)
- Very low energy prices.

- Lack of incentives for farmers to deliver milk to the formal market or improve milk quality.
- When overall milk production is low (e.g. due to drought), the entire milk production can be marketed during day time making the benefit of evening milk storage much lower than expected.
- High distribution and maintenance cost in remote areas where the benefit of milk cooling is at highest.
- Donations of on-grid refrigerators and milk tanks affect the willingness to pay.

What is your experience with reference to the findings and recommendations of the INVESTA project?

- Knowledge of clients needs, market and value chain dynamics.
- Price premium for cooled milk to convince early technology adopters.
- Establishment of well defined indicators and impact monitoring.
- Importance of local ownership, maintenance and availability of spare parts.
- Attract local entrepreneurs.
- Consideration of the co-benefits of solar milk cooling.
- Establishment of standards for milk cooling equipment + Capacity Building.
- Insurance and financing products tailored to farmers (e.g. pay-as-you-go milk cooling)
- Reform electricity tariffs to support the use of renewable energy.

- Set minimum food quality standards and enforce quality checks. (might not work if milk demand is very high / Could negatively affect income of remote farmers)

- **Suggestion of recommendation for Kenya: Consideration of several steps of the value chain to obtain robust business models.**

  Eg. Improved feeding + milk cooling + Pasteurisation!

Postharvest and by-product management for sustainable rice production value chain

Nguyen Van Hung and Martin Gummert

Postharvest and Mechanization Clusture, Sustainable Impact Platform,

IRRI

Investments in Energy Sustainable Technologies in the Agrifood Sector (INVESTA) Workshop

FAO, Rome, 23-24 Nov, 2017

11/29/2017

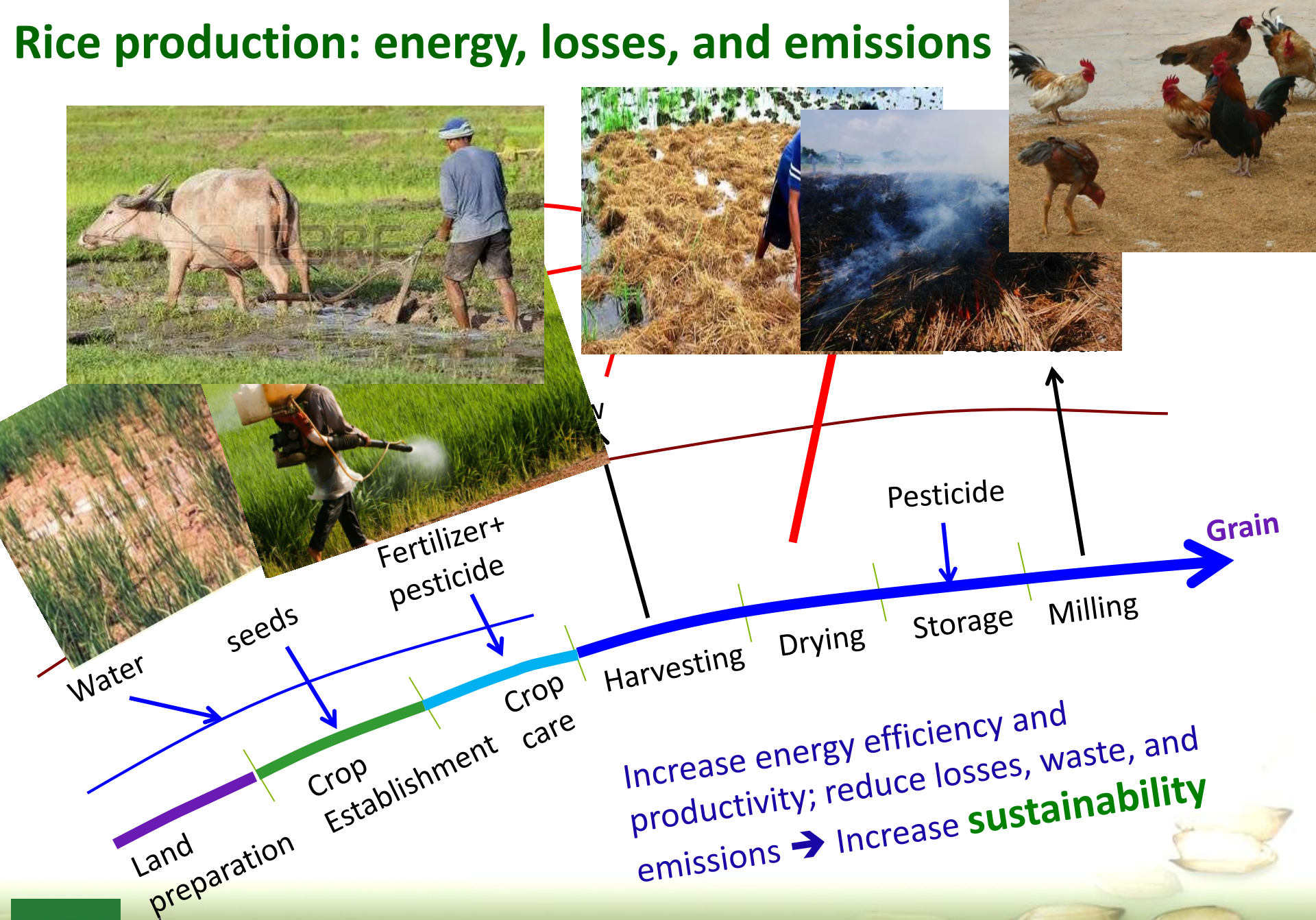
International Rice Research Institute

Our Mission:
To reduce poverty and hunger, improve the health of rice farmers and consumers, and ensure environmental sustainability through collaborative research, partnerships, and the strengthening of national agricultural research and extension systems.

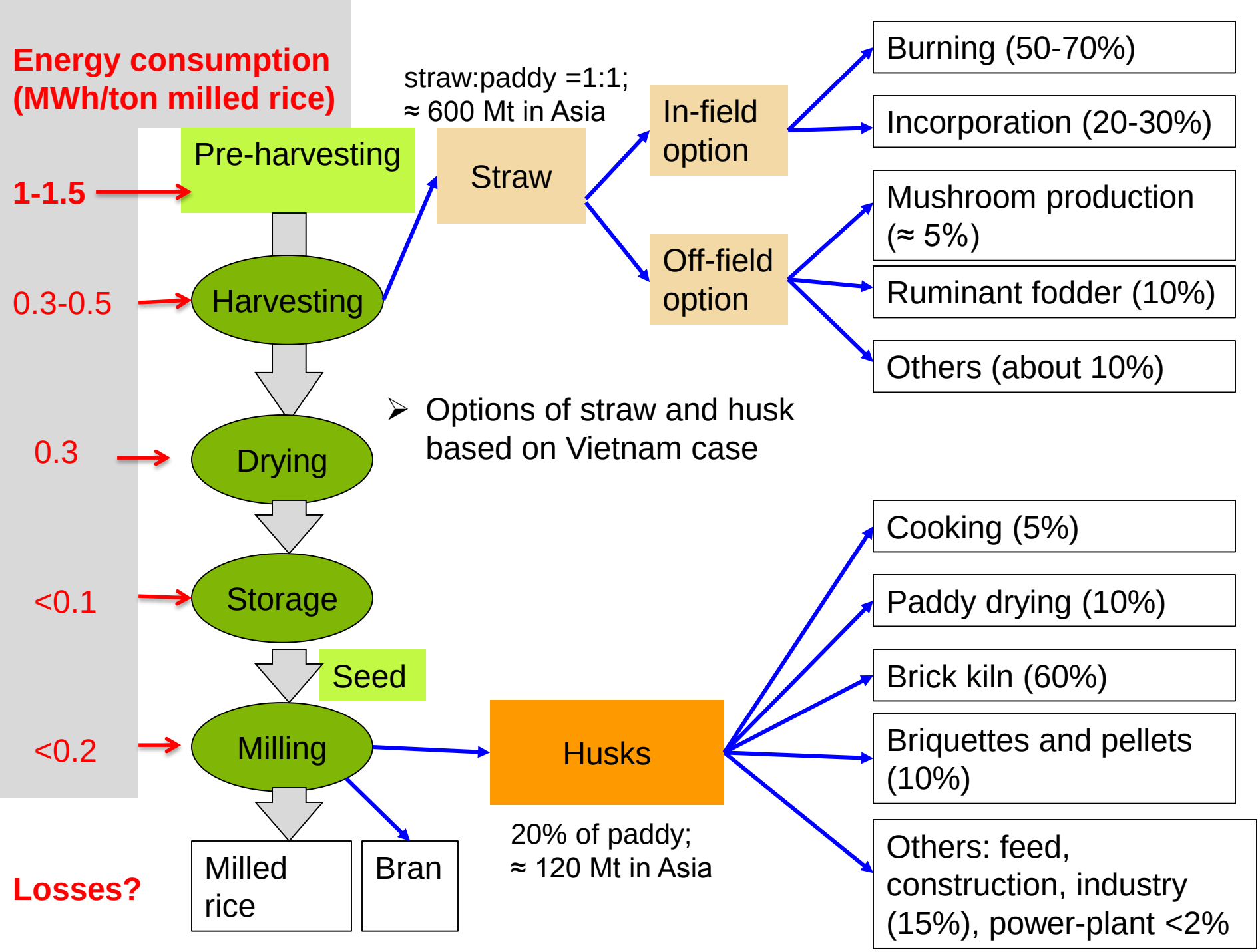
1000 Employees, 100 International Staff

Research station: Los Baños, Philippines
17 country offices: Bangladesh, Cambodia, India, Indonesia, Lao, Myanmar, Thailand, Vietnam, Africa program in 3 countries
250 ha Experiment Station

Rice production: energy, losses, and emissions

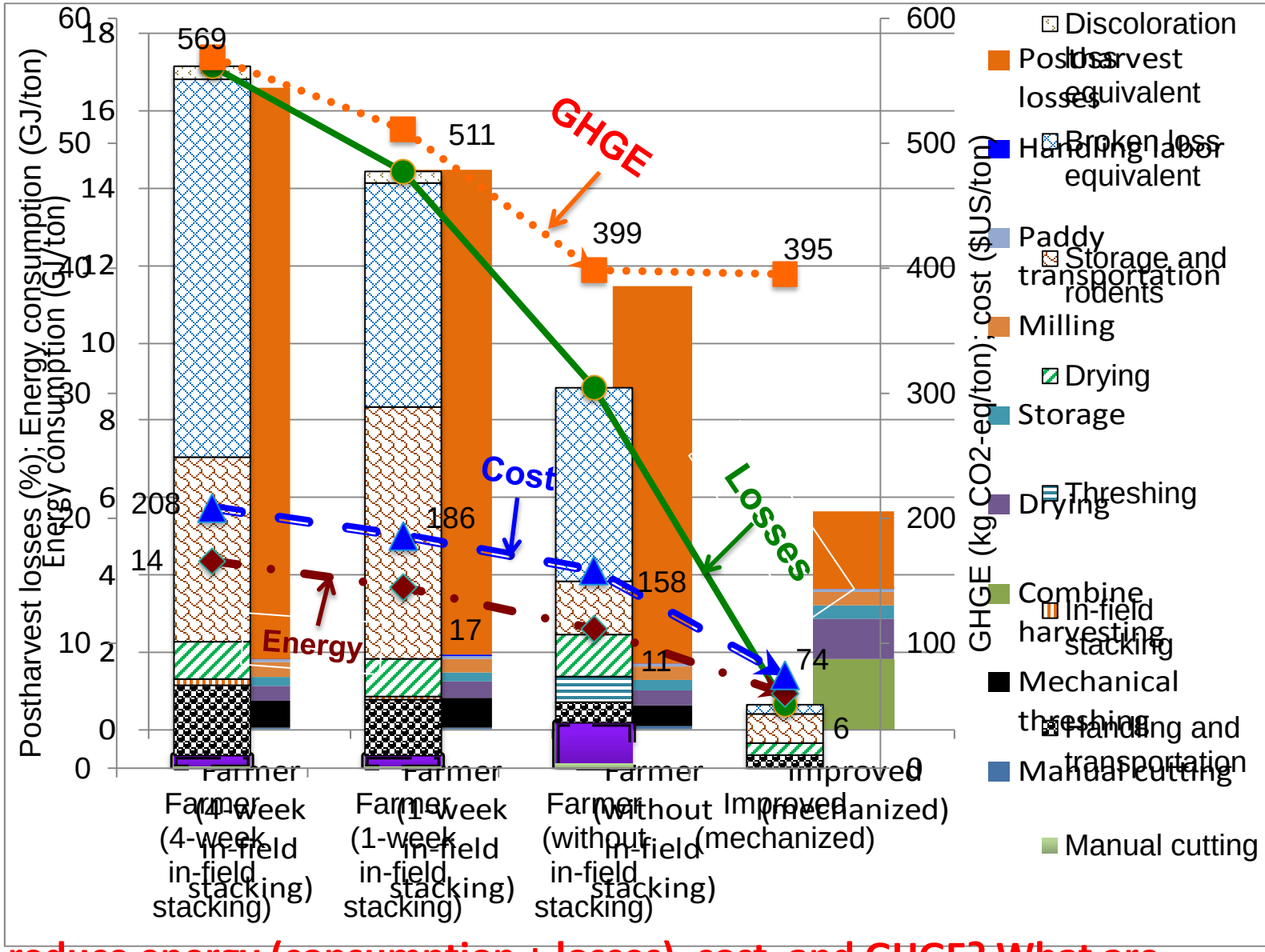


Increase energy efficiency and productivity; reduce losses, waste, and emissions ➔ Increase **sustainability**


Energy consumption (MWh/ton milled rice)
1-1.5
0.3-0.5
0.3
<0.1
<0.2
Losses?
Pre-harvesting
Harvesting
Drying
Storage
Seed
Milling
Milled rice
Bran
Straw
straw:paddy =1:1;
≈ 600 Mt in Asia
In-field option
Off-field option
Burning (50-70%)
Incorporation (20-30%)
Mushroom production (≈ 5%)
Ruminant fodder (10%)
Others (about 10%)
➢ Options of straw and husk based on Vietnam case
Husks
20% of paddy;
≈ 120 Mt in Asia
Cooking (5%)
Paddy drying (10%)
Brick kiln (60%)
Briquettes and pellets (10%)
Others: feed, construction, industry (15%), power-plant <2%

Postharvest losses, energy, GHGE, cost of different practices – case study

Source: MyRice project (ACIAR)



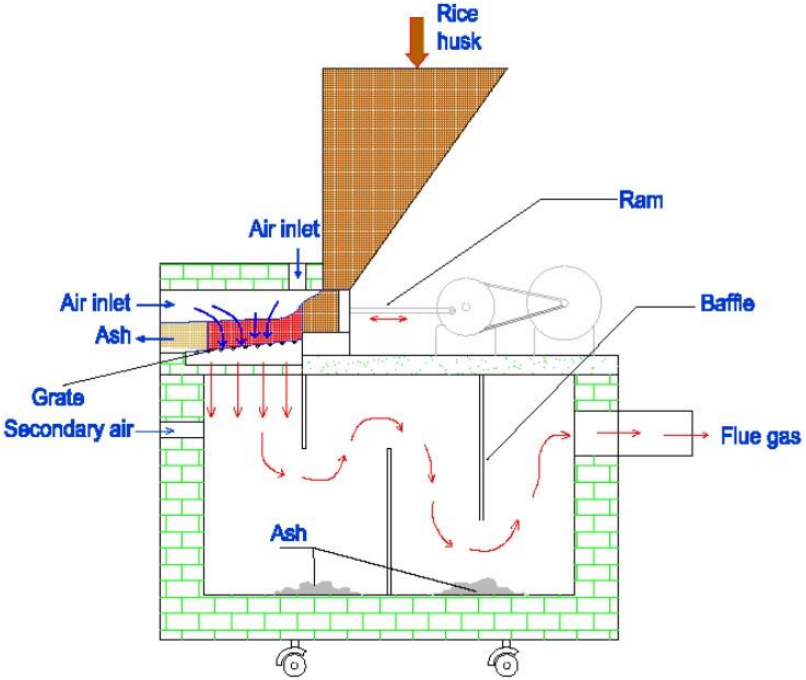
How can we reduce energy (consumption + losses), cost, and GHGE? What are the most significant inputs?

➔ **losses (30-80%), harvesting (20-30%), drying (10-20%), milling (5-10%)**

Drying and Storage

Solar Bubble Dryer (IRRI+HHU + GP): uses only solar energy, zero

Flatbed dryer with rice husk furnace
E.g. used for drying ≈ 45% paddy in Mekong Delta of Vietnam



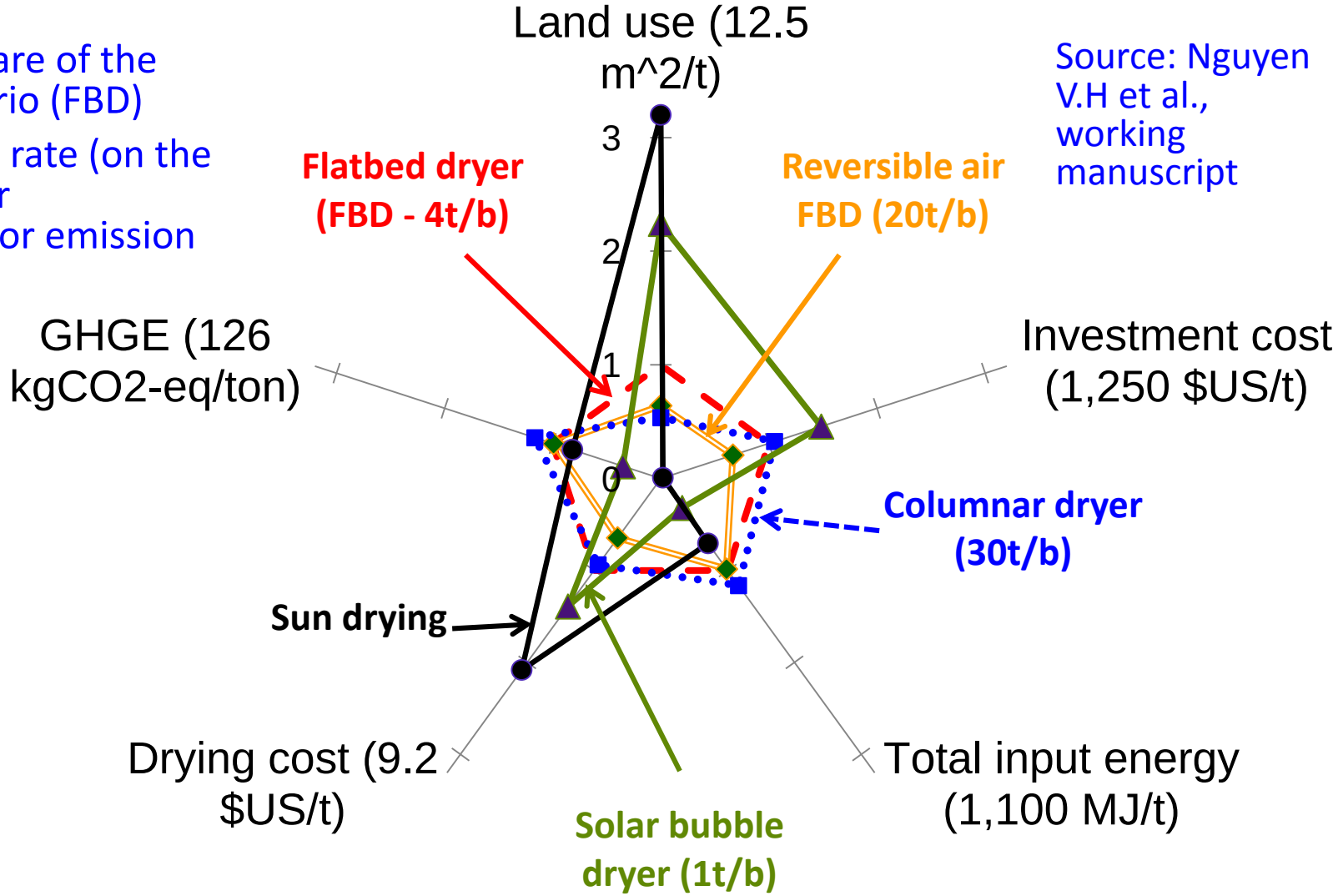
Downdraft rice husk furnace developed by IRRI, HHU, NLU (heat efficiency = 70-80%)

Hermetic Storage System (IRRI+GrainPro): No energy consumed, no pesticide used

Energy consumption, cost, and other factors for different drying practices (example for Philippines, Vietnam, Cambodia)

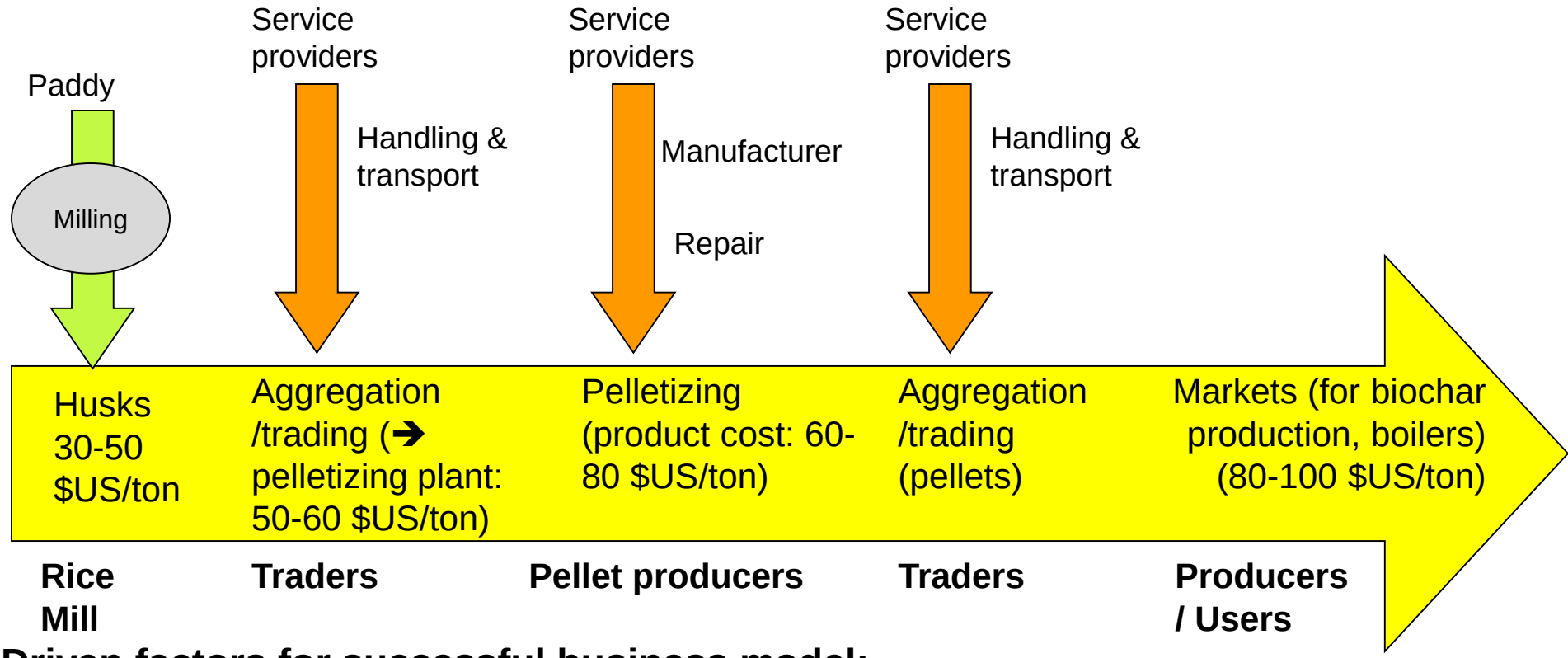
- Values in (…) are of the control scenario (FBD)
- Higher fold or rate (on the axes) = higher consumption or emission

Source: Nguyen V.H et al., working manuscript



Consider energy inputs and GHGE ➔ Solar bubble dryers is the best, but cost ➔ flatbed dryers is best (80% of dryers in SEA are FBDs)

Example of a value chain of rice husk pellets in Vietnam



Driven factors for successful business model:

- High demand
- Low energy cost: cheaper by 50-70% than that of coal
- Pellet combustion technology (furnace): available and low investment or transformation (from coal to husk pellets)

Example rice straw supply chain in Vietnam (sustainable alternative to avoid burning – BMZ funded project)

Rice production

Harvesting

Fabricators

Distributor

Dealers

Service / Repair

Component Suppliers

Straw — Farmers

Collection — Service providers

Compacting, storage, transport — Traders

Processing — Producers

Markets (mushroom, cattle feed, etc)

Exp: Business model of collection + compacting:

Net profit 38,000 $US/year; Capital return = 1 year

Lessons learned from IRRI's interventions and projects

Barriers of renewable energy investment:

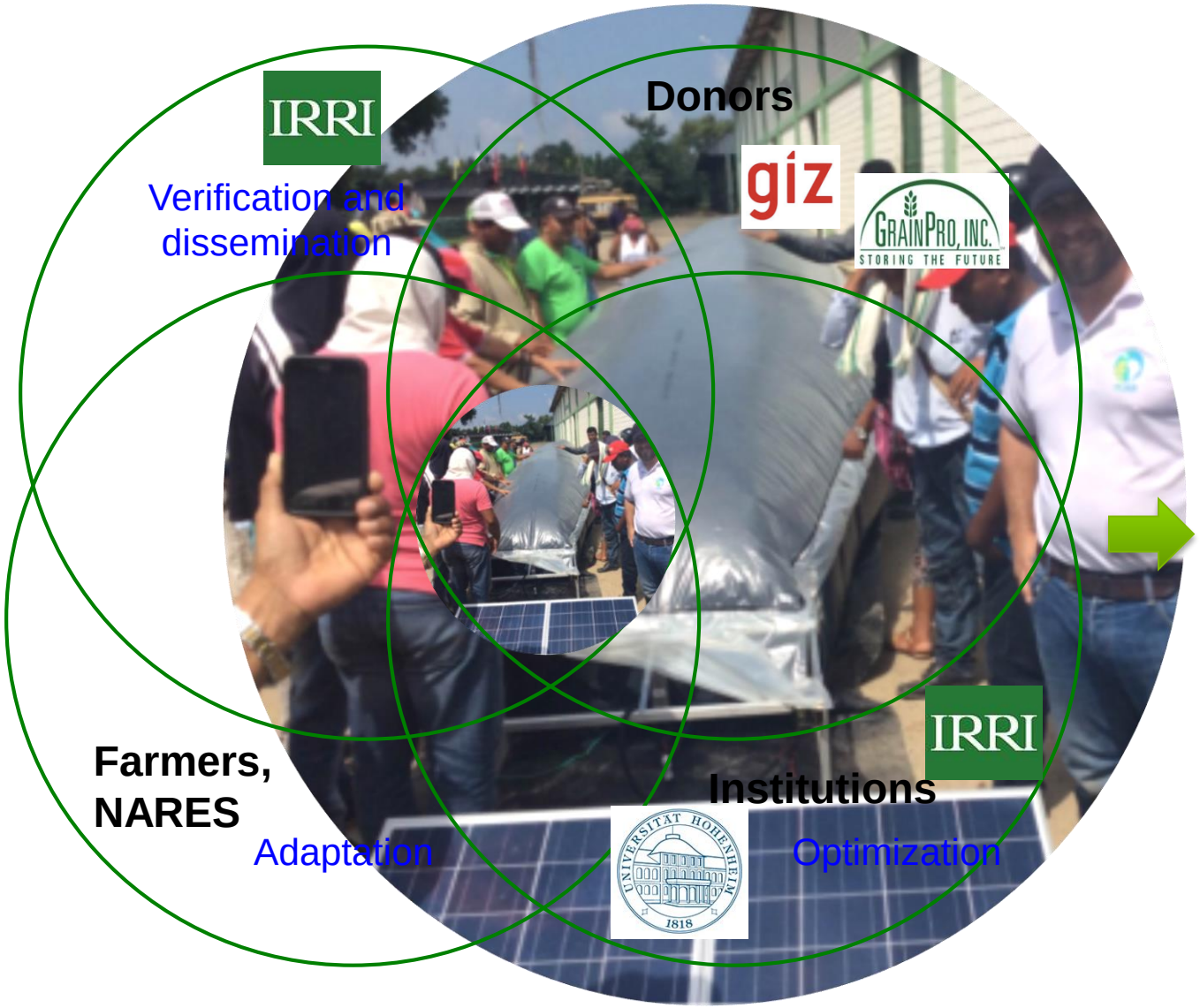
- Energy price: compete with low price of electric power, fossil fuel, and low environmental cost
- Electrification of rice husk/straw: high cost of feedstock (transportation, handling, storage); maintenance and management, waste/pollution management (e.g. waste water from gasification).
- Lack of demonstrated technologies and business models

Recommendations for sustainable development investments:

- Looking at the whole value chain, not just on single technology component. E.g energy = losses + consumption resulted from land leveling + pre+post production; consider to the specific context/ perfective/ market
- For rice residues: key criteria is to reduce transportation cost ➔ for drying (at or nearby rice mills), pellets/briquettes ➔ further uses/processing
- Technology localization and capacity building are important points for out-scaling
- Make the technologies involved in the Government's supporting programs (e.g. extension, promoted and priority to be subsidized)➔ need a PPP model

For technology developments: PPP model

Case study of IRRI solar bubble dryer



From concept to commercialization: 2 years

Thank you

Contacts and further information:
www.irri.org; www.ricestraw.irri.org
Email: m.gummert@irri.org; hung.nguyen@irri.org