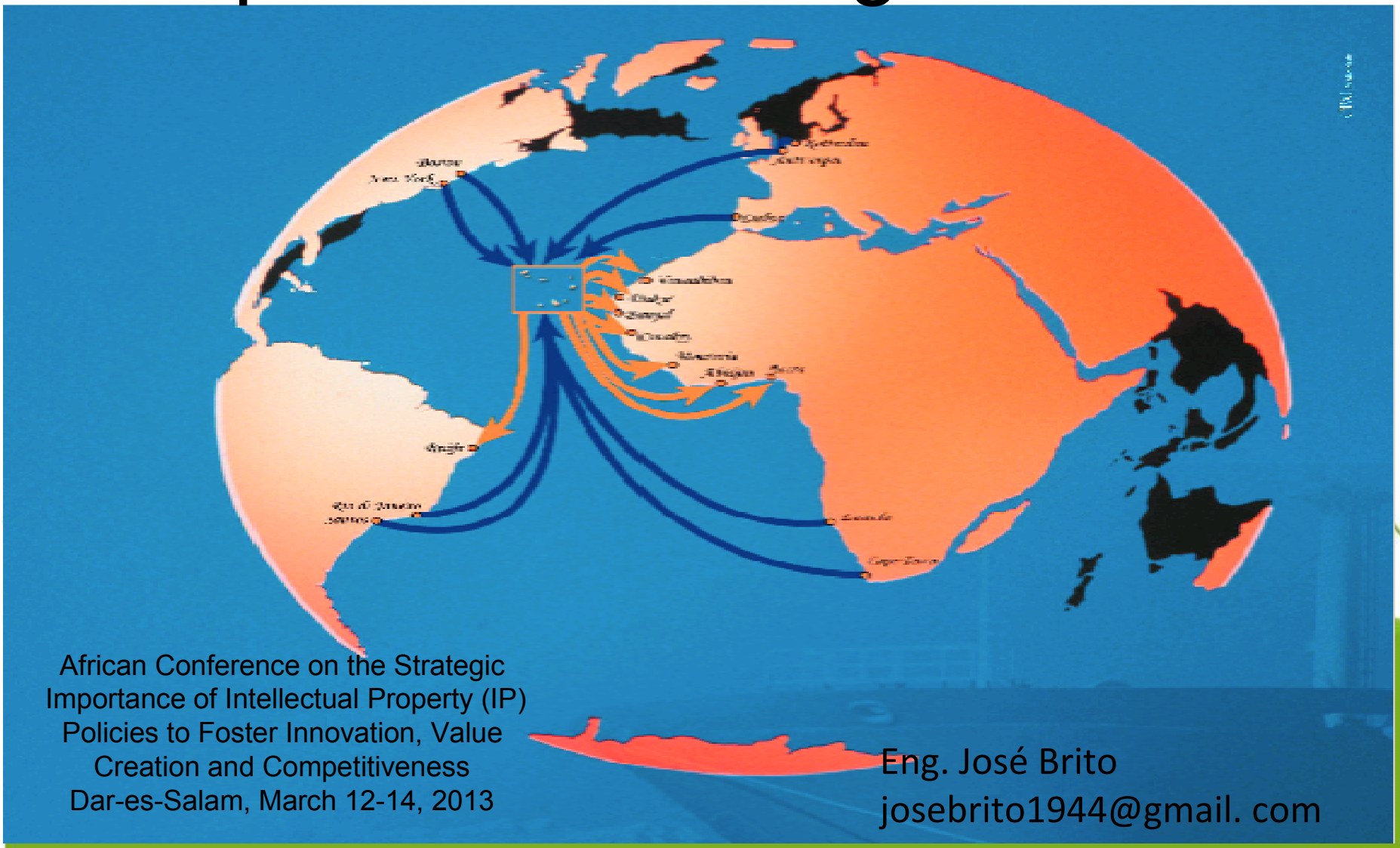
Cape Verde: Achieving Fossil Fuel Independence through Innovation



African Conference on the Strategic Importance of Intellectual Property (IP) Policies to Foster Innovation, Value Creation and Competitiveness
Dar-es-Salam, March 12-14, 2013

Eng. José Brito
josebrito1944@gmail. com

- Established in Cape Verde in 2012
- Our mission is to “build enterprises and nurture innovation in Africa”
- Our vision is “transforming Africa”
- Our approach is to incubate creative ideas into businesses, support innovators, and build innovation friendly environment in Africa

ihaba
building enterprises

What we are doing now...

238CV – tourism

- Online tourism market place for Cape Verde

Bonako

- Mobile Applicatiions
- Digital games inspired by African folktales & myths

Seed Africa – venture development

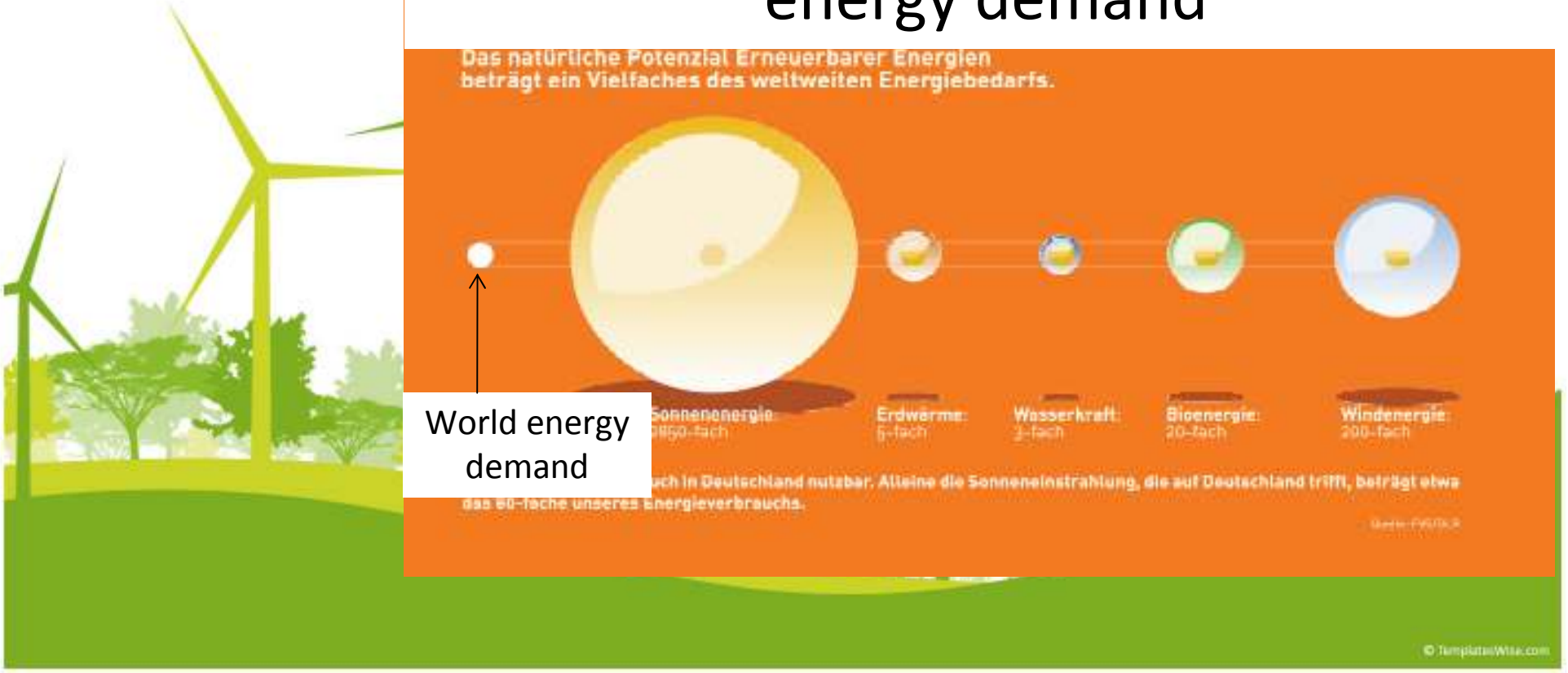
- Startup Acelerator
- Seed Africa Fund
- Innovation Summits

Renewable Energy

- Large scale biofuel farms and processing
- Renewable Advisory

Huge variety of potentials

Renewable energies have huge but different potential for covering the energy demand



We are spending more & more to satisfy our energy needs with fossil fuel

Costs for fossil energy imports in Germany

in 2000: 44 billion Euros

- in 2005: 91 billion Euros
- in 2007: 145 billion Euros

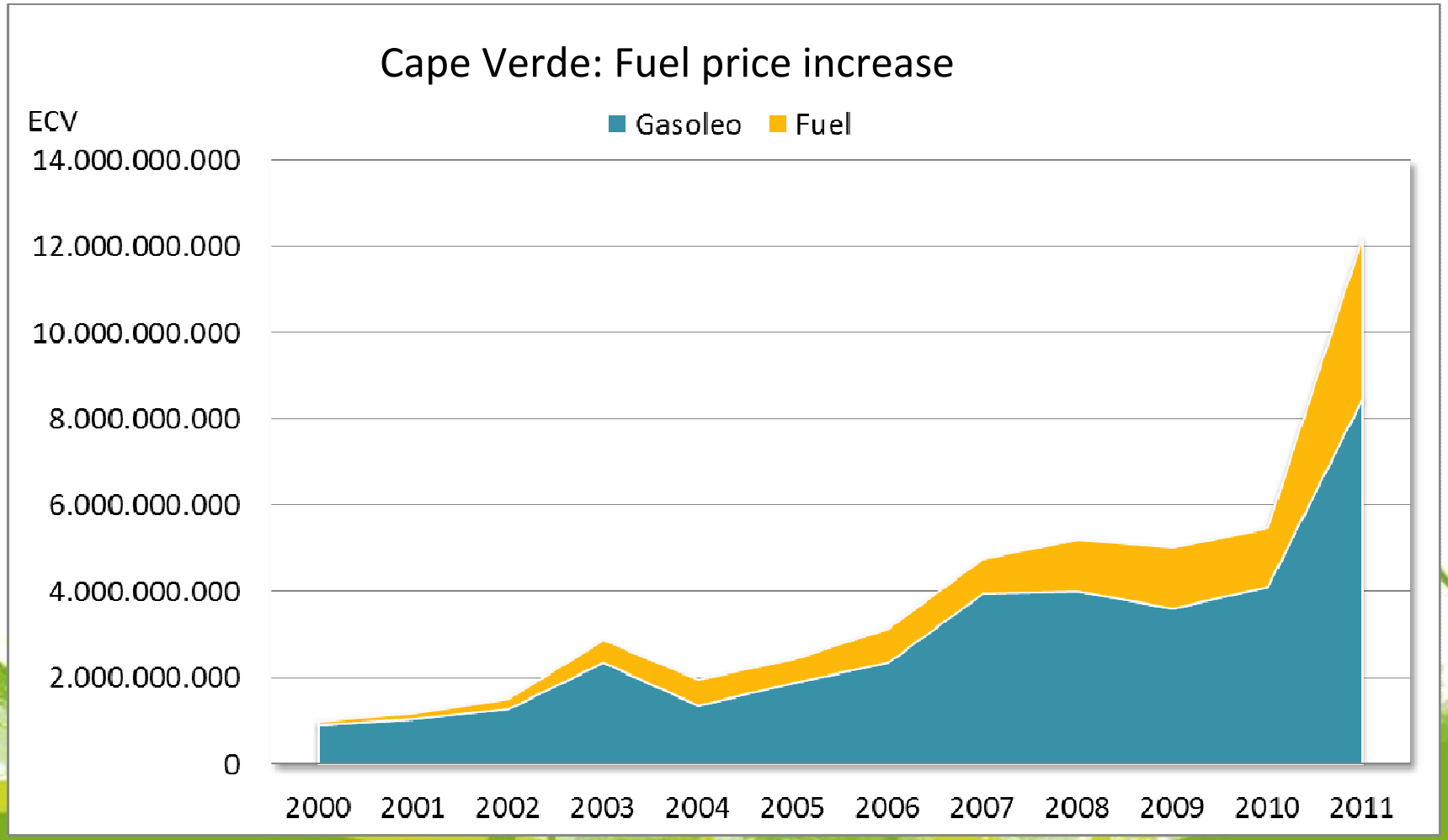
In a village (20.000 inhabitants):

→ in 2000: ~ 6,9 Million Euros

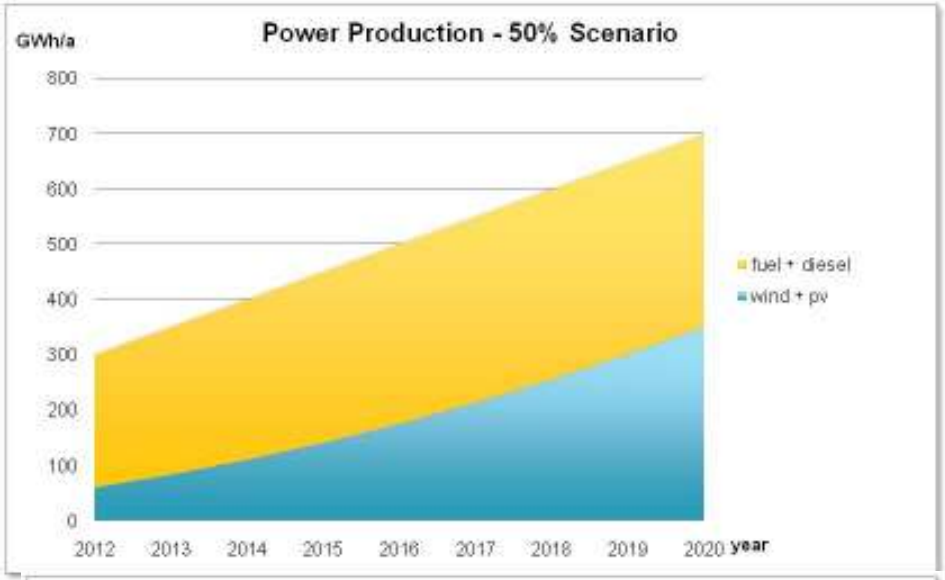
→ in 2005: ~ 15,1 Million Euros

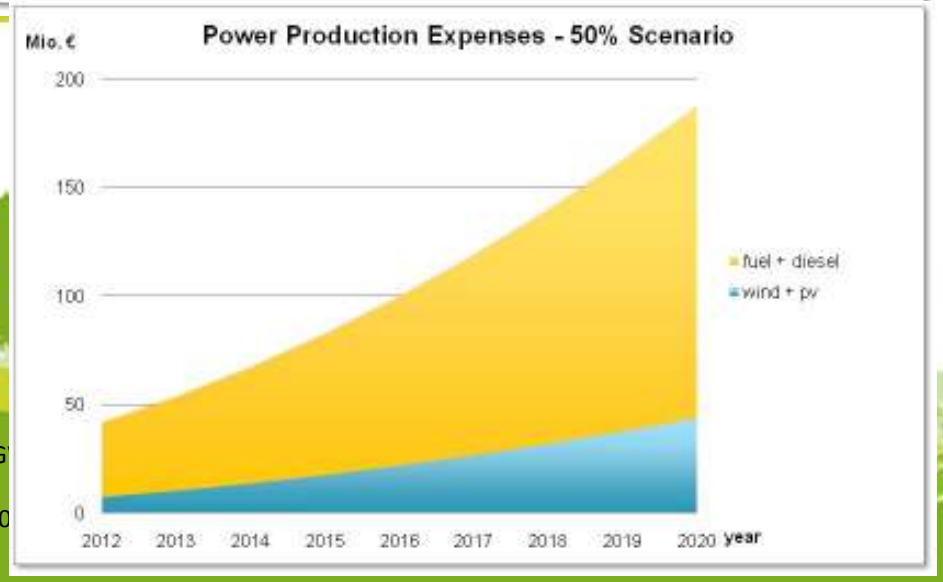
→ in 2007: ~ 24,5 Million Euros

We are spending more & more to satisfy our energy needs with fossil fuel



Even with 50% of RE, we will still be paying a lot of money





Assumptions

PV	3.400 €/kW
Wind	2.200 €/kW
Thermal Group	1.000 €/kW
Efficiency	30 %
Fuel Cost (act.)	0,71 €/l
Diesel Cost	1,09 €/l
Increase rate	15 %/a
	8,5 %/a
Electr, Prod.	300 → 700 G
RE	20 → 50 %
Timeframe	2012 → 2020

50% Fossil Energy Production

=

75% of the Total Lifecycle Expenditure!

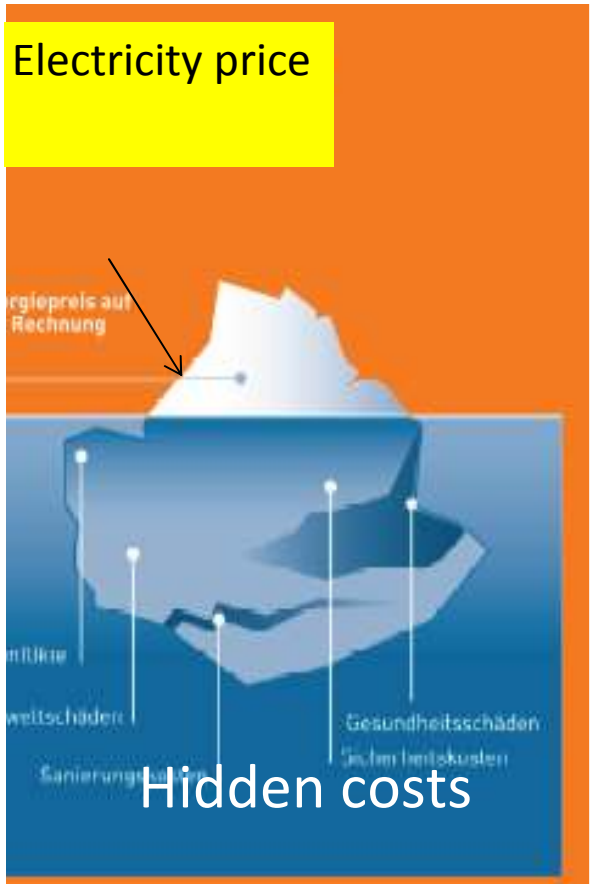
=

+800% of GHG Emissions!

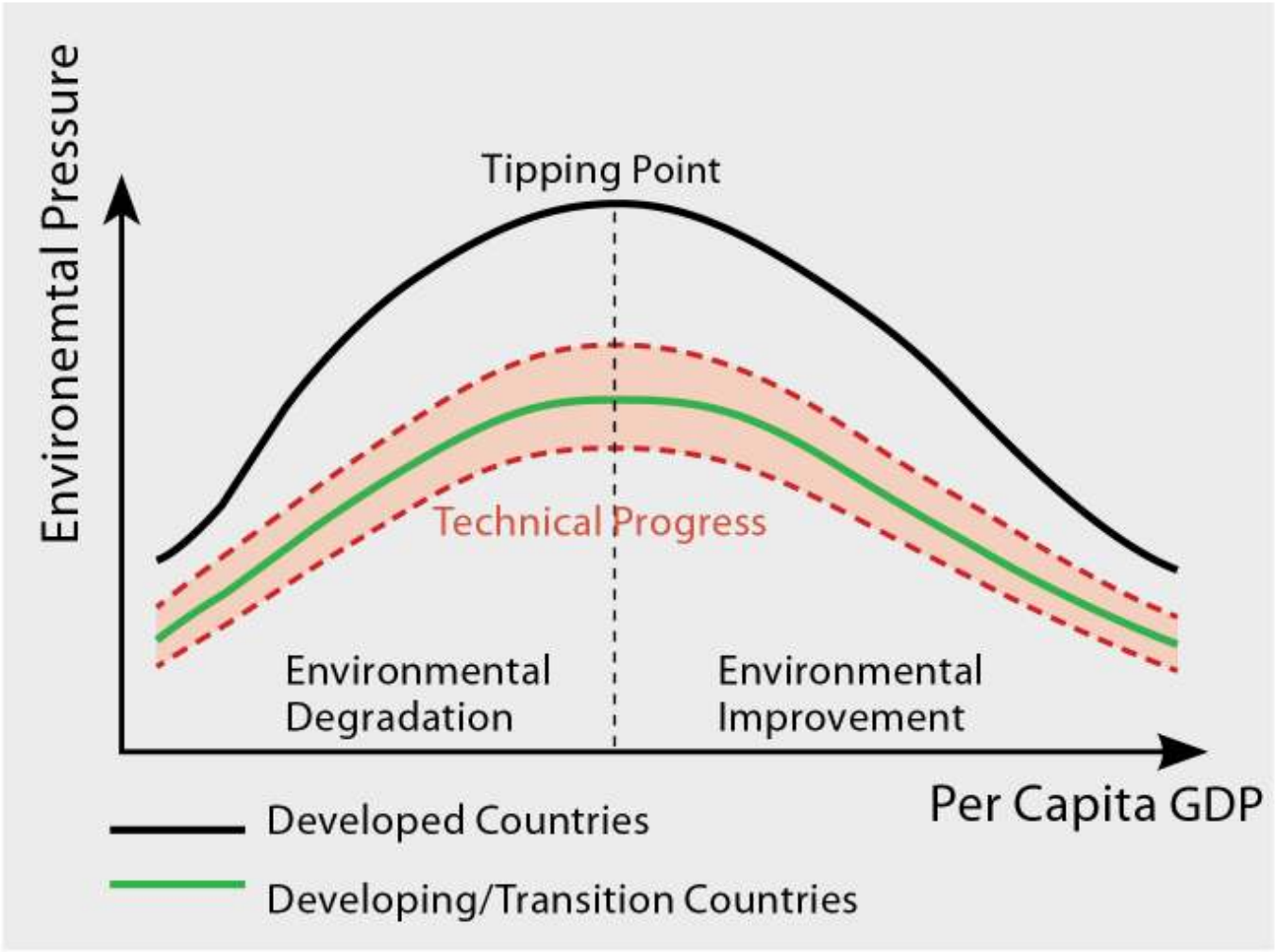
What to compare with?

Many hidden subsidies and risks of fossil fuel and nuclear energies:

- External costs
- Health risks
- Wars and military expenditures
- Supply chain safety
- Technical risks



Zero Emission: the global perspective

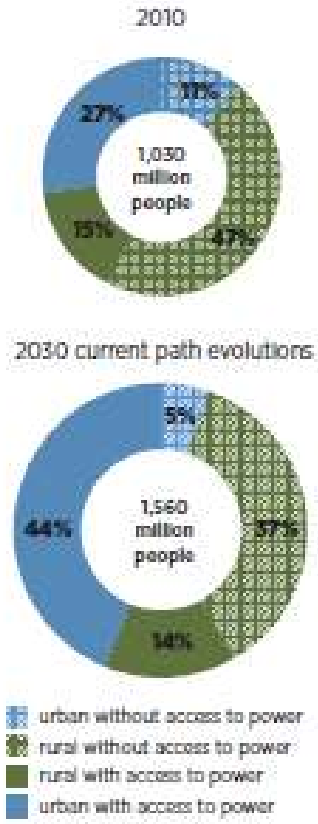


A Continent of Opportunity

ource: IRENA, adapted from United Nations Cartographic Section map 4045 Rev.7, Environmental Systems Research Institute, Africa Infrastr
ountry Diagnostic GIS data (the World Bank)

A Continent of Opportunity

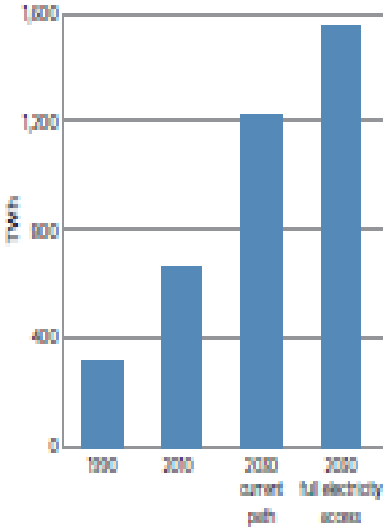
Figure 1: Comparison of rural and urban electricity access in 2010 and 2030, if current trends continue



Source: IRENA analysis based on IEA: World Energy Outlook 2012; UN: World Population Prospects 2010 Revision

Africa is undergoing unprecedented and sustained growth. By 2050, the continent will be home to at least 2 billion people – twice as many as today – with 40% living in rural areas.1 In 2010, about 590 million African people (57% of the population) had no access to electricity, and 700 million (68% of the population) were living without clean cooking facilities. If these current energy access trends continue, in 2030 there will still be 655 million people in Africa (42% of the population) without access to power, and 866 million (56% of the population) without clean cooking facilities, depriving the majority of the population of the opportunity to pursue a healthy and productive life.

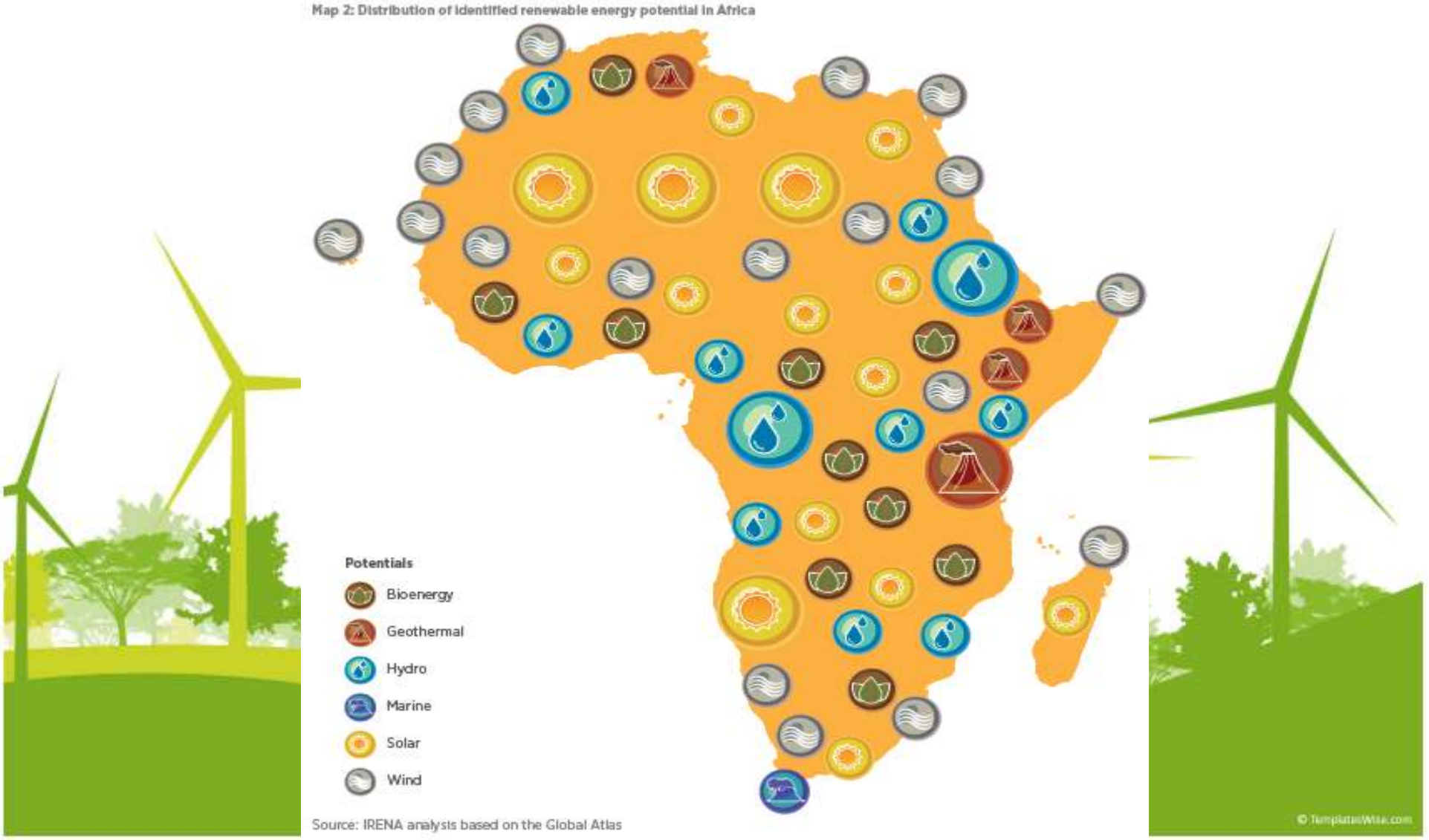
Figure 2: Comparison of Current African Power Consumption Trend vs. Full Access in 2030



Source: based on IEA: World Energy Outlook 2012 and IRENA analysis

Africans currently consume only one quarter of the global average energy per capita, using a mix of hydropower, fossil fuels and biomass – mostly in traditional uses. As shown in Figure 2, providing full electricity access to all Africans would require only an additional 900 TWh over 20 years, an amount that corresponds to one year of current additional global power consumption.

Distribution of Identified Renewable Energy Potential in Africa

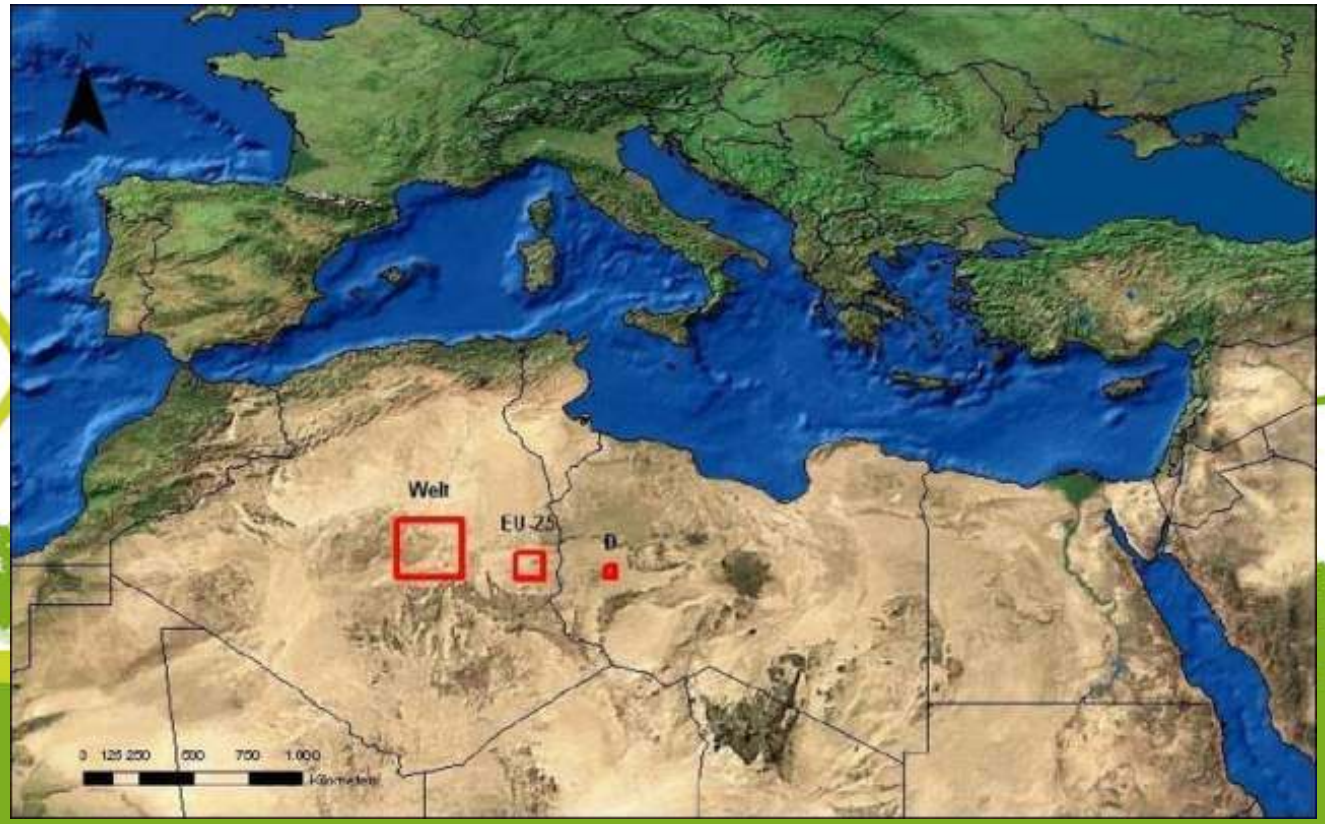


Energy – A Huge Potential in Northern Africa

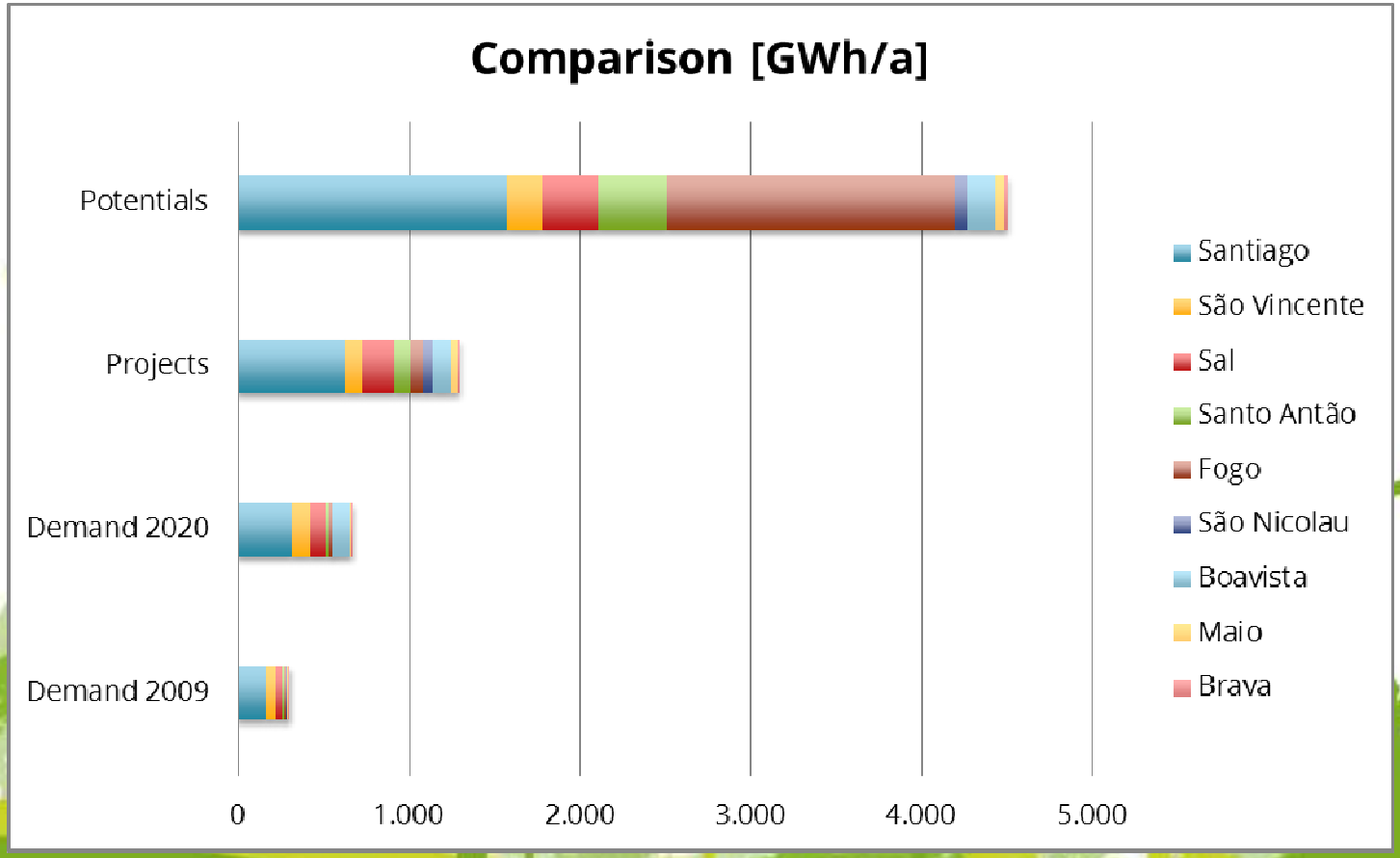
➔ Less than 4% of the Sahara area is sufficient to cover world electricity demand

➔ An area of 600km x 600km would provide enough electricity for the world

➔ The boxes indicate the necessary space to cover the electricity demand of the world, the EU-25, Germany



Large potentials identified and manifold surplus in renewable sources



Decrease in Photovoltaic Price

Cost Decrease for Photovoltaic Systems

- since 2000 - 75 %
- since 2008 - 50%
- until 2016 - 50% - on top on 2012 level

Source: Agentur für Erneuerbare Energien, BMU

Comparing Cost

cost for power generation (ex generator)

- no grid
- no sales

Calculation model

– 20 year service period

	PV	Wind		Fuel 180	Diesel
Investment	3.406 €/kW	2.212 €/kW	**Investment**	1.066 €/kW	1.066 €/kW
interest	5 %	5 %	interest	5 %	5 %
duration	20 a	20 a	duration	20 a	20 a
annual cost	273 €/a	177 €/a	annual cost	86 €/a	86 €/a
financial cost	5.466 €/kW	3.550 €/kW	**financial cost**	1.711 €/kW	1.711 €/kW
operation & maintenance	2 %	5 %	**operation & maintenance**	5 %	5 %
annual cost	68 €/a	111 €/a	annual cost	53 €/a	53 €/a
operation cost	1.362 €/kW	2.212 €/kW	**operation cost**	1.066 €/kW	1.066 €/kW
service time	1.745 h/a	3.056 h/a	**service time**	6.000 h/a	6.000 h/a
effiency			effiency	38,6 %	33,3 %
fuel energy density			fuel energy density	10 kWh/l	10 kWh/l
fuel cost (actual)			fuel cost (actual)	0,78 €/l	1,09 €/l
increase rate			increase rate	13,9 %/a	8,5 %/a
annual cost (actual)			annual cost (actual)	1.212 €/a	1.964 €/a
total fuel cost	0 €/kW	0 €/kW	**total fuel cost**	111.847 €/kW	97.787 €/kW
levelized cost of energy	0,1956 €/kWh	0,0943 €/kWh	**levelized cost of energy**	0,9321 €/kWh	0,8149 €/kWh

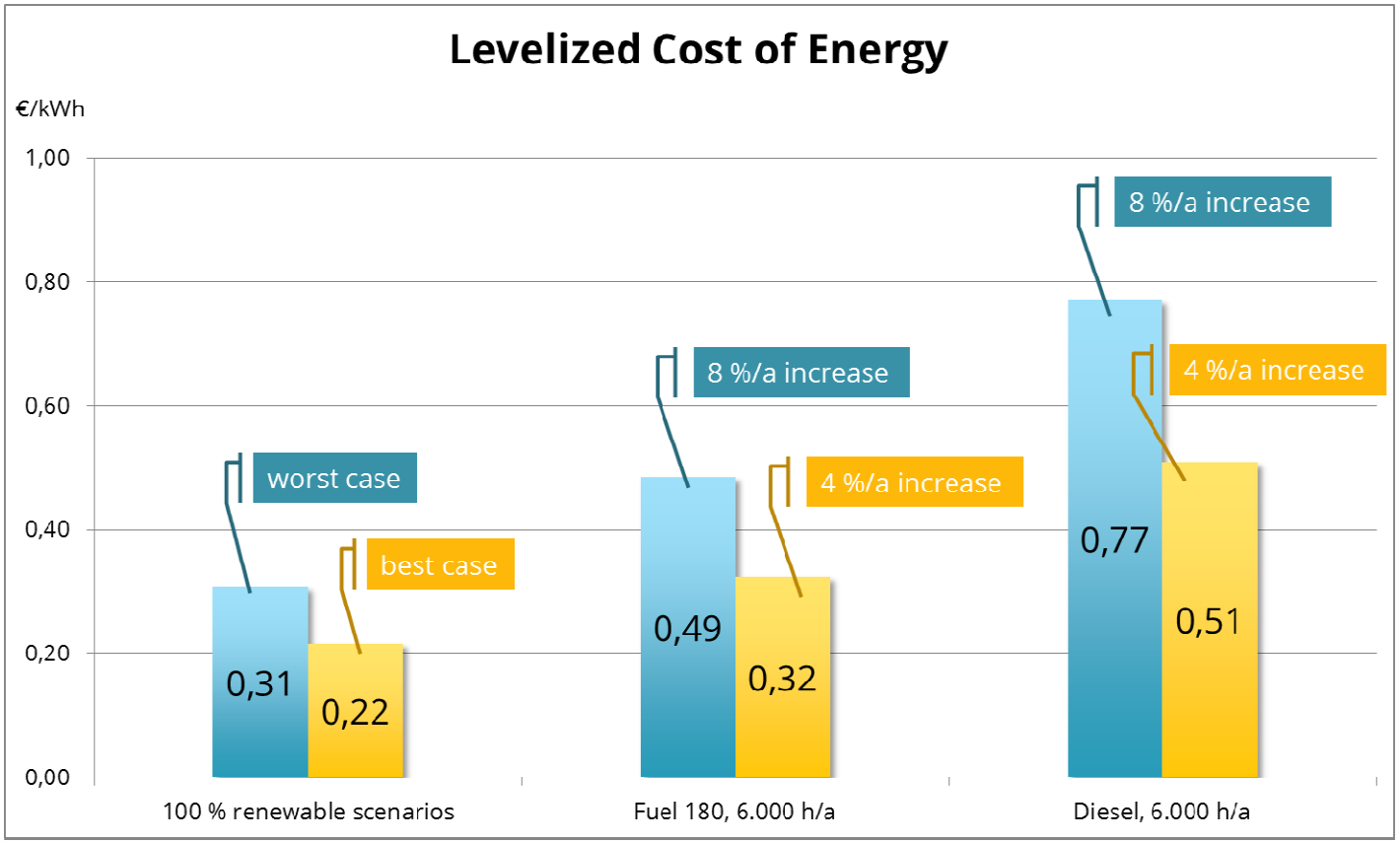
source Gesto

Cost Comparison

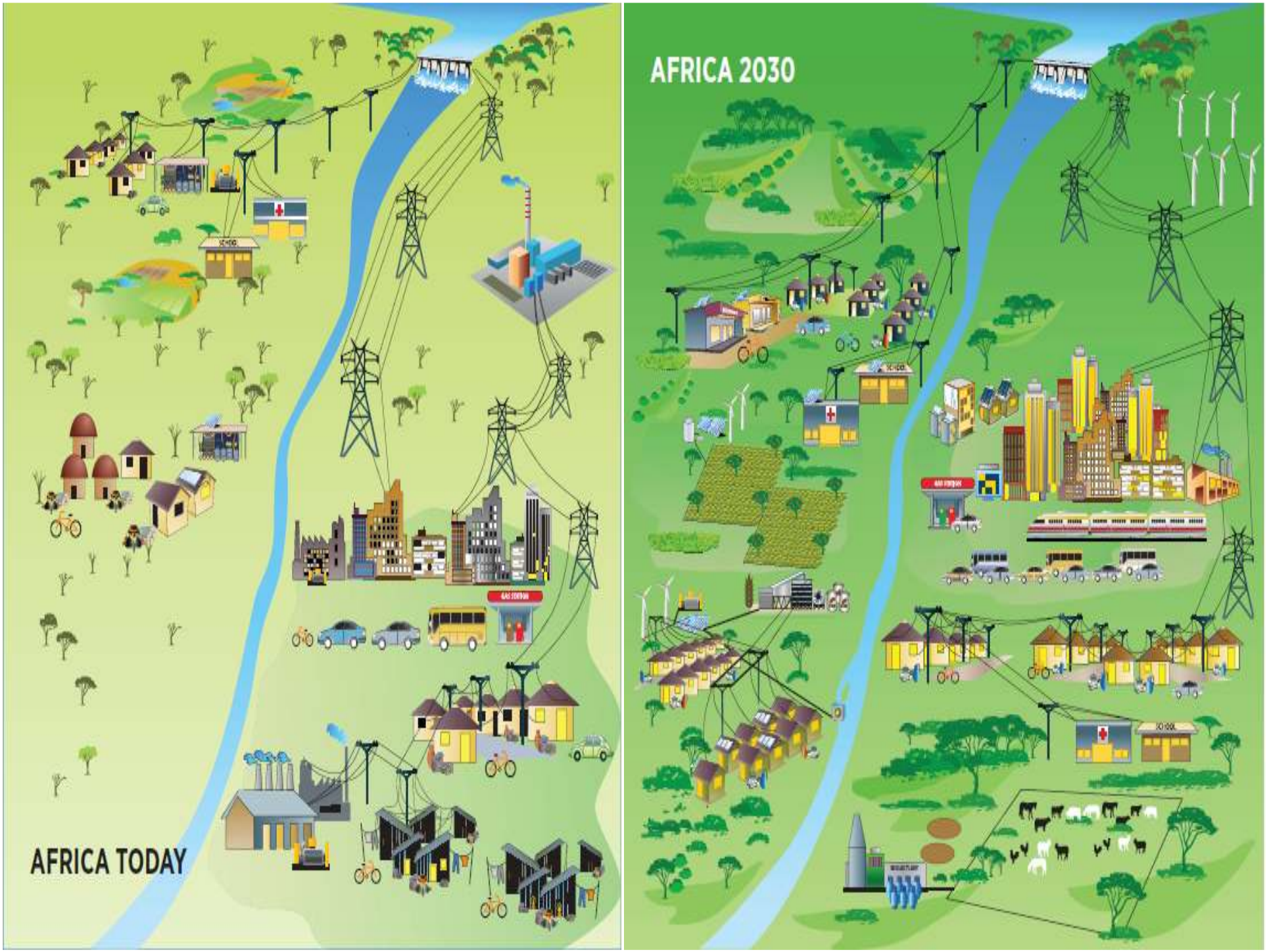
average over 20 years service period

cost for power generation
(ex generator, incl. storage for renewable)

- no grid
- no sales

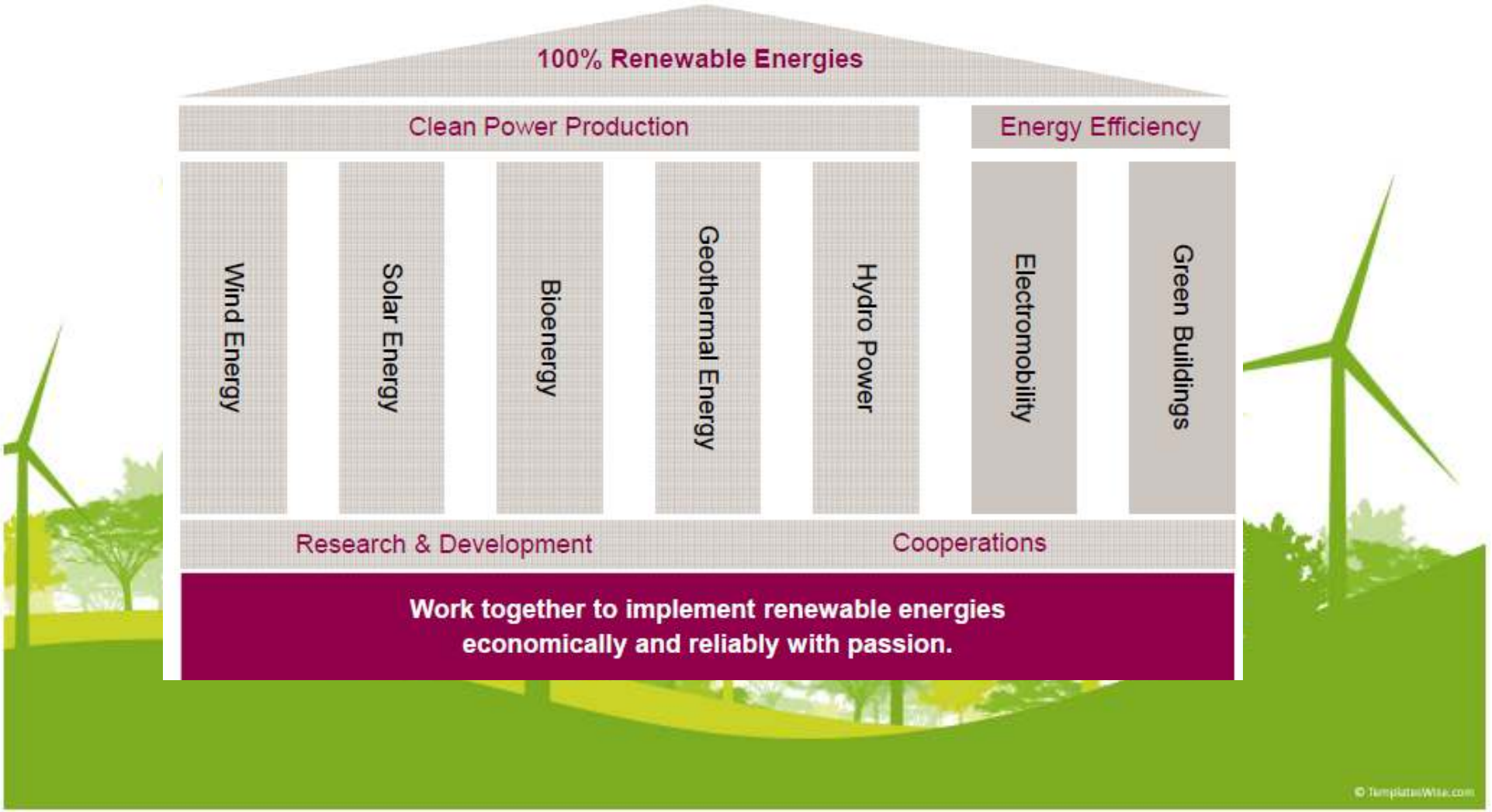


source
Gesto, Electra, IfaS

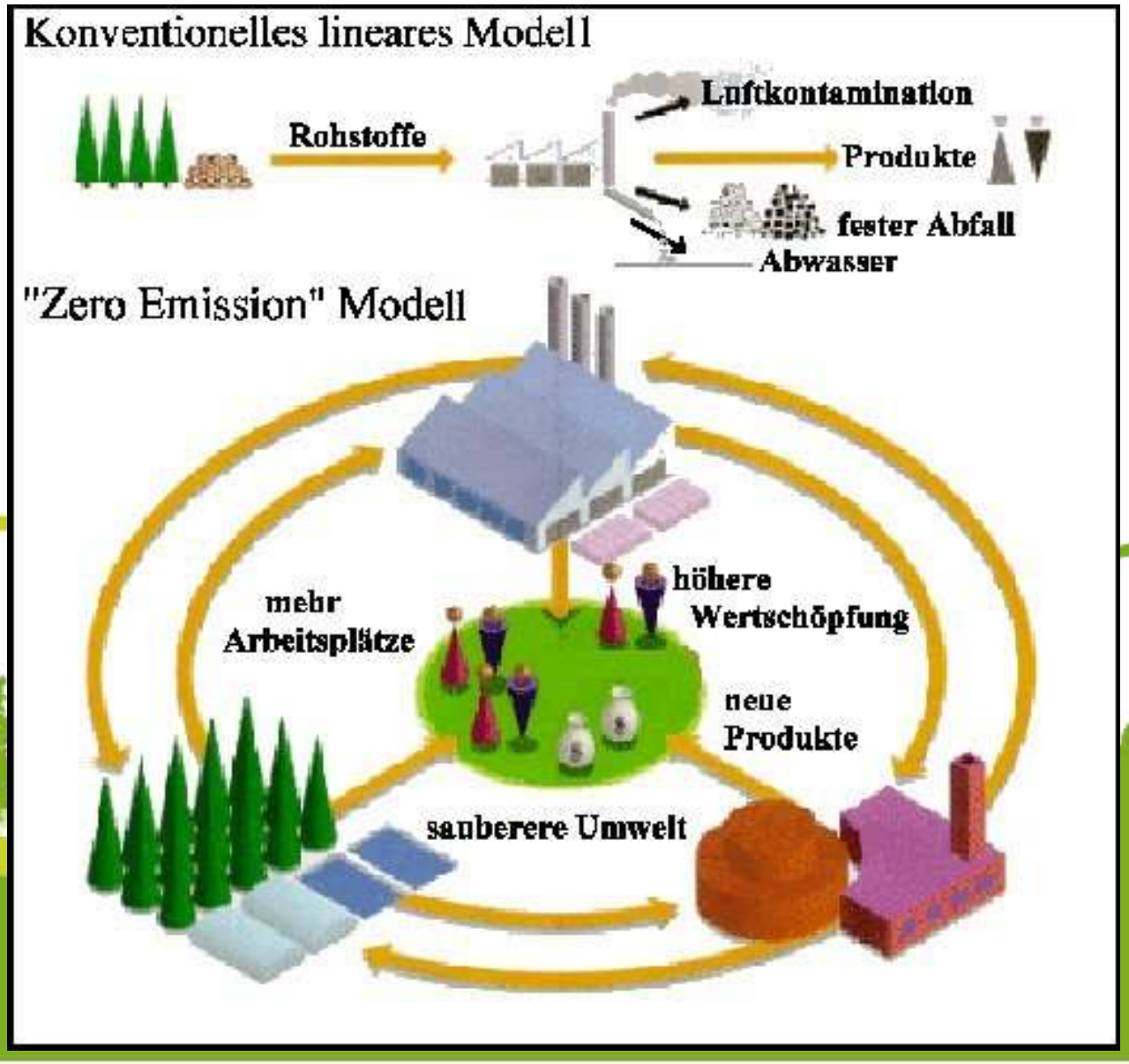

AFRICA TODAY
AFRICA 2030

OUR VISION:

VISIONARY, AMBITIOUS but FEASIBLE



Conventional Linear Model vs. CE-Model

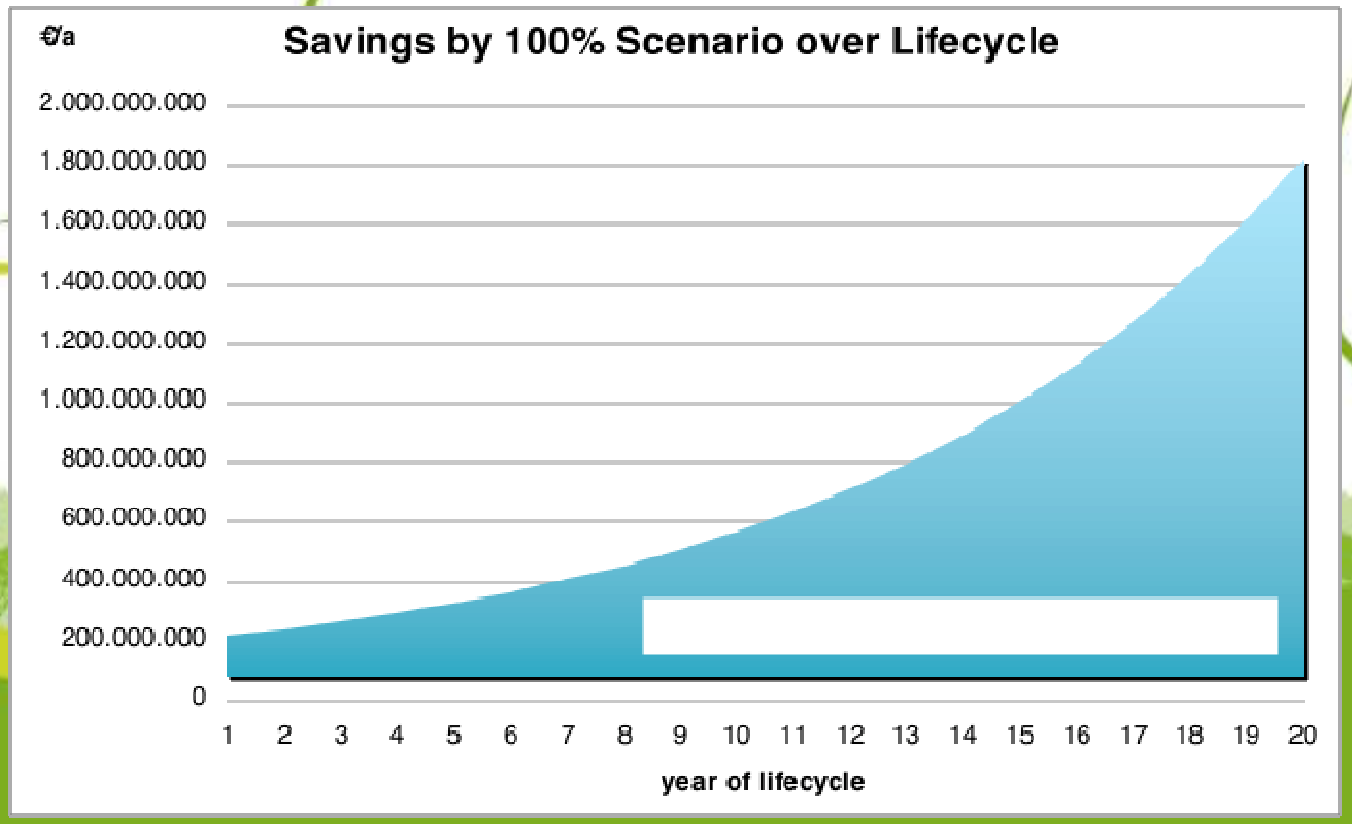


Absolute savings (100% scenario)

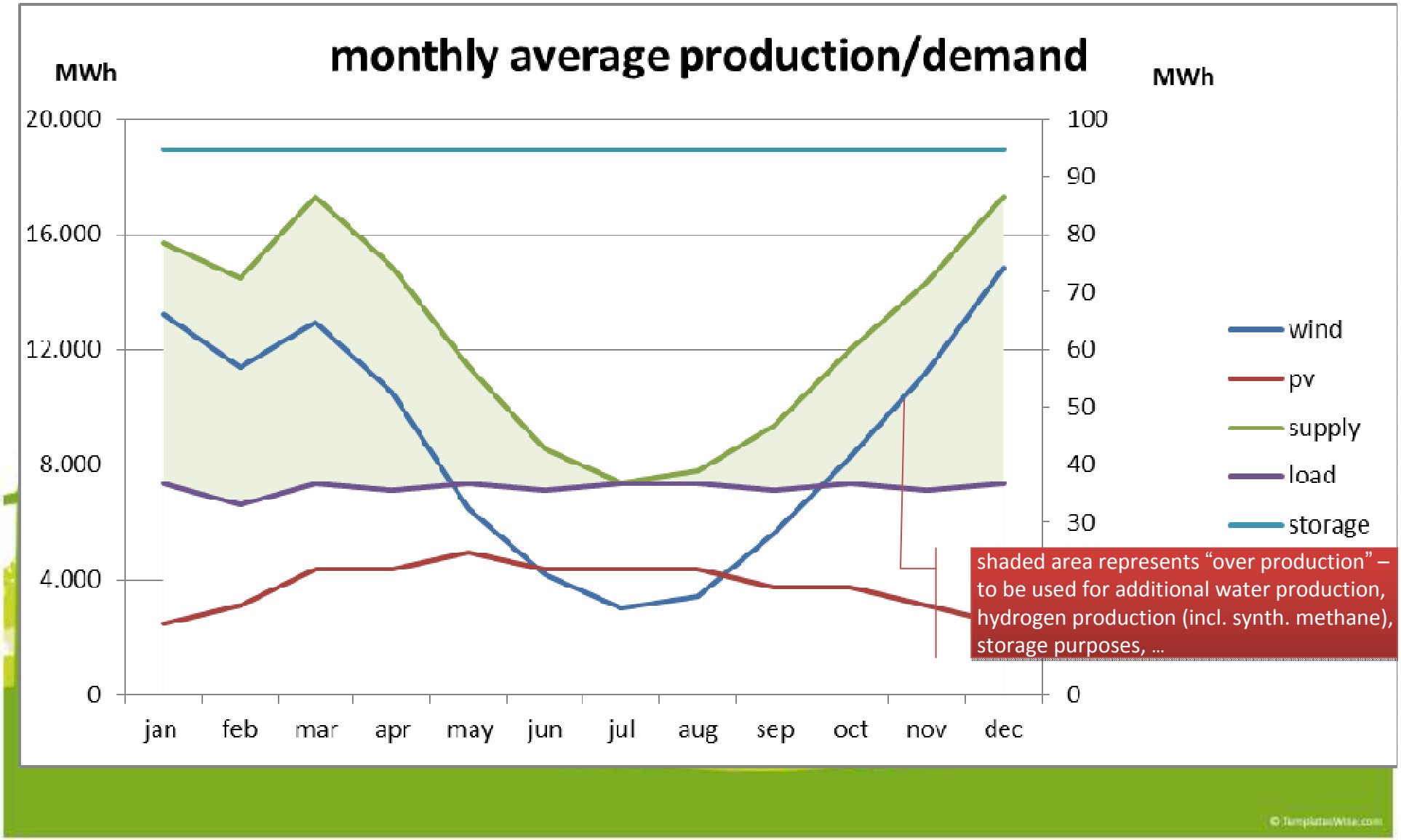
450 MW wind and 350 MW photovoltaic equivalent to 330 MW thermal (6.000 h/a) and 1.5 billion Euros of Investment

Assumptions

PV	3.400 €/kW
Wind	2.200 €/kW
Thermal Group	1.000 €/kW
Efficiency	30 %
Fuel Cost (act.)	0,71 €/l
Diesel Cost	1,09 €/l
Increase rate	15 %/a
	8,5 %/a
Service Time	6.000 h/a
Life Cycle	20 a



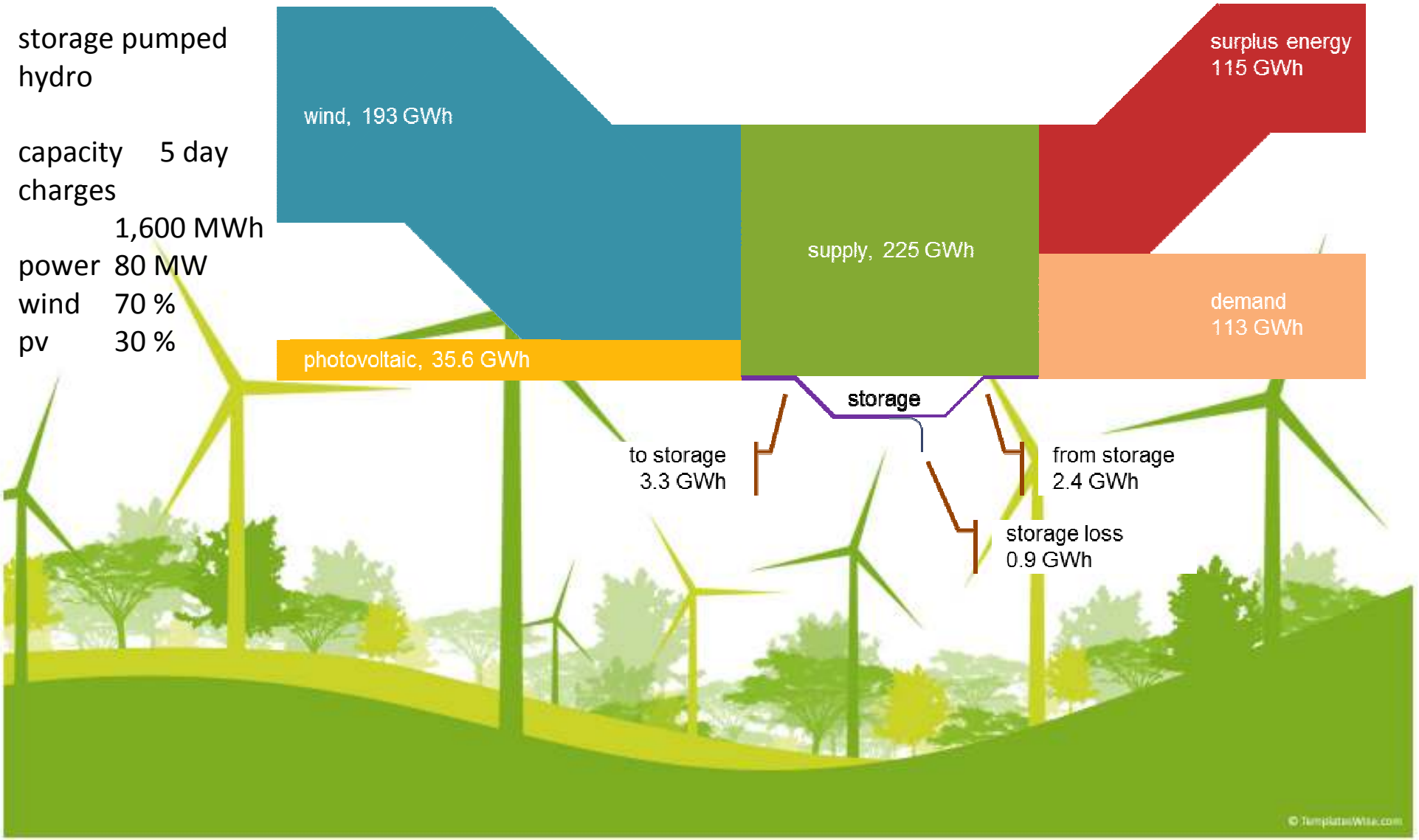
100% Renewable in Sal Island: Production/Demand



Sal 2020 - Energy Flow

storage pumped hydro

capacity 5 day charges
1,600 MWh
power 80 MW
wind 70 %
pv 30 %



Cost Scenarios for different storage options

Technology Scenario of 70MW installed RE combined with Power-To-Gas and Battery Storage system requires a total of 158 Million Euros (185 Million Euros – existing installations) investment, and this will deliver:

- Predicted Energy Demand of 113 GWh and 65% Surplus Electricity / 68GWh
- Constant Electricity Generation Cost of 0,20 (demand only) or 0,12 EUR/kWh stable for the next 20 years!

methane	pv	wind	battery	synth. methane	daily charges	load	production	oversupply**
90 MW	27,1 MW	62,9 MW	9,0 MW	1.600 MWh	5,0	113 GWh/a	222 GWh/a	97 %
	6,8 Mio. €/a	13,9 Mio. €/a	1,4 Mio. €/a	5,4 Mio. €/a	1.541 MWh	0,2442 €/kWh	0,1236 €/kWh	
232 Mio. €	67,8 Mio. €	106,9 Mio. €	16,2 Mio. €	41,6 Mio. €				
80 MW	17,1 MW	62,9 MW	9,0 MW	2.500 MWh	8,0	113 GWh/a	204 GWh/a	81 %
	4,3 Mio. €/a	13,9 Mio. €/a	1,4 Mio. €/a	5,5 Mio. €/a	2.466 MWh	0,2227 €/kWh	0,1228 €/kWh	
208 Mio. €	42,8 Mio. €	106,9 Mio. €	16,2 Mio. €	42,5 Mio. €				
70 MW	7,1 MW	62,9 MW	9,0 MW	3.700 MWh	12,0	113 GWh/a	186 GWh/a	65 %
	1,8 Mio. €/a	13,9 Mio. €/a	1,4 Mio. €/a	5,6 Mio. €/a	3.699 MWh	0,2015 €/kWh	0,1220 €/kWh	
185 Mio. €	17,8 Mio. €	106,9 Mio. €	16,2 Mio. €	43,7 Mio. €				

Already Installed: 2.5 MW 8 MW

2-5 % of demand)

Regional Added Value – SURPLUS ENERGY

Surplus Energy (70MW scenario) of 73GWh (without energy efficiency) could be utilized as:

- Water and electricity (Cooling) for an agricultural production site of approx. 1.000ha
  - 300.00 Million Investment
  - 200.000 tons of food production (export) and 5.400 jobs
  - Annual Profit of 38 Million EUR (at 0,15 EUR/kWh)
- Lower domestic water price
- Production of 36.5 GWh_{therm} synthesized methane or 3.650.000m3 methane
- Substitution for cooking gas
- Substitution of diesel (transportation)
- Used as diesel substitute in tri-generation processes at tourism facilities for hot water, decentralized electricity and cooling energy

Cabo Verde: RE as the option for the future

2500 MW = 600 %

- Saving 100 % on imported fuel in the long run by using a small part of the RE potentials
- Building an high efficiency agriculture based on water turned RE!
- Building a modern cooling logistics for fishery and vegetables based on RE
- Building a modern engineering and training society based on RE