The energy architecture of LDCs and their policy & technology choices

UNCTAD Executive Session:
Sustainable Energy for Structural Transformation in LDCs

Dr. Mauricio Bermudez-Neubauer
Independent Consultant

Geneva, February 6, 2017

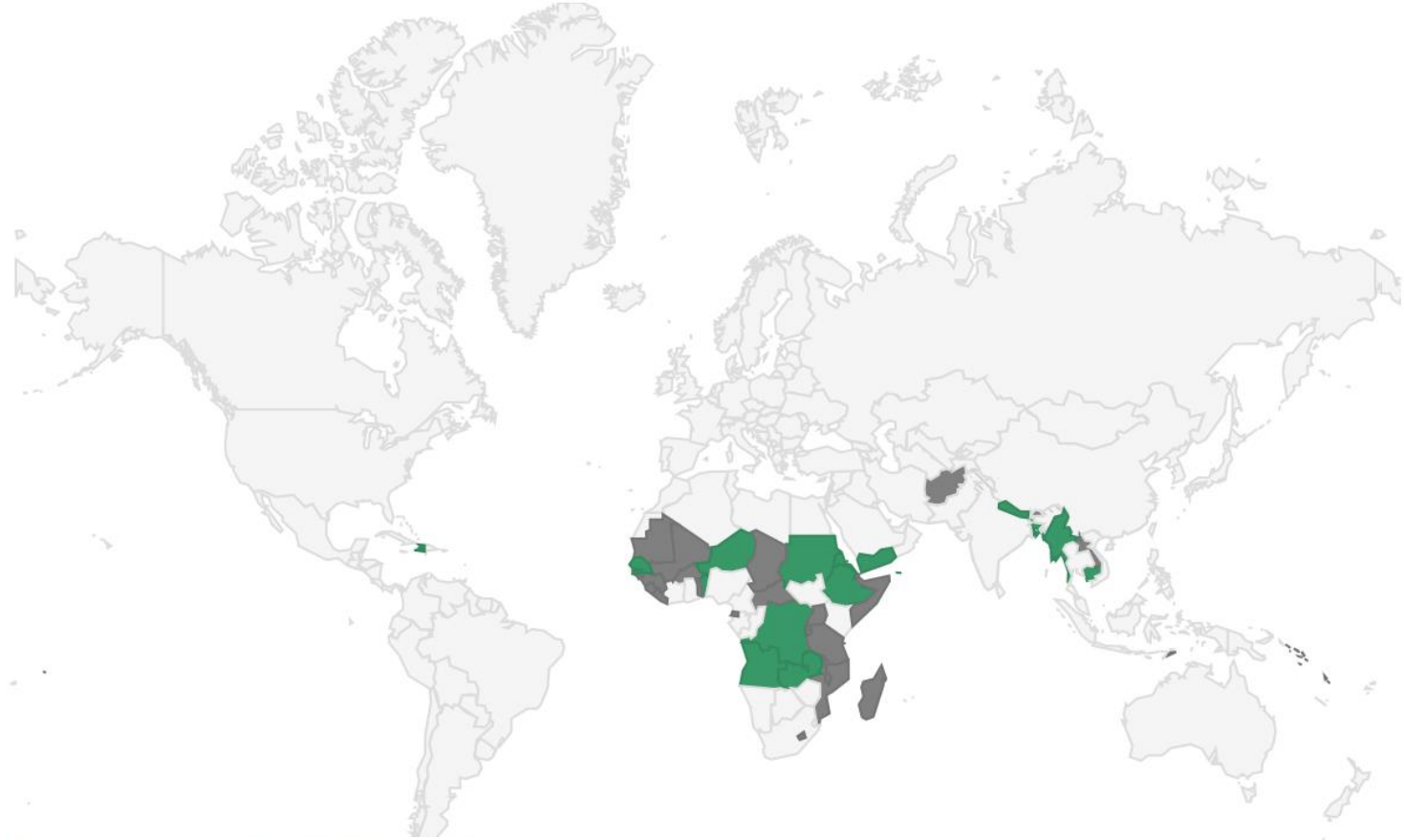
UNITED NATIONS
UNCTAD

Contents

- **Energy architectures & its drivers**
- **Can LDCs leapfrog to a sustainable architecture?**
- **Barriers and enablers to sustainable energy in LDCs**

More LDC data needed!

LDCs & IEA World Energy database

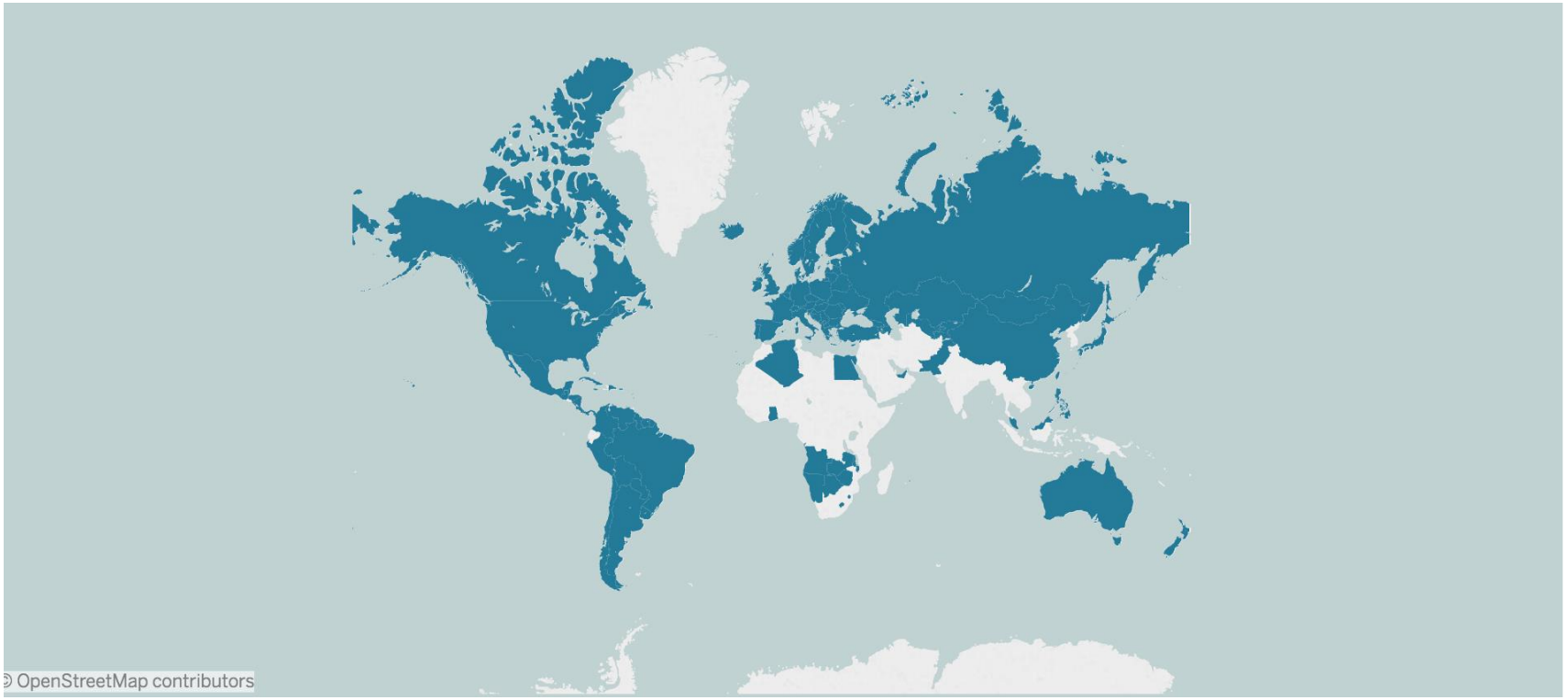


LDCs
LDCs in IEA dataset

Source: IEA Energy Balances 2016

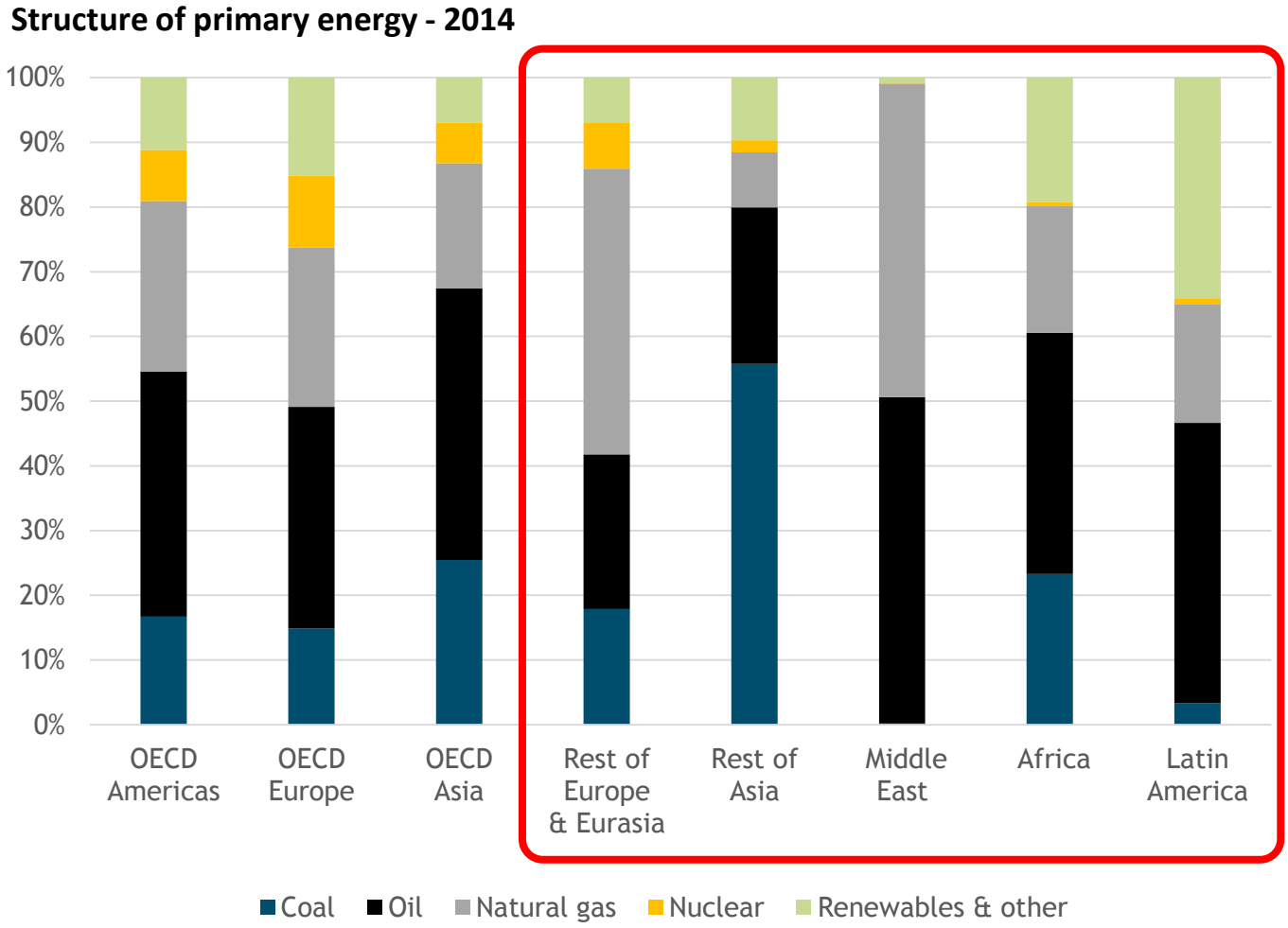
More LDC data needed!

Countries included in IRENA renewable energy balances database



Source: IRENA

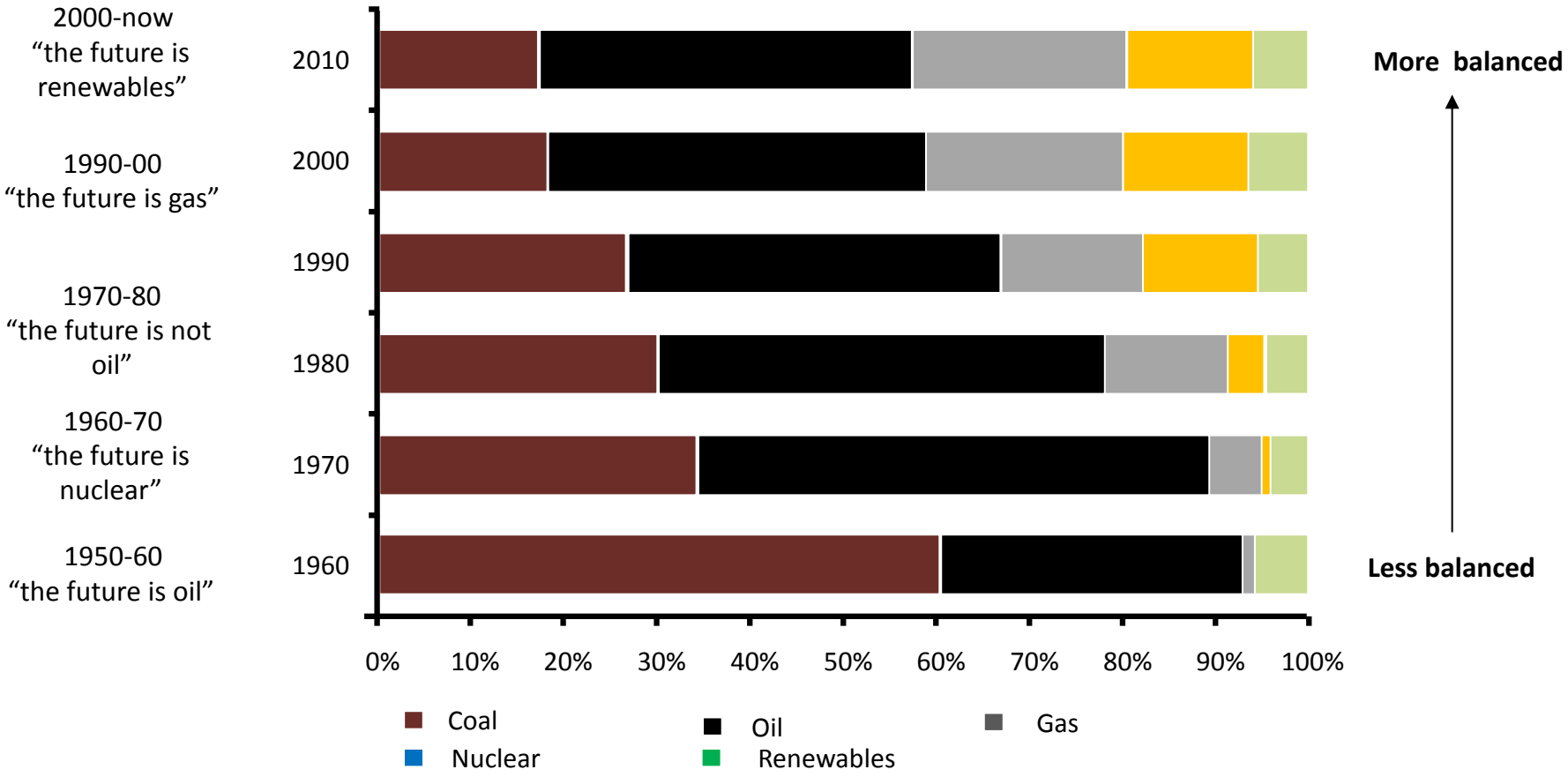
Advanced economies tend to have a more balanced portfolio, emerging economies tend to be less diversified, intensive in national endowments



Source: EIA International Energy Outlook, 2016

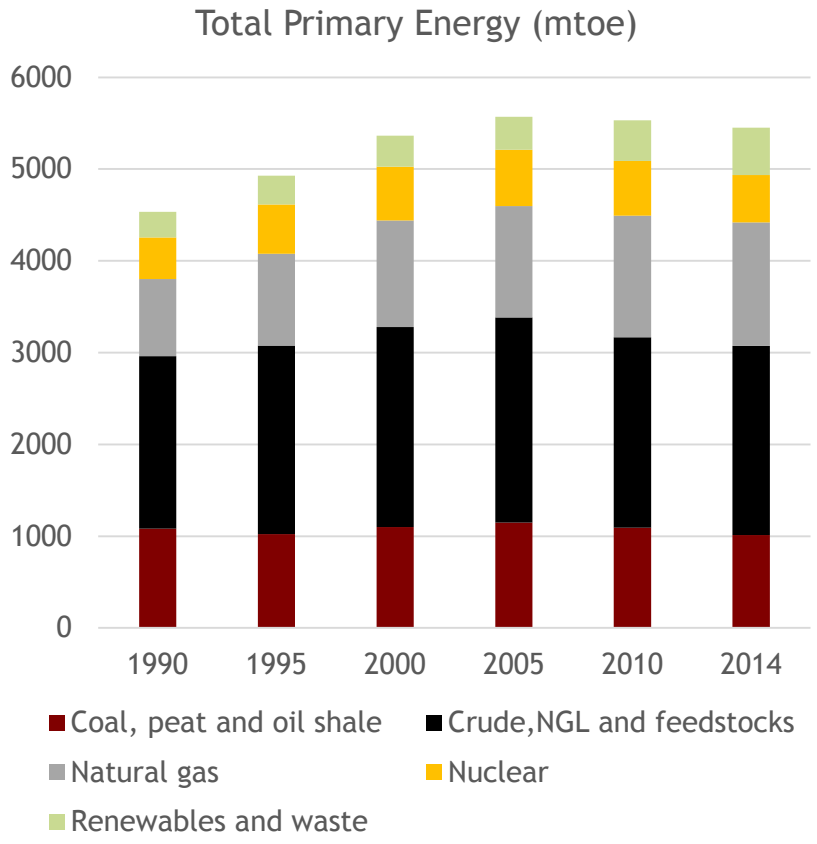
Economic development, technology, policy, markets and resource endowments all impact structure of Total Primary Energy (TPE). Trend is towards a more balanced structure.

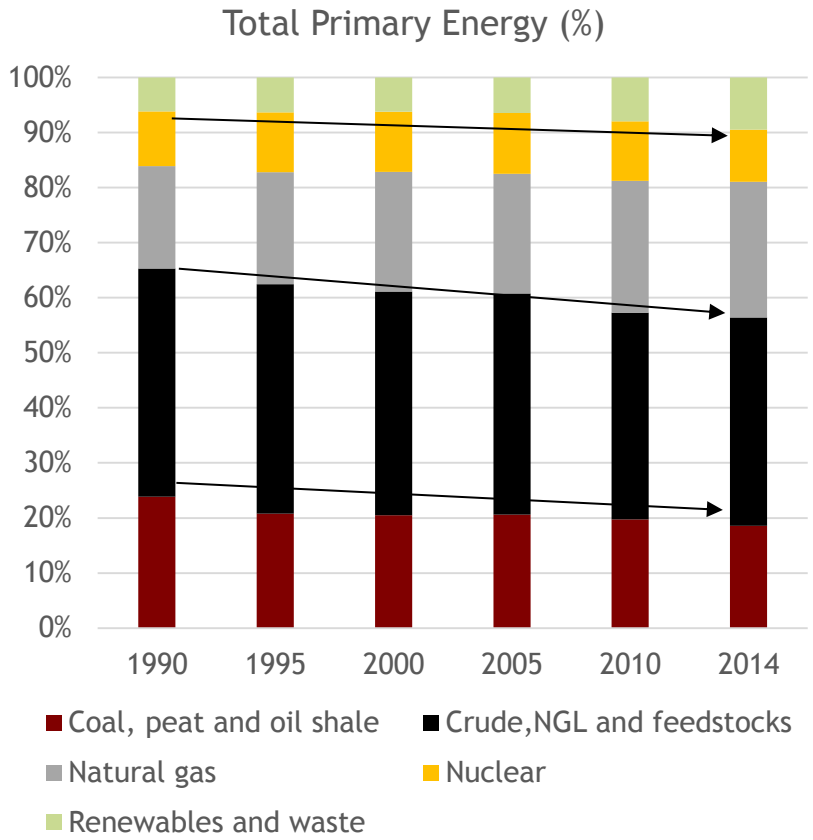
Evolution in the structure of TPE in the EU: by fuel



Source: IEA Energy Balances 2016

Evolution and composition of TPE: OECD

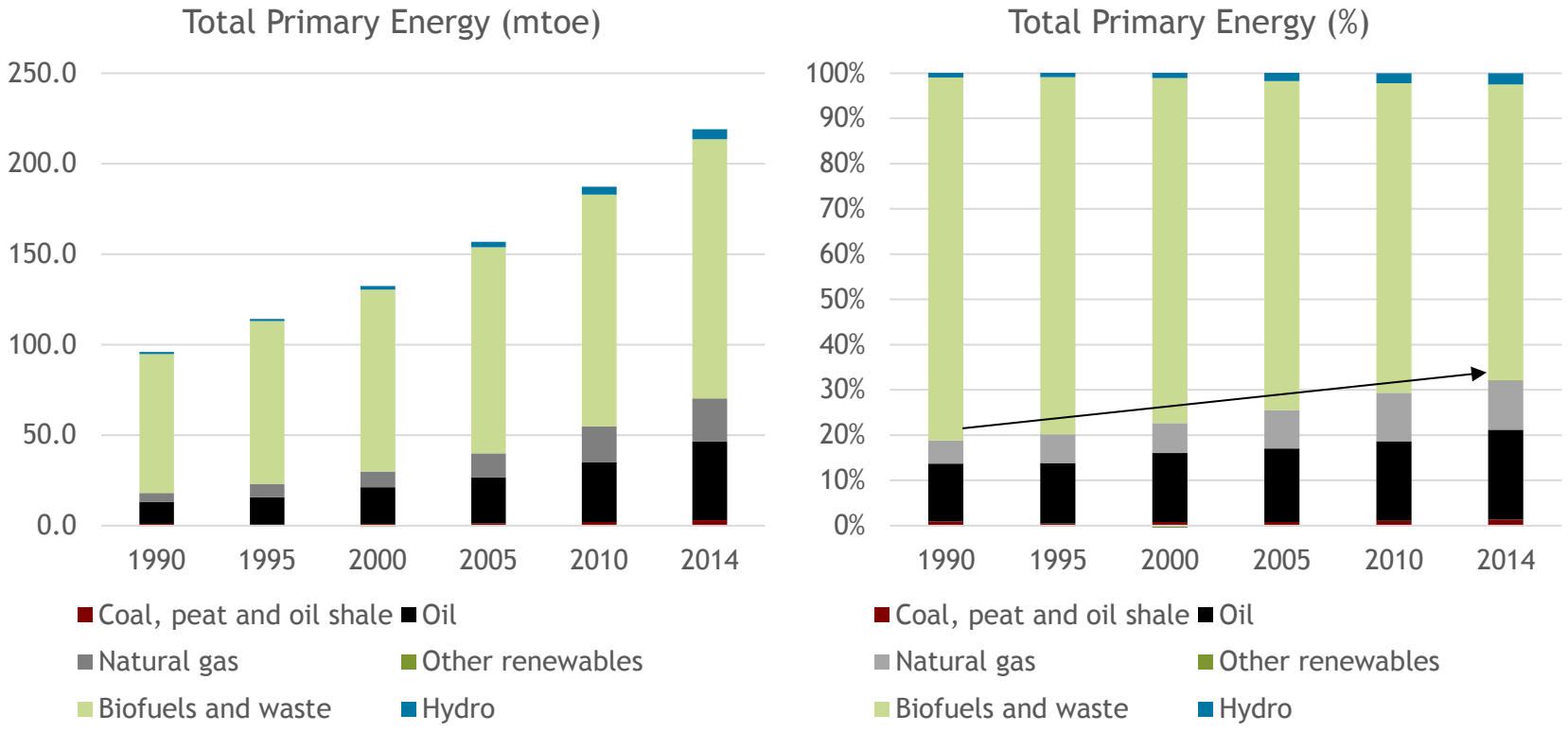




Source: IEA Energy Balances 2016

- Stagnating growth as economies de-industrialise (CAGR: 0.8%)
- TPE has a balanced structure, oil and coal being replaced by gas and renewables

Evolution and composition of TPE
Selected LDCs (subgroup of 17 LDCs with IEA data*)

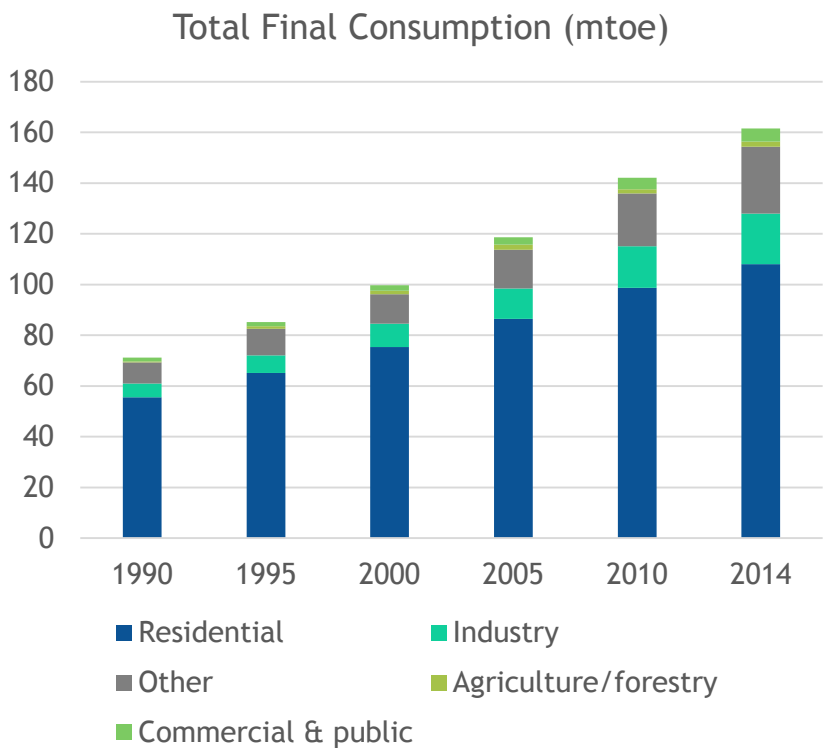


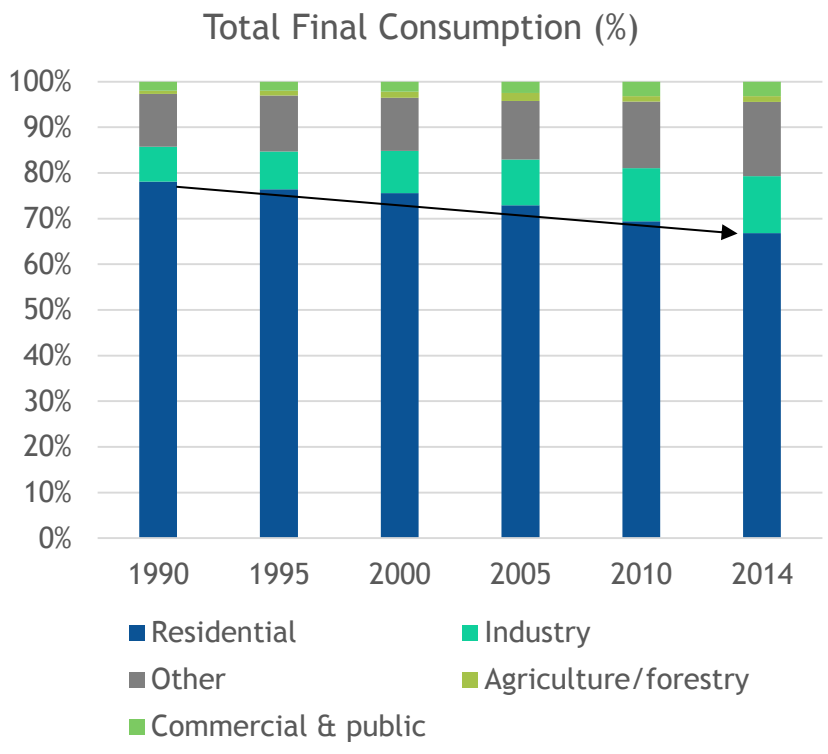
Source: IEA Energy Balances 2016

* Angola, Bangladesh, Benin, Cambodia, DR of Congo, Eritrea, Ethiopia, Haiti, Mozambique, Myanmar, Nepal, Niger, Senegal, Sudan, Togo Yemen, Zambia

- Rapid growth, as labour & energy intensive sectors develop (CAGR: 3.5%)
- TPE is mainly biomass, but replaced by oil & gas as development advances

Evolution and composition of Final demand
Selected LDCs (subgroup of 17 LDCs with IEA data)



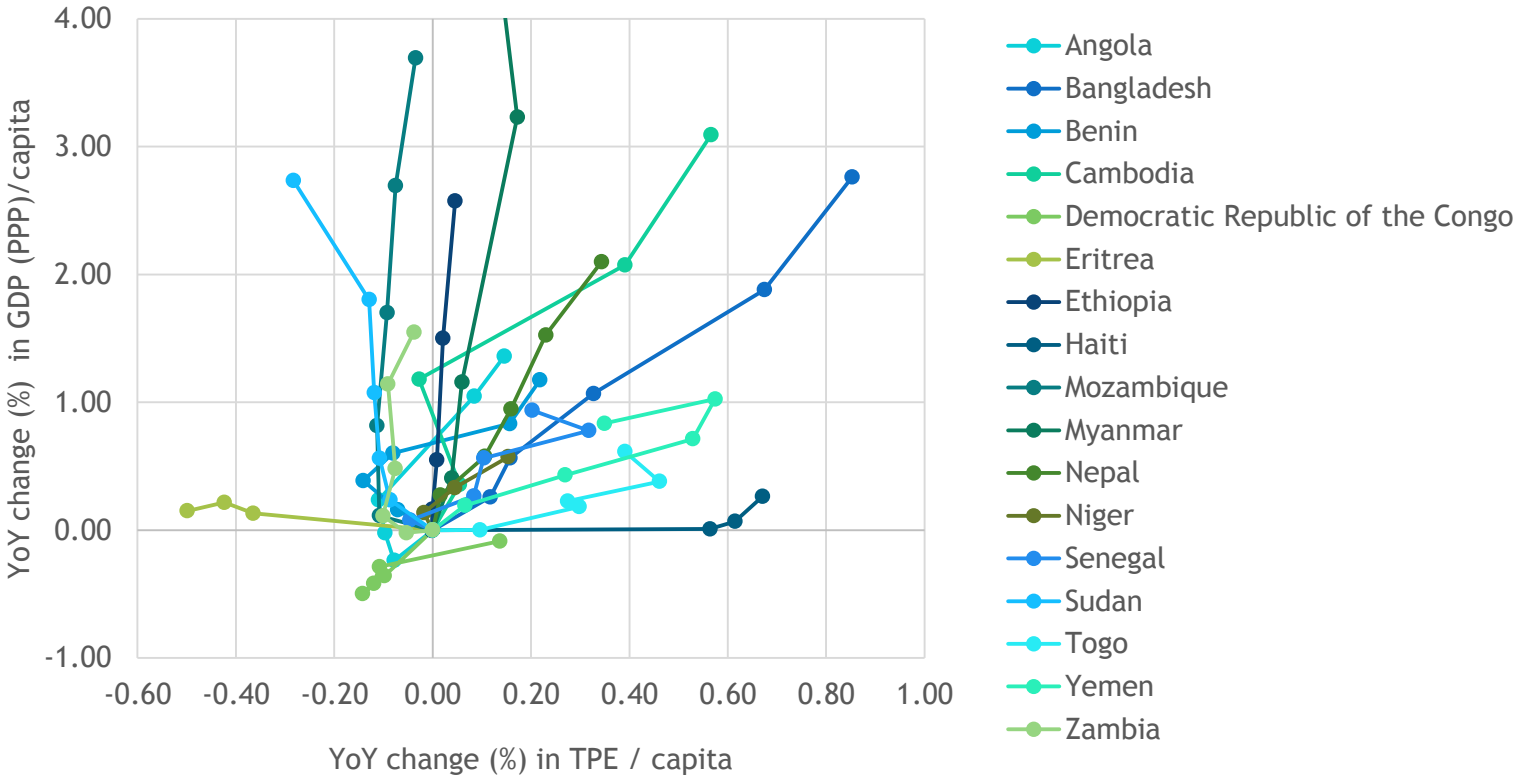


Source: IEA Energy Balances 2016

- Growth in tandem with primary energy (CAGR: 3.5%)
- Final demand is mainly residential but growing slowly (CAGR: 2.8%)
- Fast growing sectors are agriculture, commercial and industry (CAGR: 5.8%)

LDC's output intensity and energy intensity are typically coupled. This trend usually continues until economies de-industrialise.

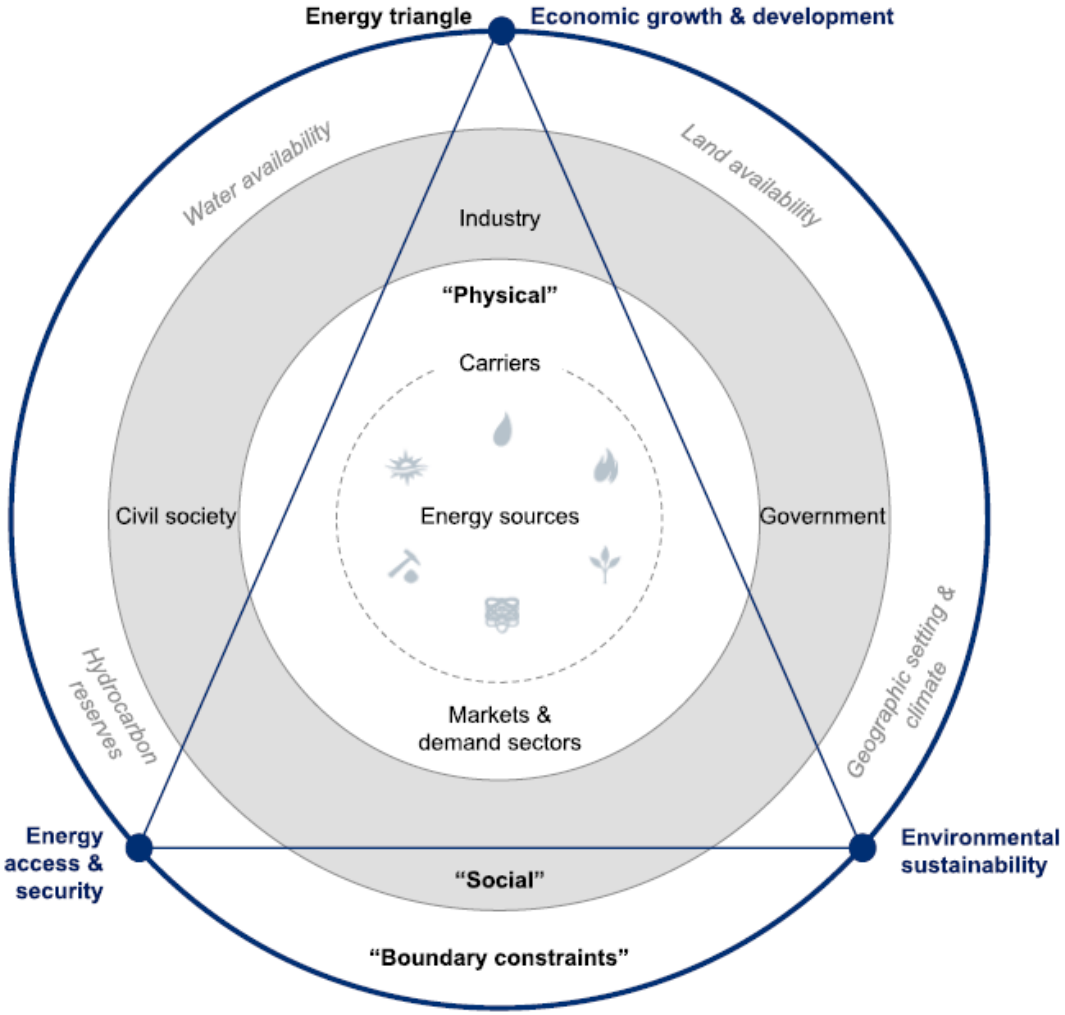
GDP (PPP)/capita vs TPE/capita in selected LDCs (1990-2014)



Source: IEA Energy Balances 2016 and World Bank statistics 2016

- GDP/cap growth (avg ~1.0%) tends to exceed TPE/capita growth (avg ~0.1%)
- Trend is typical of emerging economies as energy + labour intensive sectors grow.

Each jurisdiction has a unique current and potential energy architecture, defined by the interplay of physical and social determinants



Definitions

Physical elements: includes energy sources, their carriers and end markets

Social elements: includes political institutions, industry and civil society, which shape the physical elements

Energy triangle: ultimate objectives that the energy architecture is designed to support

Boundary constraints: factors limiting performance against the energy triangle, both physical and social

Source: Accenture and World Economic Forum, The Global Energy Architecture Performance Index Report 2013

Sustainability requires LDCs to develop their energy architectures via a different path

		LDC	Developing	Advanced
Historical	Energy Mix	• Mainly biomass	• Mainly fossil fuels	• Diversified but carbon intensive
	Energy Demand	• High growth	• Medium growth, all sectors	• Flat to declining growth overall
	Energy Supply	• Large share of self sourced	• Shift to centrally sourced	• Move to nationally decentralised
Sustainable	Energy Mix	• **Efficient biomass, solar, wind and other low cost RES**	• Fossil fuels + high share of RES	• Highly diversified, zero net carbon
	Energy Demand	• **High growth, some decoupling from econ growth**	• Medium growth, decoupling from economic growth	• Strong decoupling from economic growth
	Energy Supply	• **Large share of collectively sourced**	• Mix of distributed and centralised	• Highly decentralised, regionally integrated

Can LDCs “leapfrog” directly to sustainable energy architectures?

Business momentum & perception shift:
Renewables are now the first-choice option for power system investments, globally.

Capacity from renewables represented 61% of all new power generating capacity added worldwide in 2015 (IRENA, 2016).

Favourable economics:
Wind, PV, biomass are competitive with conventional sources of electricity and will continue to make cost reductions.

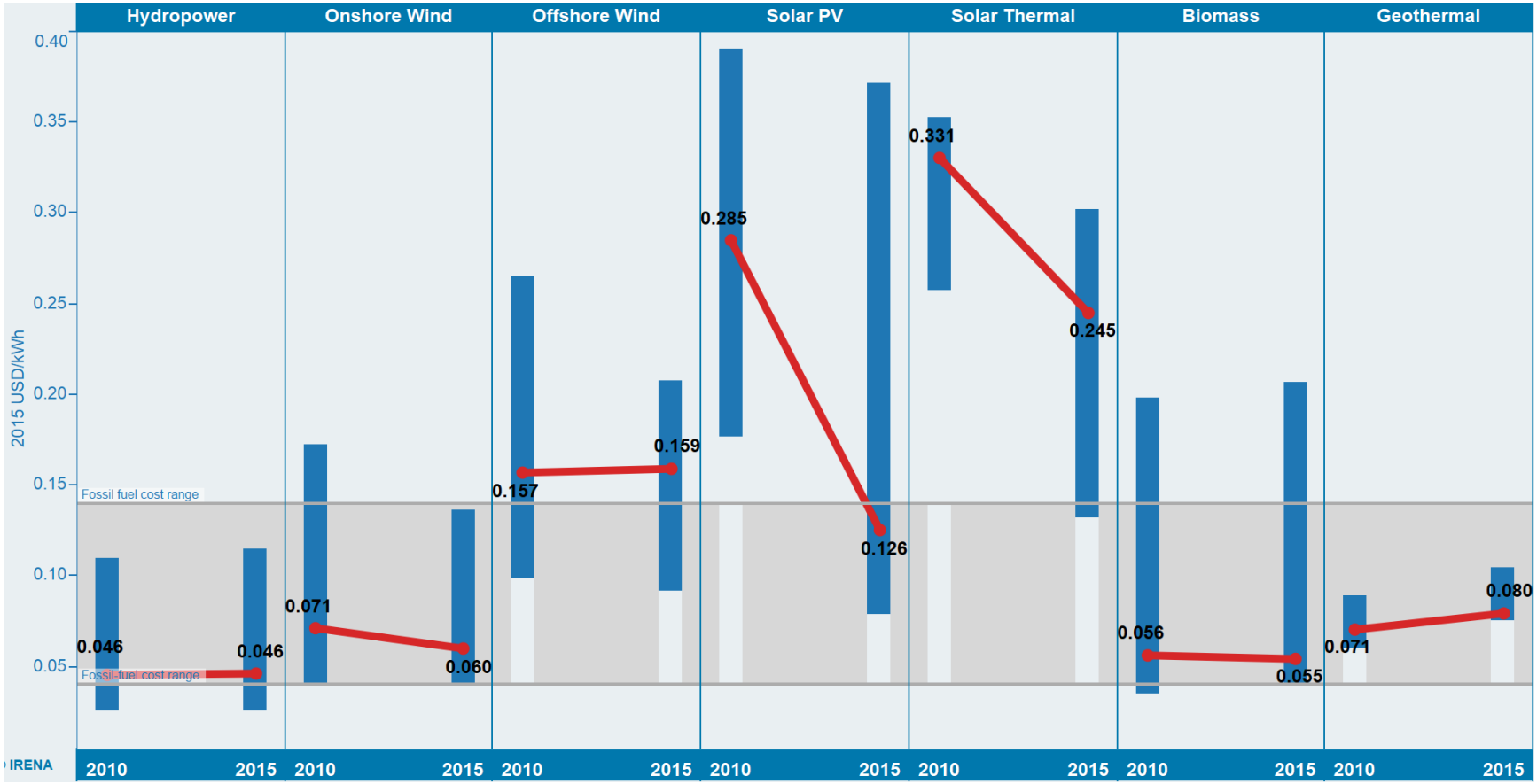
Cost of wind turbines has fallen by ~33% since 2009 and solar PV by ~80%. Onshore wind, biomass, geothermal and hydropower are all competitive or cheaper than coal, oil and gas-fired power stations, even without financial support and despite relatively low oil prices (IRENA, 2016).

Political attractiveness and lever for economic growth:
Renewables create much more jobs than conventional energies & create positive reputational externalities.

Renewables are a significant source of new employment. In Bangladesh and Sub-Saharan Africa, more than 158,000 people were directly or indirectly employed in the RE industry. Moreover, RES investments drive much more jobs than traditional technologies (IRENA, 2016).

Average levelised cost of electricity (LCOE) for most RES is now competitive with fossil fuels, reducing the need for subsidies, but still necessitating investment and deployment stimulus

Global Trends in Levelised Cost of Electricity, 2010-2015 (Ranges and Weighted Averages)

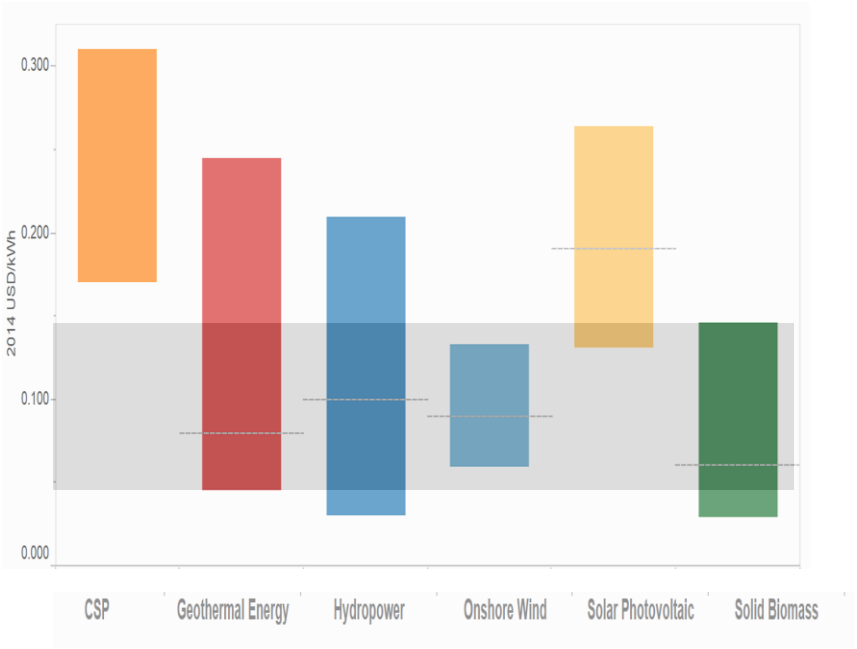


Source: IRENA - http://resourceirena.irena.org/gateway/dashboard/?topic=3&subTopic=33

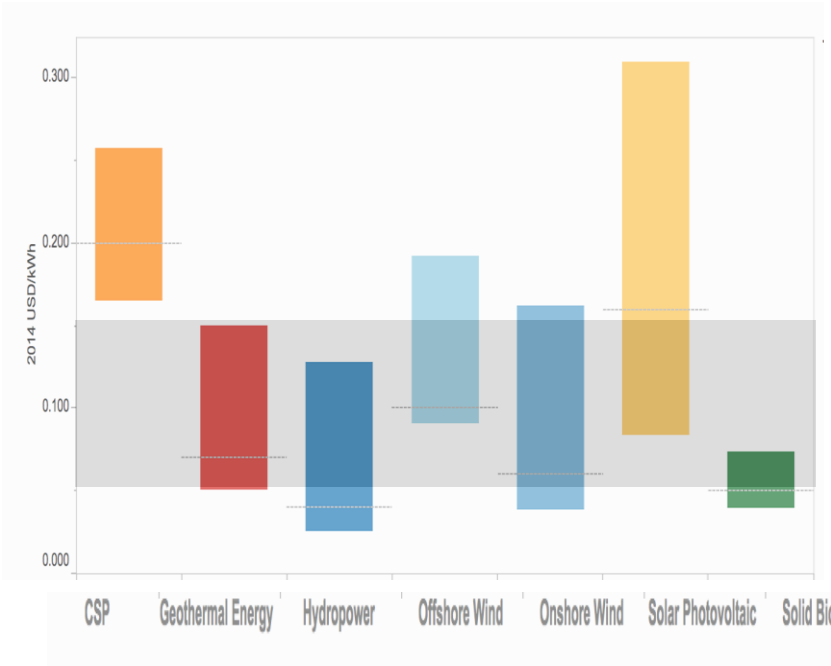
In main LDC regions, renewables are competitive with conventional sources of electricity. Further rapid cost reductions, especially in PV, are expected

Levelised Cost of Electricity 2014 (Ranges and Weighted Averages)

Africa



Asia

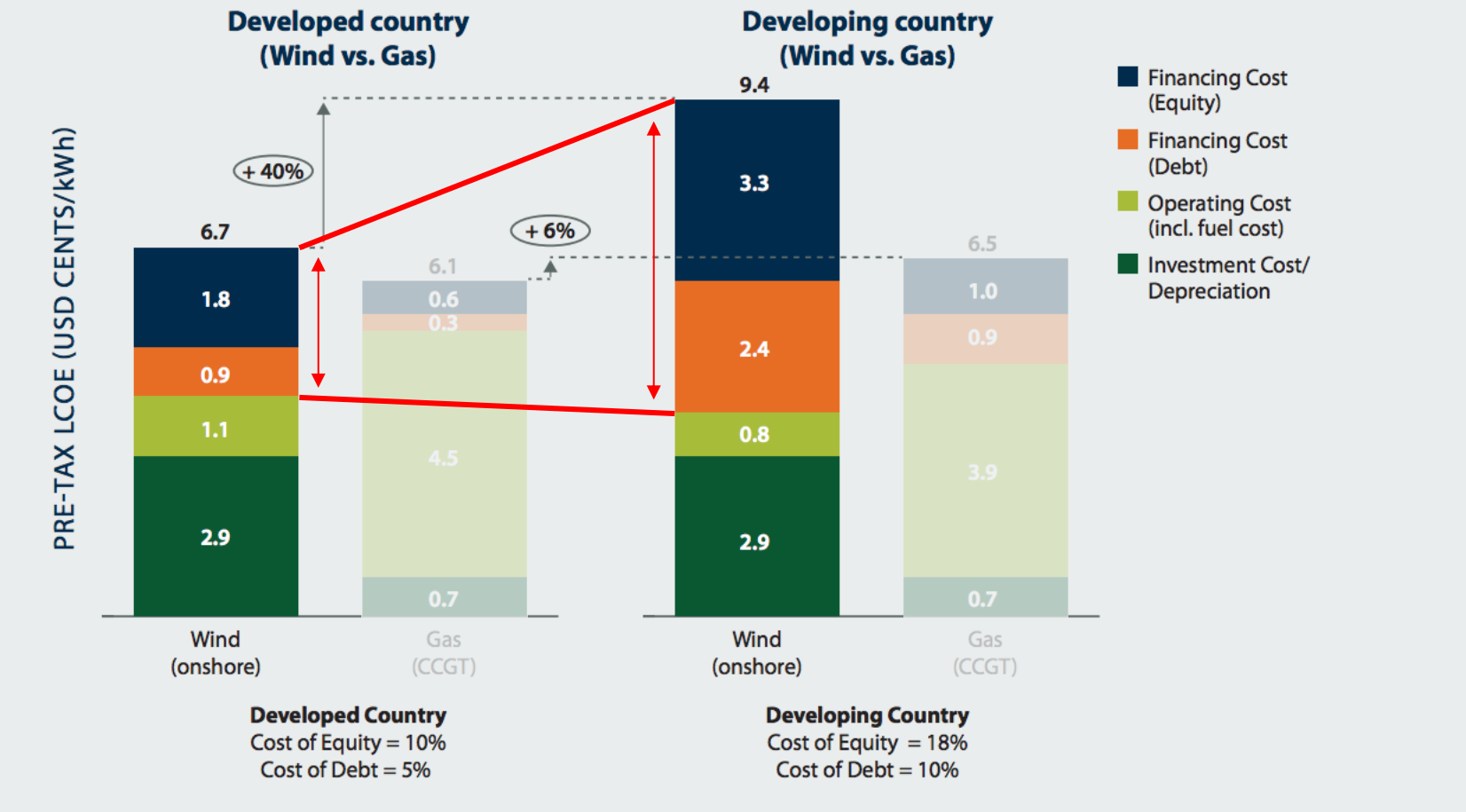


Fossil fuel cost range

Source: IRENA - http://resourceirena.irena.org/gateway/dashboard/?topic=3&subTopic=9

Cost of financing renewable energies is significantly higher in developing countries

Impact of financing costs on wind generation costs



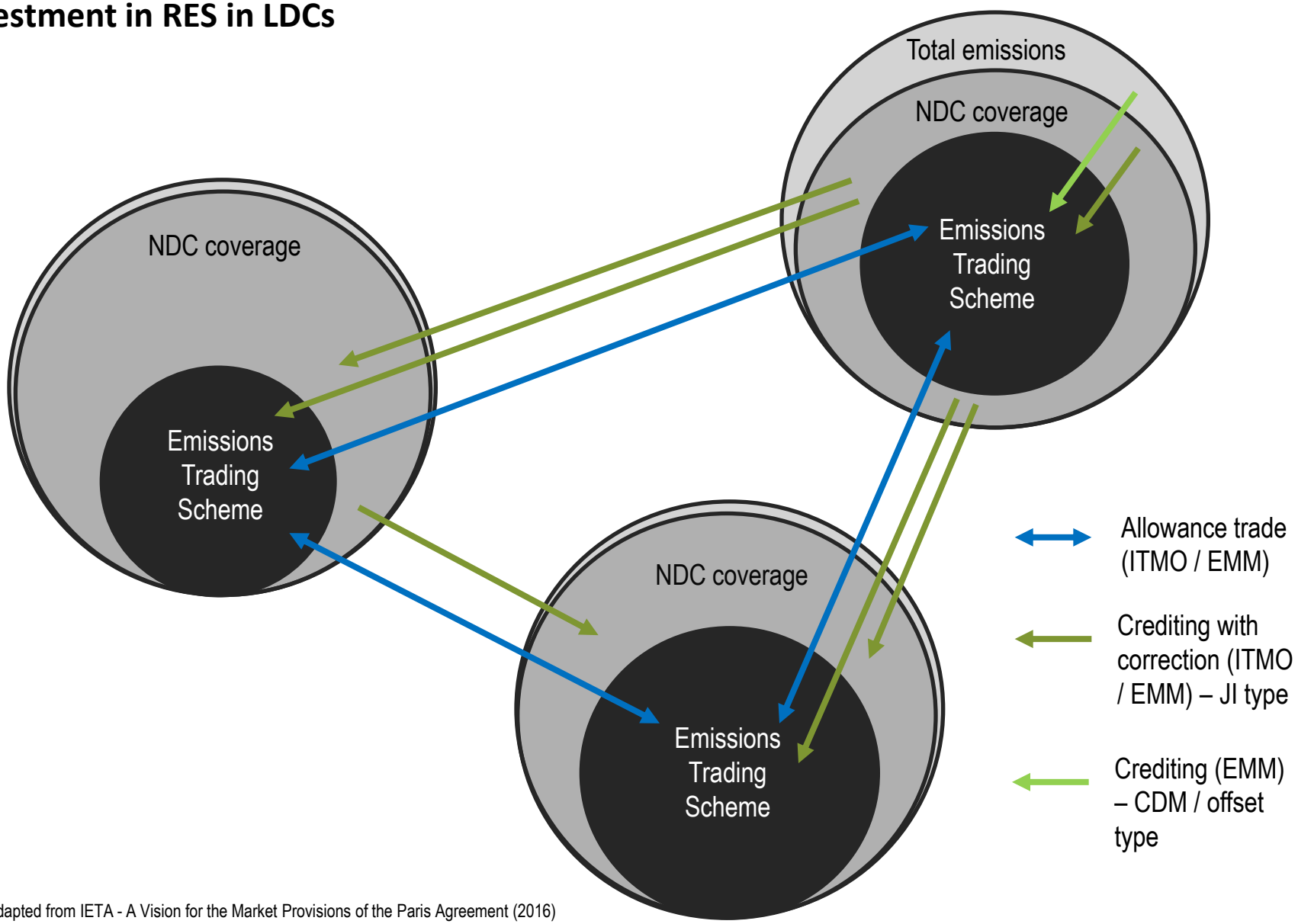
Source: UNDP - https://goo.gl/JLefDd

Overview of RES support policies in Africa

	REGULATORY POLICIES							FISCAL INCENTIVES AND PUBLIC FINANCING				
	Feed-in-tariff (incl. premium payment)	Electric utility quota obligation/RPS	Net metering	Tradable renewable energy certificate	Auctions	Heat Obligation/ Mandate	Biofuel Obligation/ Mandate	Capital subsidy, grant, or rebate	Investment or production tax credits	Reductions in sales, energy, CO_2, VAT, or other taxes	Production payment	Public investment, loans, or grants
Algeria	●				●				●			
Angola							●					●
Benin										●		
Botswana								●		●		
Burkina Faso					●				●	●	●	
Cabo Verde			●		●					●	●	
Cameroon										●		
Côte d'Ivoire										●		
Egypt			●		●			●		●		
Ethiopia							●			●		●
Gambia										●		
Ghana	●	●		●		●	●	●		●		●
Guinea										●		
Kenya	●				●	●				●	●	●
Lesotho			●		●							●
Libya										●		
Madagascar										●		
Malawi							●			●		
Mali							●			●		●
Mauritius	●				●			●				
Morocco					●							●
Mozambique							●					●
Niger										●		
Rwanda	●									●		●
Senegal		●				●				●		
South Africa		●	●		●		●	●		●		●
Sudan							●					
Tanzania	●				*		●			●		
Togo										●		
Tunisia			●					●		●		●
Uganda	●							●		●		●
Zambia							●	●		●		
Zimbabwe							●					

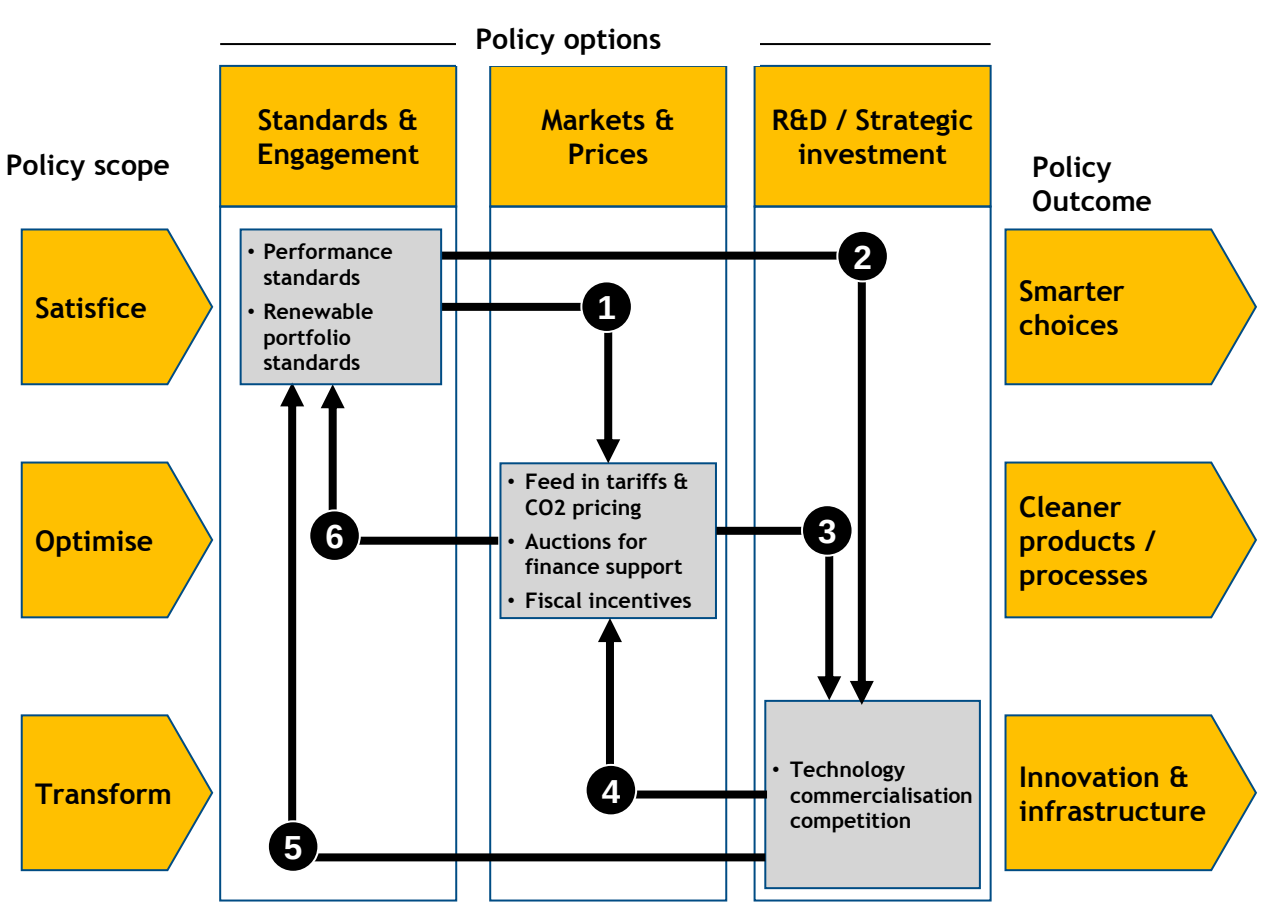
Source: IRENA - http://www.irena.org/DocumentDownloads/Publications/IRENA_Africa_2030_REmap_2015_low-res.pdf

The Paris Agreement contains multiple provisions that could enable connections across jurisdictions, potentially an important source of finance and technology transfer for investment in RES in LDCs



Source: Adapted from IETA - A Vision for the Market Provisions of the Paris Agreement (2016)

RES penetration requires a step change in policy & regulatory coordination and integration



Benefits / value of policy integration

1. Manage bills, increase responsiveness
2. Values and pull preferences
3. Revenues, revealed costs, strategic value
4. Technology options and competitiveness
5. Education, access and control
6. Attention, products & finance

Source: Adaptation from Grubb, Hourcade, Neuhoff. *Planetary Economics.* 2014.

Barriers to deployment of sustainable energy in LDCs

- **Fossil fuel subsidies** undermining competitiveness of RES
- **Project by project approaches and culture**
- Lack of **skills / capacity building** in government and private sector
- **Adherence to traditional finance instruments**
- Corruption / vested interests / regulatory capture
- **Long term fossil fuel** contracts

Enablers to deployment of sustainable energy in LDCs

- **Commitment to SDGs and Paris Agreement NDCs** in the political and business spheres
- Develop **national and macro-regional energy plans and targets**: stationary power demand and supply are key but plan should also integrate buildings, industry and transport.
- **Implement through policy packages** that effectively combine standards, incentives, regulations, finance and capacity building.
- **Design for stable and long term development but build in policy flexibility and resilience** to adjust with rapidly evolving tech and commercial landscapes
- **Recognise alternative development opportunities**, including importance of off-grid, mini-grid approaches.
- **Ensure energy policies are adequately integrated with other policies** (e.g. macro, employment, industrial)
- **Leverage regional and international cooperation for sharing resources,** increasing efficiency, capacity building etc.
- **Foster new business models and innovative partnerships** with private sector and foreign investors (leasing, ESCOs, corporate sourcing of RES)
- **Develop frameworks and incentives for private sector** to sustain the costs and risks associated with sustainable energy investments
- Make use of **new capital markets instruments and institutional investors**

Main takeaways

- Important **information gaps** on LDC's energy sectors
- Each country's energy architecture is unique, defined by a host of factors. **No one size fits all solutions**.
- The **timing and context is good for LDCs to leapfrog towards sustainable energy architectures**, enabled by investment momentum, attractive economics and political attractiveness
- Delivering sustainable energy architectures in LDCs can be made possible if the **via public and private leadership to activate and enhance technology, policy & finance enablers**

Thank you!

@Dr_Bermudez