



25th INPRO Dialogue Forum on Nuclear Energy
Development in Embarking Countries

Cost-to-GDP concept to assess and optimize the real cost of power generation and local content of the nuclear power program in embarking countries

Sergey Rozhenko

Director, Power Analytics, Kept (Russia)

November, 2025

Nairobi, Kenya



LCOE

A measure of the average net present cost of electricity generation for a generator over its lifetime

What is LCOE used for:



Comparison of electricity production costs by source



Energy planning – core of methodology of Least Cost Generation Planning

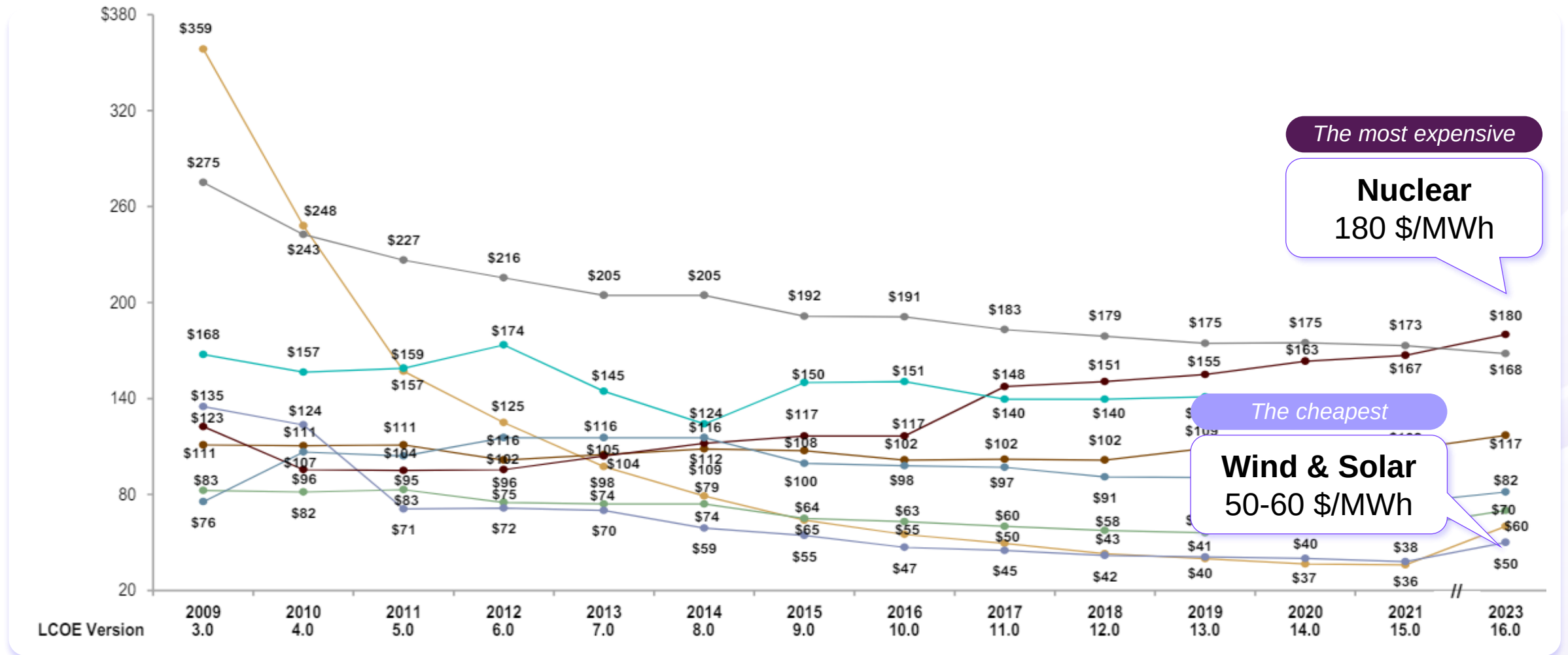


Policy advocacy and lobbying

Simple and powerful political tool

LCOE: Historical Utility-Scale Generation Comparison

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Source: Lazard (2023)

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System LCOE: method to account for integration costs

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System LCOE for increasing shares of wind

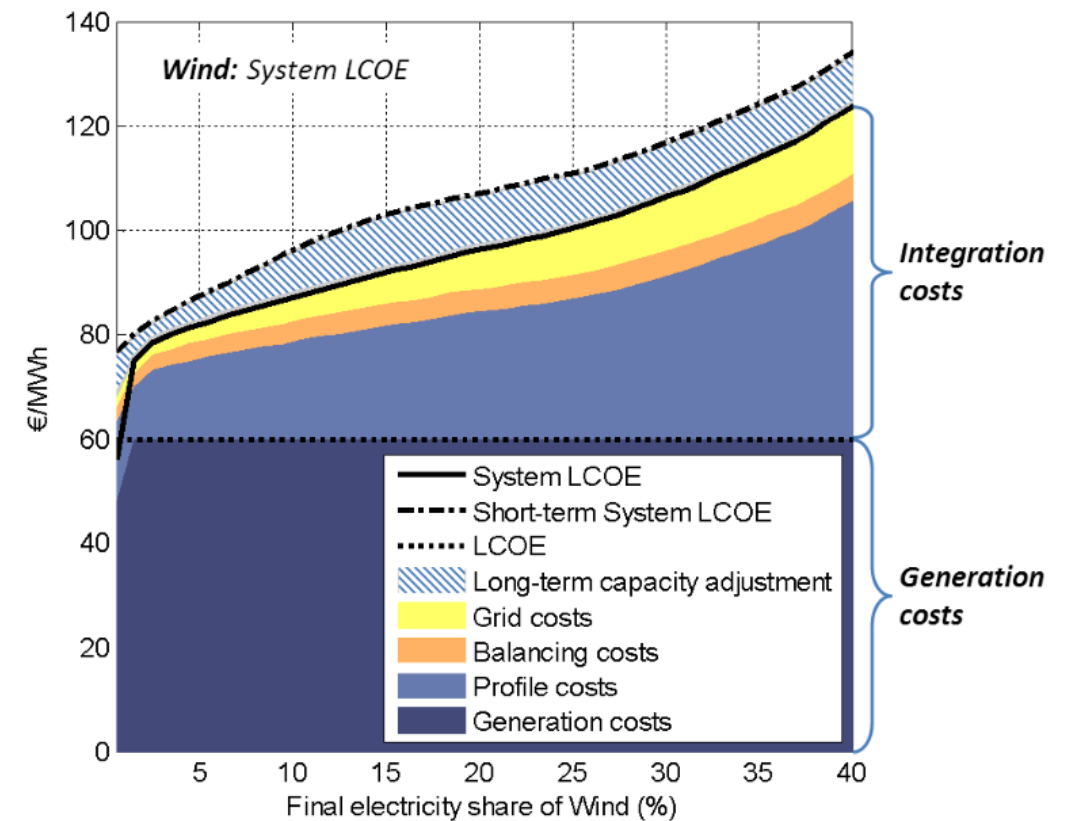
System LCOE

=

Generation costs

+

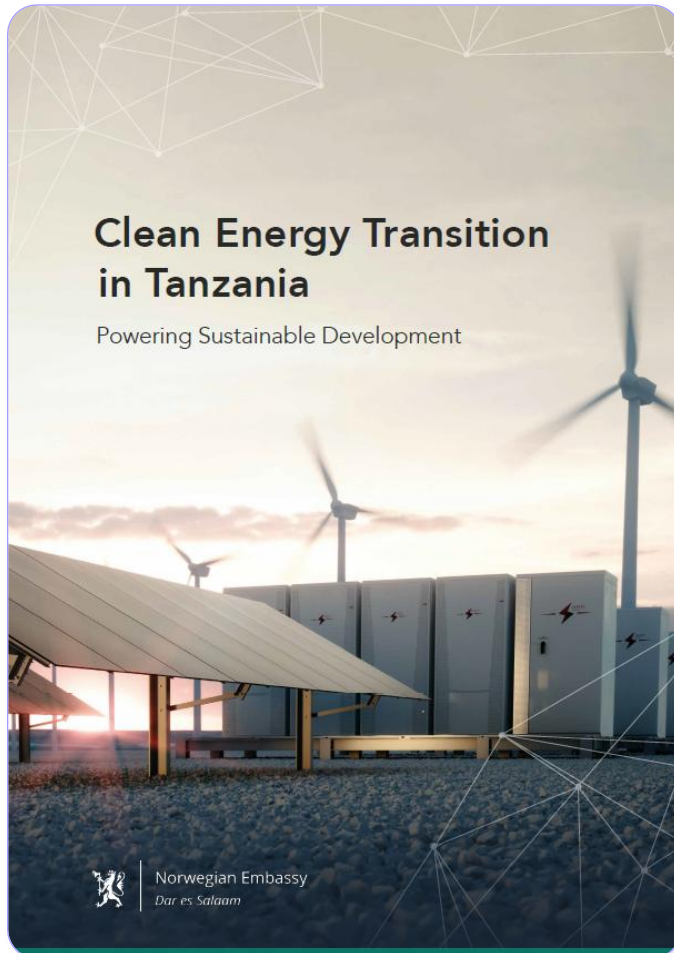
Integration costs
(balancing, profile, grid)



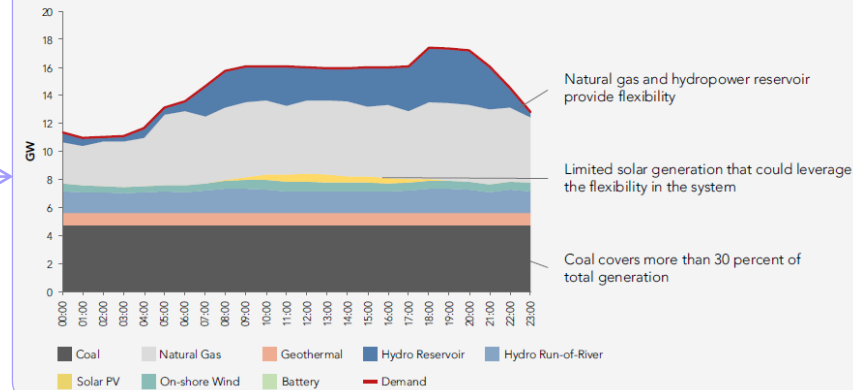
Source: UECKERDT, F., HIRTH, L., LUDERER, G., EDENHOFER, O., System LCOE: What are the Costs of Variable Renewables, Potsdam-Institute for Climate Impact Research, Germany, 2013.

LCOE concept is core to Least cost generation planning (LCGP): Donor funded LCGP for Tanzania (example #1)

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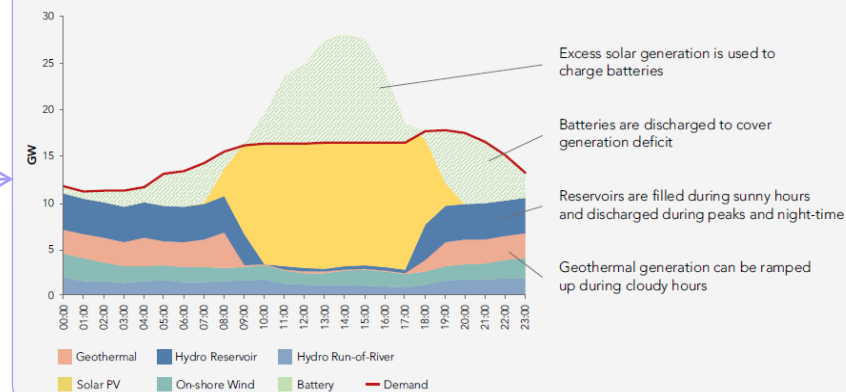


PSMP scenario: Meeting demand during a typical day in 2050



Scenario
“Unaffordable fossil fuels”
(nuclear is usually missing at all)

CETT scenario: Meeting demand during a typical day in 2050



Scenario
“Cheap green future”

... but often fails to deliver in practice

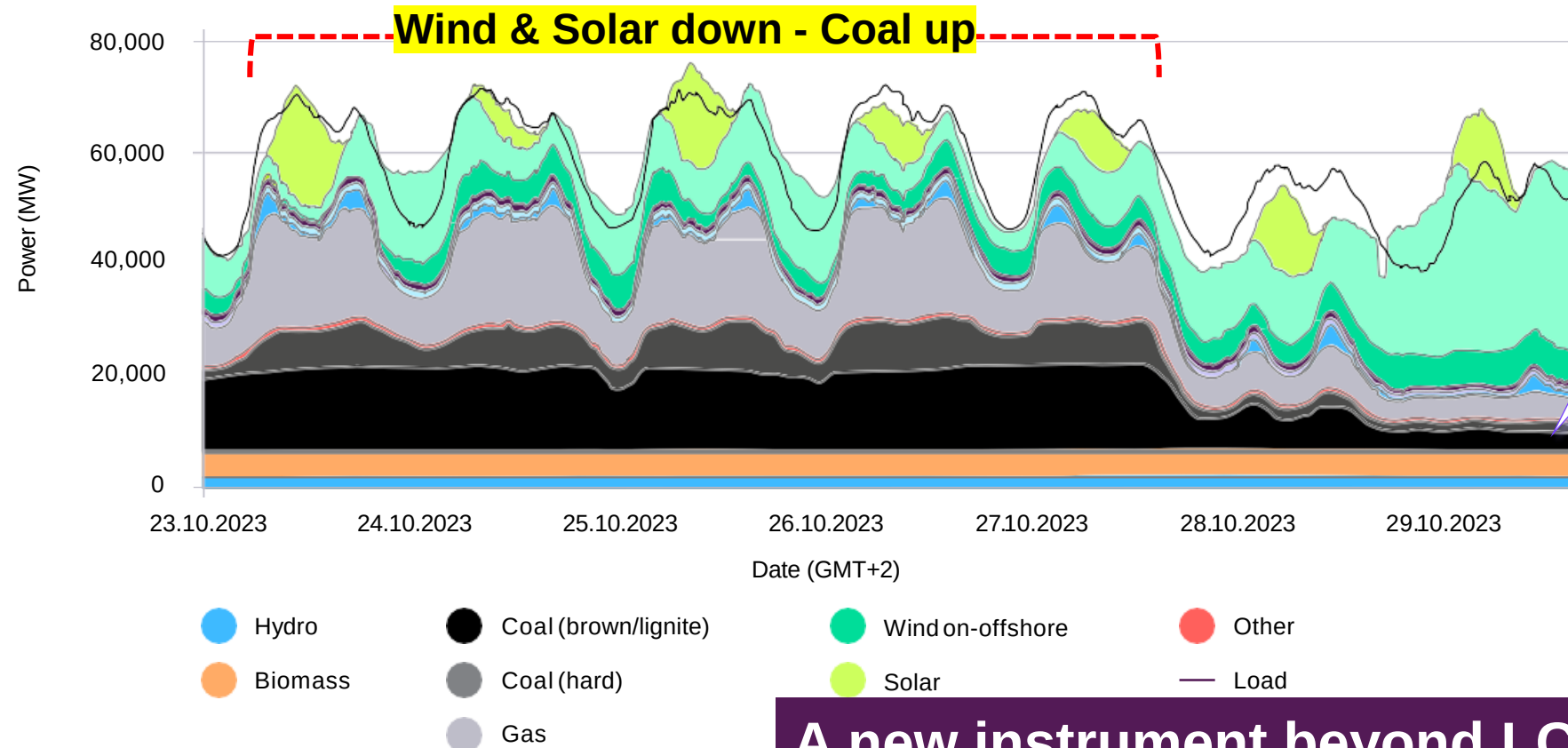
Source: Royal Norwegian Embassy, Multiconsult.

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LCGP Technical issues not addressed: “Dunkelflaute” and dispatchable generation in Germany (example #2)

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Power generation by plant type in Germany, week 43, 2023



Germany invested €15 bn into coal generation in 2018-2020 due to the need for dispatchable generation

Plans for additional **10GW gas TPP** new builds released Feb 2024

Source: S&P Global Analytics, Energy-Charts.info, Kept analysis.

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A new instrument beyond LCOE is needed to justify policy level decision making

Cost-to-GDP concept

Part 2

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Cost to GDP (Real LCOE) based comparison of generation sources

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Cost-to-GDP Concept

Least cost generation planning



Economic and GDP planning

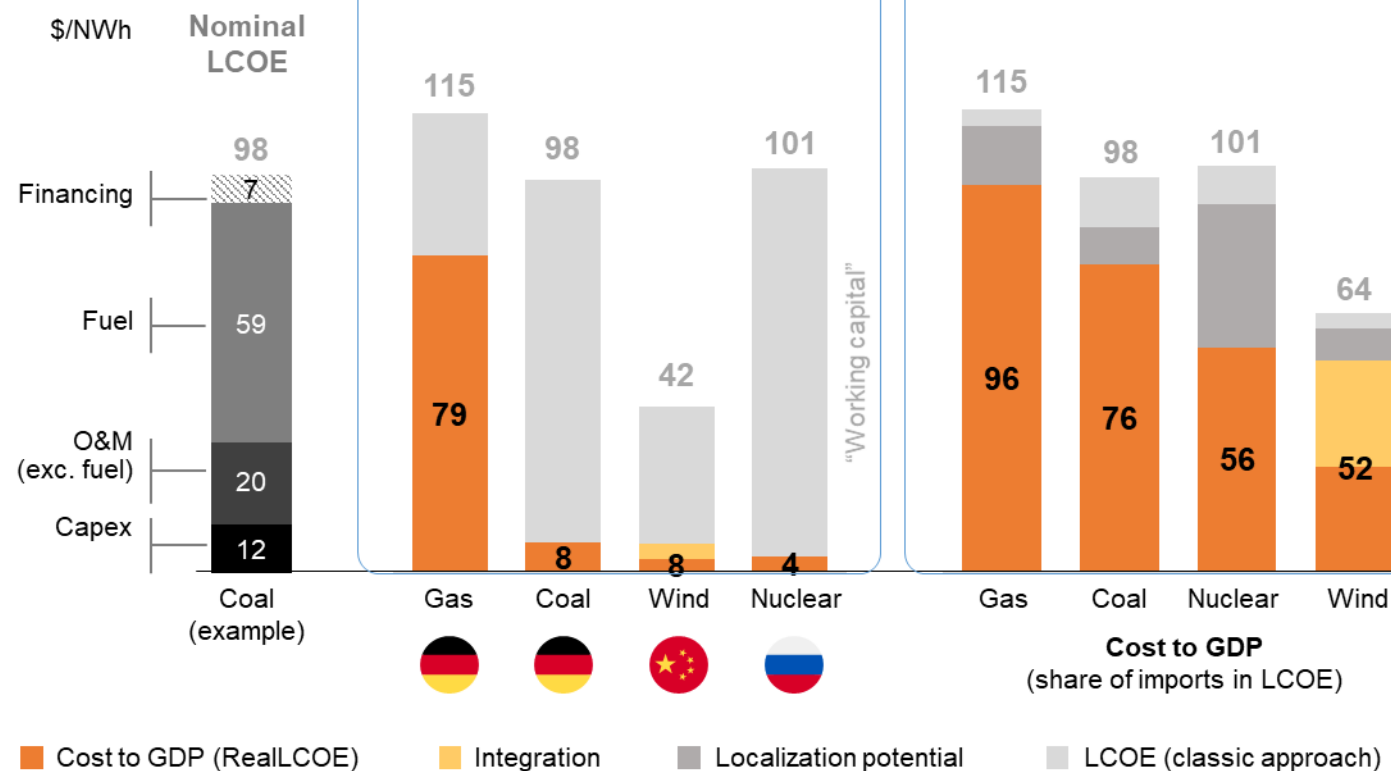


Least cost to GDP concept

Source: IEA, IAEA, NEA, NREL, Lazard, Kept analysis.

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Real LCOE approach



Cost to GDP – new concept of energy planning

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RealLCOE

New integral
electricity cost metric

cost share of imports within LCOE comprising
imported fuel, equipment and services,
adversely impacting GDP



Cost-to-GDP study for Eastern and Southern Africa, 2024

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Key issues

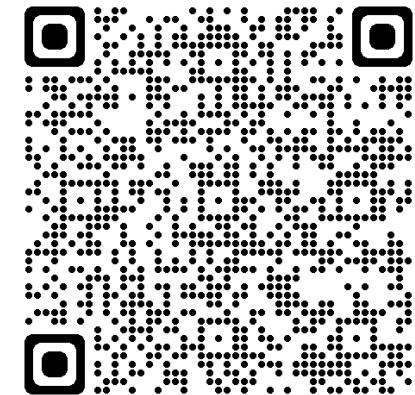
- 1 Scale of challenge
- 2 Transition paths
- 3 Role of energy sources
- 4 Climate impact
- 5 Affordability
- 6 Manageability of Transition

>10,000 variables

21 countries

4 regions:

Egypt, EAR, SAR, South Africa

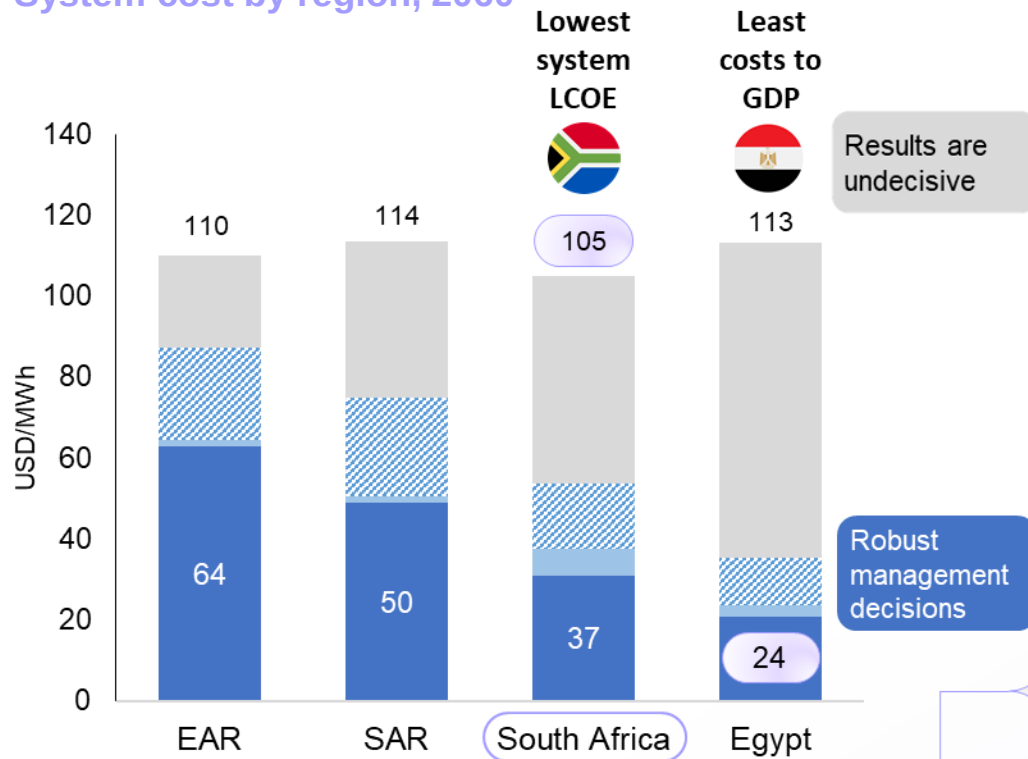


RealLCOE and System costs by technology and region

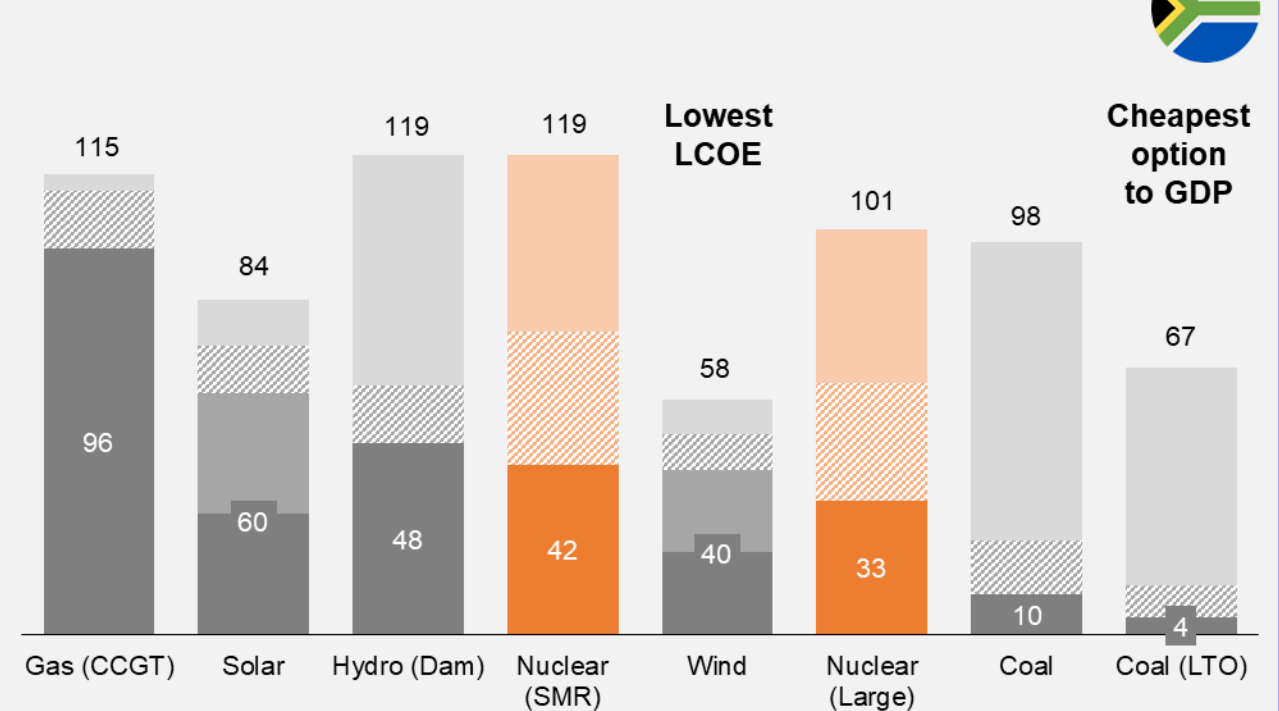
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Current and future localization level by type of technology and region

System cost by region, 2060



South Africa: Cost to GDP (Real LCOE) by technology



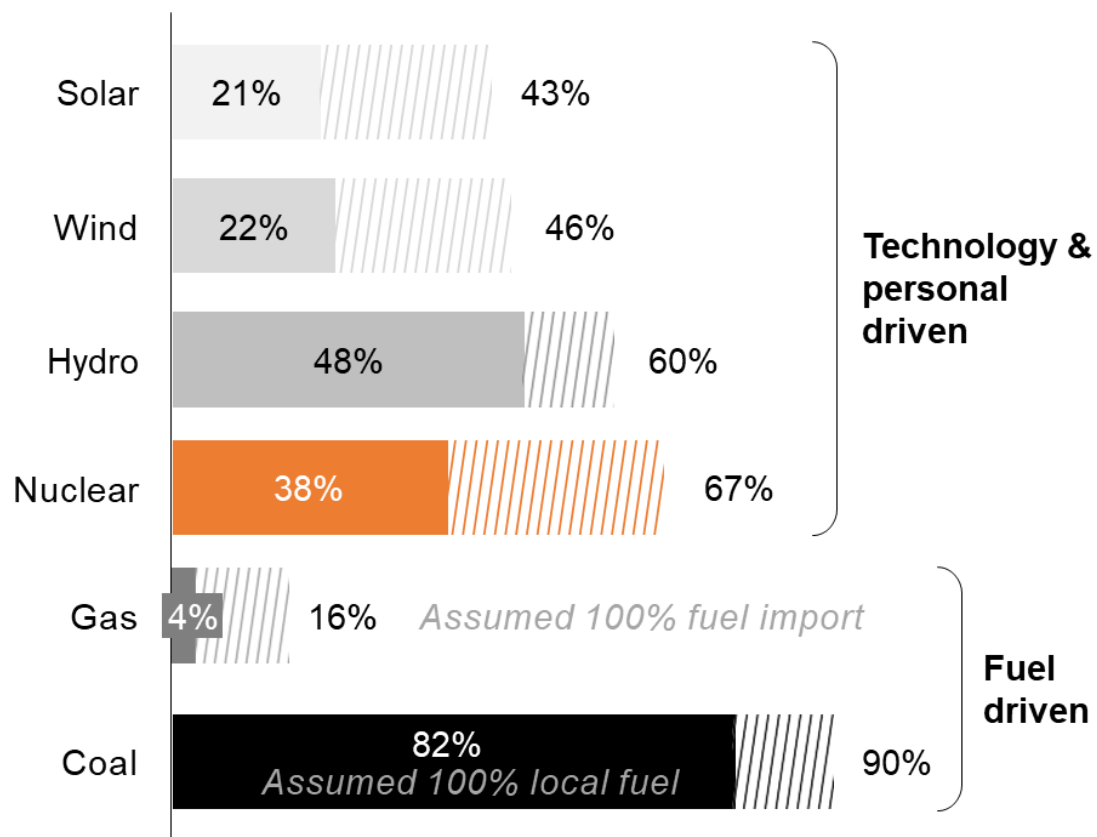
Source: IEA, NEA, IRENA, NREL, Lazard, EIU Data, Kept analysis.

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Local Content impact on RealLCOE in a country

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Current and future localization level by type of technology and region



Local content



Solar, Wind

< 20-25 %

reference values



Nuclear & SMR

> 35-50%

with up to 70% possible

Cost-to-GDP method for embarking courtiers

The logo for 'kept' is located in the top right corner. It features the word 'kept' in a white, lowercase, sans-serif font. To the right of the text is a circular graphic element with a glowing, orange and yellow ring, resembling a stylized atom or a futuristic lens.

1. **Benchmark** real full costs **of generation**
2. **Estimate localization value** for national GDP (“capital leakage”)
3. **Communicate** nuclear **benefits** with decision makers

Source: “Scaling Success. Navigating the Future of Small Modular Reactors in Competitive Global Low-Carbon Energy Markets”, NNWI, 2023.

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Example #1: SMR cost benchmarking by method

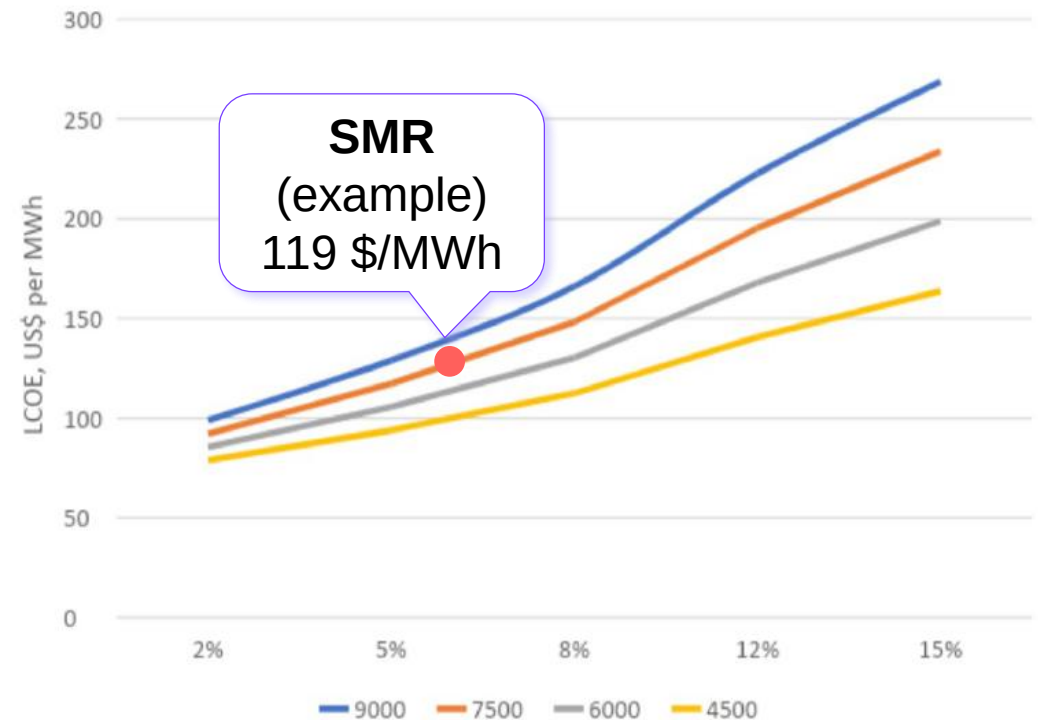
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Small Modular Reactors

SMRs are defined as nuclear reactors with a maximum output of 300 Megawatt electric (MWe) for generating electricity.

Cost range of SMRs

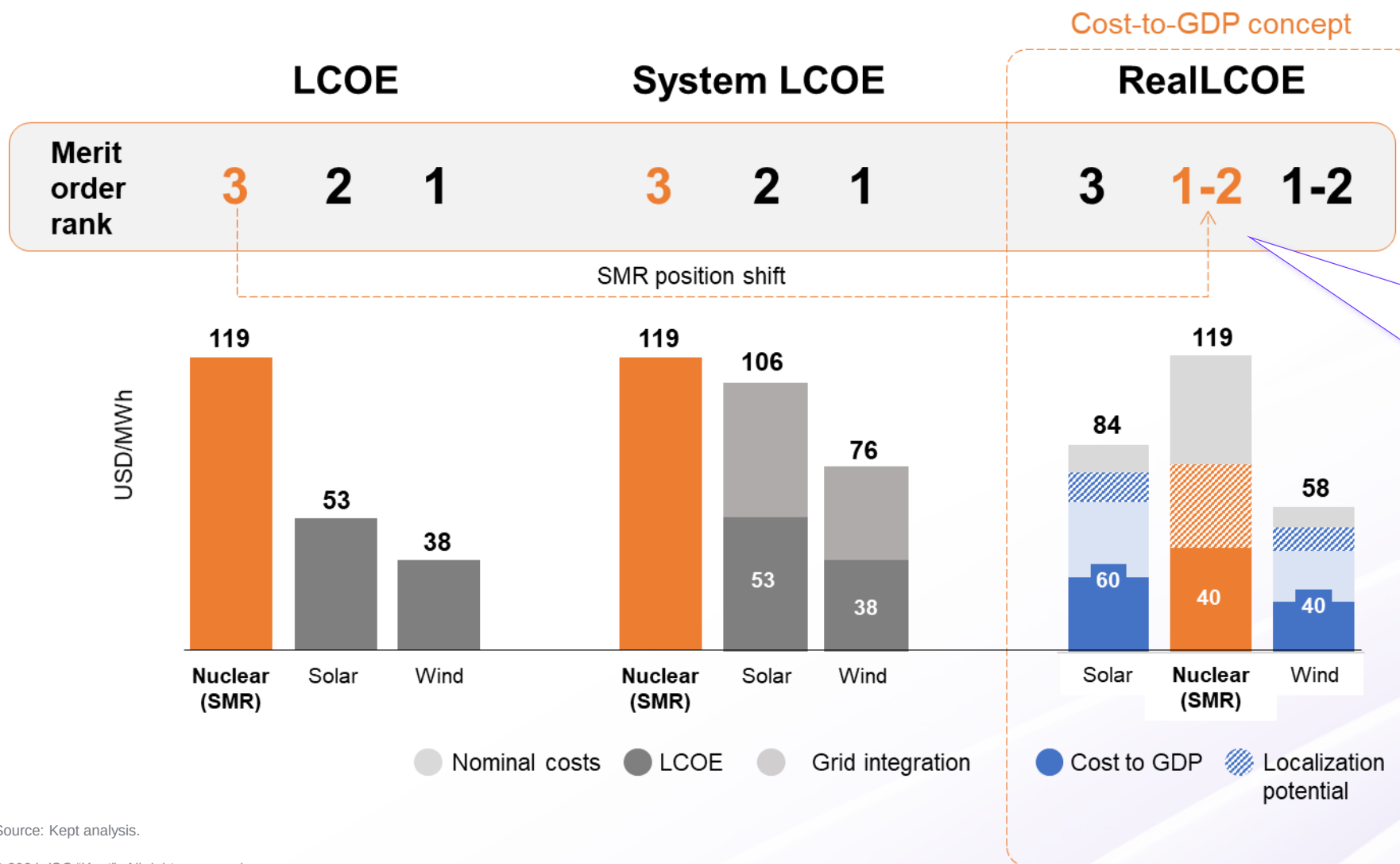
'Generic' SMR LCOE sensitivity to Cost of Capital



Source: "Scaling Success. Navigating the Future of Small Modular Reactors in Competitive Global Low-Carbon Energy Markets", NNWI, 2023.

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Example #1: SMR cost benchmarking by method



Costing Method Impact

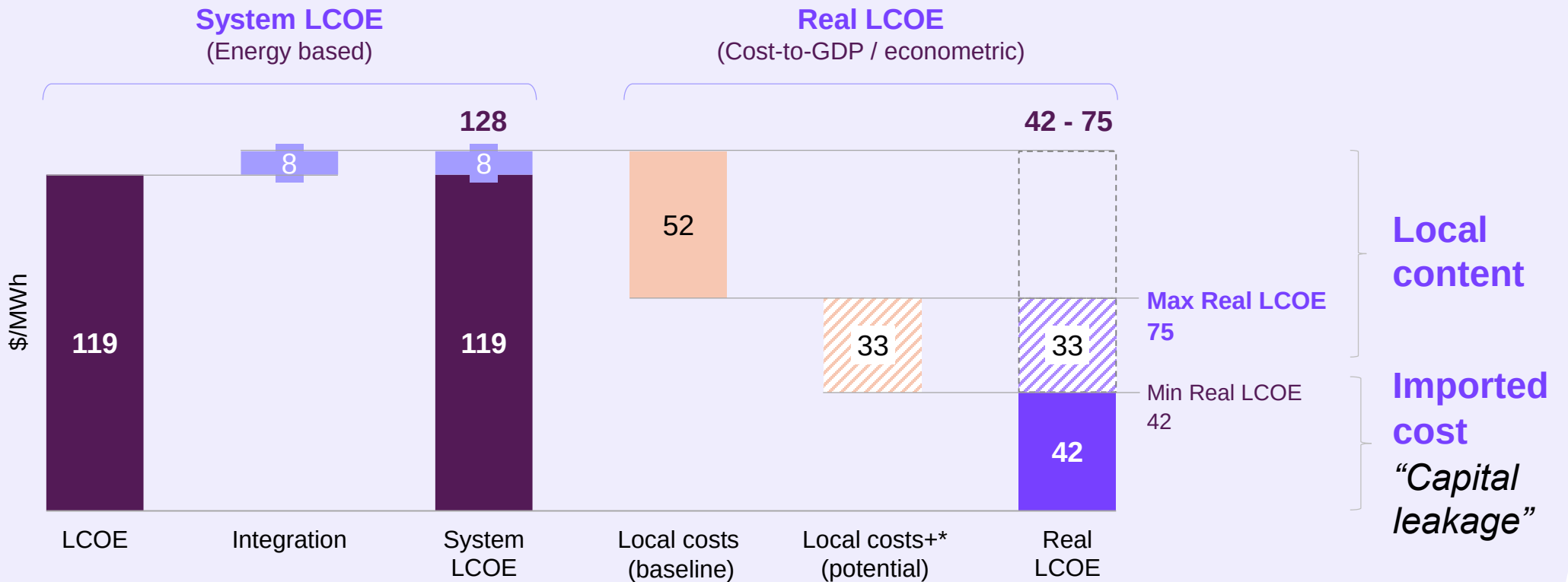
SMR is often cost competitive vs renewables on total power system and economic costs (cost to GDP)

Example #2: Estimation of cost localization value

(equipment + construction + operation + fuel + finance + people)

Generation costs by method

Example for nuclear generation (SMR) in the Country X (equipment importer)



*Project specific potential for full exploration of local supply chain, including fuel, employees, construction and installation, service and capital.

Source: Kept analysis.

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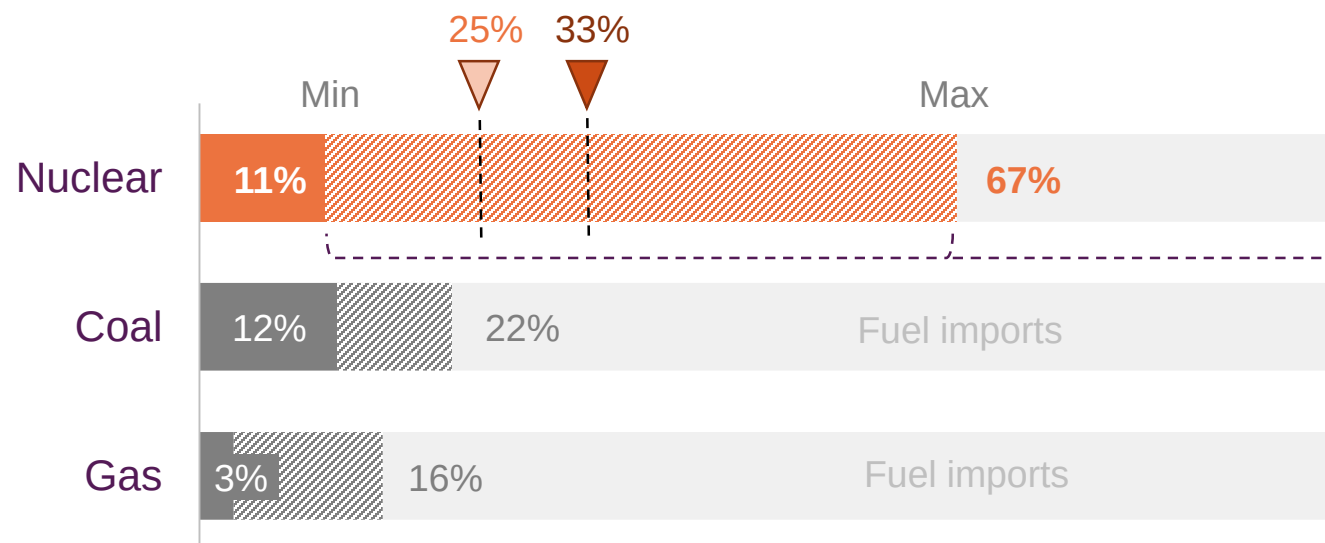
Example #2: Estimation of cost localization value

(equipment + construction + operation + fuel + finance + people)

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**Fuel & Tech
Importing Countries**

**Dispatchable
power**

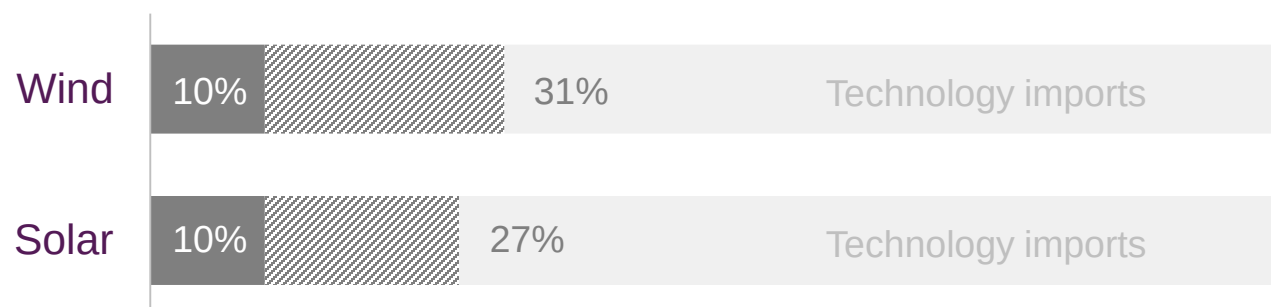


**Localization impact on GDP
for nuclear generation**

25% Break even level

>33% Positive impact*

**Non-dispatchable
power**



* by GDP Multiplier Range 3-4

Source: "New Just: Paths to Affordable Energy Transition in Eastern and Southern Africa", Analytical study, Kept, 2024.



LCOE – cost assessment and policy advocacy method



Cost-to-GDP approach (RealLCOE):



Objectively takes into account the **costs to the economy**:

- technology expenditures
- integration costs
- the share of local content



Provides adequate results according to the specifics of developing countries



Easy to implement for complex systems

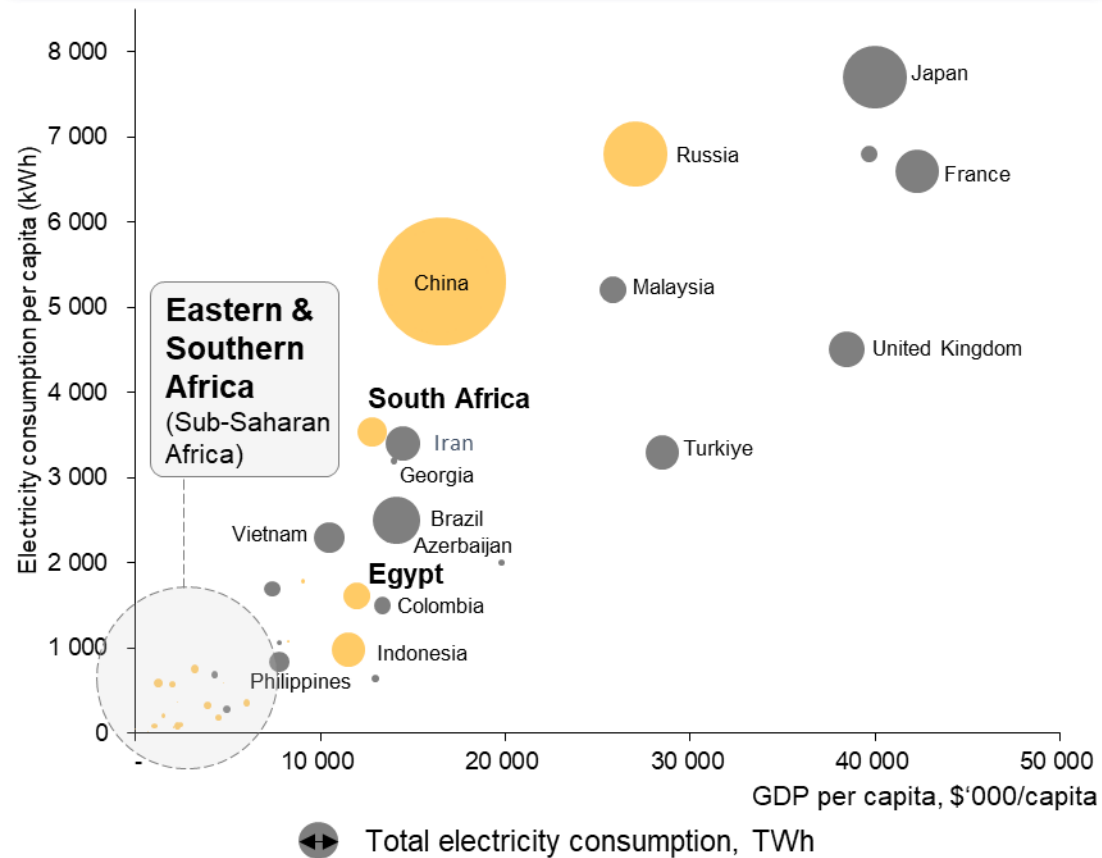


Easy to communicate with decision makers

PS: There are no rich countries with low electricity consumption

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GDP & electricity consumption by country, 2020



Electricity consumption per capita

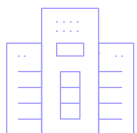
- Sub-Saharan Africa ~200 kWh
- Indonesia, India ~1,000 kWh
- South Africa 3,500 kWh
- China 5,900 kWh
- Russia 7,300 kWh
- G7 (average) 8,300 kWh
- USA 14,000 kWh

Source: AEP, IEA, World Bank, Kept analysis. Note: *Eastern and Southern Africa (ESA) not including South Africa and Egypt

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more than 35 years
(“KPMG Russia and CIS” before 2022)



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- South Asia
- Middle East

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Sergey Rozhenko

Director, Kept
Power Analytics
Center of Excellence

T: +7 495 937 44 44
M: +7 916 063 03 19
E: srozhenko@kept.ru



Vadim Karle

Manager, Kept
Power Analytics
Center of Excellence

T: +7 495 937 44 77
M: +7 926 777 65 62
E: vkarle@kept.ru

www.kept.ru

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