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# Power Sector Trends

## Arab Electricity Regulators Workshop

12/15/2022



# In the room today

## Introduction

### North America

**Mark Hoffman**  
25 years experience  
Lead – Global T&D Platform

**Todd Jirovec**  
20 years experience  
Utilities strategic sourcing, supply chain synergies

**Matthew Wetmore**  
20 years experience  
National Managing Partner – Industries and Regions

**Earl M. Simpkins Jr.**  
20 years experience  
Utilities Customer Operations

**Helen Bremner**  
25 years experience  
Transformation, deregulation & privatization

### Europe

**Giorgio Biscardini**  
25 years experience  
Energy Retail and Customer Service

**Christian von Tschirschky**  
25 years experience  
Utilities M&A and transformation & digitalization

**Dr. Axel von Perfall**  
25 years experience  
Utilities performance improvement, deals & transactions

**Massimo Leonardo**  
15 years experience  
Utilities – strategy, cost optimization, op model review

**Ronan O'Regan**  
20+ year experience  
Digital Customer Enablement and agile utility operating models

**Dr. Paul Nillesen**  
20 years experience  
T&D cost transformation and operational excellence programs

**Volker Breisig**  
30 years experience  
Utilities enterprise risk management and regulatory compliance systems

**Laurent Saint Martin**  
20+ years experience  
Renewables, B2B Services, and nuclear energy

**Fabio Gungui**  
10+ years experience  
Electric Mobility and utility integration

**Marcus Eul**  
30 years experience  
Utilities digital transformation and portfolio / growth strategies

**Jeroen Van Hoof**  
25+ years experience  
Utilities Operations and Innovation

**Menno Braakenburg**  
10+ years experience  
Utility Distribution System Operator

**Vicky Parker**  
25 years experience  
Net Zero & Decarbonization strategies

**Eva Poglitsch**  
10 years experience  
Renewables Strategy, Cost transformation

### Middle East

**George Sarraf**  
25+ years experience  
Power sector strategy and institutional framework

**Georges Chehade**  
25+ years experience  
Leader of MENA Energy and Utilities practice

**Dr. Raed Kombargi**  
25+ years experience  
Strategy-based corporate transformation in utilities

**Dr. Yahya Anouti**  
15+ years of experience  
Leader of utilities practice in MENA

**Dr. Shihab ElBorai**  
15+ years experience  
Utilities restructuring and regulatory reform / RES

**Menelaos Megariotis**  
10+ years experience in GCC energy strategy and market assessment

**Dina Storey**  
10+ years experience  
In sustainability and ESG strategy

**Samer Al Chikhani**  
10+ years experience  
In government, water and environment sectors

**Ramzi Hage**  
10+ years experience  
Utility Scale RE IPP Programs

**Anthony Yammine**  
10+ years experience  
Utilities and related industrial deal strategy and execution

### South America

**Paolo A. Pigorini**  
25 years experience  
Utilities operating model and organization design

### Asia

**Varya Davidson**  
20 years experience  
Utilities M&A and operational excellence

**Timothy Jackson**  
20 years experience  
T&D Network Cost Optimization and operational excellence

**Shantanu Gautam**  
20 years experience  
Smart grid and automation of utilities services (T&D)

**Mikhail Magrilov**  
20 years experience  
Utilities CAPEX productivity and Mega Projects

**Girish Shirodkar**  
20 years experience  
Portfolio strategy, growth strategy, Governance

# In the room today

## Introduction



**Dr. Shihab Elborai**

- Partner
- 15 years of energy consulting experience
- Electric utilities policy, regulation, and strategy
- Clients include MEIM, SEC, and other MENA region utilities

### Europe

<b>Giorgio Biscardini</b> 25 years experience Energy Retail and Customer Service	<b>Christian von Tschirschky</b> 25 years experience Utilities M&A and transformation & digitalization	<b>Dr. Axel von Perfall</b> 25 years experience Utilities performance improvement, deals & transactions
<b>Massimo Leonardo</b> 15 years experience Utilities – strategy, cost optimization, op model review	<b>Ronan O-Regan</b> 20+ year experience Digital Customer Enablement and agile utility operating models	<b>Dr. Paul Nillesen</b> 20 years experience T&D cost transformation and operational excellence programs
<b>Volker Breisig</b> 30 years experience Utilities enterprise risk management and regulatory compliance systems	<b>Laurent Saint Martin</b> 20+ years experience Renewables, B2B Services, and nuclear energy	<b>Fabio Gungui</b> 10+ years experience Electric Mobility and utility integration
<b>Marcus Eul</b> 30 years experience Utilities digital transformation and portfolio / growth strategies	<b>Jeroen Van Hoof</b> 25+ years experience Utilities Operations and Innovation	<b>Menno Braakenburg</b> 10+ years experience Utility Distribution System Operator
<b>Vicky Parker</b> 25 years experience Net Zero & Decarbonization strategies	<b>Eva Poglitsch</b> 10 years experience Renewables Strategy, Cost transformation	

### Middle East

<b>George Sarraf</b> 25+ years experience Power sector strategy and institutional framework	<b>Georges Chehade</b> 25+ years experience Leader of MENA Energy and Utilities practice
<b>Dr. Raed Kombargi</b> 25+ years experience Strategy-based corporate transformation in utilities	<b>Dr. Yahya Anouti</b> 15+ years of experience Leader of utilities practice in MENA
<b>Dr. Shihab ElBorai</b> 15+ years experience Utilities restructuring and regulatory reform / RES	<b>Menelaos Megariotis</b> 10+ years experience in GCC energy strategy and market assessment
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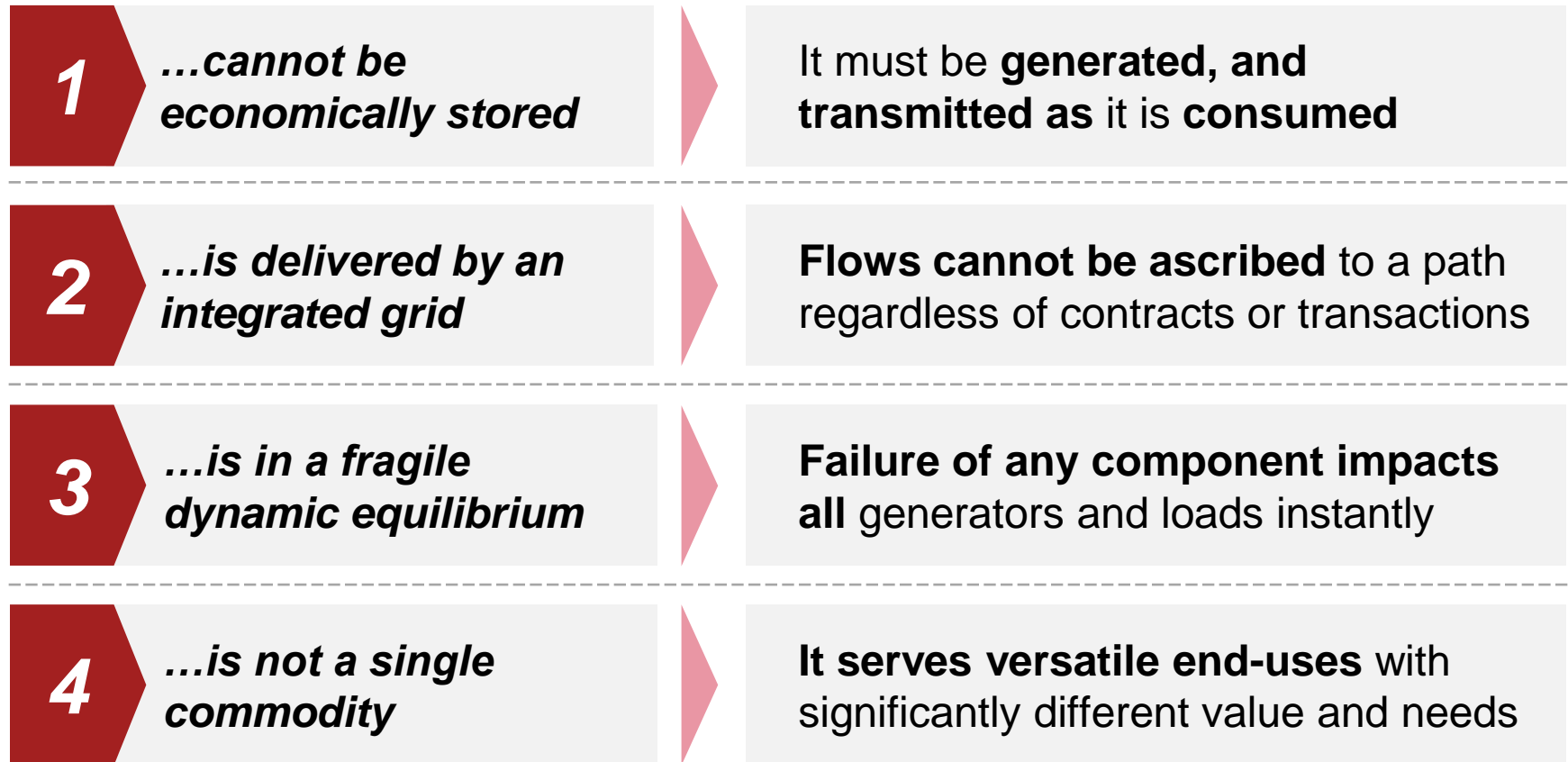
### Asia

<b>Varya Davidson</b> 20 years experience Utilities M&A and operational excellence	<b>Timothy Jackson</b> 20 years experience T&D Network Cost Optimization and operational excellence
<b>Shantanu Gautam</b> 20 years experience Smart grid and automation of utilities services (T&D)	<b>Mikhail Magrilov</b> 20 years experience Utilities CAPEX productivity and Mega Projects
<b>Girish Shirodkar</b> 20 years experience Portfolio strategy, growth strategy, Governance	

# Electricity is a commodity unlike any other

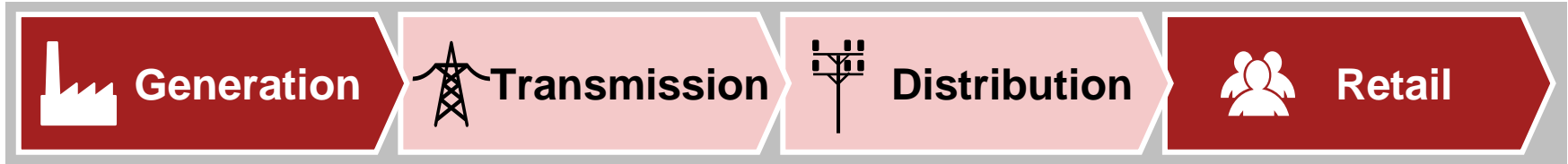
## Distinguishing Properties of Electrical Power Systems

### Electricity...



# Generation and demand must remain in perfect balance across all the links of the value chain

## Electrical Power System Value Chain

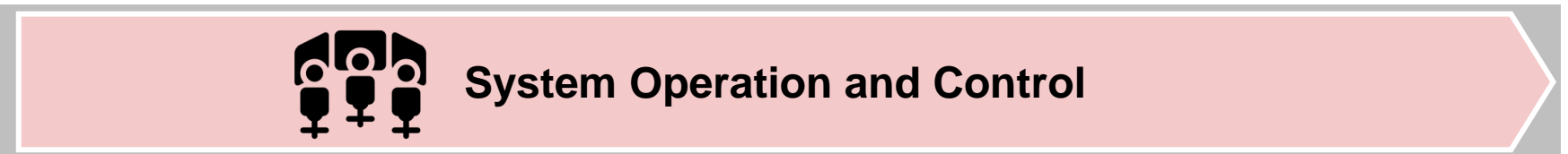


- Availability
- Heat rate
- Outage rates

- Reliability
- Asset mgmt.
- Congestion
- Technical losses

- Reliability
- Workforce mgmt.
- Technical & commercial losses

- Customer satisfaction
- Billing accuracy
- Collection rate








- CAPEX planning
- Scheduling

- Dispatch optimization
- Emergency management

# The generation needed to meet demand comes from a mix of sources optimized for cost and reliability

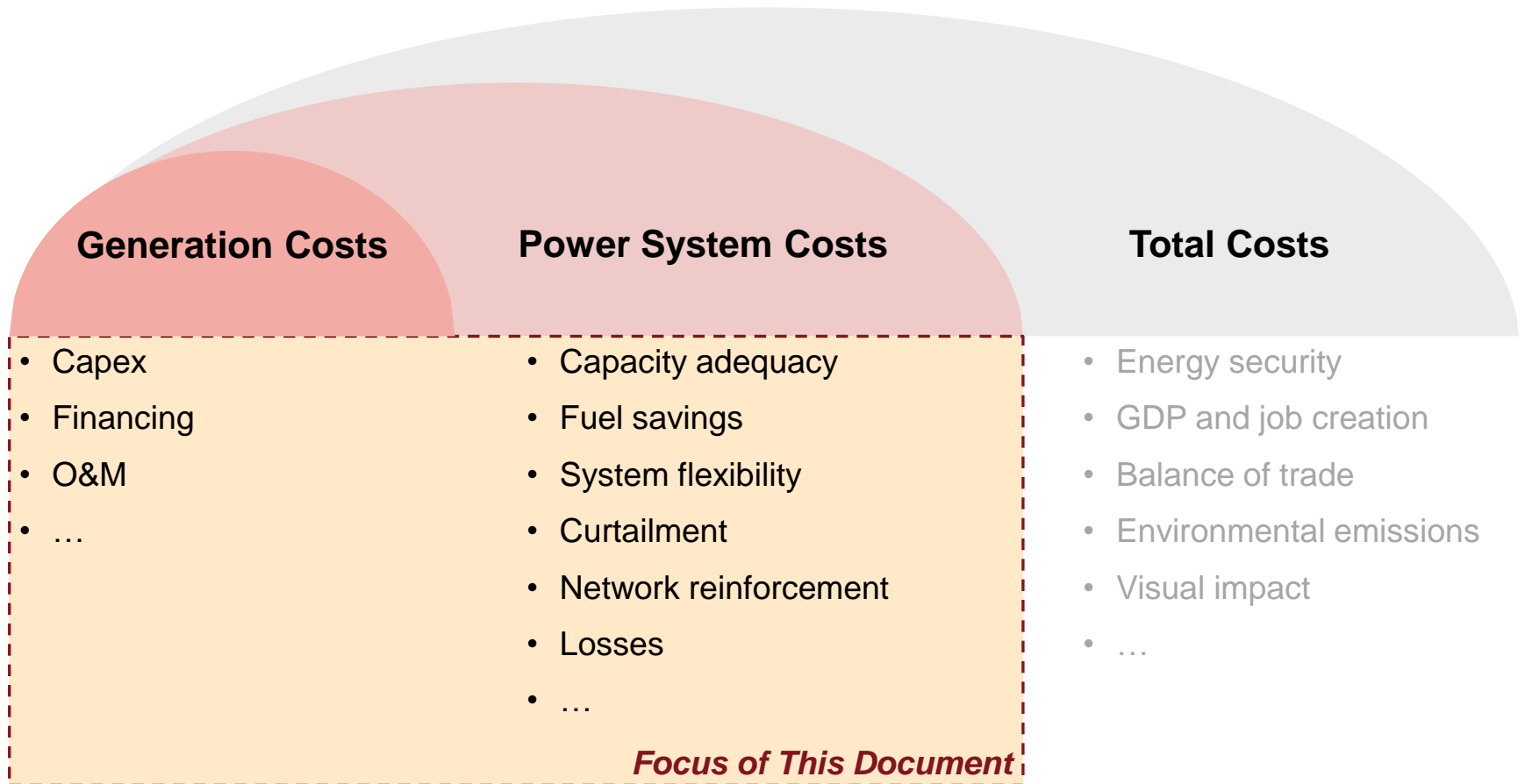
## Key Characteristics of Sources of Supply

	 OCGT	 CCGT	 STEAM <sup>1</sup>	 Nuclear	 REs
<b>LCOE Range</b> <i>(US cents/kWh)</i>	15.2 - 20.6	4.1 - 7.4	5.7 - 14.8	11.2 - 18.9	2.9 - 4.6
<b>Heat Rate</b> <i>(Btu/kWh)</i>	36%-43%	49%-56%	28%-39%	32%	NA
<b>Average Capex Intensity</b>	Low	Low	Medium	High	High
<b>EPC Lead Time</b> <i>(Months)</i>	~12	~24	~36	~72	~18
<b>Operating Mode</b>	Peaking	Cycling	Baseload	Baseload	Must-run

1) Coal based steam generation plant  
Source: Lazard 2018, Strategy& analysis

# The cost of any generation option can be assessed at multiple levels

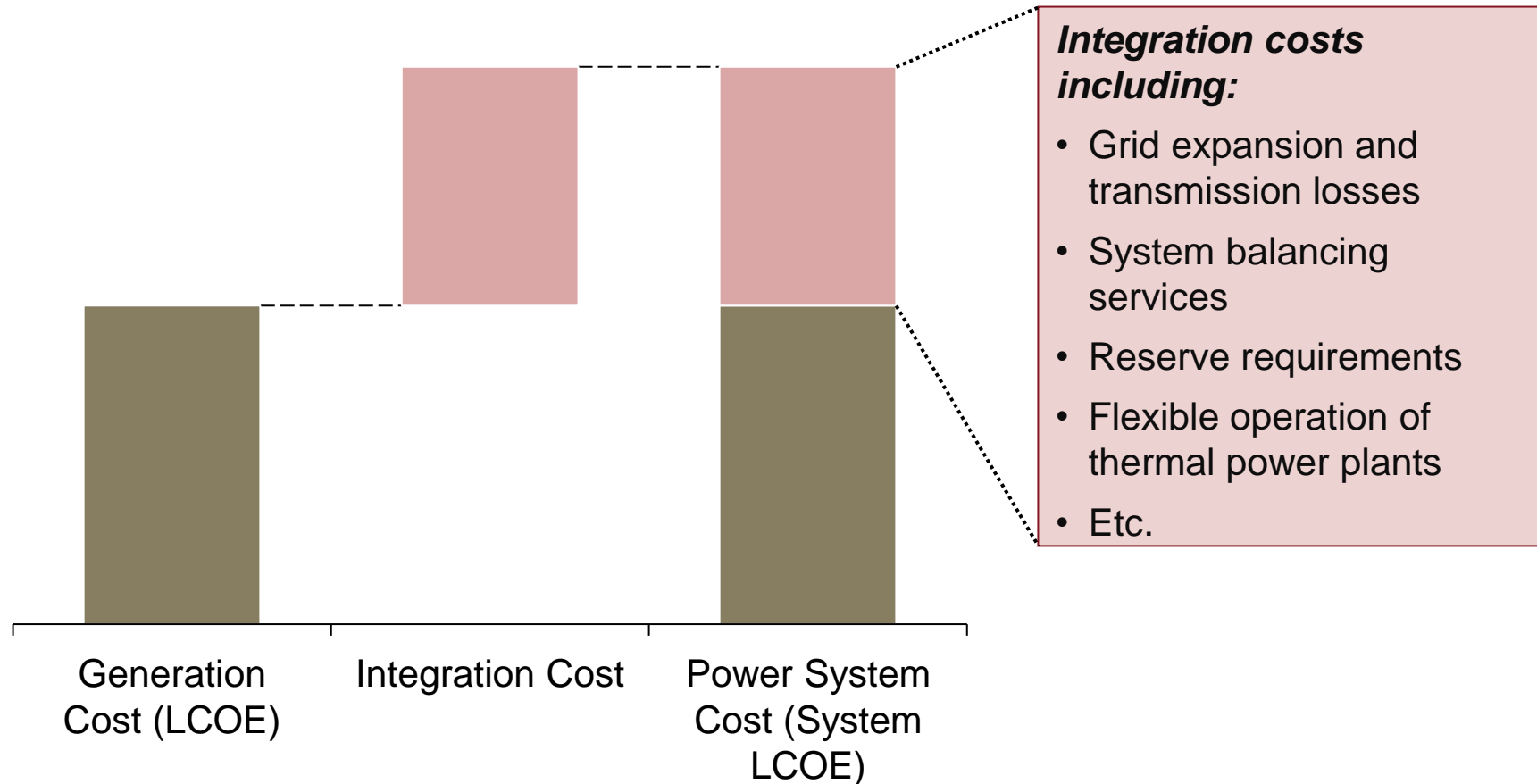
## Cost Assessment Framework



# Renewable energy power system costs comprise generation and integration costs

## Power System Cost

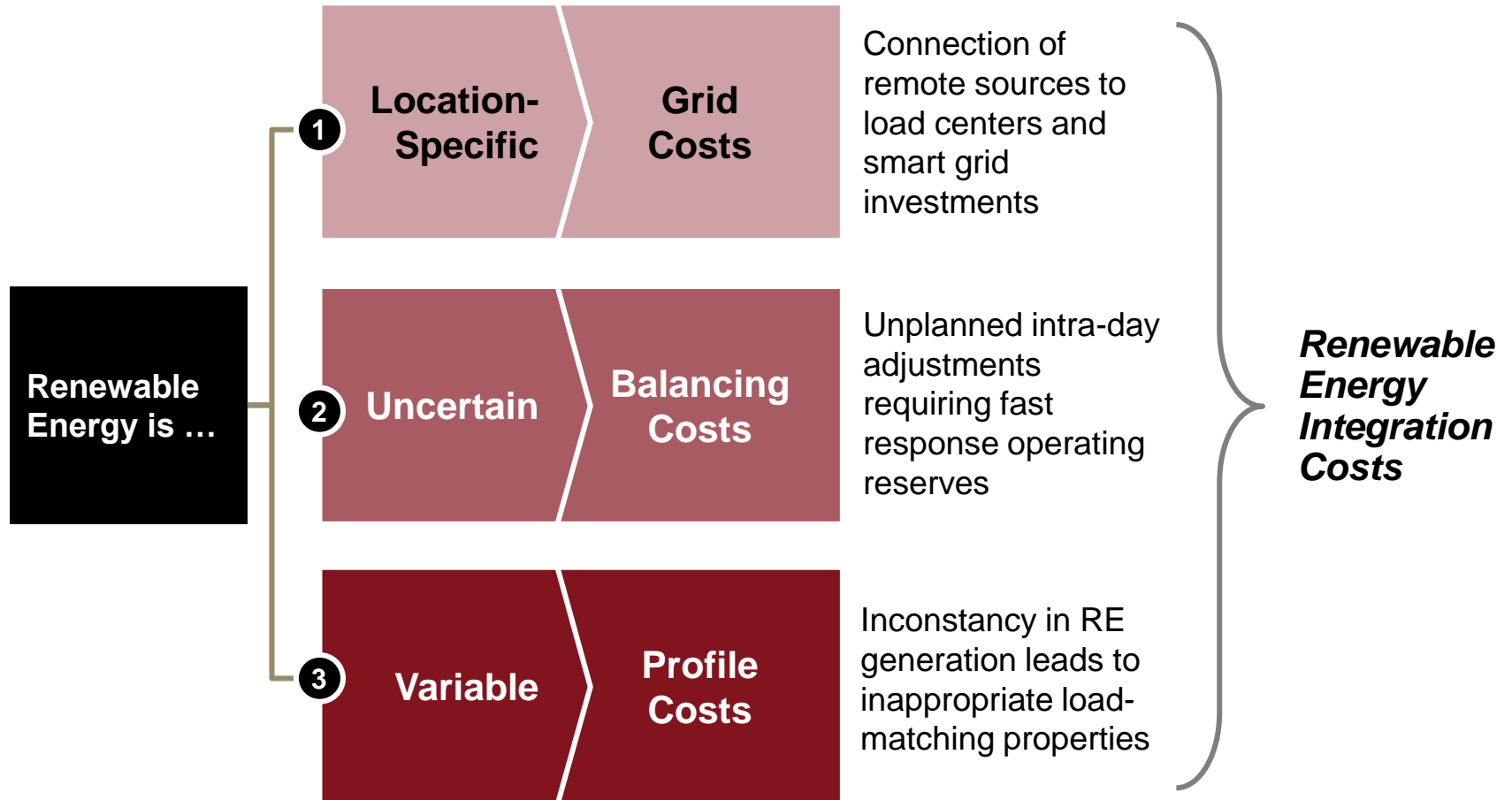
Ha/kWh





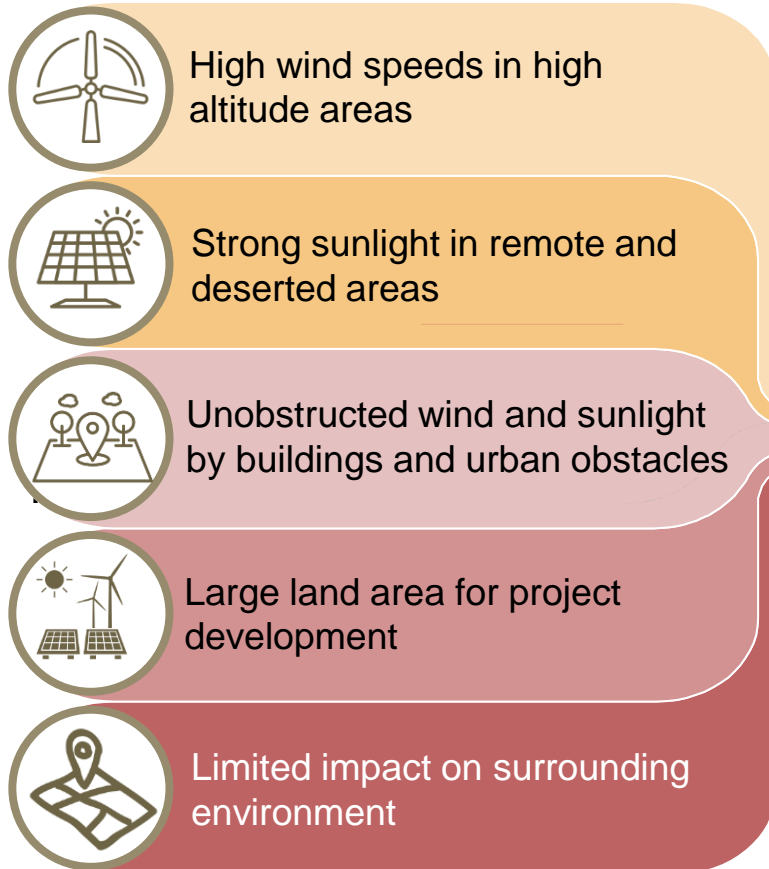
# Integration costs result from three intrinsic properties of renewable energy sources

## Intrinsic Properties and Integration Cost of Renewable Energy

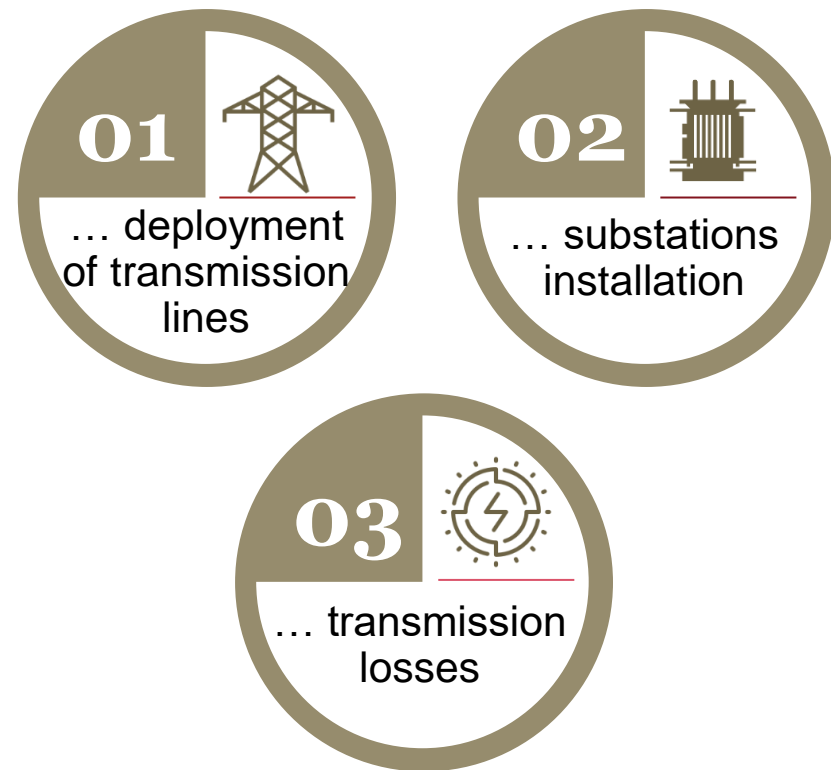


# Renewable sources are located far from demand centers and require advanced grid management

## *Rationale for installing RE in remote location*



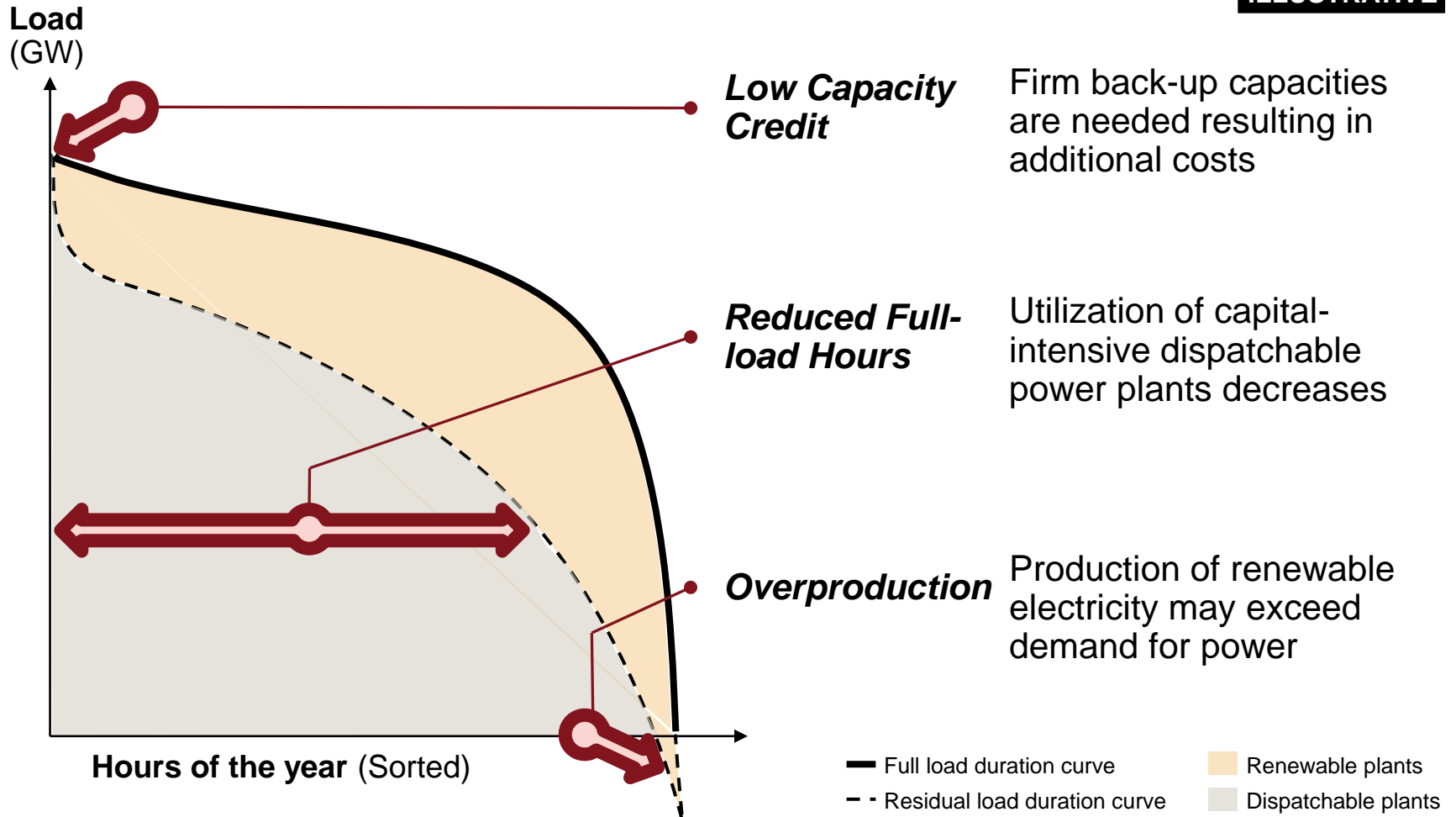
## *Additional transmission costs incurred from ...*



# At high penetration shares, variability of renewable sources leads to inappropriate load-matching

## Full and Residual Load Duration Curves

ILLUSTRATIVE

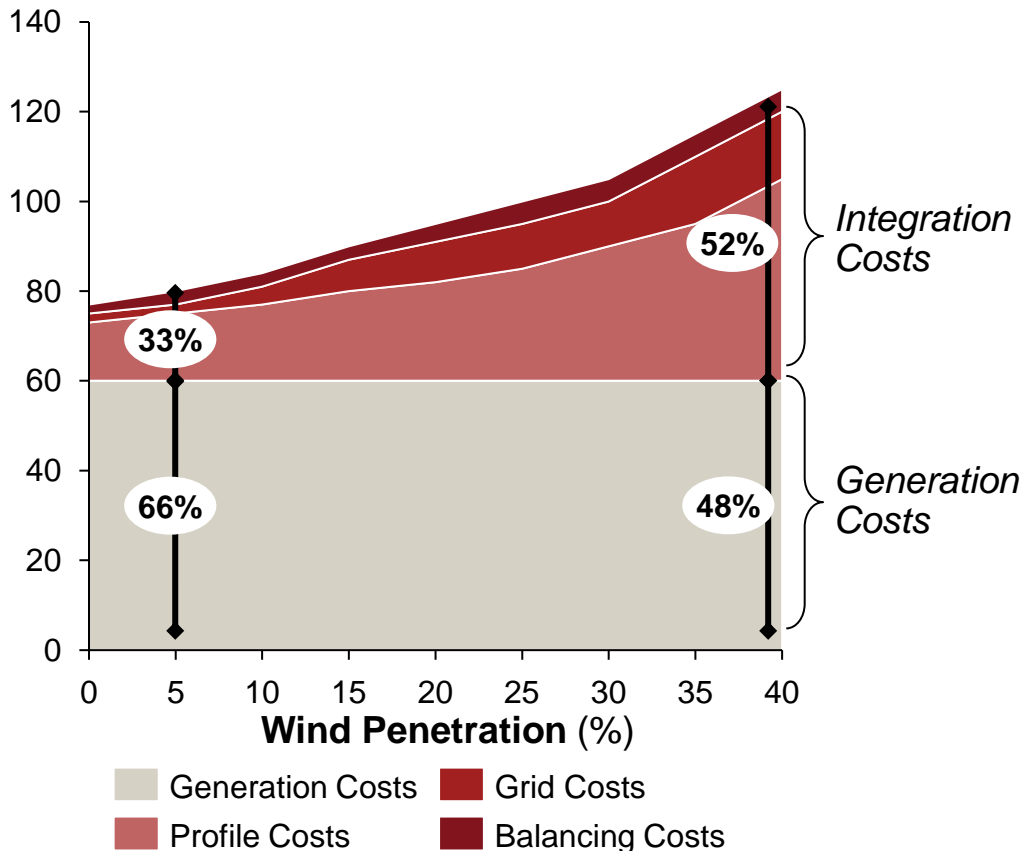


# Benchmarks show significant integration costs, especially at high renewables penetration shares

## Benchmarked Generation and Integration Costs

Germany 2012

€/MWh



### Insights

- Integration costs increase with growing share of RE penetration and can reach up to 100% of generation cost
- Profile costs are the largest component of integration costs
- Integration costs can become a barrier for further deployment of low cost renewables

Sources: Potsdam-Institute for Climate Impact Research, System LCOE

# What will the Middle East power industry look like in 2040?

## Key Long-Term Trends

### Zero-marginal-cost energy sources will lead to fixed-price billing

- Share of RE in power generation mix keeps growing
- Battery storage helps address variability
- Conventional capacity used only for back-up
- T&D investments grow to integrate REs
- Shift of value from fuel to Capex
- Energy matters less than consumption pattern (Telco?)

### Grids will become decentralized

- Distributed generation will grow
- A centralized grid is, however, still required
- New concepts emerging “Grid-of-Micro Grids” and “Crowd Balancing”
- The Grid as a physical platform of exchange and trade at the individual subscriber level

### Business models will become more customer-focused

- Shift from Meters to Customers
- The electrification of everything
- Deepen relationship with customers to provide peace of mind and convenience rather than a commodity
- Sustainability and circularity will matter more
- A zero-carbon zero-waste utility?

# Thank you

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