

IRENA

FlexTool

TRAINING FOR MENA

**SESSION 1: Power sector planning in Arab countries – the importance of a power system flexibility assessment**

# **Power sector planning in Arab countries: The importance of power system flexibility in long-term planning for VRE**

**Daniel Russo**  
**IRENA Virtual FlexTool Training for MENA**

**30 June 2020**

- 1. Background of the technical workshop and summary report**
- 2. Methodologies to represent system flexibility in government models/tools**
- 3. Improvement priorities**

# 1. Background of the technical workshop and summary report

# Long-term planning with VRE: Why?

## Government

“Deploying variable renewable energy (VRE) is beneficial.”

“Our country should adopt ambitious long-term VRE targets.”

## System operators

“VRE’s short-term variability endangers power system reliability”

“There is an upper limit of X% VRE”

## Energy planning officials

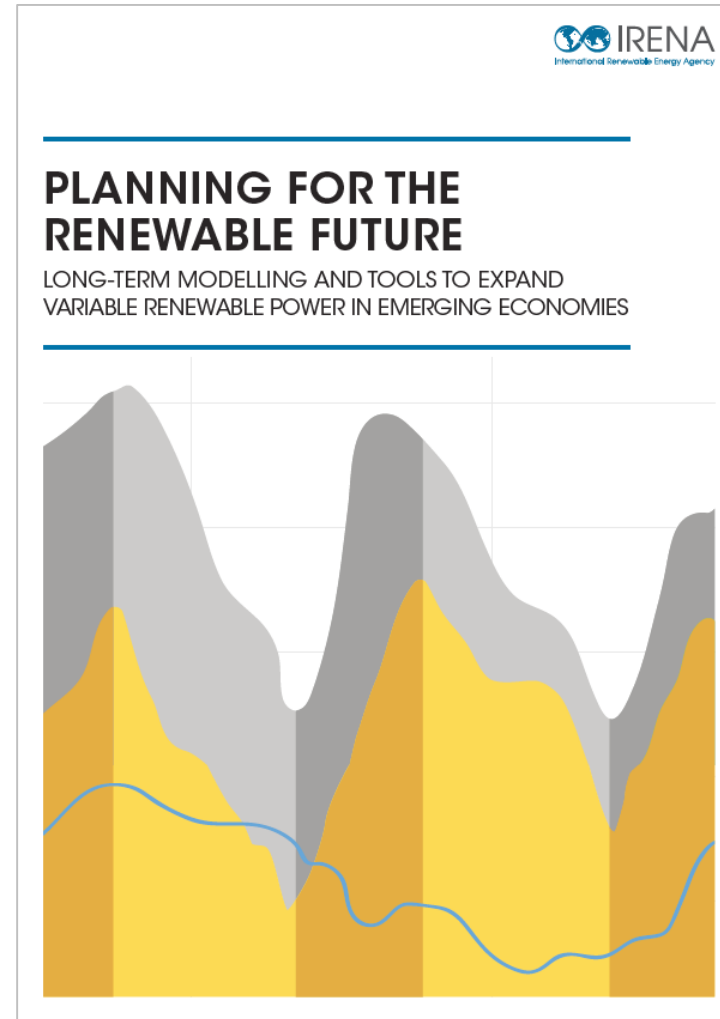
## “AVRIL” project: Key areas of focus

How does long-term generation expansion planning (e.g. to 2040) need to be changed when aiming for a high share of VRE?

- **The planning impacts of VRE’s distinct features**

What in particular needs to be changed?

- **Institutional aspects (Planning process)**
- **Techno-economic assessment methodologies (Modelling)**



**Part 1:**  
**Planning the transition to variable renewables**

**Part 2:**  
**Long-term energy models for transition planning**

# Regional AVRIL workshops

## 2017 – Buenos Aires, Argentina – LATAM

- Co-organised by IRENA and Argentina's Ministry of Energy and Mining; with representatives from NREL, OLADE, and the World Bank
- Representatives from **ten Latin American countries - Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, and Uruguay**



## 2019 – Astana, Kazakhstan – Central Asia

- Co-organised by IRENA and Ministry of Energy of Kazakhstan; with representatives from ADB, USAID, EBRD, UNECE, UNDP
- Representatives from **five Central Asia countries - Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan**

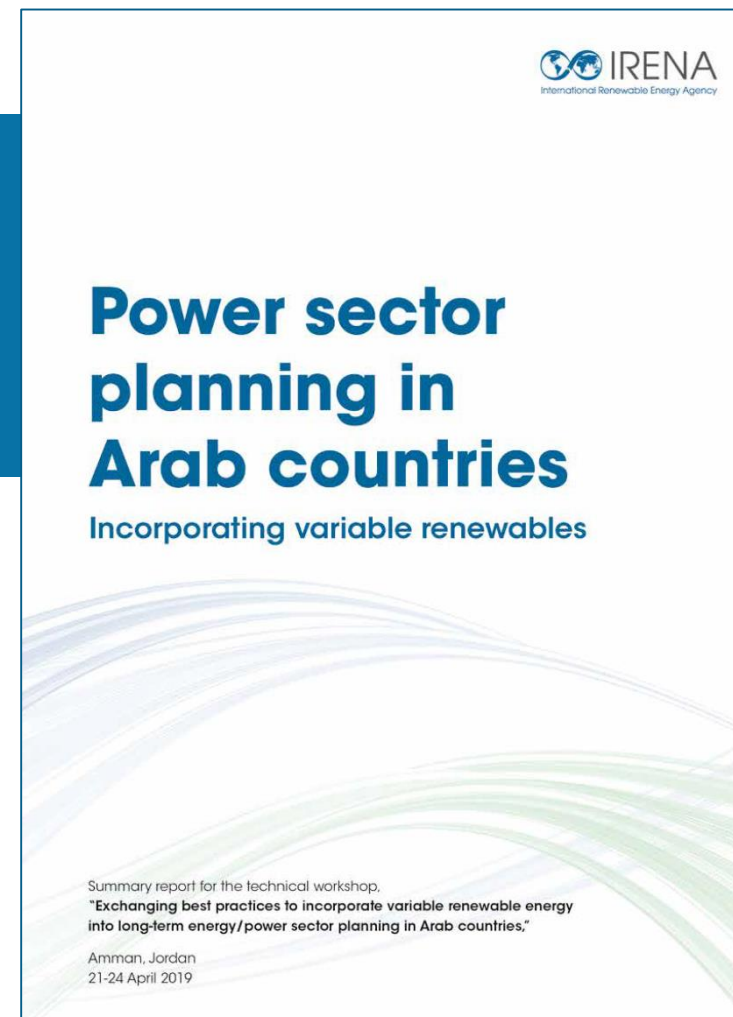


## 2019 – Amman, Jordan – Arab region

- Co-organised by IRENA, League of Arab States, IsDB and RCREEE
- Representatives from **ten Arab countries - Algeria, Bahrain, Egypt, Iraq, Jordan, Libya, Palestine, Qatar, Saudi Arabia, and Somalia**



## 2. Workshop summary report - Methodologies





# Report contents - Regional context

## Renewable shares

## Planning tools

## Planning mandates

			ected
Country	Planning steps - Institutional responsibility†		
	Energy system planning	Generation capacity expansion planning	Transmission planning
<b>Algeria</b>	Ministère de l'Énergie	Commission de Régulation de l'Électricité et du Gaz (CREG) ; Ministère de l'Énergie	Société Nationale de l'Électricité et du Gaz (Sonelgaz)
<b>Bahrain</b>	Electricity & Water Authority (EWA)	Electricity & Water Authority (EWA)	Electricity & Water Authority (EWA)
<b>Egypt</b>	Ministry of Electricity and Renewable Energies (MoERE); Ministry of Petroleum	Egyptian Electricity Holding Company (EEHC)	Egyptian Electricity Transmission Company (EETC)
<b>Iraq</b>	Planning and Study Office, Ministry of Electricity	Planning and Study Office, Ministry of Electricity	Planning and Study Office, Ministry of Electricity
<b>Jordan</b>	Ministry of Energy and Mineral Resources (MEMR)	Grid expansion section, National Electric Power Company (NEPCO)	Transmission planning section, National Electric Power Company (NEPCO)
			(CSP) under development

## Country profiles: VRE representation

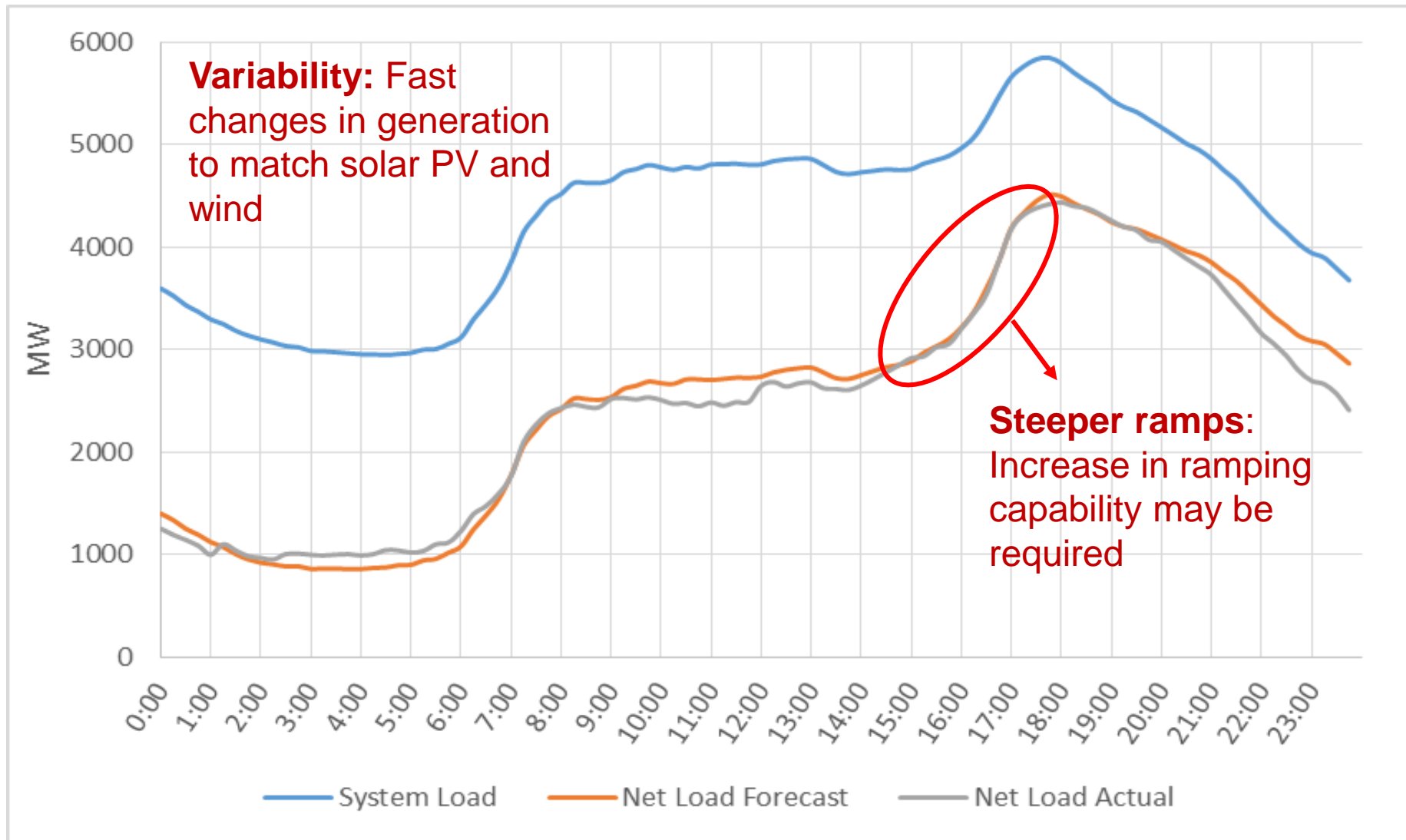
Good representation of VRE in long-term planning and modelling should reflect the consideration of:

- » Rapid cost reductions
- » Unique resource profiles
  - Firm capacity / capacity credit
  - **System flexibility**
  - Transmission investment needs
- » System stability impacts



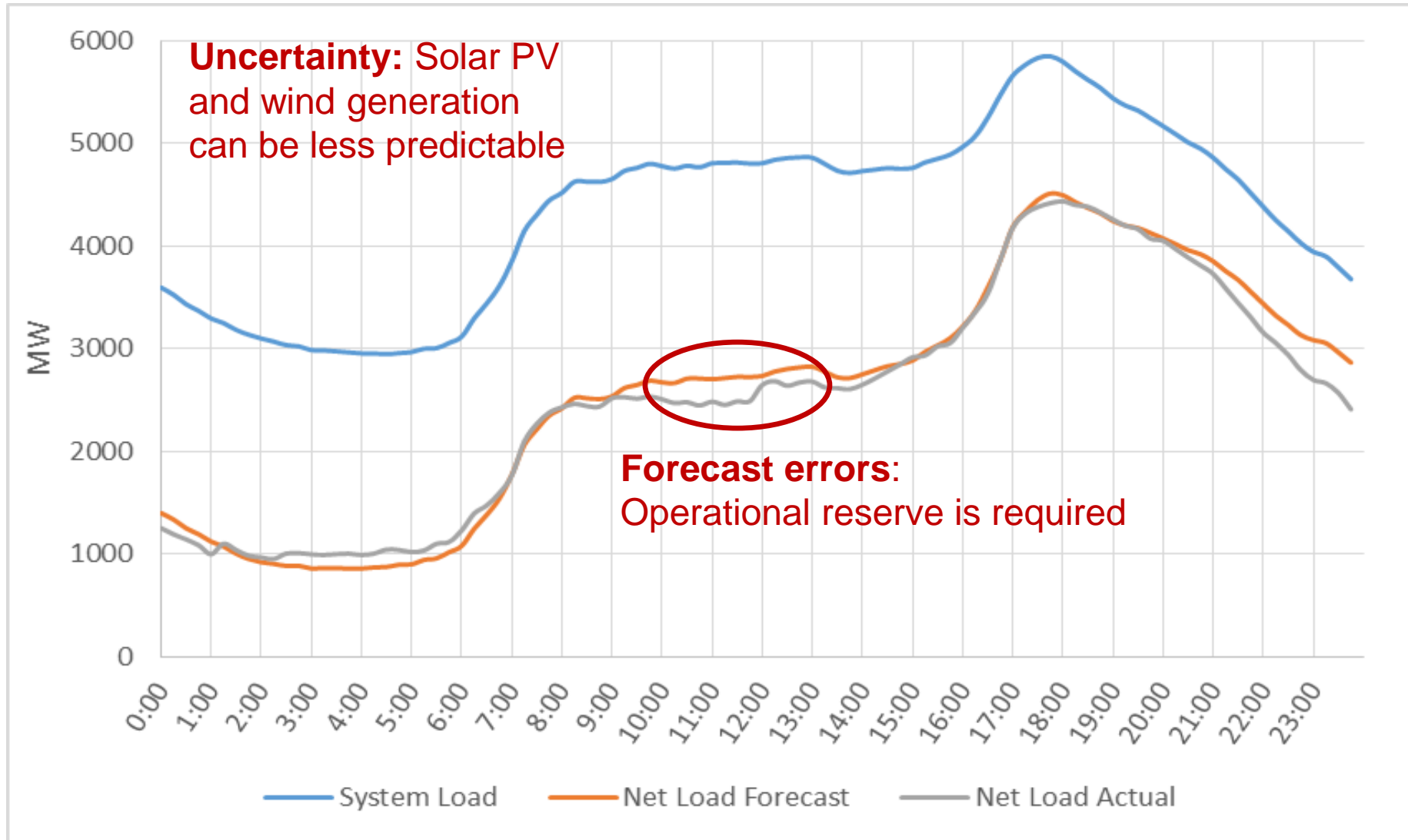
**Typically not well-covered** in “traditional” generation expansion planning models and methodologies

# Why represent system flexibility with VRE?



Source: [www.eirgridgroup.com](http://www.eirgridgroup.com)

# Why represent system flexibility with VRE?



- » Does the long-term capacity mix (e.g. in 2040) meet short-term flexibility requirements? I.e. do we have enough flexibility in the system?
- » To what extent are sources of flexibility issues represented in the long-term model?
  - » Hourly demand profiles
  - » Hourly VRE profiles
- » To what extent are sources of flexibility solutions represented in the long-term model?
  - » Ramp rates
  - » Minimum load levels
  - » Start-up times
  - » Storage
  - » Interconnectors
  - » Demand response
- » How much curtailment of VRE could occur? Is a more detailed screening analysis of results required?

# MENA context – Representation of flexibility

Summary from “*Exchanging best practices to incorporate variable renewable energy into long-term energy/power sector planning in MENA*” - 15 countries



- » Overall, there are **established power sector planning practices in only some of the countries.**
- » System **flexibility is considered in a minority of the country modelling approaches**, and not always comprehensively.
- » **Must-run units** (e.g. desalination, cogeneration, inflexible IPP contracts) are seen as a possible flexibility issues that will cause VRE curtailment as higher shares are integrated.
- » **Interconnections** are seen as an important source of flexibility if they are possible.
- » When talking about **storage solutions**, the main issue is forecasting the cost of these solutions.

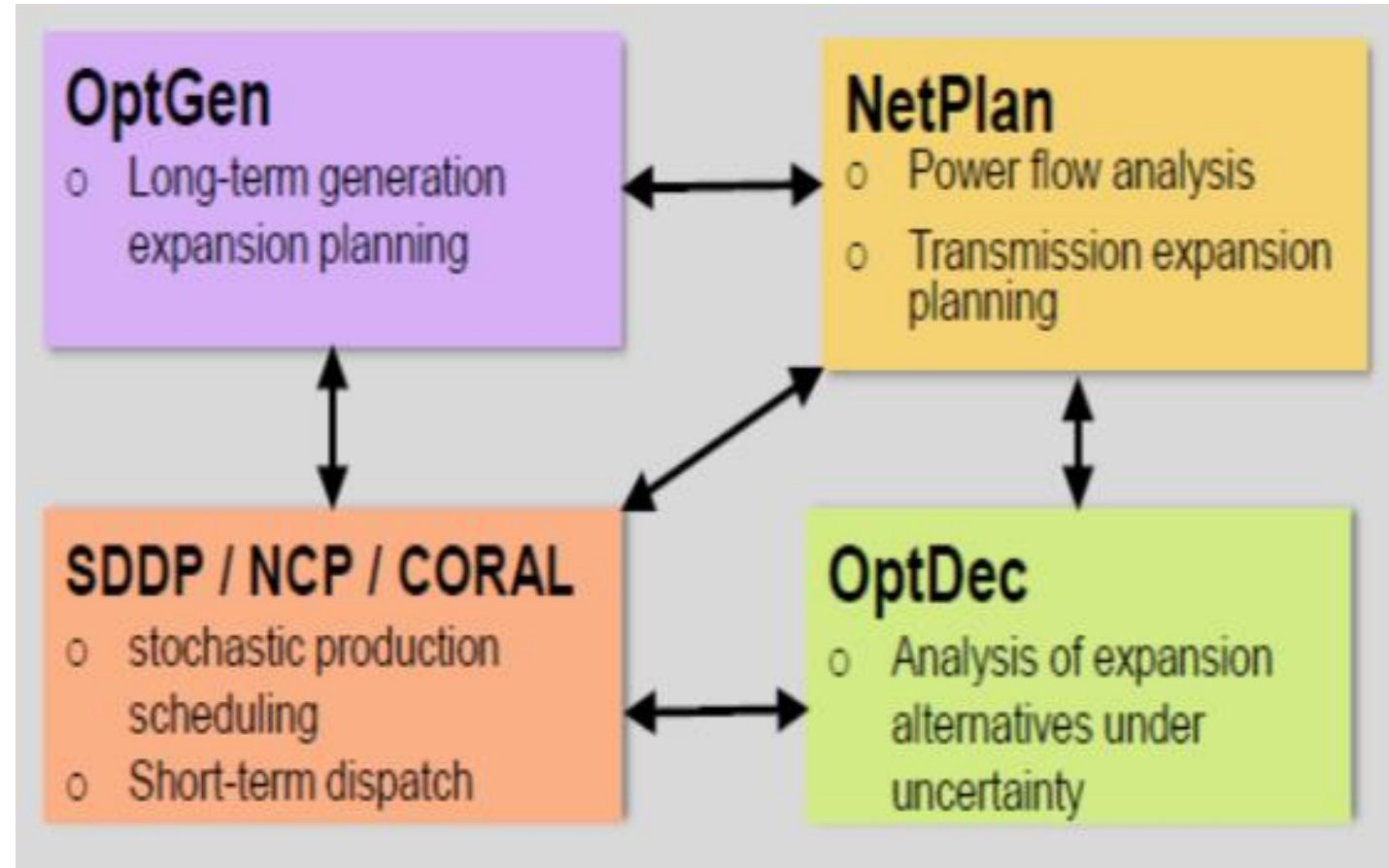
# System Flexibility Methodology– Arab region

	Represented in long-term capacity expansion?		Description
	Yes	No	
Algeria	X		Based on flexibility potential and network availability.
Bahrain		X	NA
Egypt	X		<b>By providing the detailed operational limits for generation units (ramp rates, minimum generation levels, minimum up/down times, maximum number of start-ups/shutdowns and shutdown costs).</b>
Iraq		X	NA
Jordan		X	NA
Lebanon		X	NA
Libya		X	NA
Morocco	X		<b>Hourly unit commitment taking into consideration dynamic operational constraints (start-ups, ramping, continuous minimum up/down, etc.).</b>
Oman	X		The target can be updated and the model can be revised.
State of Palestine		X	NA
Qatar	X		NA
Saudi Arabia	X		<b>A combination of minimum reserve and LOLE/P.</b>
Somalia		X	NA
Sudan		X	NA
Yemen		X	NA



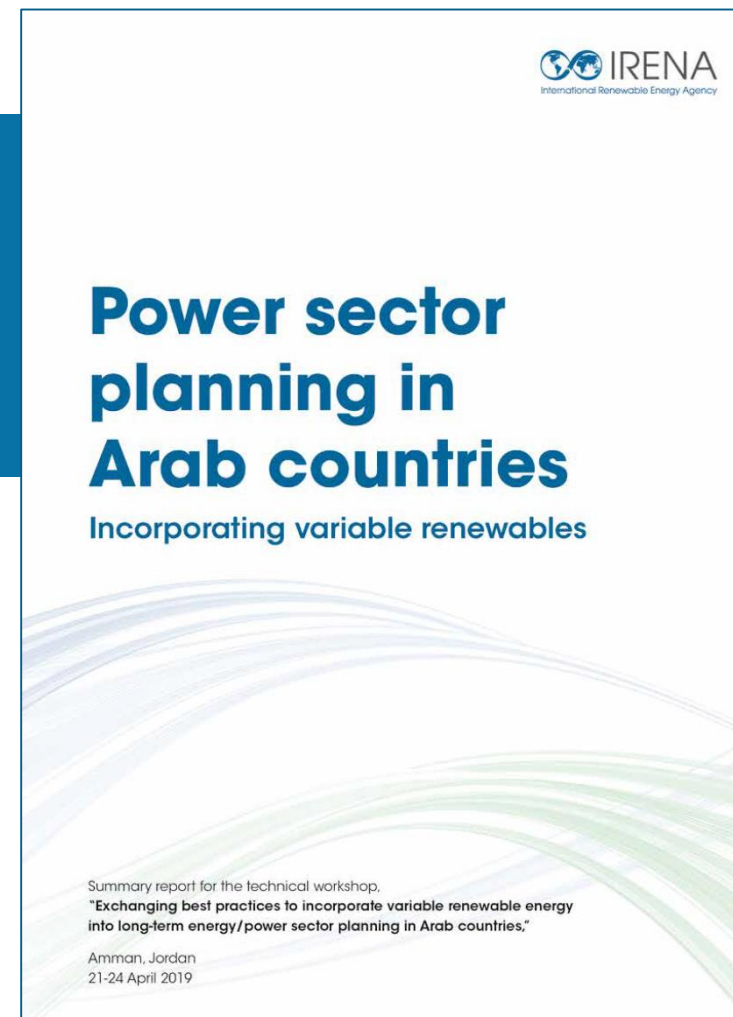
# Example – Egypt

- » More planning concepts around flexibility had to be introduced with RE targets
- » E.g. time-slice representation to hourly and even sub-hourly resolution in modelling to capture correlation between VRE generation and demand, as well as account for the need for flexibility
- » New tools were needed to complement their existing traditional long-term planning tool





## 3. Workshop summary report – Improvement priorities



## Arab region

Flexibility:	Current practice?	Improvement priority?
1. Validating that your long-term capacity mix meets short-term flexibility requirements (e.g. ramping), and assessing flexibility costs (e.g. cycling costs, efficiency losses, etc.)	7 / 15	12 / 15
2. For more advanced flexibility analysis at higher VRE penetration levels, hourly representation	6 / 15	11 / 15
3. Assessing the contribution of storage and demand response to flexibility	5 / 15	9 / 15

**Representing flexibility and stability were the two highest priorities for future work**

- **Egypt:** Further studies to define operational constraints
- **Jordan:** Grid challenges due to VRE integration
- **Morocco:** Generation profiles for each solar/wind site
- **Oman:** Co-ordinating VRE with conventional projects
- **Qatar:** Gaining experience with variable system operation

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# IRENA FlexTool Training for MENA

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RE deployment and Planning challenges in the Arab Region

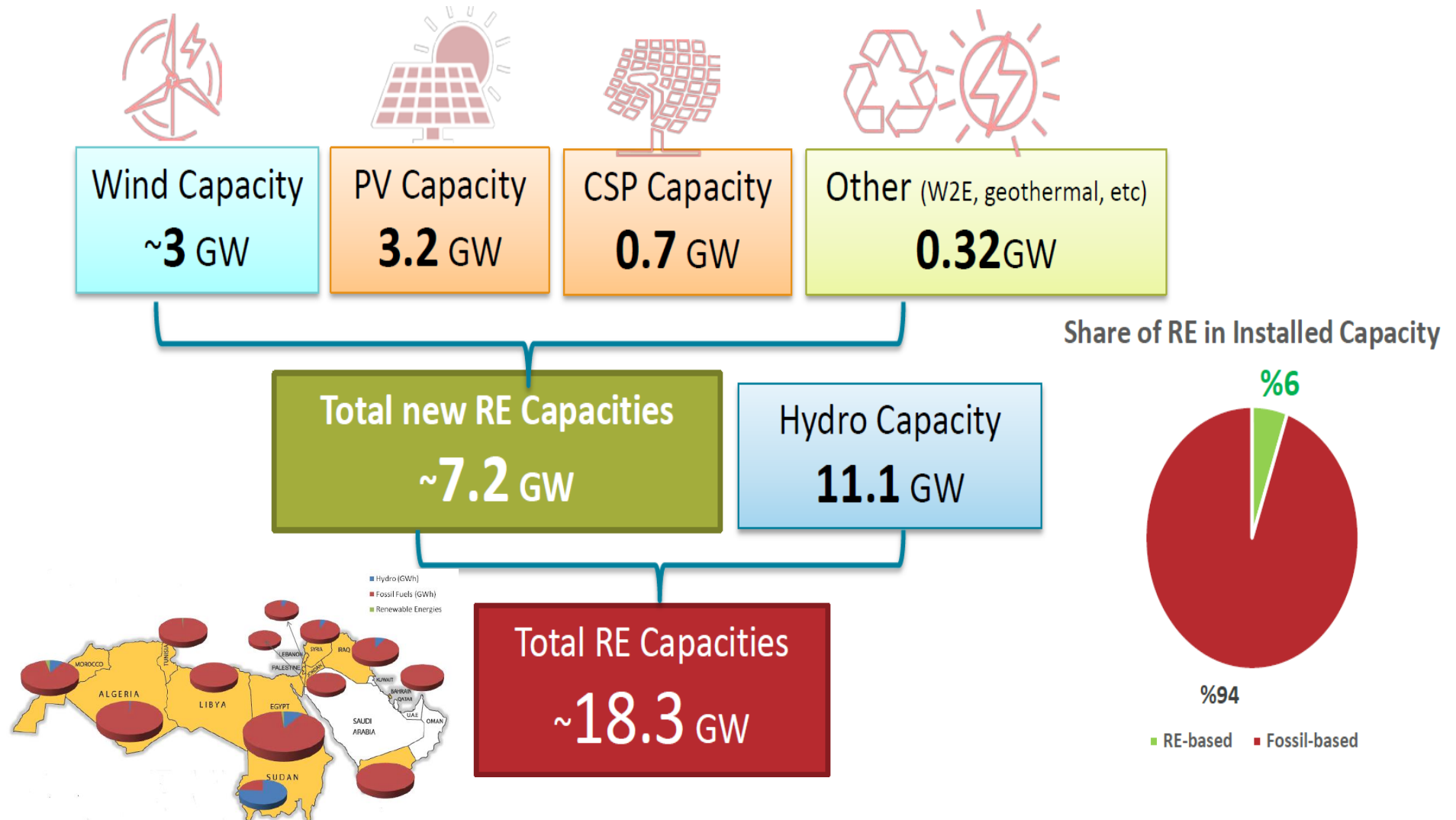


**RCREEE** 

Regional Center for Renewable Energy and Energy Efficiency  
المركز الإقليمي للطاقة المتجددة وكفاءة الطاقة

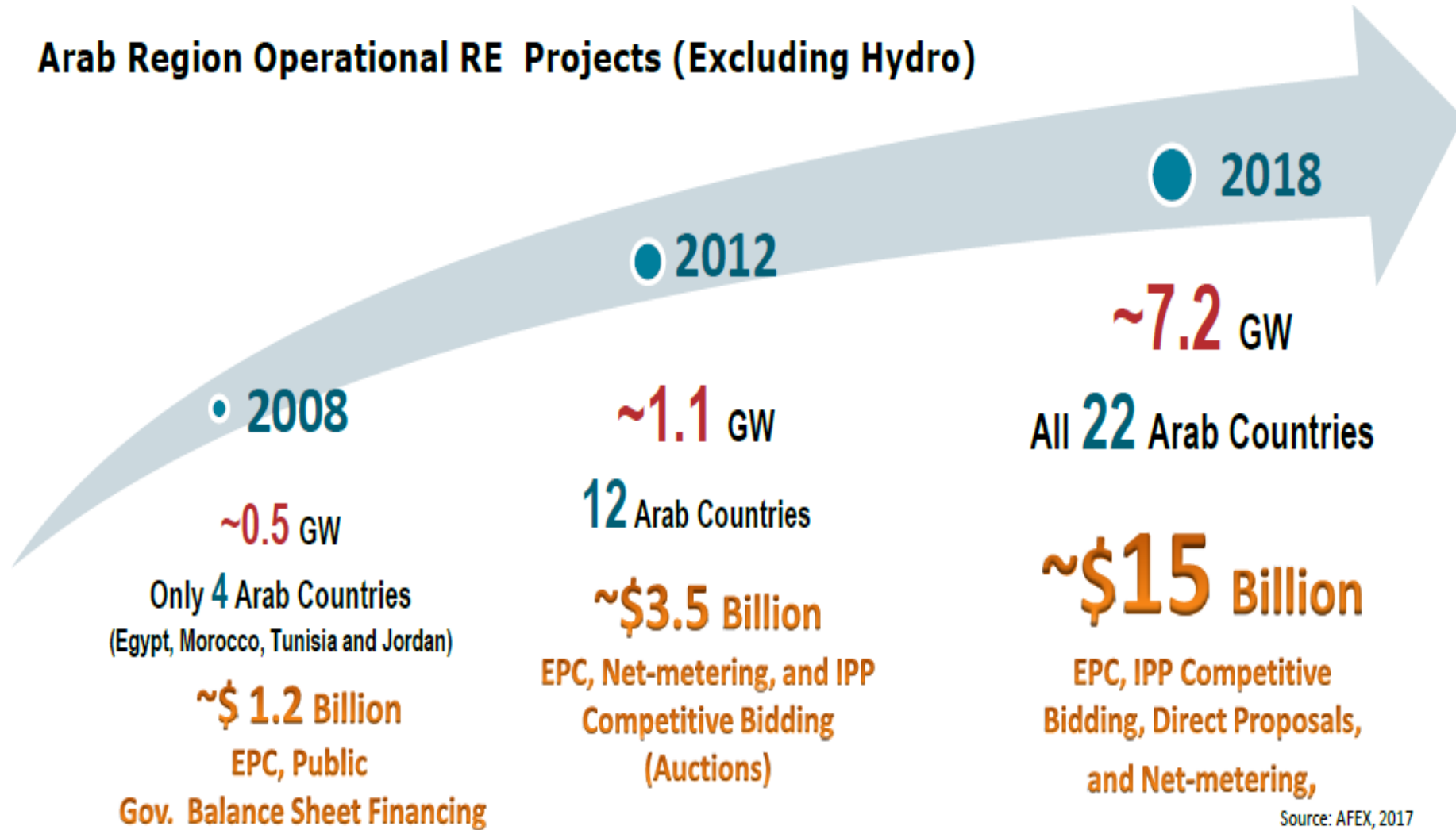
**Rim Boukhchina**  
**June 30<sup>th</sup>, 2020**

# RE Operational Capacities (Dec. 2018)



# Arab Region Progress (2008 -2018)

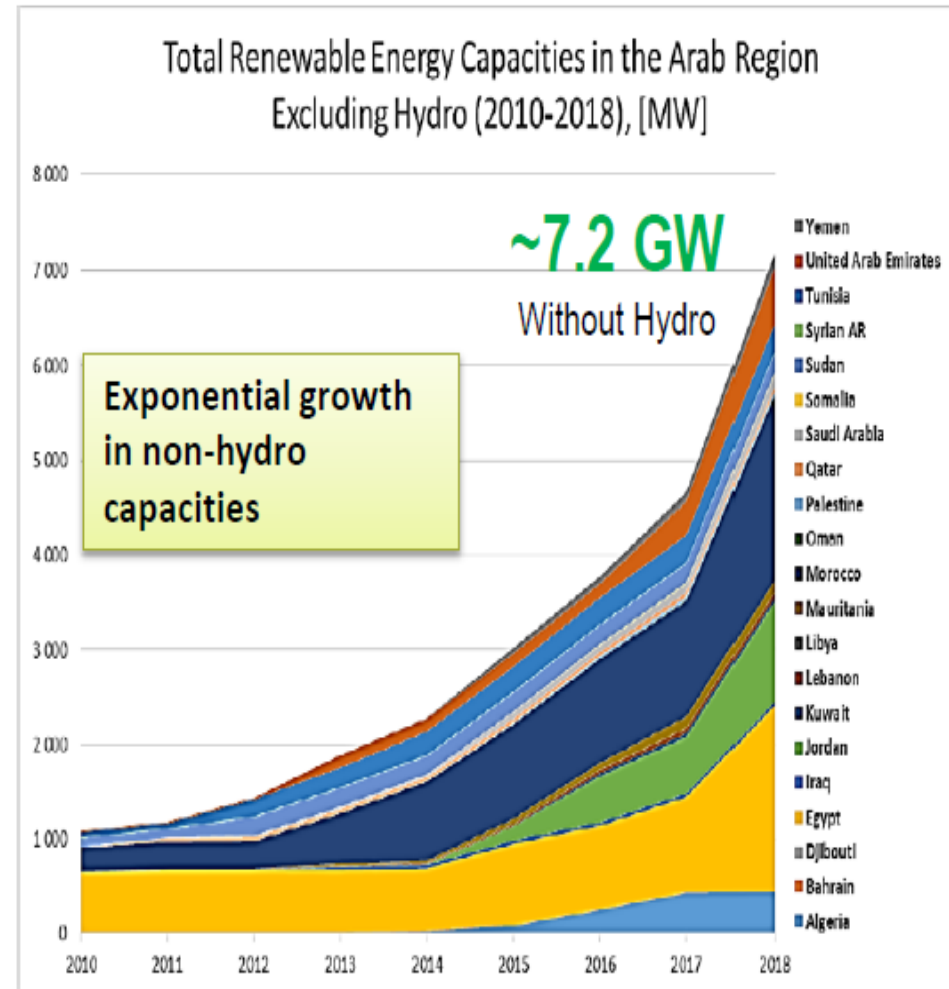
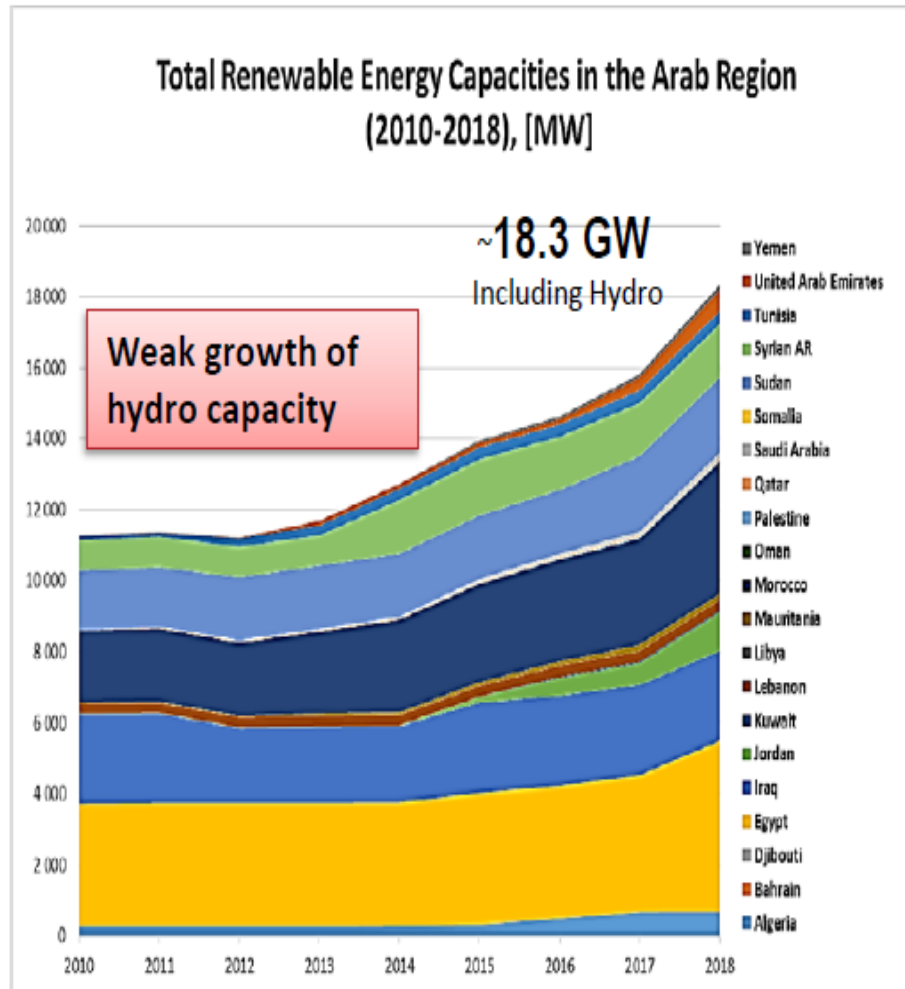
## Arab Region Operational RE Projects (Excluding Hydro)



Source: AFEX, 2017



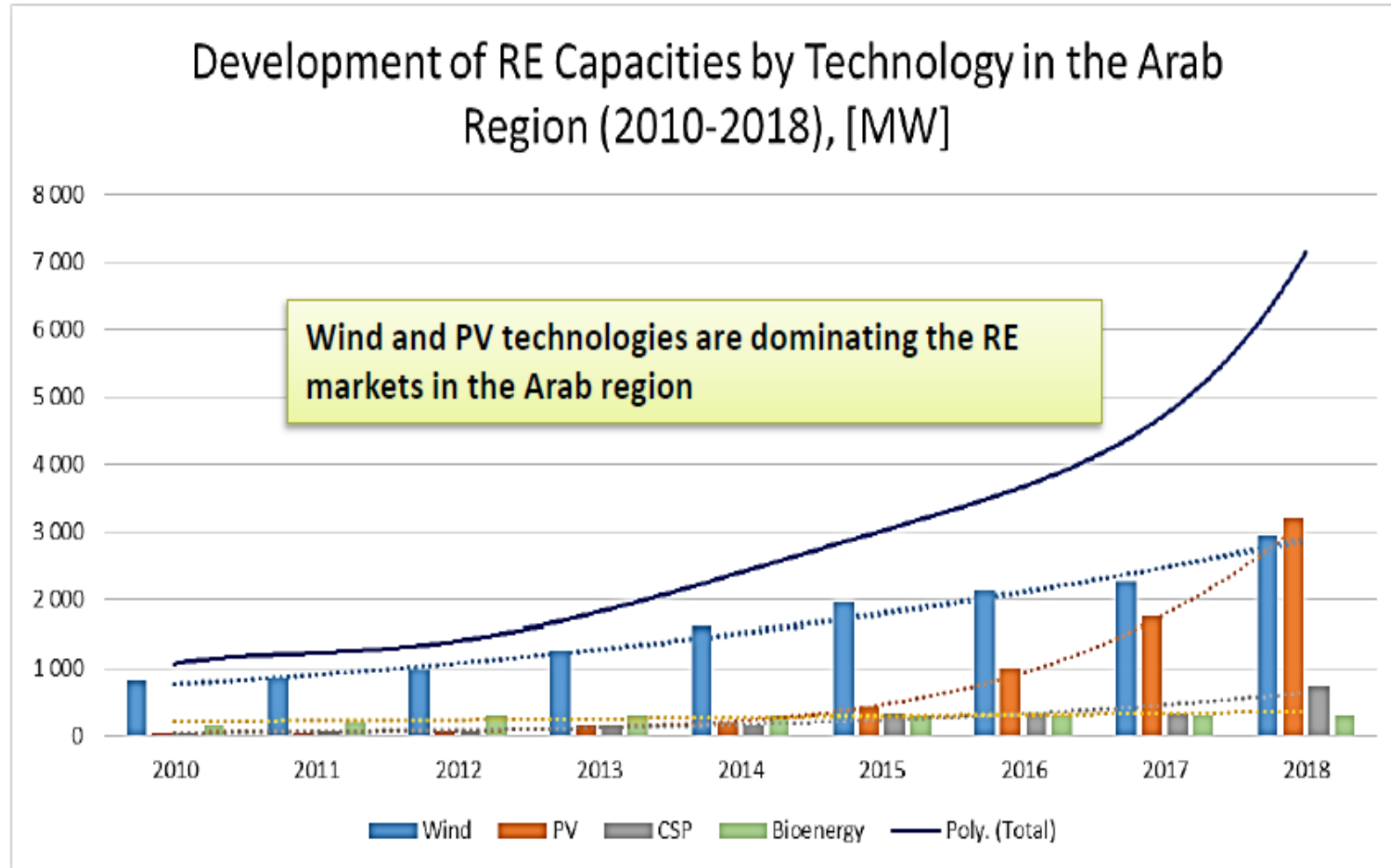
# Total RE Capacities (2010 -2018)



Source: AFEX, 2019



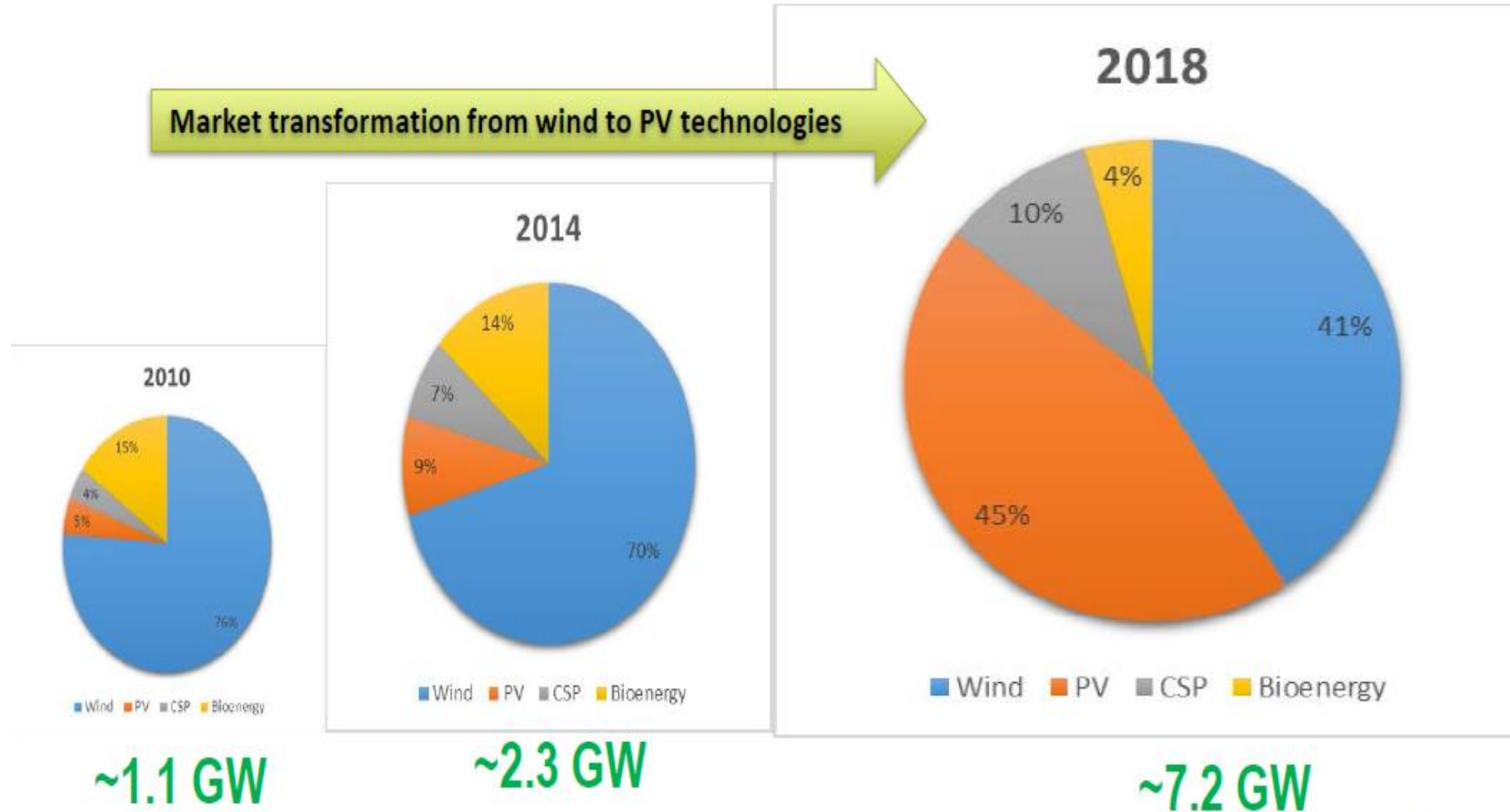
# RE Technologies Adopted in the Arab Region (2010 -2018)



Source: AFEX, 2019




# Arab Region Progress Highlights (2010 -2018)

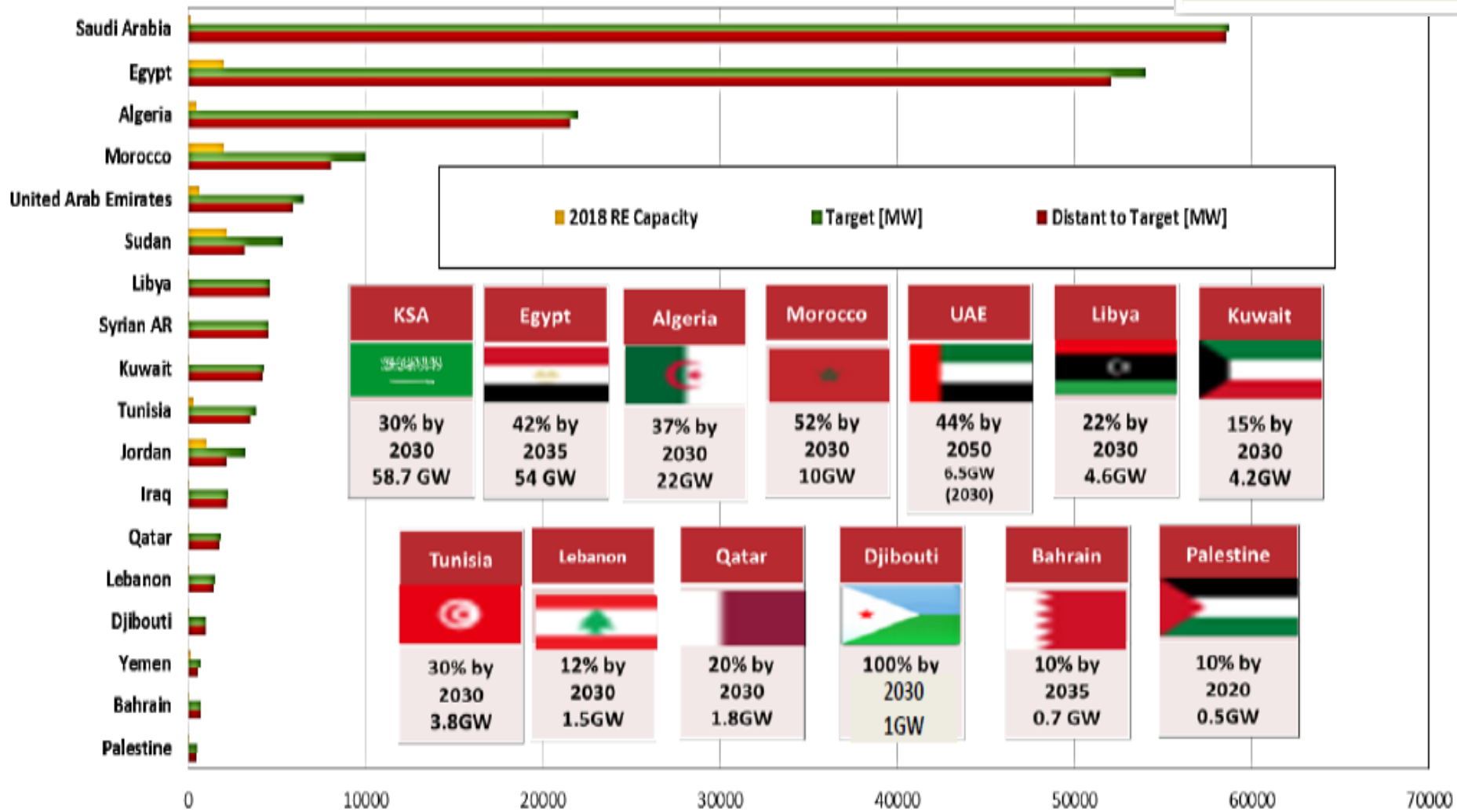


Source: AFEX, 2019

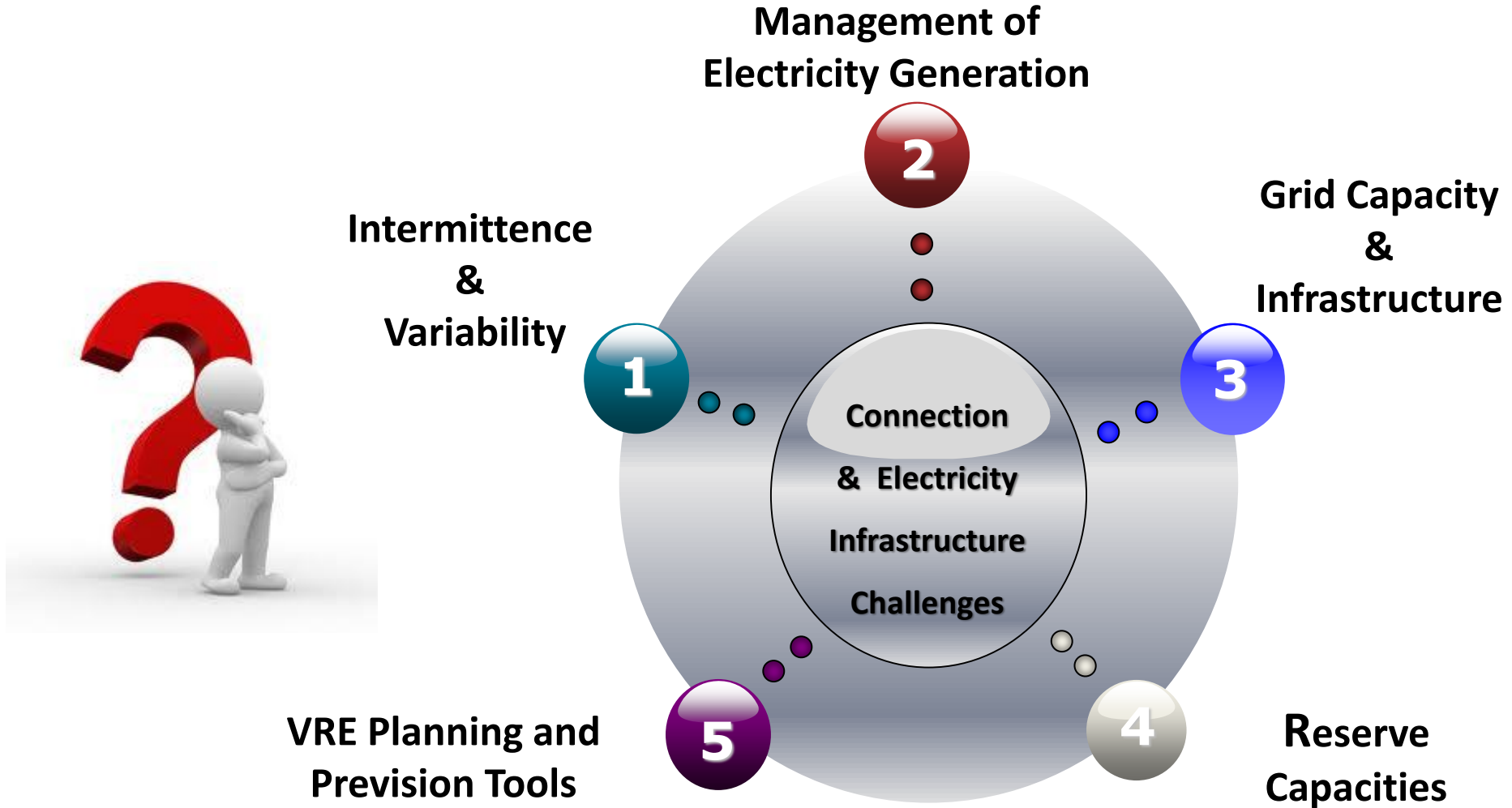
# RE Targets in the Arab Region



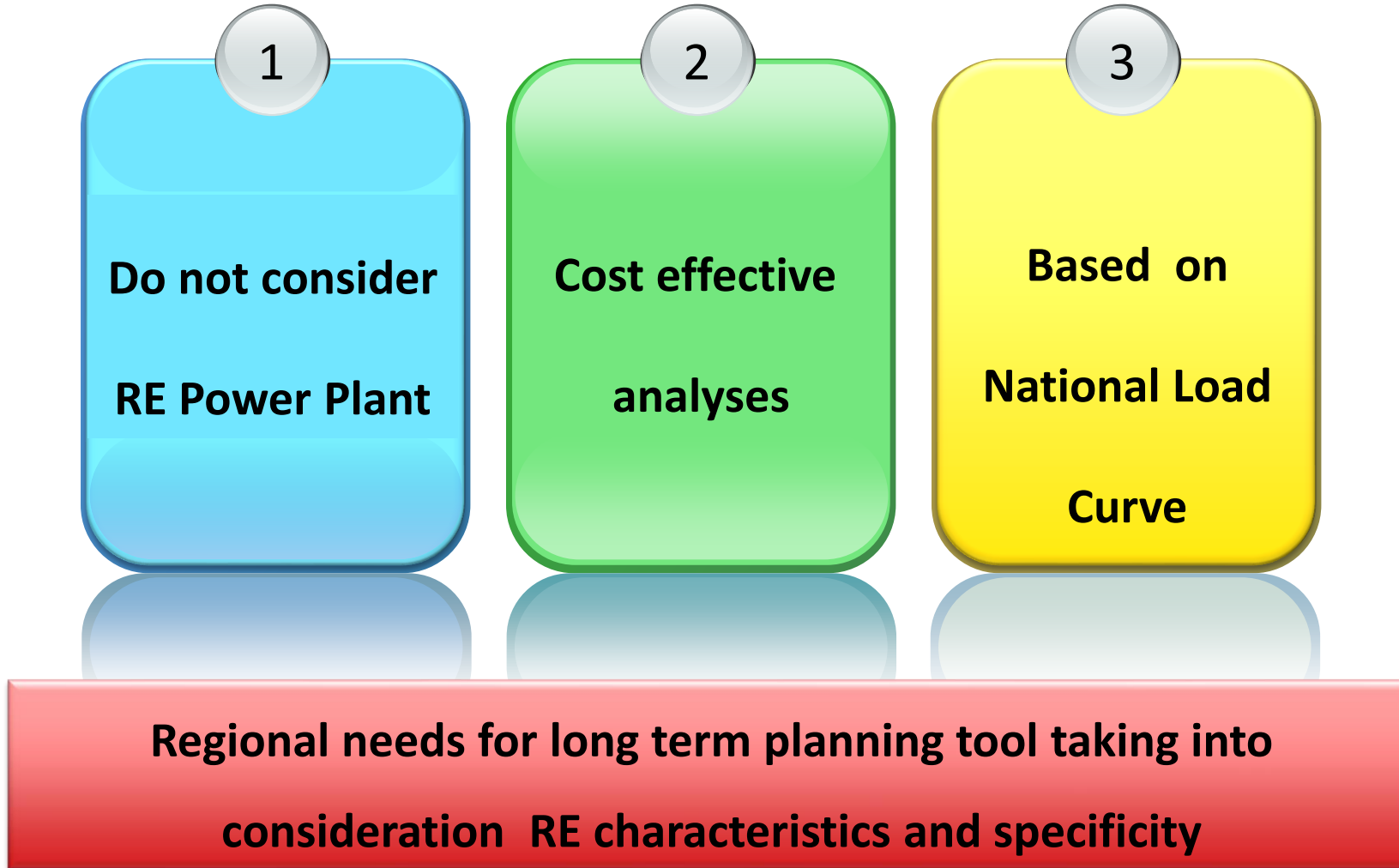
> 190 GW  
Announced targets by 2035



# RE Integration Challenges



# Existing Long-term Investment Planning Models



# Planning Challenges for RE Deployment

**Political decision for RE objectives**

**Weakness of national grid infrastructure**

**Limited interconnections between countries used basically for security basis**

**Subsidies on conventional electricity generation and high investment of RE technologies**

**Lack of Storage System (Hydro Pump-Storage, others)**

# Planning Challenges for RE Deployment

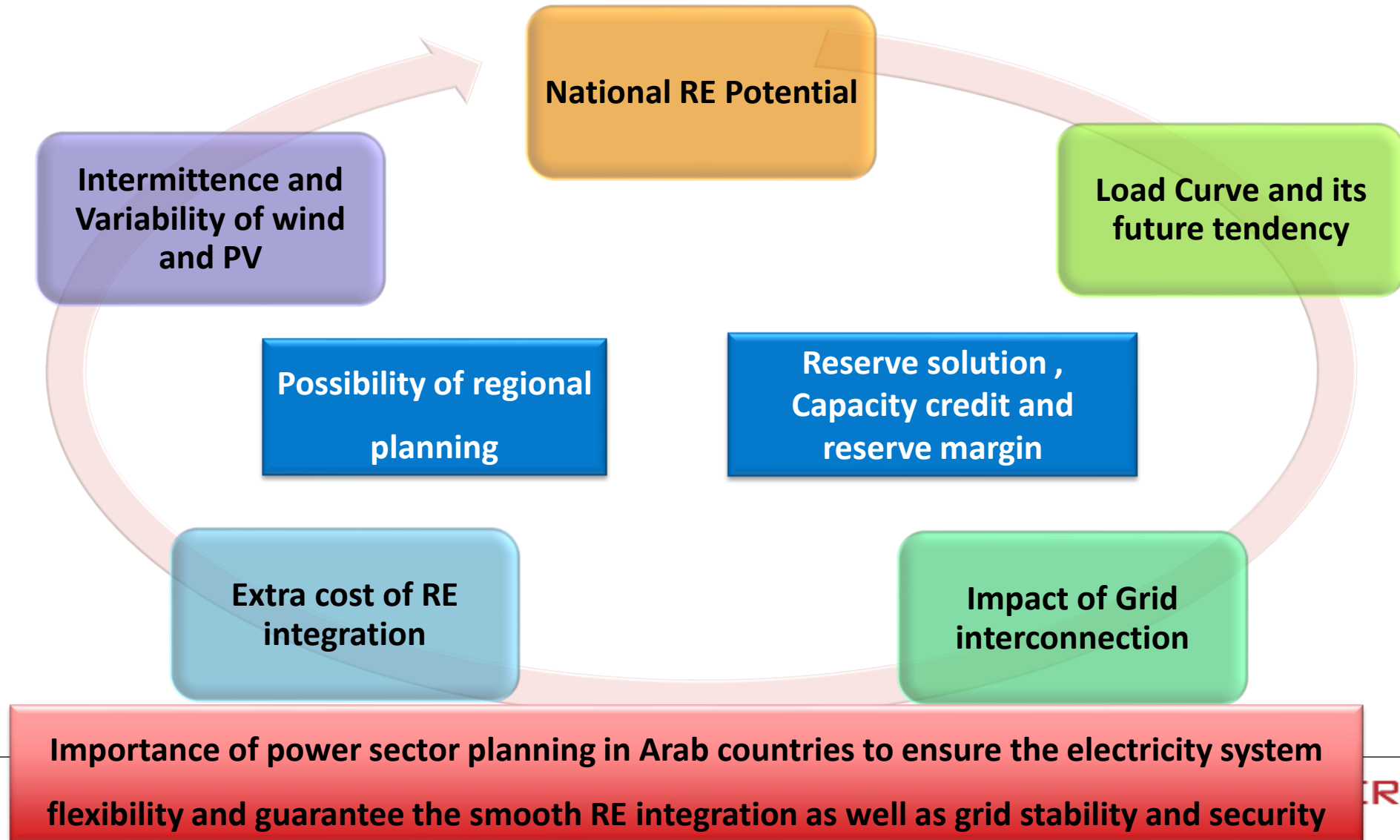
**Absence of a regional electricity market**

**Lack of RE Grid Codes in some countries**

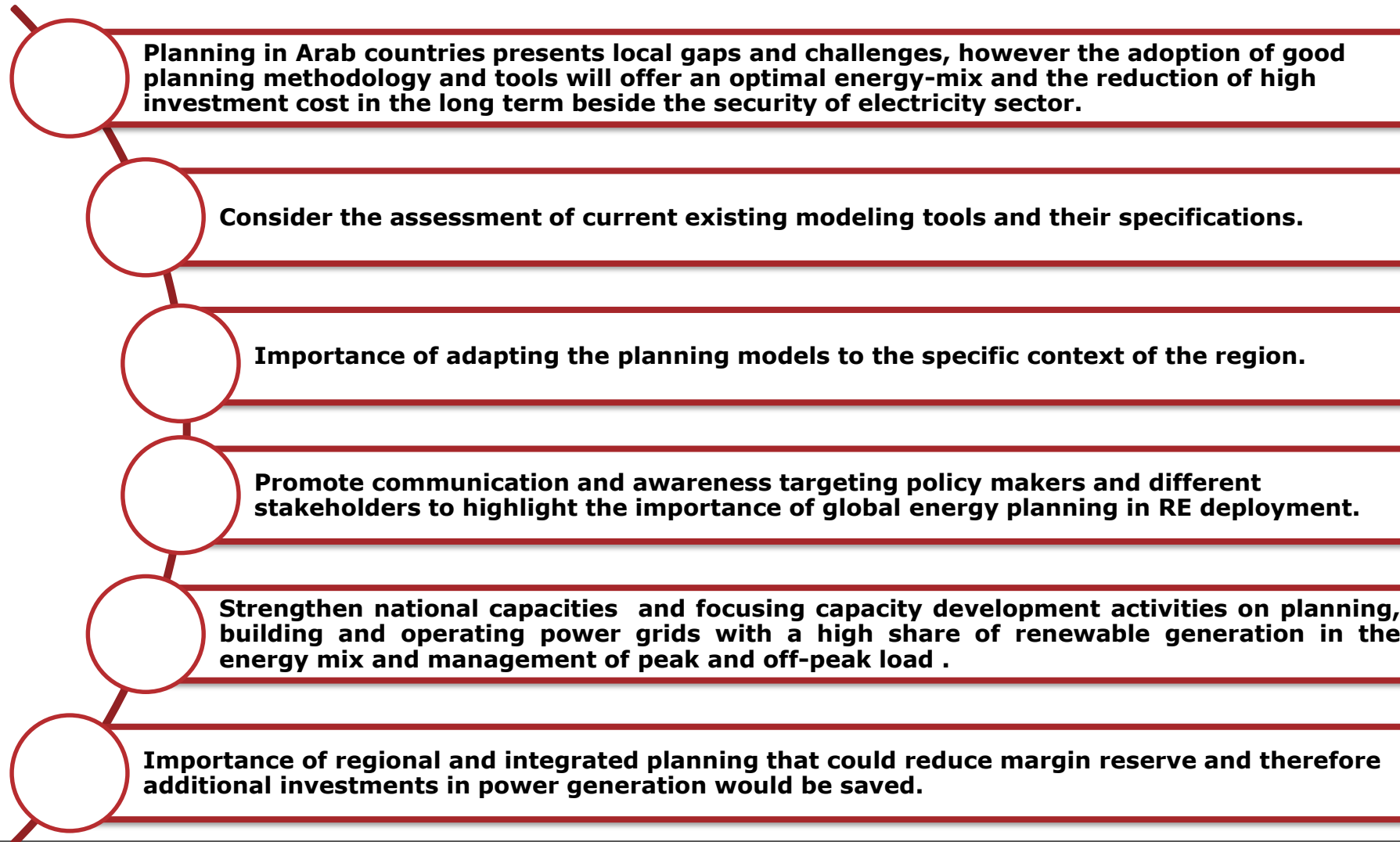
**Conventional long-term investment planning models that do not consider RE variability and intermittence**

**Lack of national and regional expertise and knowledge linked to RE long term planning and prevision of variable resources**

# Requirements for the Planning Model



# Conclusion





# Thank You for Your Attention

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**RCREEE** 

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