مدينة الملك عبد الله للطاقة
الذرية والمتجددة K•A•CARE

Building the Renewable Energy Sector in Saudi Arabia

تنشأ مدينة علمية تسمى مدينة الملك عبدالله للطاقة الذرية والمتجددة.

الأمر الملكي رقم أ/35 في 3 جمادى الأولى 1431هـ

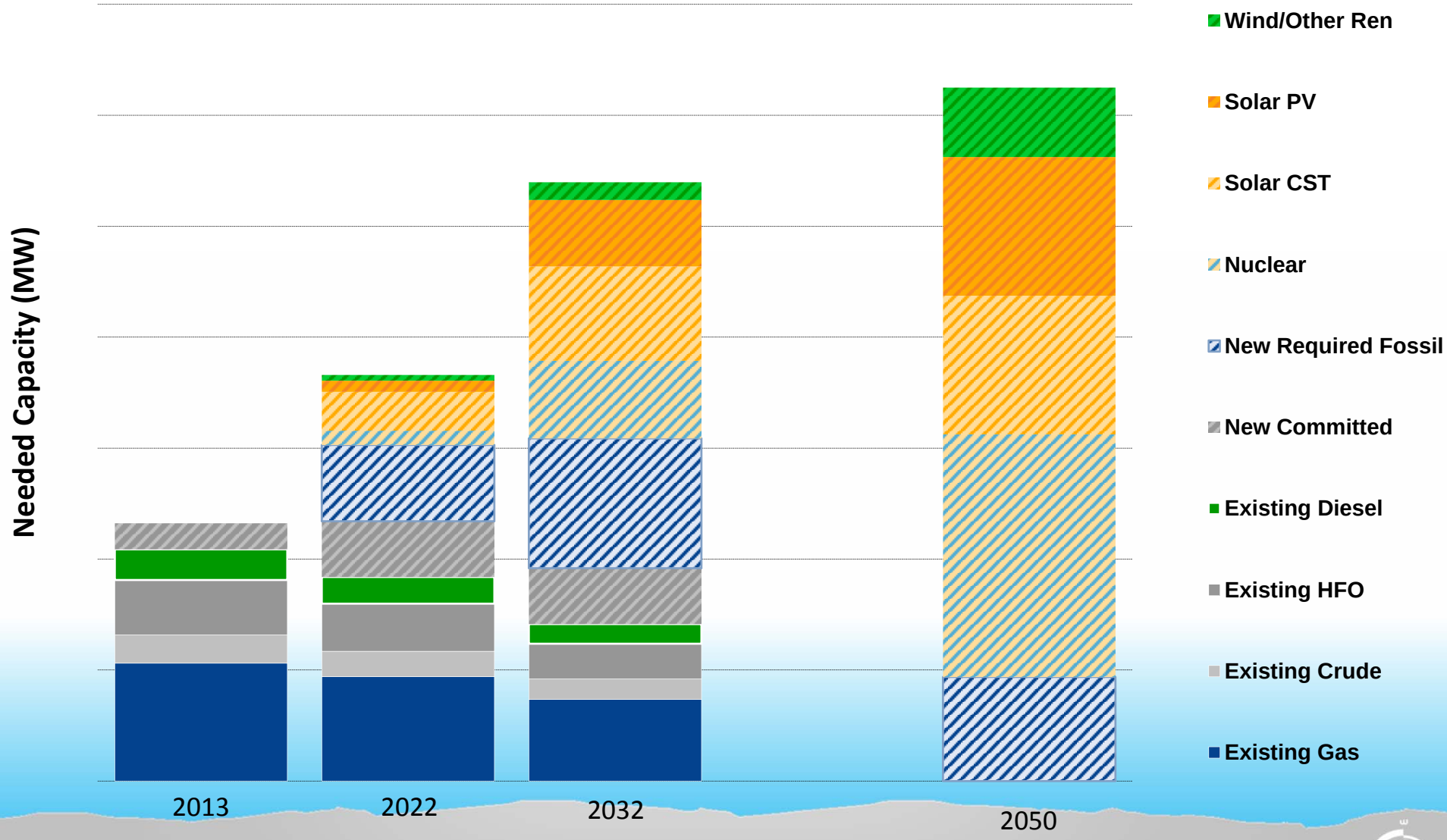
"...there shall be established a scientific city to be called, King Abdullah City for Atomic and Renewable Energy" **Royal Order No. A/35 3/5/1431 A.H.**

Target Capacity by 2032

Optimizing Energy Generation with Alternative Energy Economic Sector Development

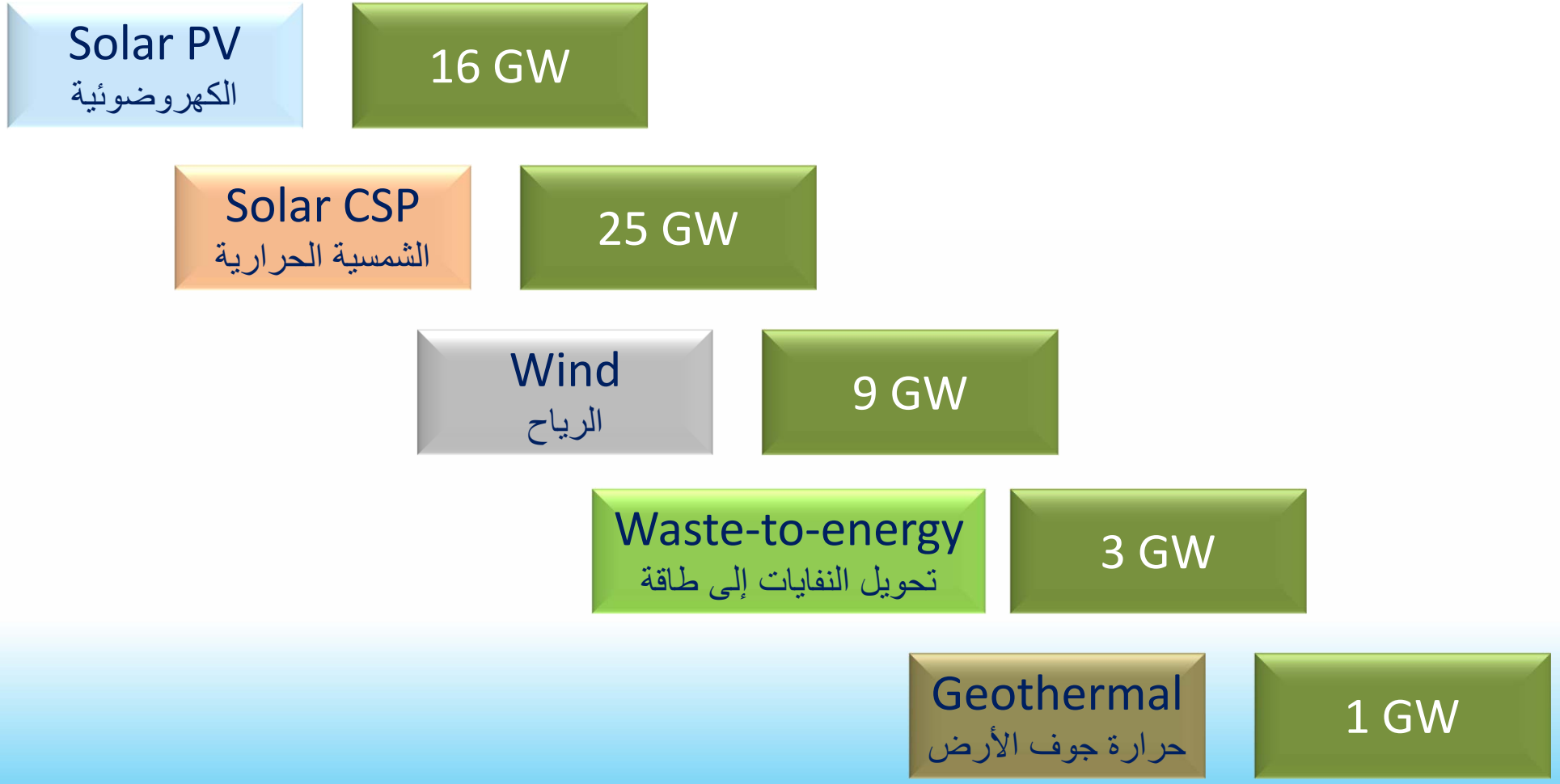
Nuclear	17 GW
Renewable	54 GW

Sustainable energy outlook for Saudi Arabia

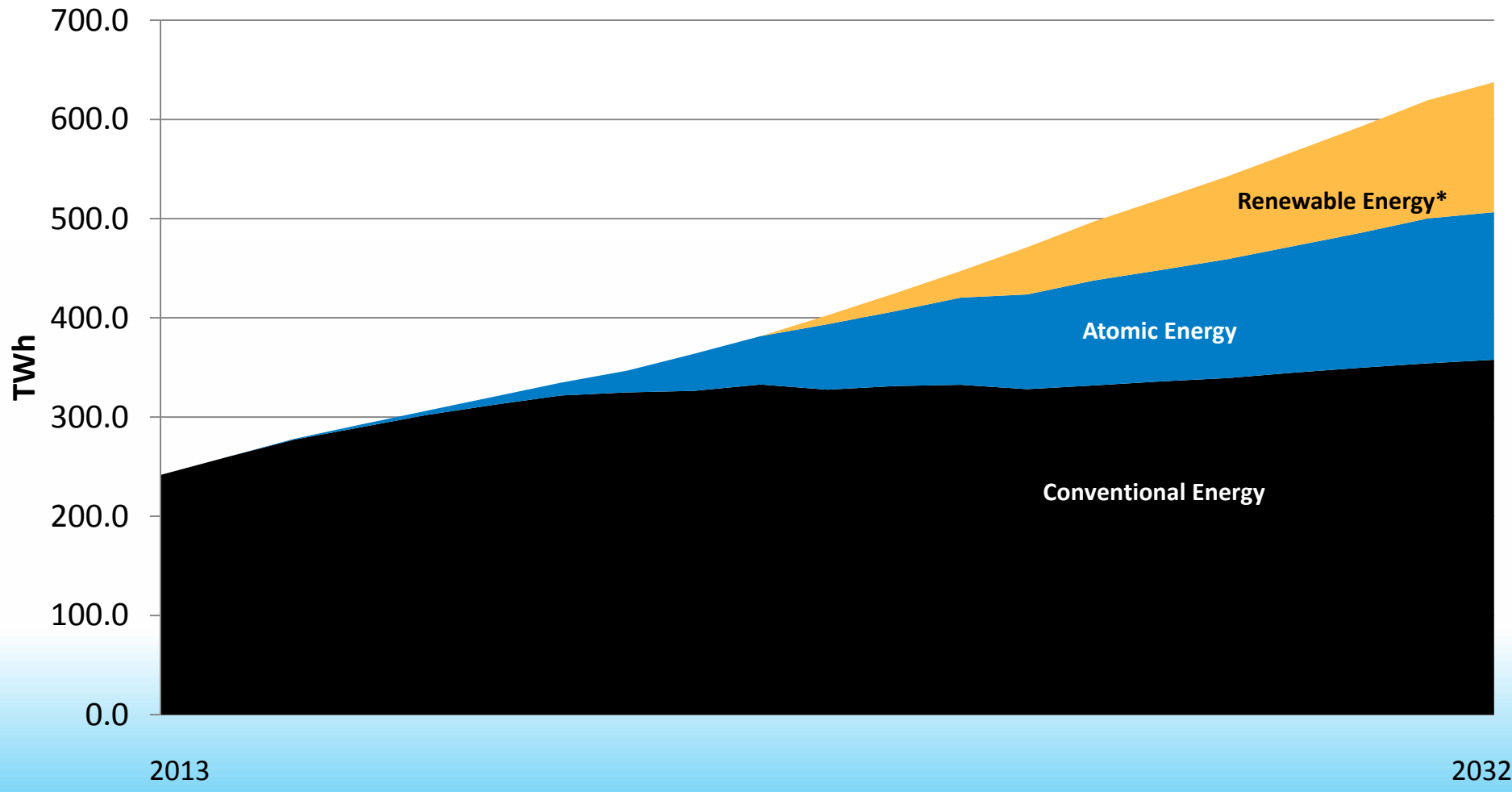


Reneweable Energy Development Targets

Target Renewable Capacity by 2032

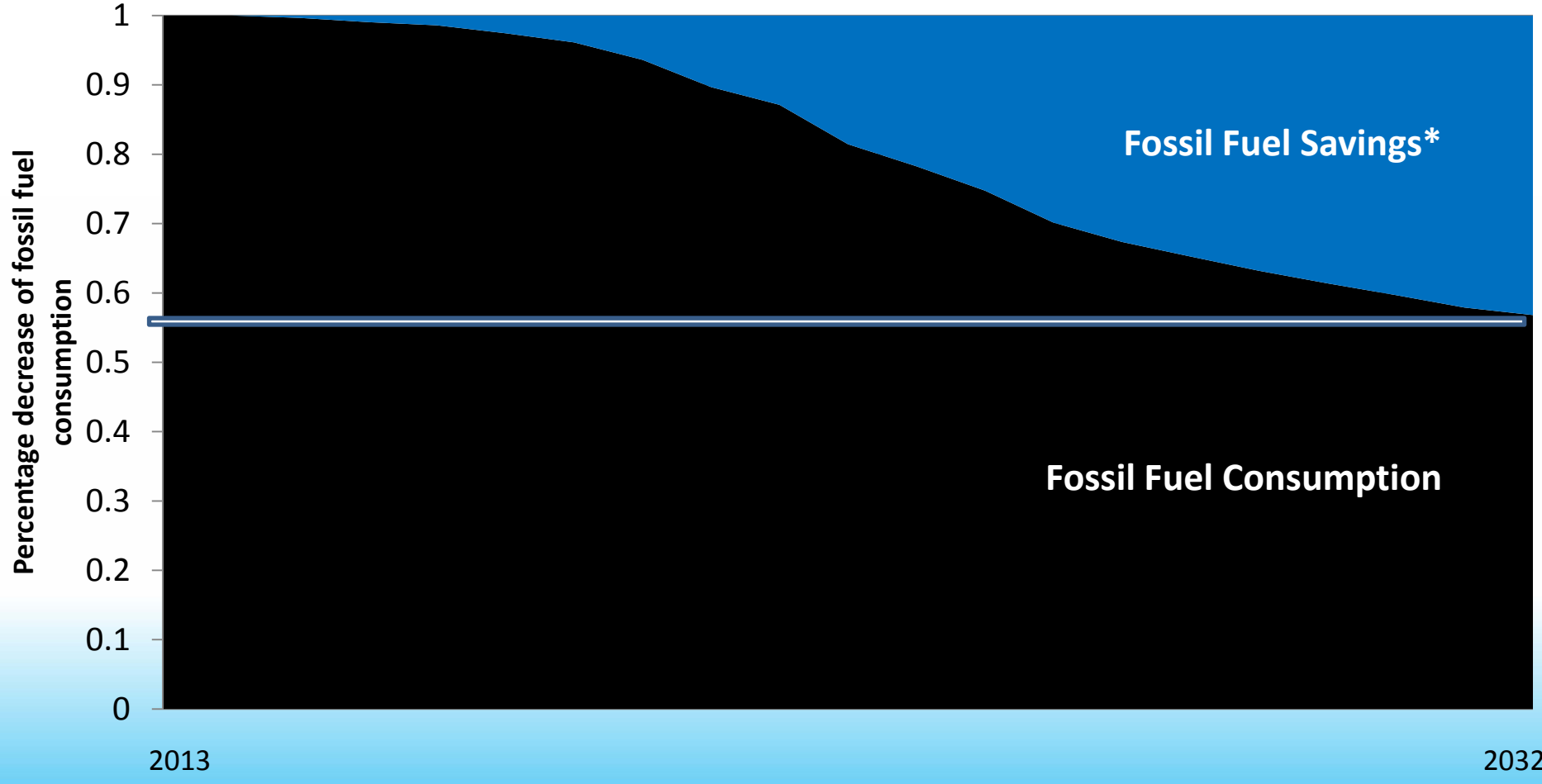


Gradual Deployment of Alternative Energy



* Load factor: PV = 0.2 , CSP = 0.34, Wind = 0.2, Geothermal = 0.9, Waste-to-energy = 0.85

Role of Alternative Energy in Reducing Fossil Fuel Consumption

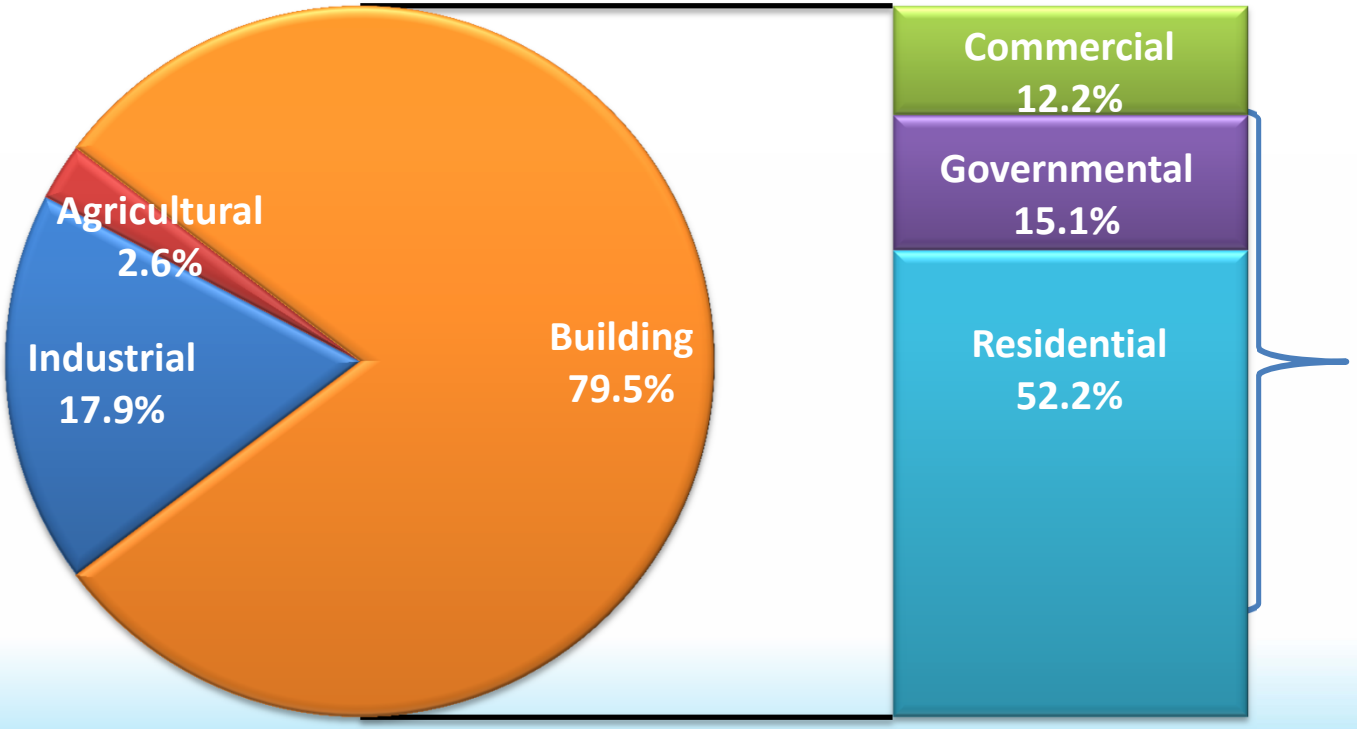


* Load factor: PV = 0.2 , CSP = 0.34, Wind = 0.2, Geothermal = 0.9, Waste-to-energy = 0.85

The Case for Alternative Energy

Energy Consumption Patterns

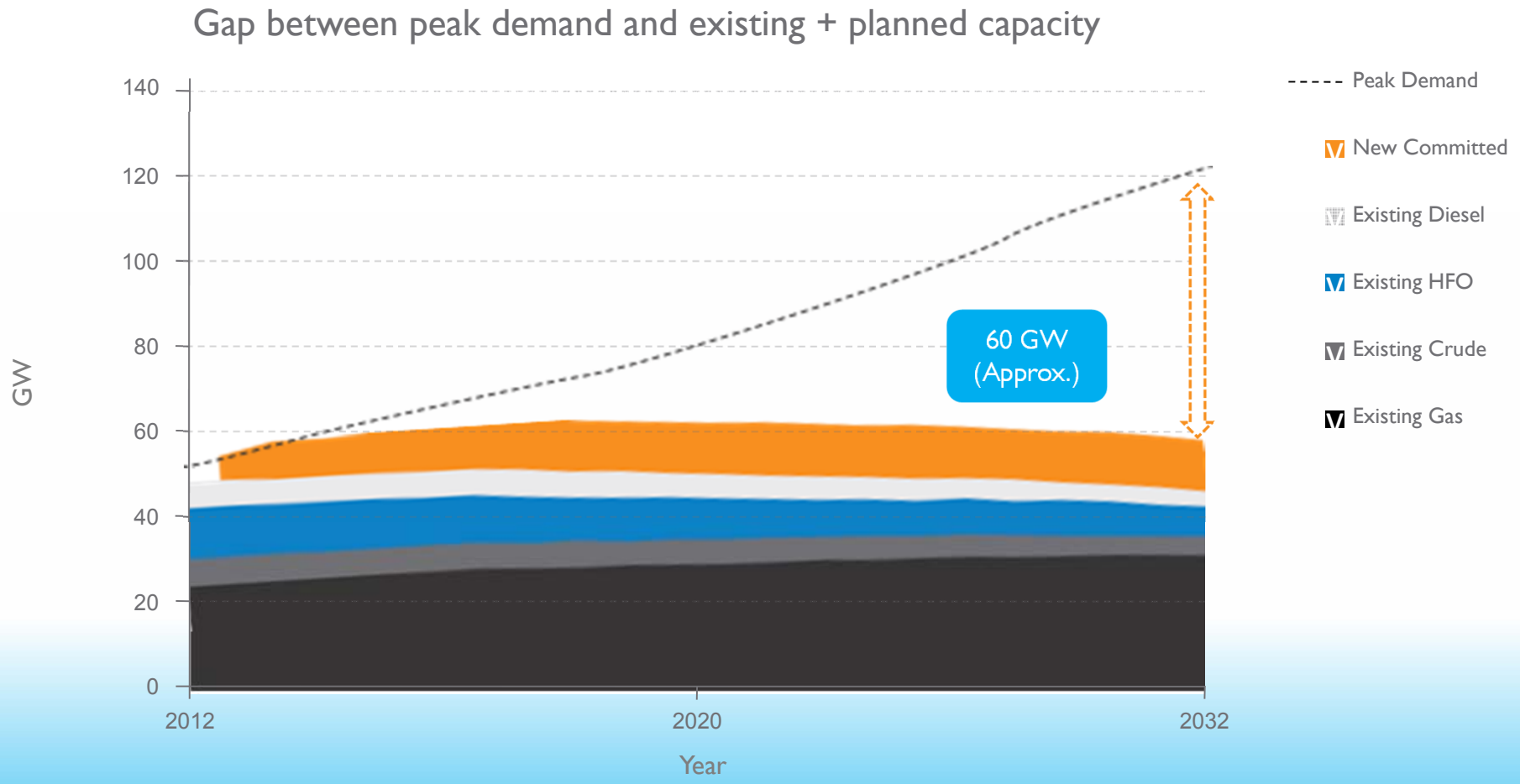
Total of 193,472 GWH



70% consumed by HVAC

Source: Saudi Electricity Company (SEC) 2009

…Creating Tremendous Capacity Gap



Business As Usual: KSA's Petroleum Demand Expected to Nearly Triple by 2032

Could impact ability to meet international oil demand

*Total local consumption (transportation, industry, electricity, etc.)

Source: Saudi Aramco 2010

Maximizing Return

Oil Saved	Economic Sector	Sustainability

How Much Can We Do ?

- Demand Growth
- Demand Pattern
- Technology Characteristics

How Much Should We Do ?

- Economics
- Sustainability
- Technology maturity

Summary of Saudi Arabia's Alternative Energy Program

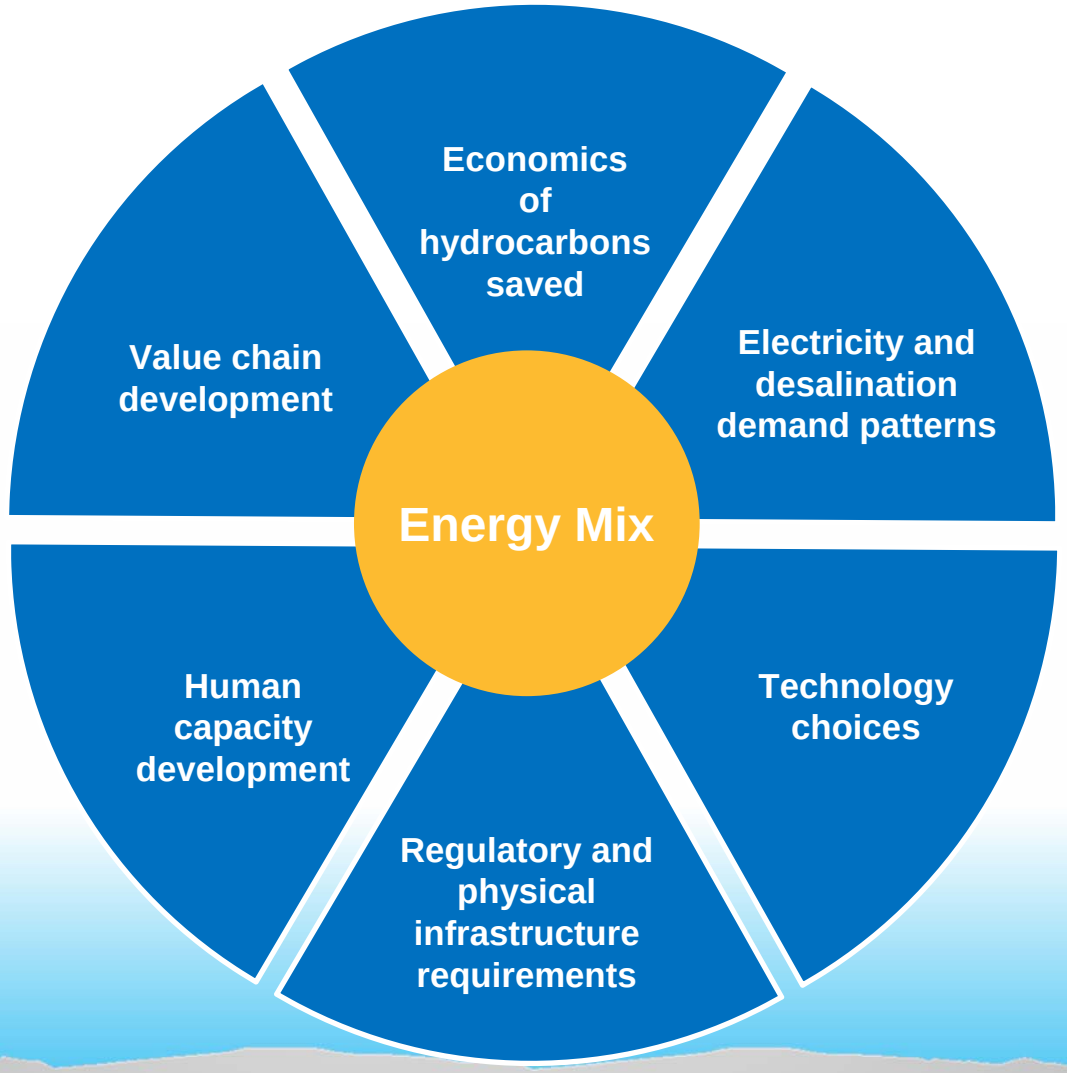
- CONTRIBUTES to a sustainable future for Saudi Arabia
- PRESERVES non-renewable fossil fuel resources
- SAFEGUARDS Saudi Arabia's international energy leadership
- ENSURES greater long-term global energy market stability
- TRANSFORMS KSA into the Kingdom of Sustainable Energy

K·A·CARE Mandate


Policies & Strategies
Execution
Regulatory
Investment & Business
R&D & Innovation
International Relations
Human Capacity
K.A.CARE City
Mandate

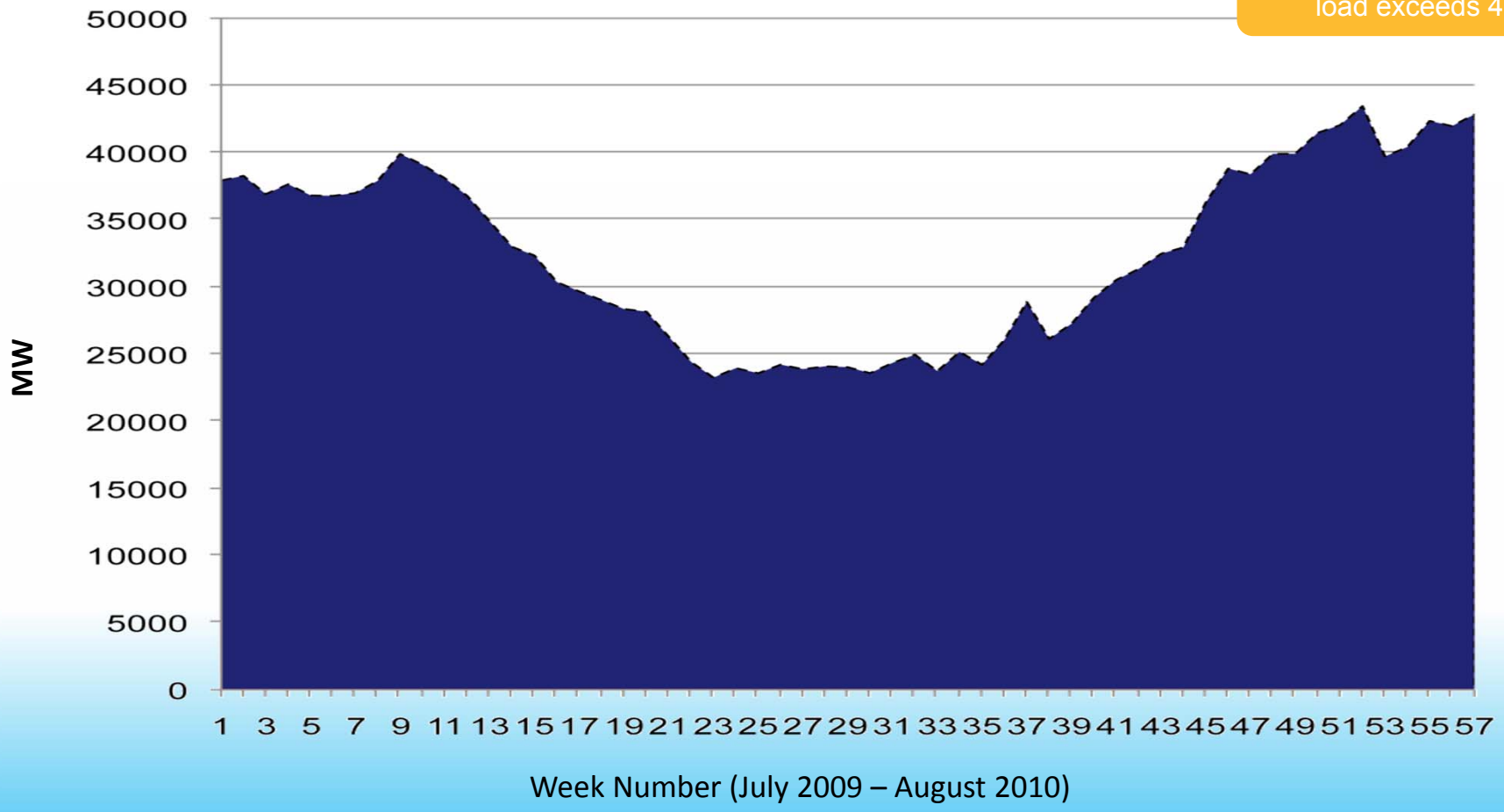
Selecting the Optimum Energy Mix

Parameters Affecting Energy Mix Development

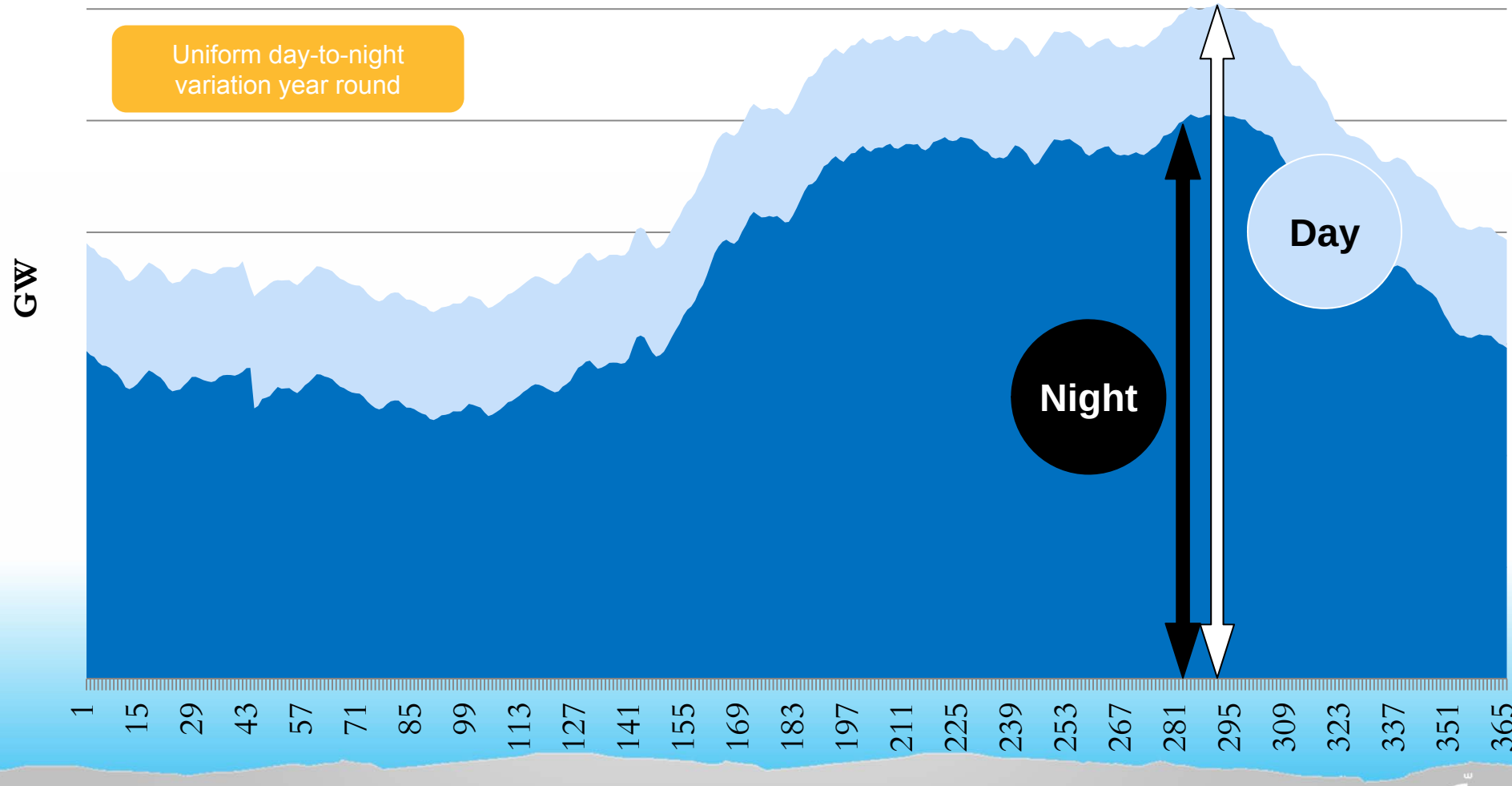


Annual Electricity Demand Pattern in KSA

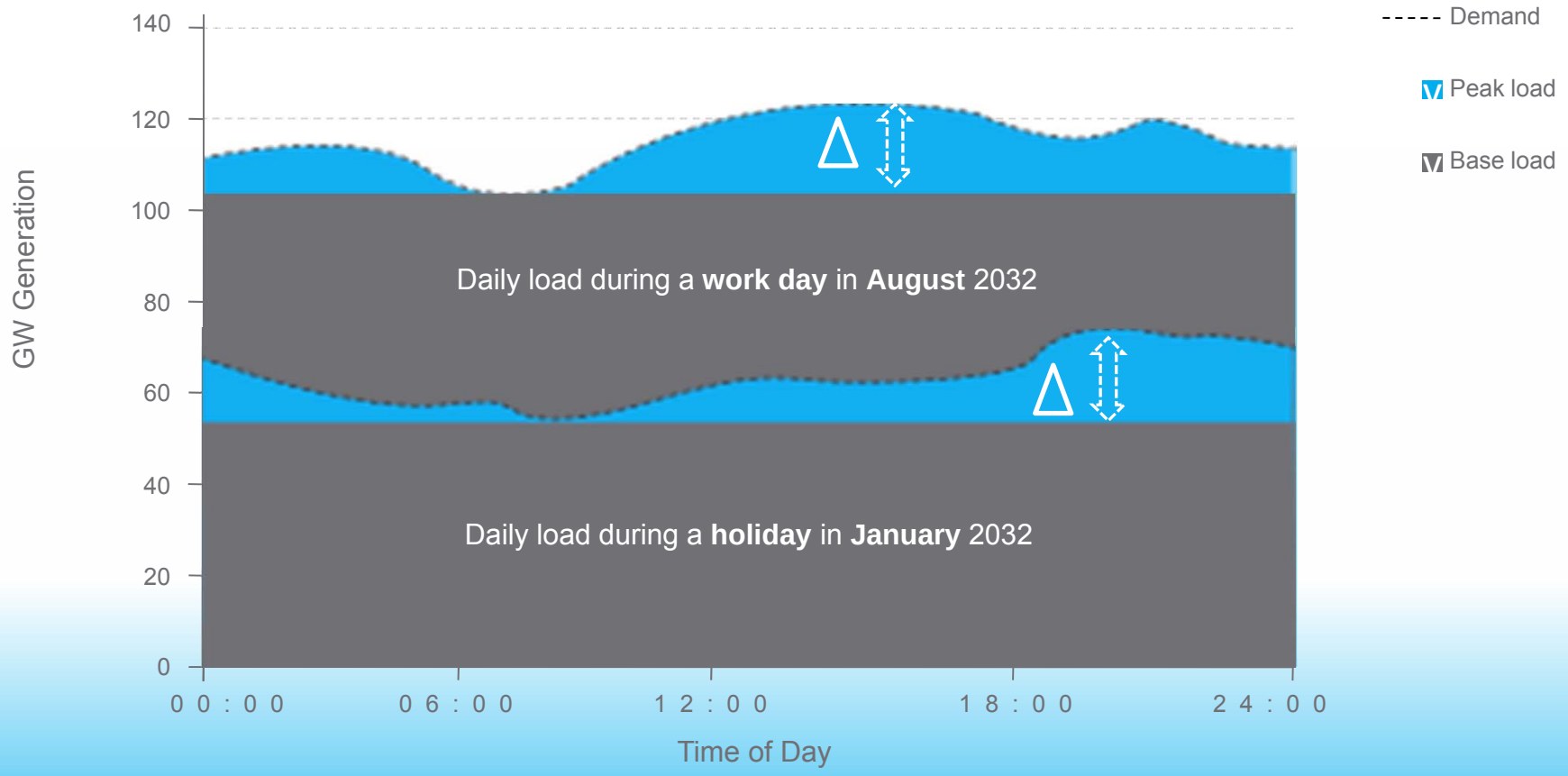
Seasonal change in peak load exceeds 40%



Day-Night Load Variation for Saudi Arabia



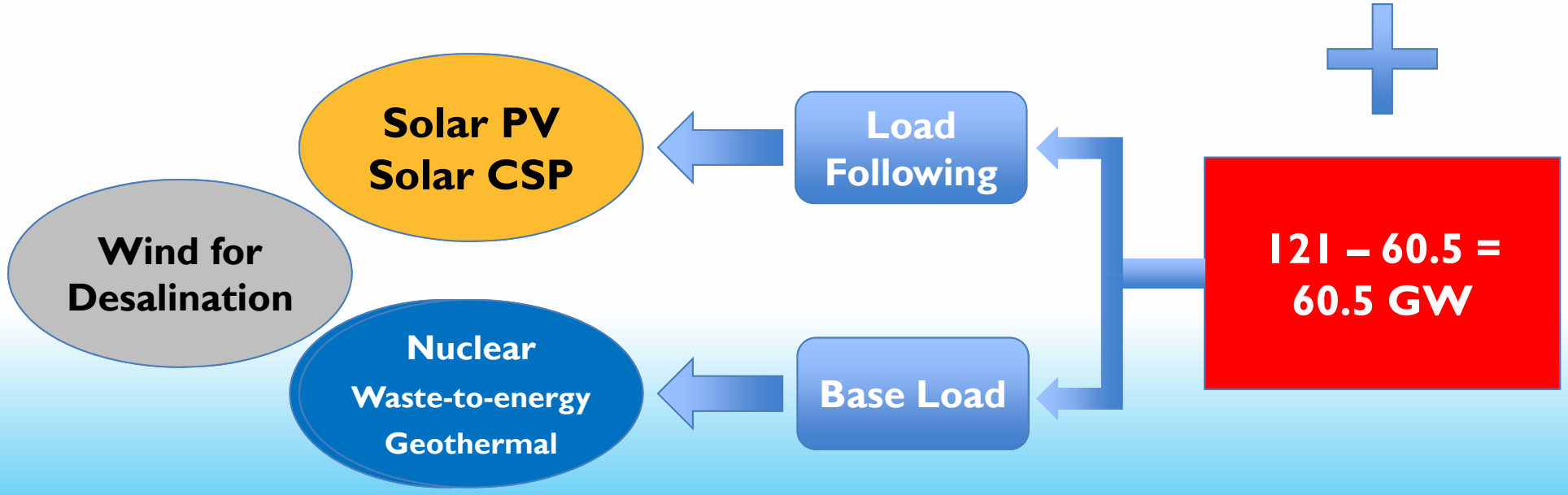
Forecasted Daily Electricity Demand Pattern 2032



Capacity Identification Using Technology – Load Matching Approach

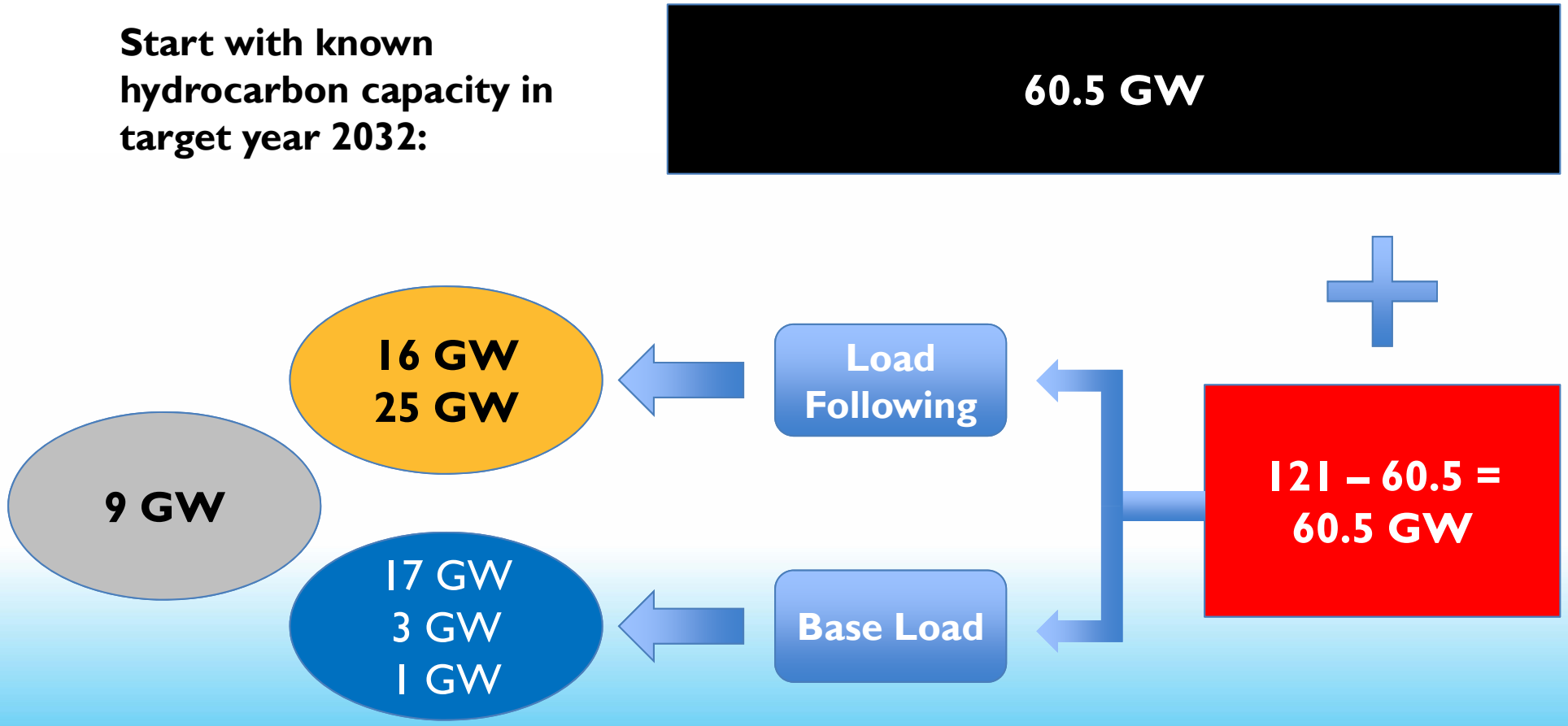
Start with known hydrocarbon capacity in target year X:

(Existing + Committed – Retiring)

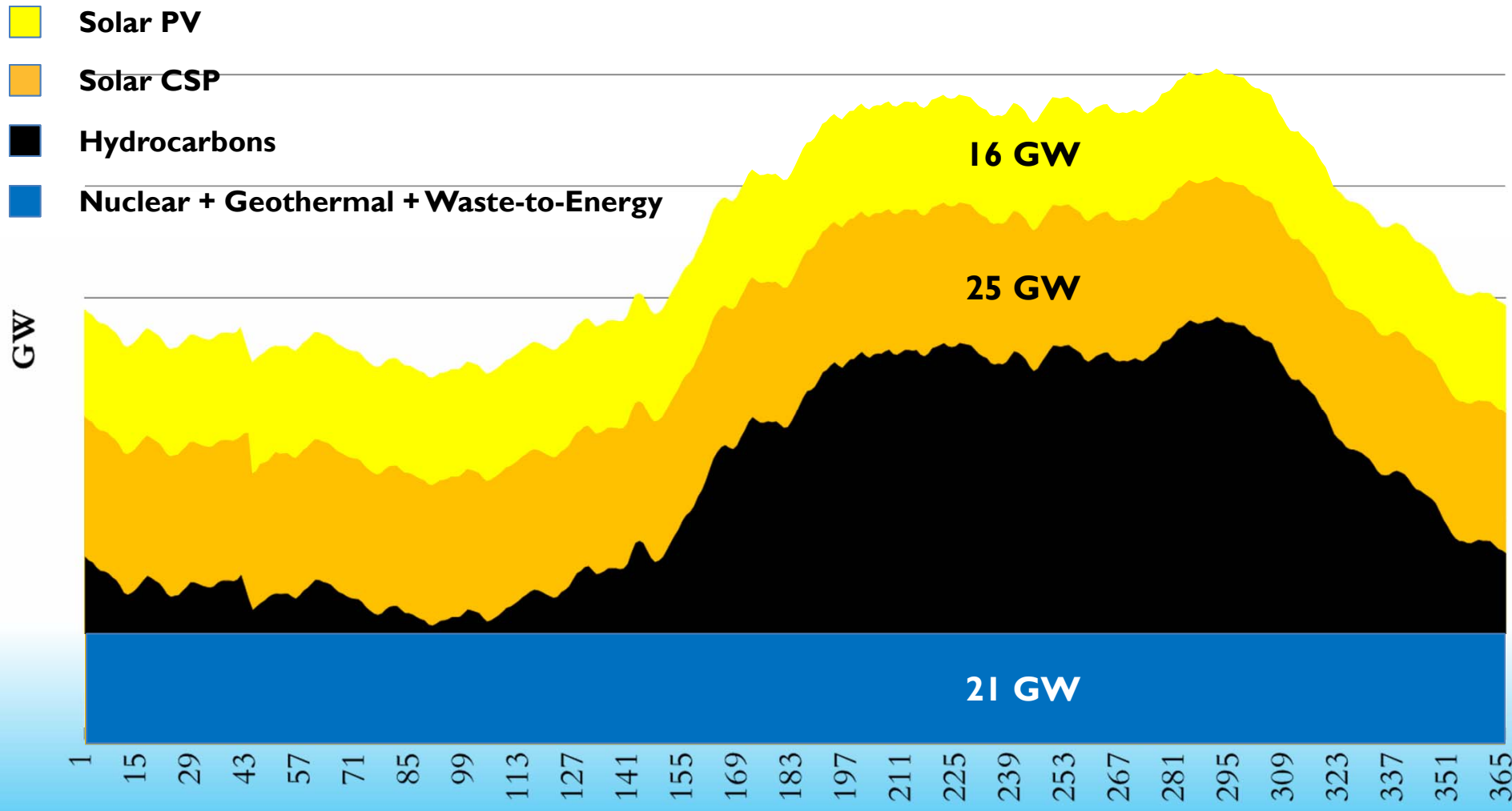


Capacity Identification Using Technology – Load Matching Approach

Start with known hydrocarbon capacity in target year 2032:



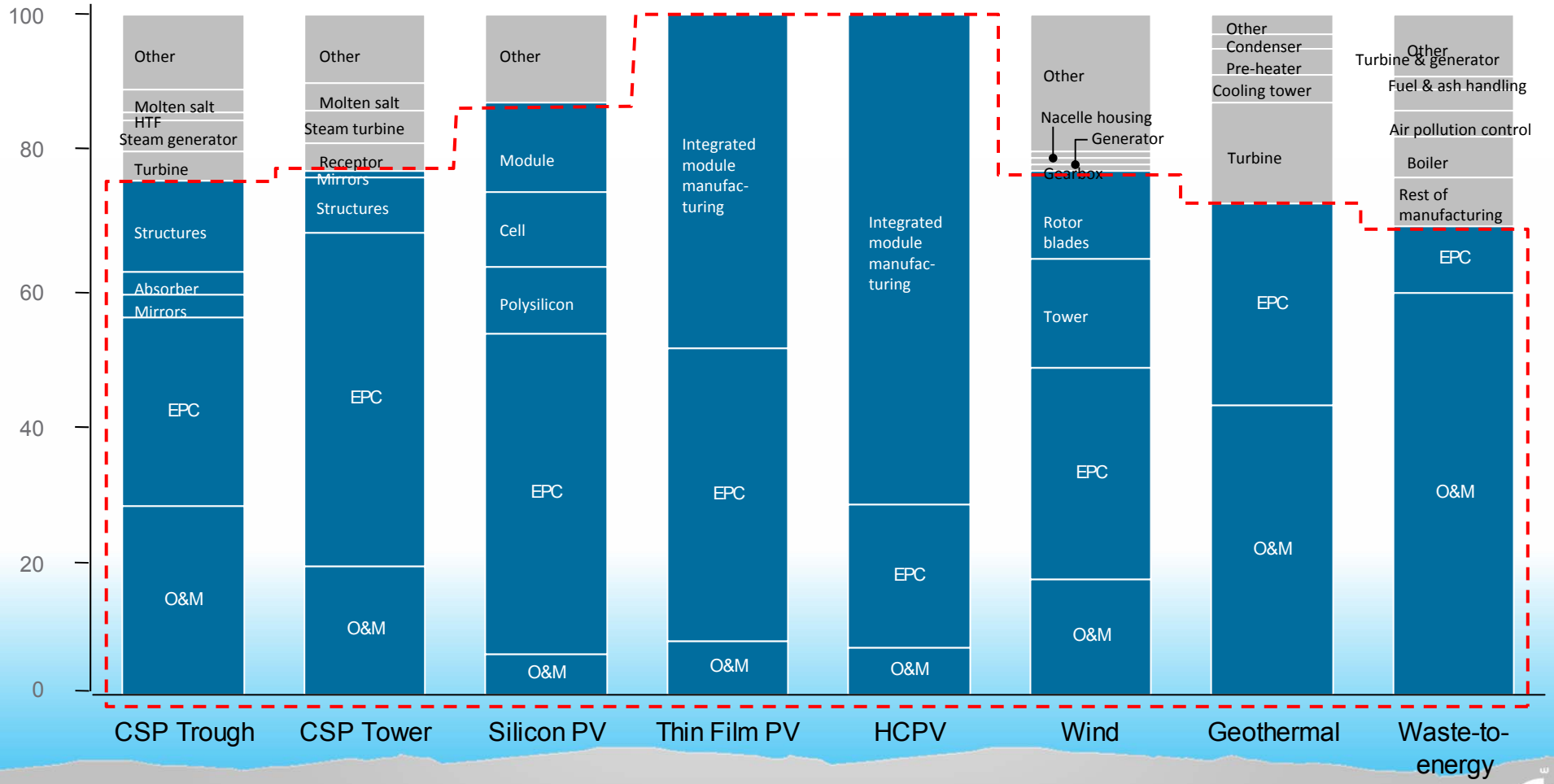
Proposed Energy Mix



Renewable Energy Value Chain Development

Manufacturing, EPC and O&M split

% total capex and opex throughout the plant lifetime



Potential RE Value Chain Components

CSP Technology	Elements
1 Trough	• Collector • Mirror • Absorber • EPC & O&M • Molten Salts • HTF • Steam turbine and generator • Storage Tank • Other power block elements • Minor elements
2 Tower	• Heliostat • Mirror • EPC & O&M • Receiver • Molten Salts • Steam turbine and generator • Storage tank • Other power block elements • Minor elements

PV Technology	Elements
3 Thin Film	• Integrated Module Factory • EPC & O&M • Inverter • Rest of balance of system
4 HCPV	• Integrated Module Factory • Tracking System • EPC & O&M • Inverter • Rest of balance of system
5 Silicon	• EPC & O&M • Poly Silicon manufacturing • Inverter • Wafer • Cell • Module • Rest of balance of system

Technology	Elements
6 Wind	• Blades • Towers • EPC & O&M • Gearbox • Generator • Power converter • Nacelle housing and assembly • Bearings • Minor elements
7 Waste-to-Energy	• EPC & O&M • Steam Turbine • Boiler • Grate • Other power block elements • Minor elements
8 Geothermal	• EPC and O&M • Steam Turbine • Heat exchanger • Condenser • Minor elements

Value Chain Development

Building a World-Class Solar Energy Sector:

Industrial investment

Research, development and innovation

Technology development

Education and training

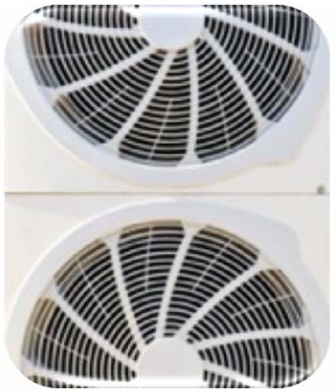
Human capacity development

Value Chain Development: Beyond the Solar Cell and the Mirror

Electricity Generation

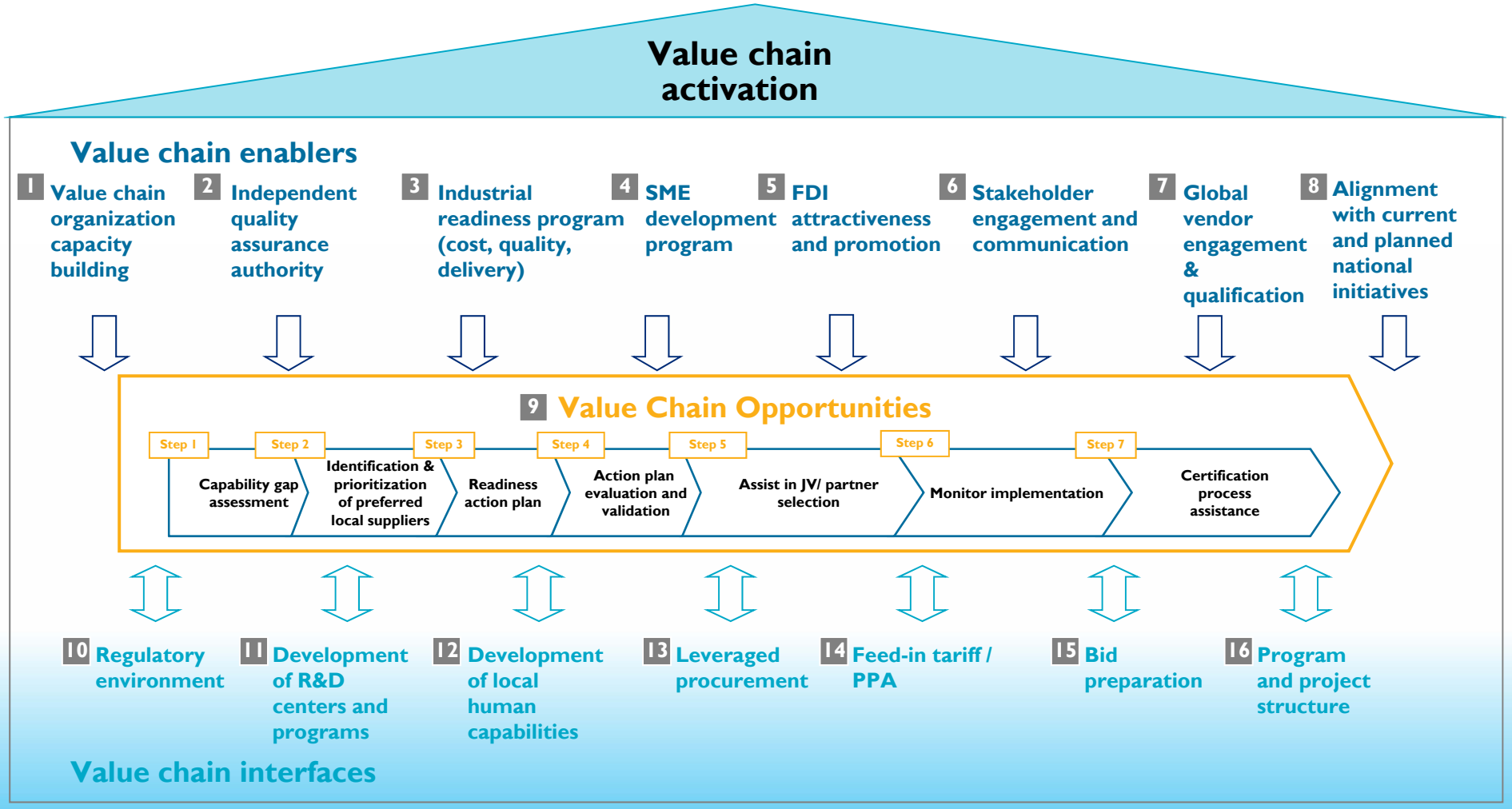
Industrial Energy Applications

Seawater Desalination & Water Management Applications



District & Solar Cooling

Value Chain Activation Plan



Socioeconomic, Environmental and Indirect Economic Impact

Potential Socioeconomic and Other Tangible Returns

Additional Returns from Alternative Energy Economic Sector Development	KPIs
Direct employment opportunities in alternative energy generation	137,000 jobs
GDP contribution from Alternative Energy employment opportunities for Saudis	USD 51 billion
Contribution to economy from export of Alternative Energy products and services	USD 40-60 billion
Reduction in CO_2 emissions from power plants	60%
Reduction in NOx emissions from power plants	75%
Reduction in SO_2 emissions from power plants	70%
Potential cross-border and intercontinental energy export (renewables)* during off-peak season	10-30 GW

* DESERTEC Industrial Initiative (DII)

The Road to Successful Implementation

Alternative Energy Deployment Roadmap

Atomic Energy

Site and technology selection

1st Concrete pouring

1st reactor connected to grid

7 reactors connected to grid 9.6 GW

12 reactors connected to grid 17.6 GW

2013 2017 2022 2027 2032

Renewable Energy

1st RE Project

2.35 GW

1.05 GW

17.35 GW

6.5 GW

28.4 GW

10.8 GW

41.1 GW

13 GW

The Kingdom of Sustainable Energy

Thank You