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

Synthesis of grid impact project

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Oct. 2014

Highlight

- K.A.CARE has been collaborating actively with key stakeholders (SEC, ECRA, MoWE, NGSA) towards the future integration of renewables
- 3 major pillars are essential to build an economic, reliable, stable and sustainable system: regulation, planning and operation
- System regulation - On Sep 10th, the GCSC[1] approved the amendments to the grid enabling the integration of renewables
- System planning and operation - We believe the introduction of renewable will satisfy all planning and operation criteria
  - A study conducted by K.A.CARE[2] demonstrated that the integration of renewables will not jeopardize the system reliability
  - Planned SEC upgrades will allow the integration of ~14 GW renewables in the grid by 2020
  - K.A.CARE adopted a renewable-mix to minimize the effect of intermittencies on the system
  - Conventional units will have sufficient dispatch flexibility in winter and summer to maximize the output of renewables while maintaining the system stability and reliability
- The introduction of renewables and the multiplication of players in generation will require the creation of an independent entity to coordinate renewable plants and support the system operators
- K.A.CARE has initiated further collaboration with key stakeholders to develop the SSECC[3]

1 Grid Code Supervisory Committee
2 K.A.CARE's grid impact project
3 Saudi Sustainable Energy Control Centre

KA CARE has been collaborating actively with key stakeholders towards the future integration of renewables

MoWE

- MoWE has clarified the broader KSA **electricity context and law**
  - International connections plans
  - Other long term plans

ECRA

- ECRA has clarified the **regulation framework**
  - Grid code
  - Costs allocation mechanism
  - Connection process
  - Market rules[1]

KACARE grid impact project

SEC

- SEC has explained the **system planning** information and requirements
  - Generation Planning
  - Transmission Planning
  - Planning methodologies and criteria
  - System modelling
  - Connection studies

National Grid SA

- NGSA has described the **system operation** and its requirements
  - Grid operation
  - Generation operation
  - Control center functions
  - Scheduling processes
  - Markets operation

1 ECRA study; Development of a Roadmap for a National Electricity Market in KSA

3 major pillars are essential to build an economic, reliable, stable and sustainable system

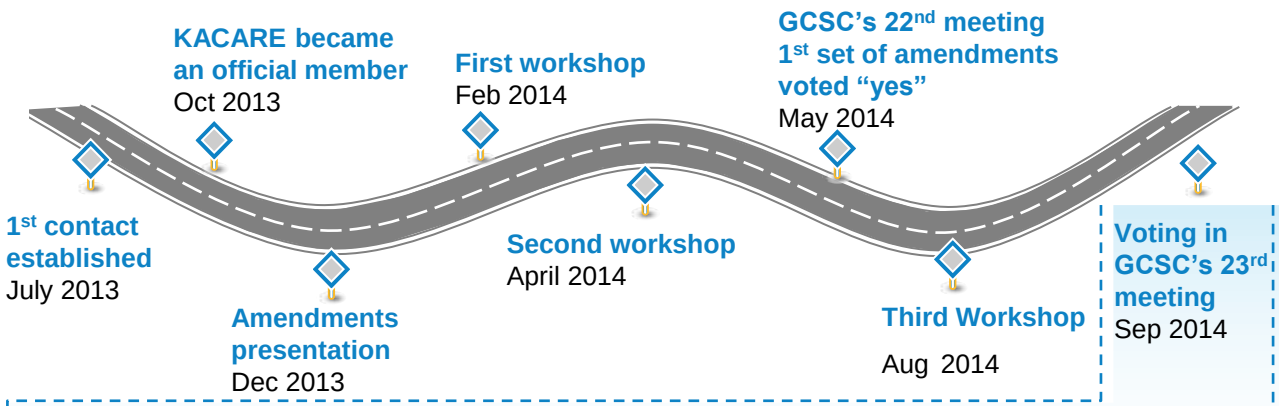
	Description	Status toward introduction of renewables
 **System Regulation**	▪ Set of rules governing the sector – Grid code – Cost allocation mechanism – Connection process	▪ Critical amendments to the grid codes were voted in Sep. 2014 enabling the future introduction of renewables ▪ An active working group with ECRA has been created to follow-up progress of system regulation
 **System Planning**	▪ Long term vision of sector development – Generation mix adequacy – Transmission security	▪ Technical study regarding effect on renewable on system planning and operation finalized ▪ An active working group with SEC has been created to follow-up on system planning
 **System Operation**	▪ Day to day management of the system – generation flexibility – Grid operations	▪ An active working group with NGSA has been created to follow-up on system operation

On Sep 10th, the GCSC approved the amendments to the grid code enabling the integration of renewables

Why modifying the grid code?

- The grid code defines **obligations**, **responsibilities**, and **accountabilities** of all the parties towards ensuring **open**, **transparent**, non-discriminatory, and **economic access and use** of the grid while maintaining its safe, reliable, and efficient operation
- It was initially drafted for conventional units only, i.e. some clauses:
  - are irrelevant for renewables
  - will generate additional costs to renewables

Introduction of new amendments



On Sep 10th, the 2nd set of Amendments proposed by KA CARE were approved

8 institutions
14 votes

- All sets (+20) amendments have been unanimously voted YES.

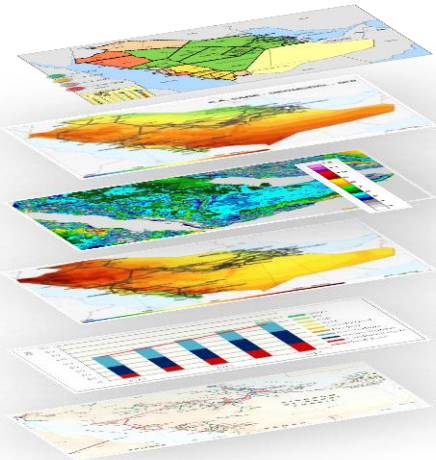
"This is a milestone, it has been a very long time that we haven't all agreed on so many new amendments"

– Voter

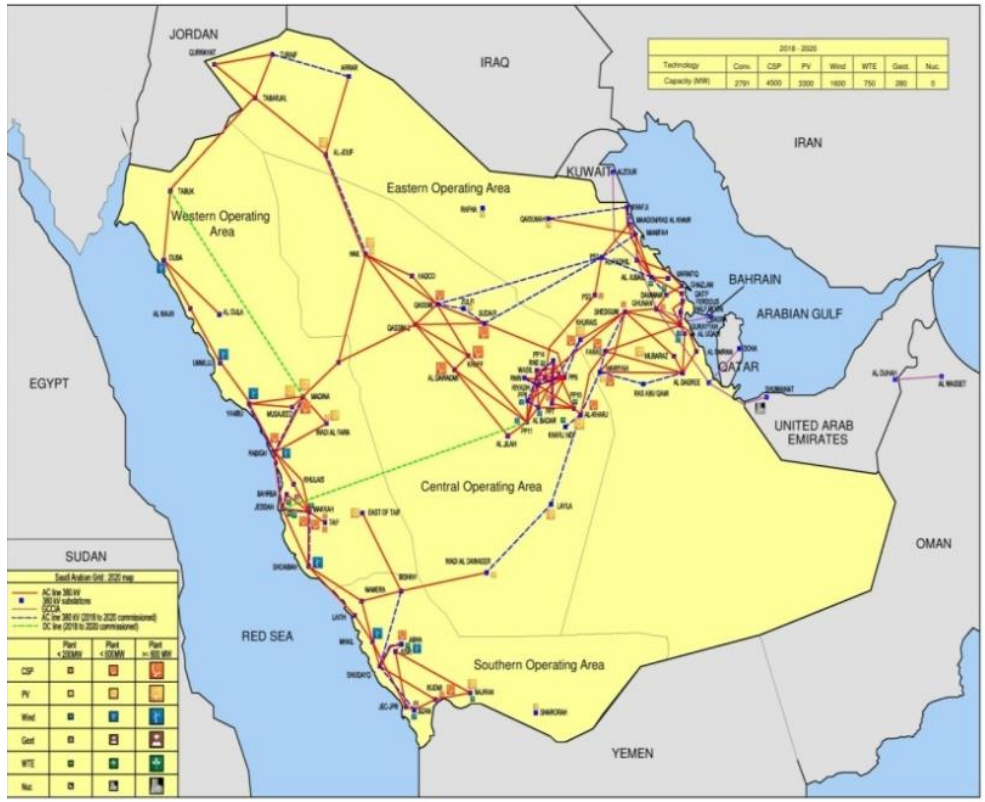
Planned SEC upgrades will allow the integration of ~14 GW renewables in the grid by 2020

SEC planned upgrades by 2020[1]

- Development of 1500km HVDC transmission corridors
- Reinforcements of 380kV interconnections between operating areas
- Connection of isolated areas
- Other reinforcements inside the operating areas



Scenario of 2020 KSA grid with renewables



~14 GW renewables could be integrated in specific mode of the 2020 grid without major reinforcements

1 Description of major upgrades

SOURCE: SEC, KACARE study on grid impact

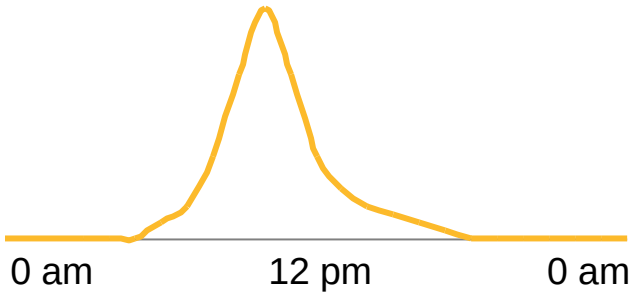
K.A.CARE adopted a renewable-mix to minimize the effect of intermittencies on the system

CONCEPTUAL

Renewable generation is intermittent

Typical PV output[1]

MW

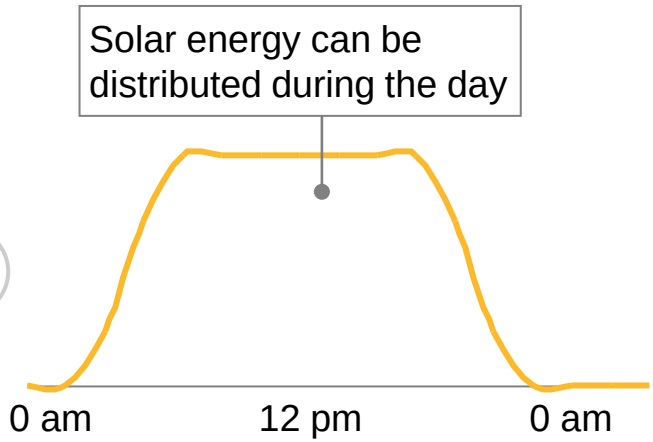


- PV do not generate energy at night
- Weather disturbance during the day could reduce energy output
- Wind power is also intermittent across the day

CSP with storage can help compensate intermittencies

Possible CSP with storage output[1]

MW



- Storage allows for a controlled distribution of energy during the day
- KSA could leverage this technology to compensate other renewable intermittencies

KSA could develop an optimized renewable mix that will minimize the need for compensation from conventional capacity

All renewables will be connected to the grid

1 During a 24hours period

The introduction of renewable and the multiplication of players in generation will require the creation of a national entity to coordinate renewable plants and support the system operators

Development of generation

- KSA will see a multiplication of players in generation
  - KSA has seen the introduction of new generation players with the introduction of IPP in the past 10 years
  - While this is expected to continue, the introduction of renewables and nuclear will bring other players
- The introduction of renewable will require further coordination between generation units
  - Intermittencies will require compensation within renewable sources and from conventional plants
  - Dispatch and maintenance optimization schedule will be required

Creation of a new national coordination entity

- As observed in many countries leveraging significant renewable capacity, the Saudi Sustainable Energy Control Center (SSECC) will:
  - facilitate the integration of sustainable generation in the power system and support the TSP[1]
  - organize and centralize data from generation plants (e.g., forecast, maintenance requirements, etc.)
  - coordinate generation plants forecasted dispatch

1 Transmission system provider

SOURCE: KACARE study on grid impact

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الـذريـــــة والـمـتـجـــددة K•A•CARE

Thank you…

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