Arabian BEC Ltd.

Business & Economic Consultants

SOLAR INVESTMENT IN SAUDI ARABIA: FIRST STEP

MG-Si

Metallurgical Grade Silicon

OVERVIEW

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Report summary by:

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Despite great upheaval in the solar power industry, profitable investment opportunities remain as Saudi Arabia continues to be one of the lowest cost production bases.

Solar market changes

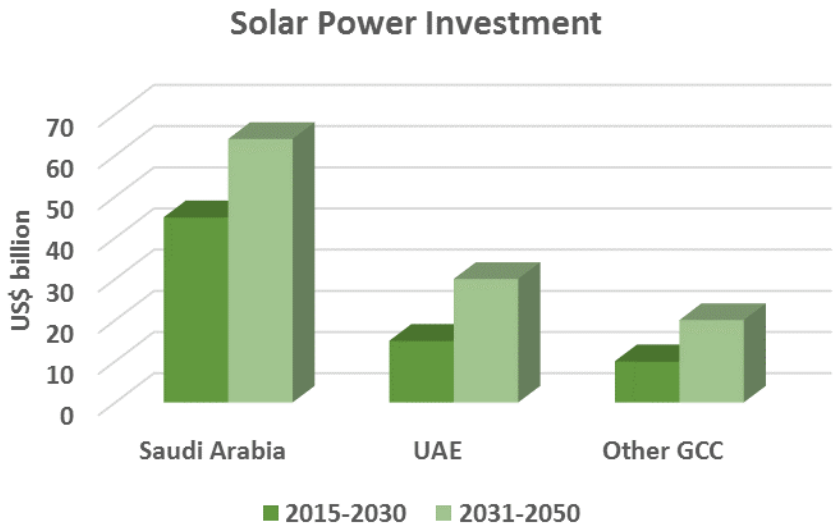
Analysis of the Saudi solar industry in 2010 identified over 20 separate investment opportunities with estimated returns of over 20%. These investments ranged from primary manufacturing and assembly of solar equipment to the provision of services and development of solar farms.

Since 2010 the solar market space has undergone substantial changes:

- Recession and cuts in government supports in Europe and North America have cut potential export markets for Saudi solar products.
- Lower oil and gas prices have impacted on the competitiveness of solar energy.
- Domestic market growth has slowed following delays with the Saudi Government's solar programmes (e.g. KCARE) .
- Solar equipment costs, in particular photovoltaic panels, have continued to fall.
- Excess capacity and falling prices have pushed the industry into another round of mergers.

Despite these changes, the market fundamentals remain strong:

- Investment of over $40 billion in solar power capacity in Saudi Arabia is expected over the next 15 years with a further $25 billion in the rest of the GCC.
- This investment can support local production and assembly of solar power products (polysilicon, aluminium frames, mirrors, etc.).
- For most of these operations, Saudi Arabia has the raw materials and low production costs, and is the prime location for investment.



A prime solar opportunity in Saudi Arabia is MG-Si production, which has a high return, low risk investment potential.

Excellent potential for MG-Si production in Saudi Arabia

One of the outstanding opportunities in the Saudi solar industry is investment in manufacturing MG-Si (metallurgical grade silicon).

MG-Si is a form of purified silicon (99.5% pure) that is the key raw material for the production of photovoltaic cells.

Saudi Arabia is one of the lowest cost production bases for MG-Si in the world, with abundant supplies of the key raw material (high quality silica), and low cost energy.

As well as potentially high returns, investment in MG-Si is a relatively low-risk first step in the solar sector.

MG-Si - Low Risk Investment

Technology Risk

- MG-Si production technology is stable.
- Similar technology successful in the GCC.
- End-user PV technology is changing, but all volume routes require MG-Si.

Market risk

- MG-Si widely used input in chemicals and metals.
- Growing demand in Saudi and GCC markets.
- Flexible production process that can be adapted produce other silicon-based alloys.

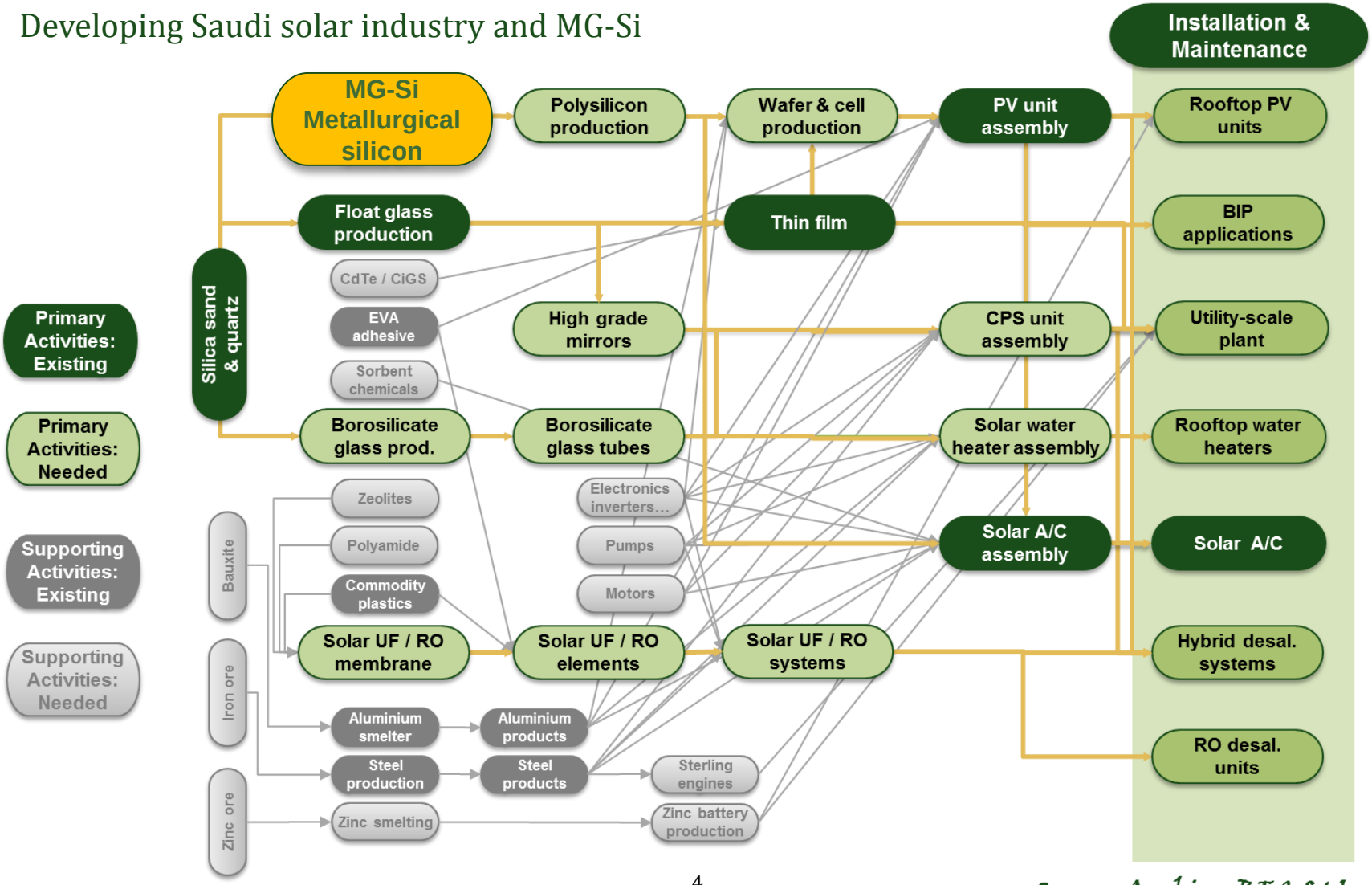
Investment risk

- Turnkey project development possibilities.
- Product offtake agreements possible.
- High project returns possible.
- Excellent leverage potential with SIDF financing.

MG-Si is a key product

Manufacture of MG-Si is a primary activity in the solar industry which links into a wide range of activities and services. At present, many of these activities exist in Saudi Arabia, but both the scale and level of integration is limited.

Developing Saudi solar industry and MG-Si



Source: Arabian BEC Ltd.

Polysilicon production in the GCC is set to take off and provide a core market for local supplies of MG-Si.

Progress expected on delayed GCC projects

In the last decade several large-scale polysilicon projects have been planned for the GCC, but have been subject to delays as a result of the market downturn in 2009 and questions over technology. But these projects are expected to get back on track:

- **Demand outlook:** In the last year polysilicon demand has picked up, increasing by 16% in 2014 and is forecast to rise by over 20% in 2015.
- **Technology:** REC's fluidised bed reactor now offers a significant cost advantage over the standard Siemens process in large-scale production. While purity levels are lower (6N-7N* compared with 9N for Siemens), these are acceptable in most photovoltaic applications.

The polysilicon projects identified (see right) would require nearly 50,000 tonnes per year of MG-Si. In addition to this, even greater volumes are needed in the GCC's expanding aluminium, and chemicals industries.

Polysilicon Projects in the GCC

IDEA Polysilicon
- Saudi Arabia
- j.v. with REC Silicon
- 20,000 t/y

Polysilicon Technology Co
- Saudi Arabia
- j.v. MEC (Swicorp) – KCC
- 3,350 t/y

Qatar Solar Technologies
- Qatar
- J.v with SolarWorld AG
- 8,000 t/y

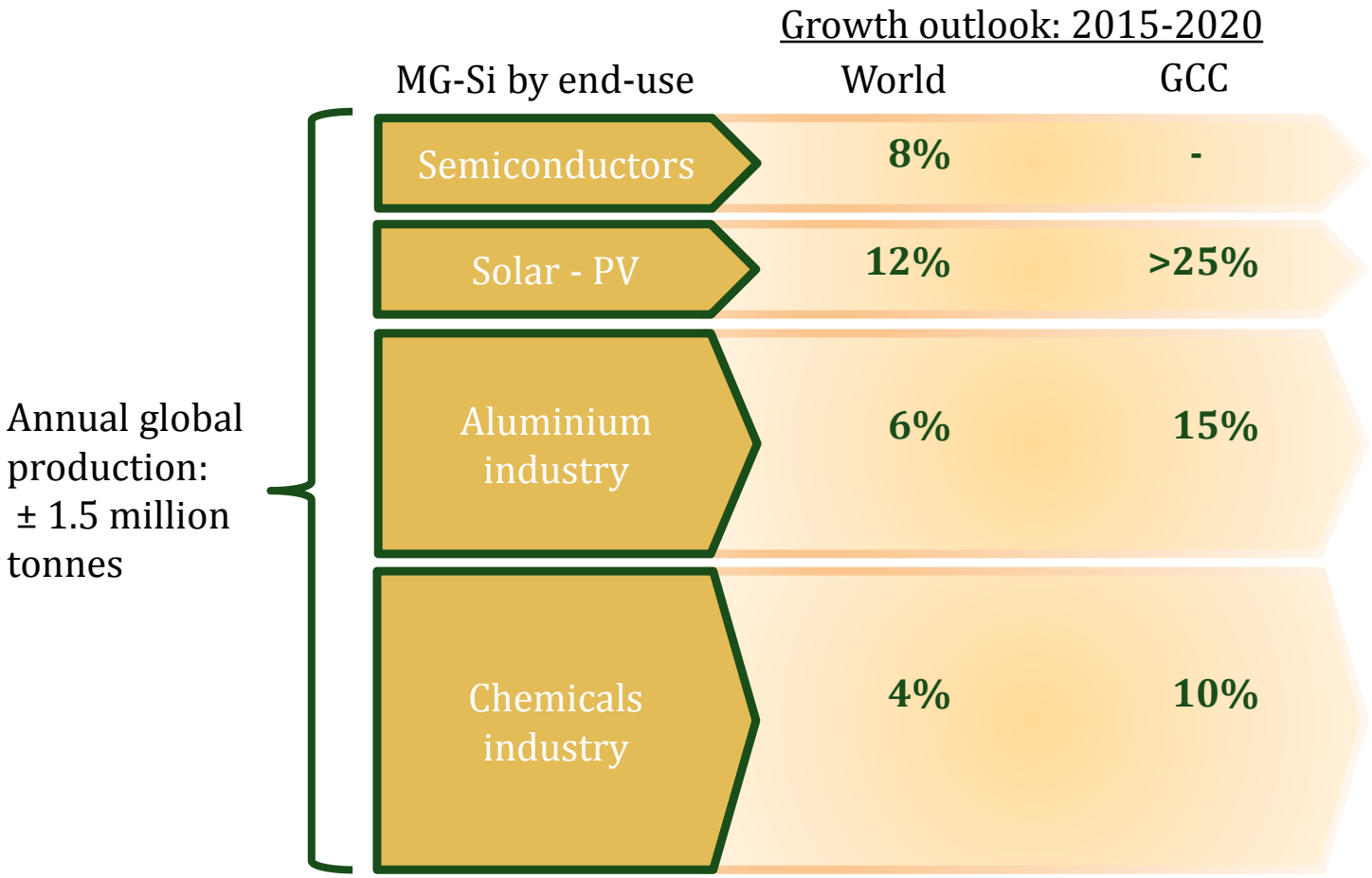
MBM Solar Holdings
- Dubai
- 2,500 t/y

* 6N purity is 99.999% Si, while 9N is 99.9999999% Si which is the *gold standard* for semiconductors.

Market risk with MG-Si is low as the product is widely used in a number of core and growing markets, both in the GCC and worldwide.

Strong growth outlook for MG-Si in most markets

While the nascent GCC solar industry would be the ideal target for a Saudi MG-Si plant, silicon metal has a wide range of applications and demand in other end-use sectors is also strong. In particular, the GCC's aluminium and chemicals industries require substantial and increasing volumes of MG-Si.



With known technology, strong market growth and a highly competitive low-cost production base, the potential returns are high.

Potential for maximising returns on equity by locating in Jazan

MG-Si production costs worldwide range from $1,400 to over $2,500 per tonne. A Saudi plant has the potential to produce at MG-Si at the bottom of this range, with the key cost advantages being:

- **Low cost energy:** average industry electricity price ($0.043/kWh) competes favourably with the best in the world, including China and Iceland - the key locations for new MG-Si capacity.
- **Local quartz**: this is the primary raw material and there are high quality commercial deposits near Jazan.

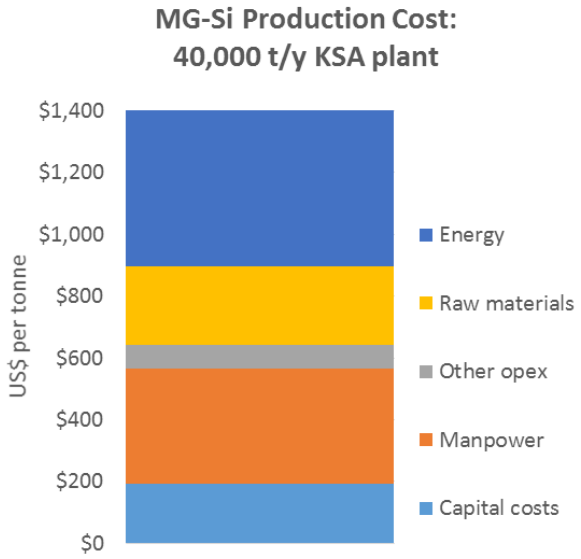
Energy costs could be reduced further (up to $200 per tonne) by scheduling production cycles to meet off-peak power prices ($0.027/kWh), or using oil or gas.

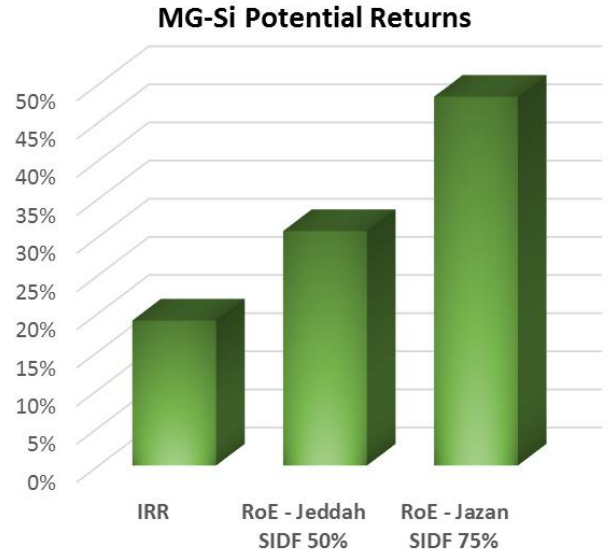
A conservative estimated of the overall project return (IRR) for a standard 40,000 t/y MG-Si plant in Saudi Arabia is 19%.

Standard SIDF* financing, covering up to 50% of total capex with a 2% charge over 15 years, is available for investments in the main cities (Riyadh, Jeddah, Dammam-Dhahran). This alone (excluding commercial loans) would support a return on equity of just over 30%.

Locating the plant in Jazan would give access to SIDF financing covering 75% of capex over 20 years, and this raises the potential return on equity to just under 50%.

Locating in Jazan has the added advantages of local supplies of quality quartz and ready access to the port, and potentially lower cost energy in the way of off-gases from new Jazan refinery.





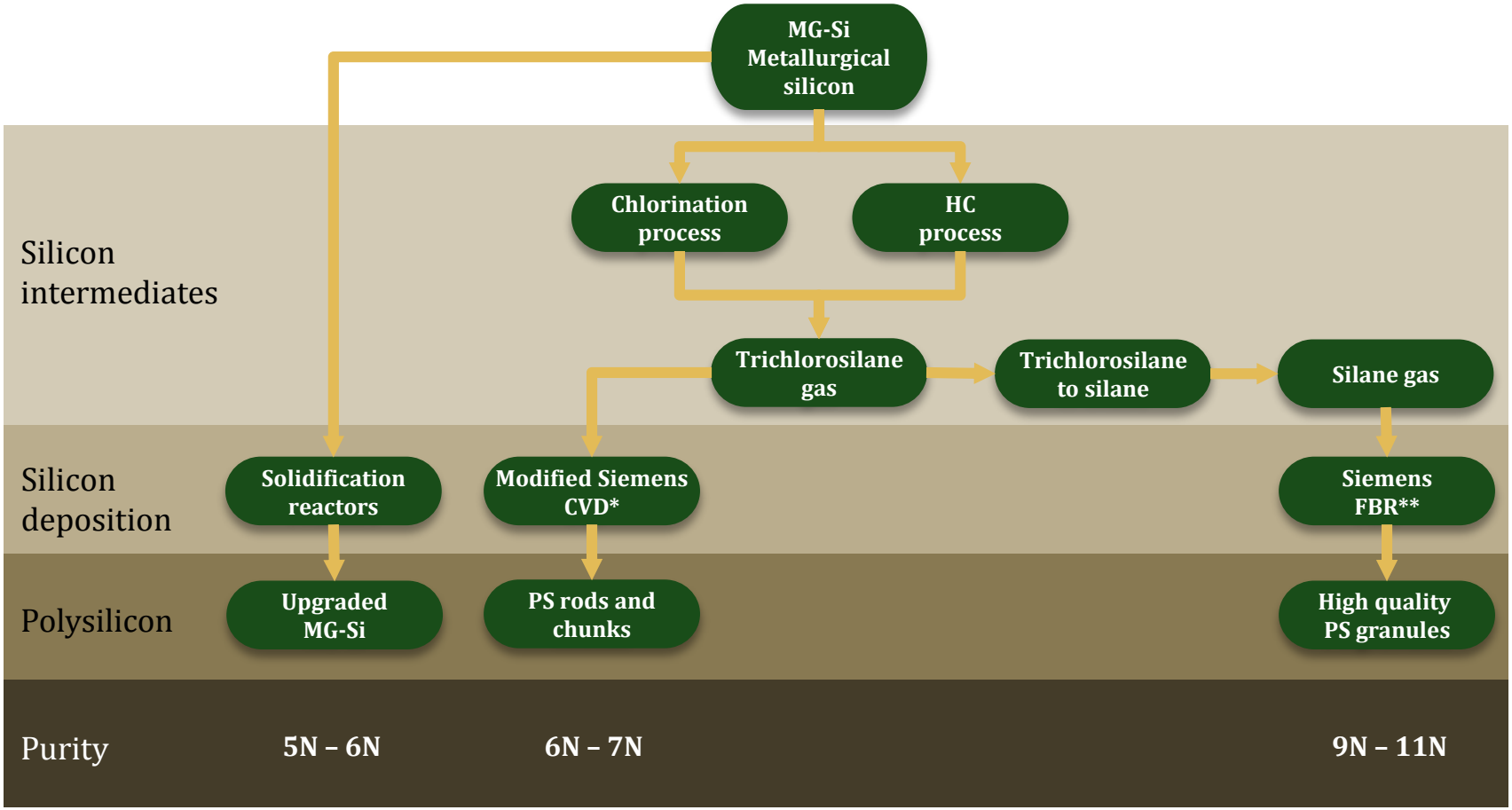
* SIDF – Saudi Industrial Development Fund

MG-Si is the key feedstock for all volume production of photovoltaic panels as well as semiconductors.

MG-Si is used in all mainstream PV technologies

Some 90% of photovoltaic (PV) cells produced in 2014 were based on silicon technology. With the widespread availability of silicon (compared with competing rare materials such as CdTe), silicon's market dominance is expected to continue.

While there are competing silicon PV technologies, they are all based on using MG-Si as a feedstock.



*CVD – chemical vapour deposition

**FBR – fluidised-bed reactor

Saudi solar investment potential

In addition to MG-Si, there is excellent potential for a wide range of solar energy-related investments in Saudi Arabia and the rest of the GCC.

Our consultants have identified several dozen solar investment opportunities that capitalise on the region's competitive strengths: low cost raw materials, serviced industrial land, existing business operations, low-cost finance and growing demand for solar power systems.

While growth in demand for solar power systems has been erratic, rapid expansion is now expected. We estimate that total investment in solar power installations and solar desalination plants in the GCC will reach $ 12 billion per year by 2020, with these installations being split evenly between photovoltaics, concentrated solar thermal and desalination technologies.

Further information

For further information on MG-Si or other solar investment opportunities in Saudi Arabia and the GCC, contact:

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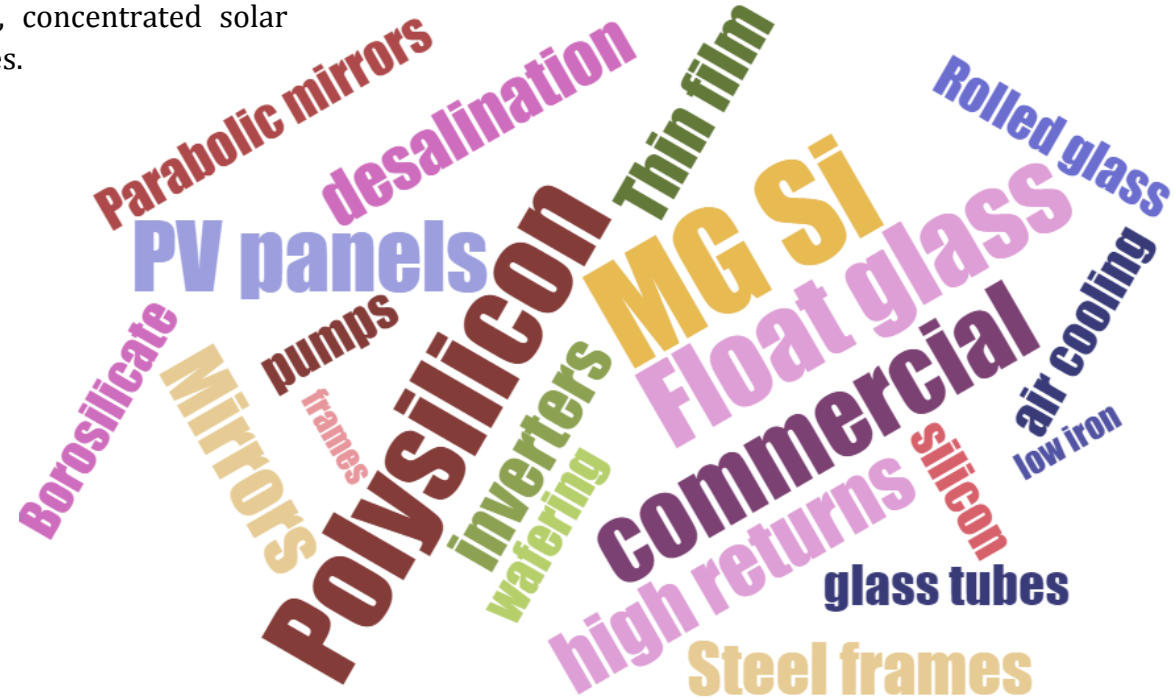

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Arabian BEC Ltd. is an economic and business consultancy. Established to meet the needs of business in the Arabian Gulf markets, we are focused on delivering cost-effective solutions to clients.

Arabian BEC Ltd. was founded by experienced consultants that have worked on investment projects and market studies throughout the Arabian Gulf states as well as in most parts of the MENA region.

For further information visit:

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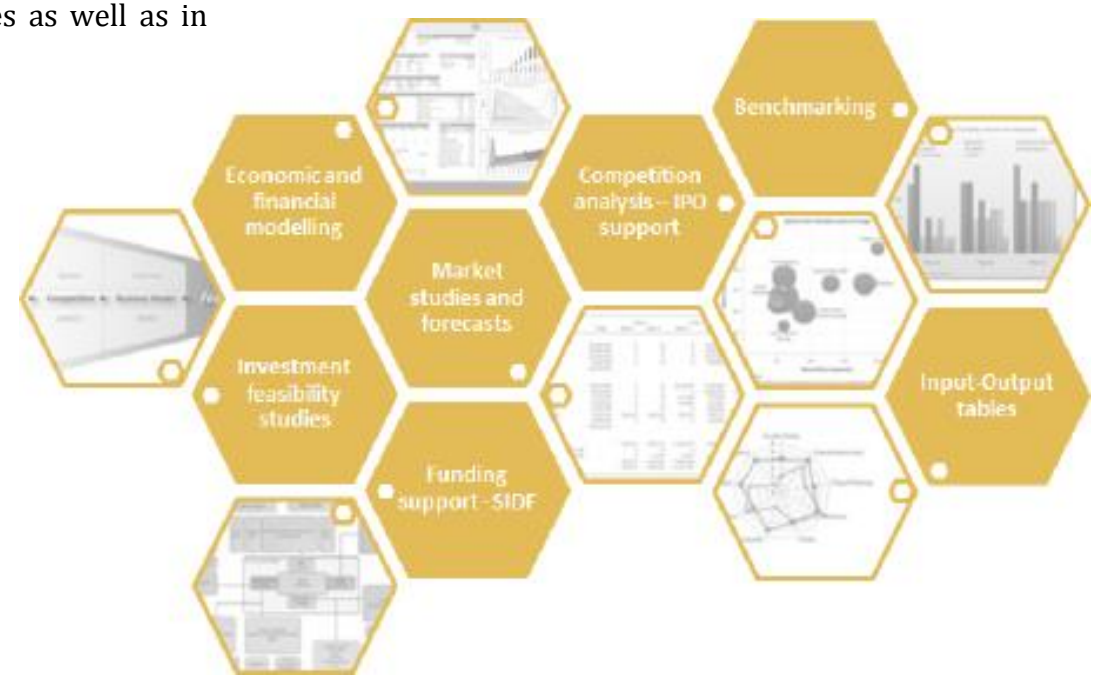
Our services

We provide a full range of business and market services for our clients from project identification and pre-feasibility to implementation planning. Our key services are:

- Feasibility studies
- Benchmarking studies
- Financial and economic modelling
- Due diligence
- Market studies and forecasts
- SIDF and other finance applications
- Input-Output tables



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