



HYDRO

Creating winners
among nations
and companies

Abidjan, November 4,
2013, Odd Ivar Biller

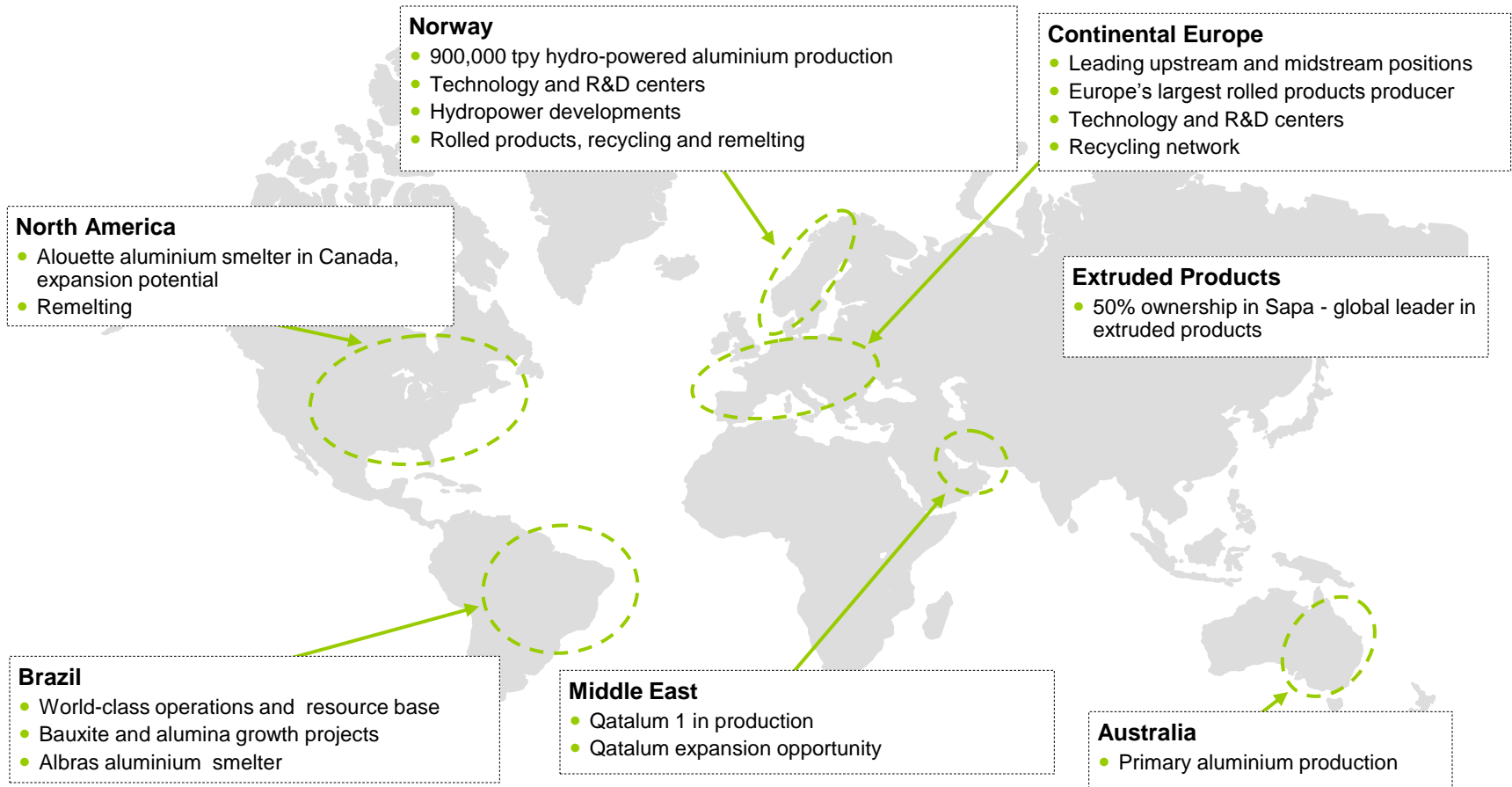


Norsk Hydro- co- builder of nation



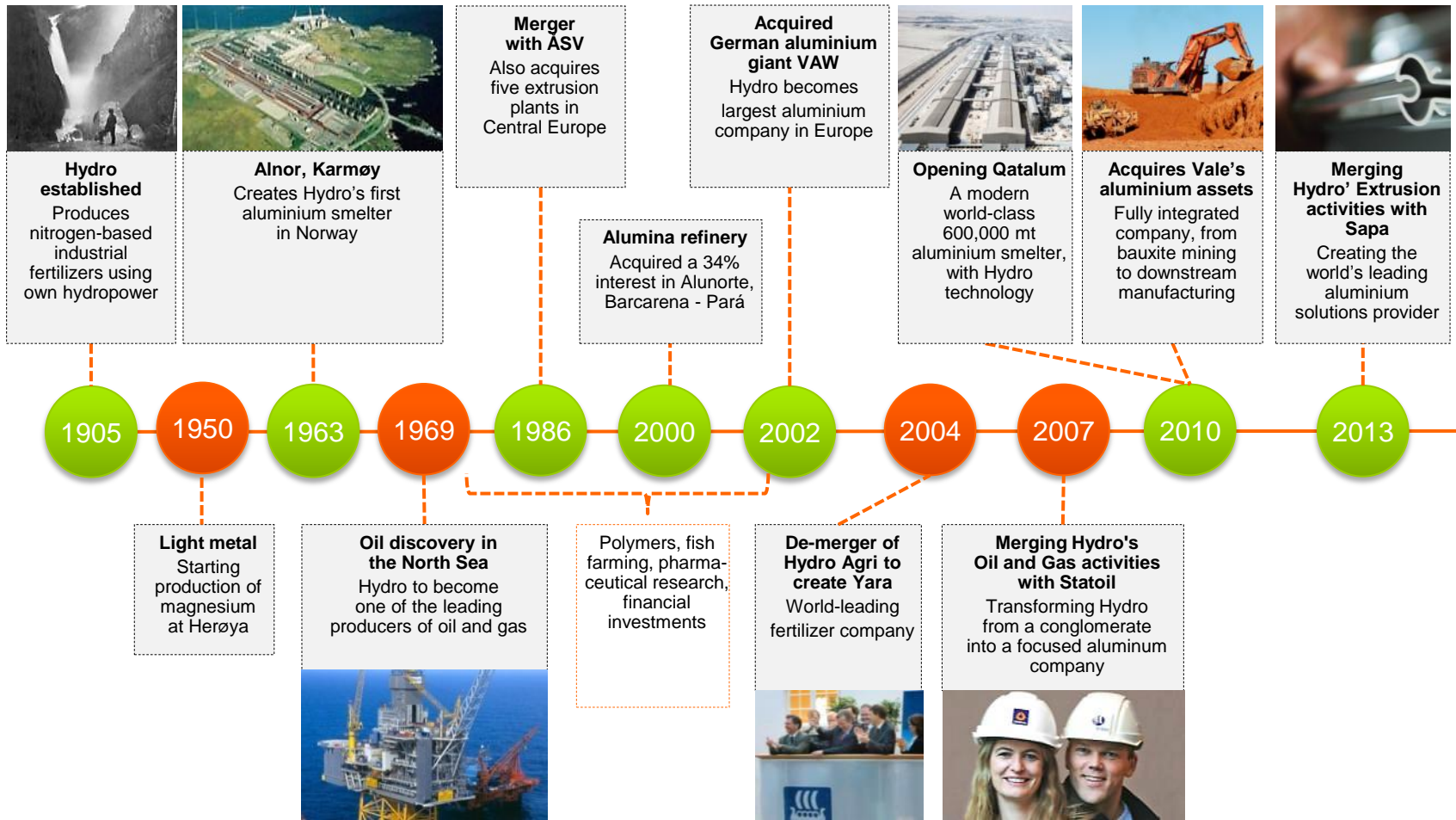
- Front runner in industrialization of Norway
- Based upon natural resources
- Multi business operations till 2008
 - Oil & Gas
 - Hydroelectric power
 - Fertilizers
 - Petrochemicals
 - Aluminium
 - Magnesium
 - Fish farming
- Today a major aluminium company in the world
 - Captive power production

Global reach



More than a century of innovation and development

Courage, Respect, Cooperation, Determination – and *Foresight*



Norway and Qatar- «parallell lives» as petroleum nations



- New oil & gas nations mainly from 1st oil shock 1974
- Substantial production of oil and gas
- Exporting similar amounts of natural gas
- Different strategies for use of petroleum resources
- Norway few gas based industries and other domestic use of natural gas
- Qatar extensive gas based industries and gas fired power
 - Hydro present in Qatar with fertilizers since 1972
 - Vinyl petrochemicals since 1998
 - Aluminium since 2008

Difficult to emulate success stories

- National strategies depend on
 - resource base and characteristics
 - market conditions
 - status of industrial and national developments
 - individual national priorities



Norway- geography and demography

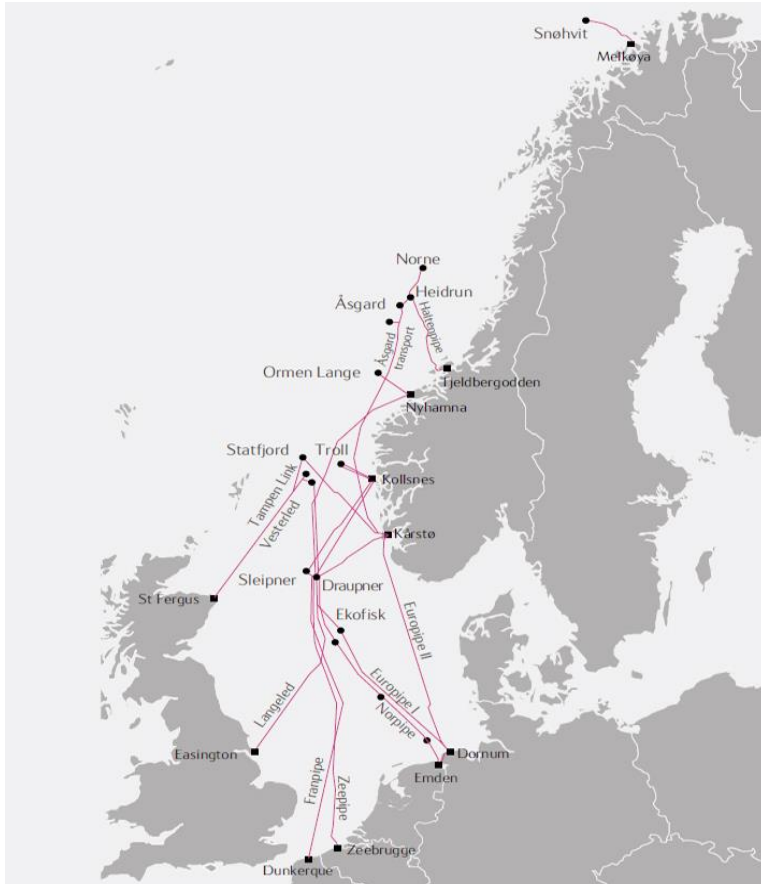
- Same geographical size as Cote d'Ivoire
- Distance from South to North the same as Abidjan- Dakar
- Large areas of mountains, and large number of islands
- 5 million inhabitants dispersed all over the country



Norway- industry development

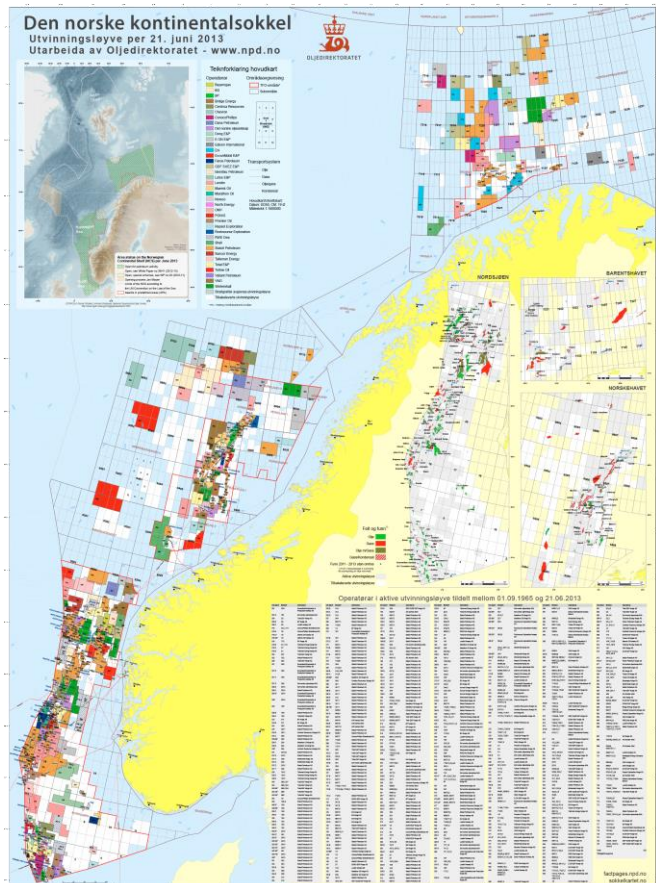
- **Resource based industries**
 - **Hydro power development and production**
 - **Fertilizers and metallurgical industries based on water power**
 - **Fertilizers and petrochemicals based on imported oil products**
 - **Fisheries, fish farming and fish processing industries**
 - **Oil & Gas field development**
 - **Gas based petrochemical industries**
 - **Oil & Gas service industries**
- **Shipping and shipbuilding**

Norway a large exporter of natural gas



- All petroleum activities take place on seabed of continental shelf
- 100 billion standard cubic meters per year (bscm/y) of piped gas
- Equivalent to 30 pct of global LNG exports, same as Qatar
- One LNG train far north
- 8100 km of gas pipelines

Norway- ownership of oil & gas and related industries



- Discoveries and first developments by foreign oil companies
- Oil and oil products belonging to concession holders
- Norwegian companies with relevant industry experience to become front players upstream and downstream
- Norwegian companies oil & gas field operators from late 1970's
- Norwegian companies owners of petrochemical industries
- Long standing cooperation with local technical universities
- Good basis for own research and development

Norway- limited use of gas as feedstock for industry

- Separation of condensate and NGL from dry gas on all landing points
- Refining of NGL through fractionating only at first landing point
- Third largest export terminal for LPG in the world
- LPG shipped to petrochemical plants in eastern Norway
- Ethylene cracker, olefins and polyvinyl products
- Fertilizers based on LPG
- Methanol plant on one landing point



Norway- reasons for limited use of gas as feedstock

- High landed natural gas prices Europe
- Long term oil indexed take-or-pay contracts
- Low pipeline transportation costs
- Oil companies until recently owners of pipeline network
- Export prices for LPG high
- LPG transportation cost low
- High net back prices for buyers
- Oil companies joint interest with Norwegian state through 78 pct tax rate on revenues
 - Lower taxes on profits for onshore industries
- Owners of the gas not part of the downstream industries
 - ConocoPhillips participating in the methanol plant

Norway- limited use of dry gas for energy

- **No use of dry gas for heating and cooking**
- **Natural gas is not used as fuel for cars**
- **Limited production of electricity from gas fired power plants**
 - **One for general consumption, 430 MW, not in use**
 - **One for electrification of offshore petroleum production and onshore treatment**

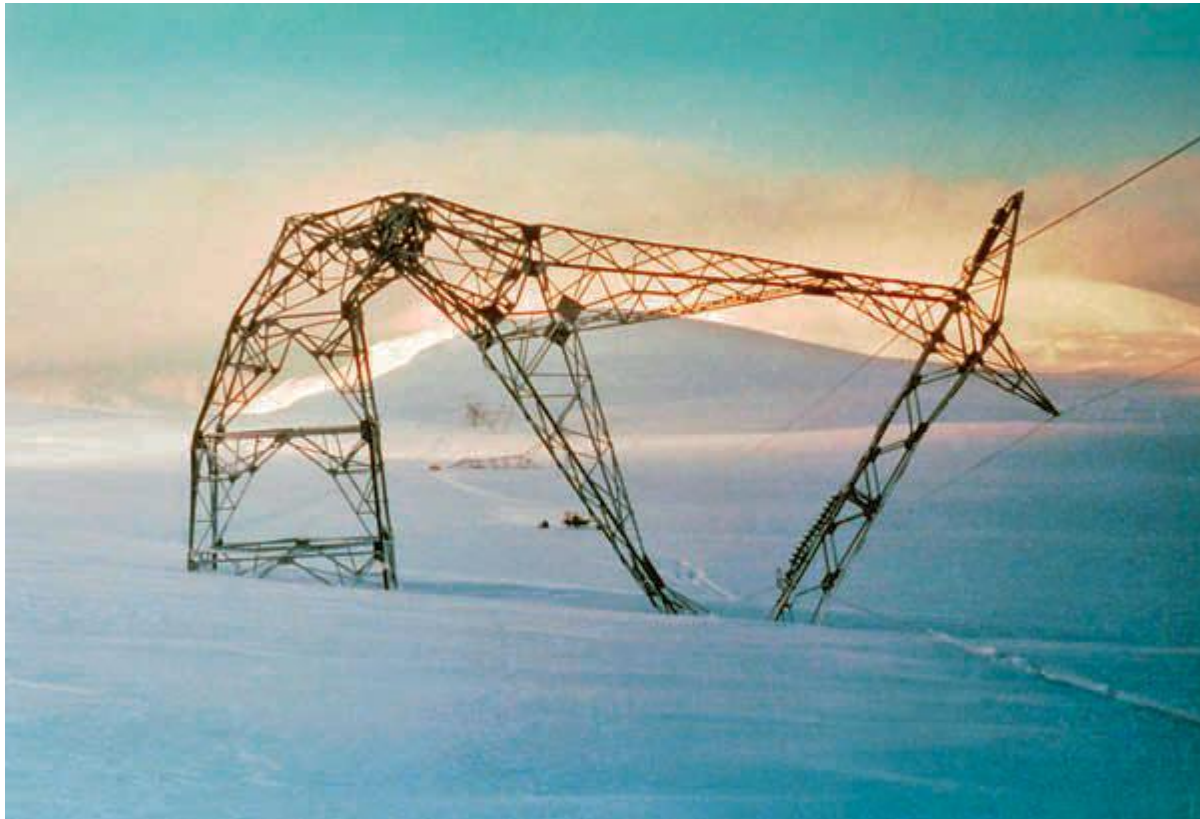


Norway- abundance of «white gold» = hydropower



- **20-25 000 MWH utilized capacity**
- **More than West Africa capacity with 300 million people**
- **100 pct of electricity consumption depending on precipitation**
 - **55 pct heating and cooking,**
 - **25 pct energy intensive industries,**
 - **20 pct for other industrial usage**
- **130 000 km of grid, three times the distance around Equator**

Electricity grid under harsh weather conditions



Qatar story- main take-away

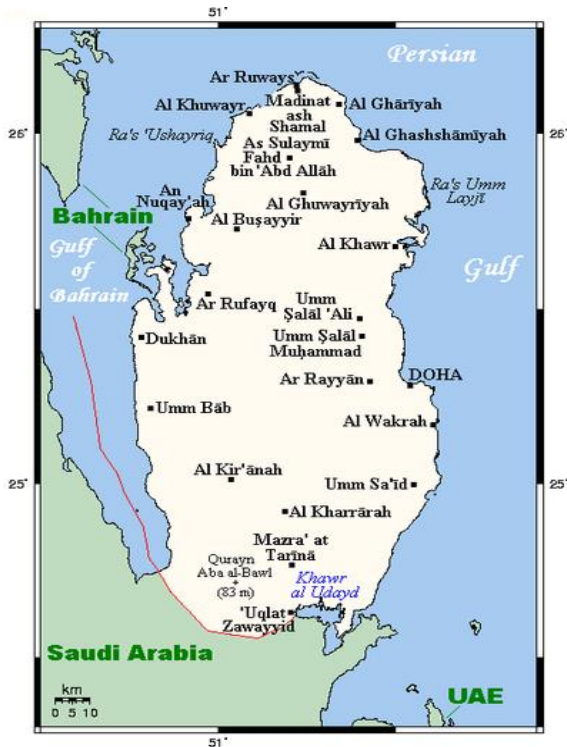
How can countries which do not have an industrial base build up a leading portfolio in the world of oil and gas industry and associated industries from scratch ?





Home page - Qatar Industrial Manufacturing Company

Qatar- Geography and demography



- Tiny geographical area, 140 x 60 km
- 250 000 nationals
- Migrant work force of 1.7 million not allowed to stay
- Largest GDP per capita in the world

Qatar Fertilizer Company –QAFCO



“QAFCO's inception in 1969 as a joint venture company to produce chemical fertilisers was the first and a significant step in Qatar's industrial diversification program to utilize its abundant natural gas resources.”

[From Qatar Petroleum's internet home page]

Hydro in Qatar- QAFCO

- **First industrial joint venture partner with the state of Qatar**
- **Then 110 000 inhabitants -full independence from Britain in 1972**
- **In production 1972**
- **Qatar 75 pct, Hydro 20 pct, Hambros Bank London 5 pct**
- **Hydro providing technology, project management, operational experience – and doing marketing**
- **Qatar Petroleum to deliver dry gas as feedstock**
- **Hambros to deliver financing with British export credits**
- **QAFCO is today the worlds' largest fertilizers complex**
- **Produces 20 times more ammonia and urea than 40 years ago**
- **Capacity extensions based on project finance**



Hydro in Qatar- Qatar Vinyl Company (QVC)



- In production in 2001
- Partner together with Qatar Petroleum (QP) and Atochem
- Production of VCM- and EDC, building blocks for PVC
- Hydro- project manager
- Marketing agreements with Hydro and Atochem
- QP to provide ethylene as raw material and infrastructure
- 2007: QP exercise of Right of First Refusal after Hydro sale of petrochemicals business

Hydro in Qatar- Qatar Aluminium Company (Qatalum)

- Qatar Aluminium Company (Qatalum) in production from 2010
- 600 000 tons per year, total project cost \$ 6 bn
- Hydro and QP 50/50 ownership
- Hydro delivering technology, project management, operational experience
- Hydro doing marketing
- QP supplying gas for power and infrastructure
- Both partners key in obtaining project financing



Qatar Petroleum- history

- **Established in 1974**
- **Flying start taking over all oil and gas fields expropriated 1974-1976**
- **Established production from onshore Dukan oil field and non-associated gas field**
- **Associated and non-associated natural gas transported to the Eastern coast**
- **Dry components used as feedstock for Qatar Fertilizers Company -“stranded gas” at very cheap prices**
- **No alternative use; 1974: 60 pct flared, 1979 :5 pct flared NB**
- **Domestic use of NGLs for petrochemical industries 1976**
- **Big leap forward with LNG projects from 1998**

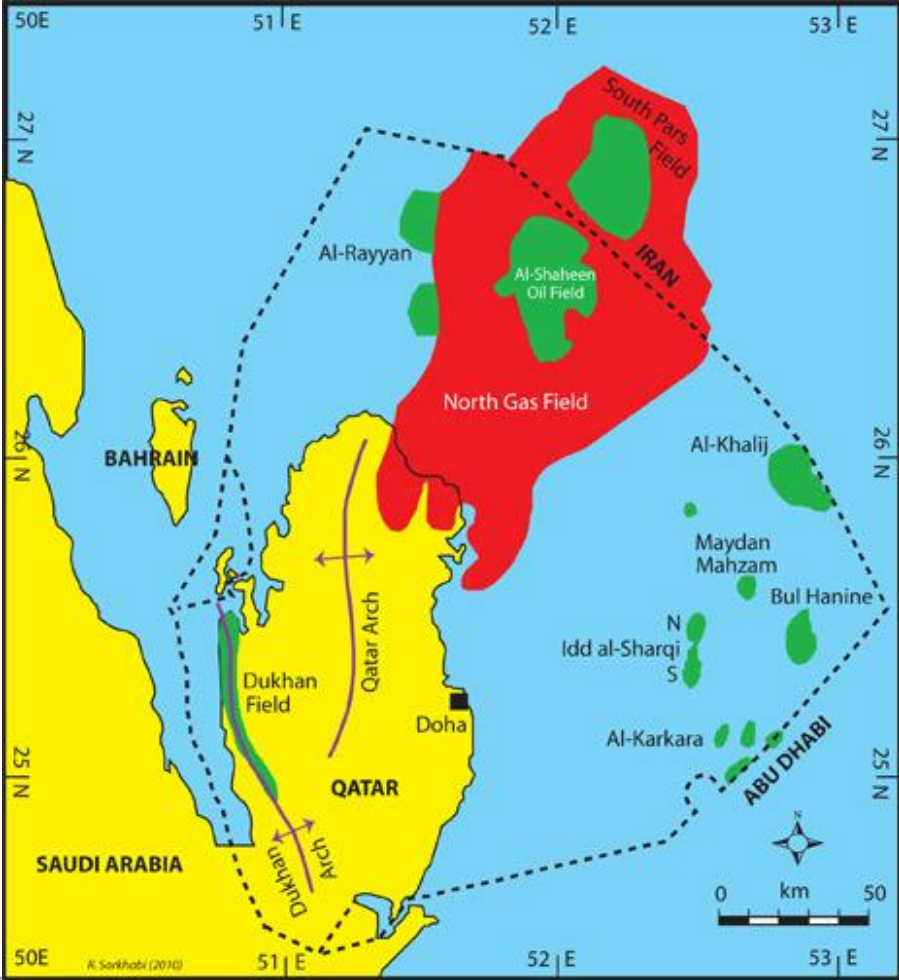


Qatar industrial development- LNG

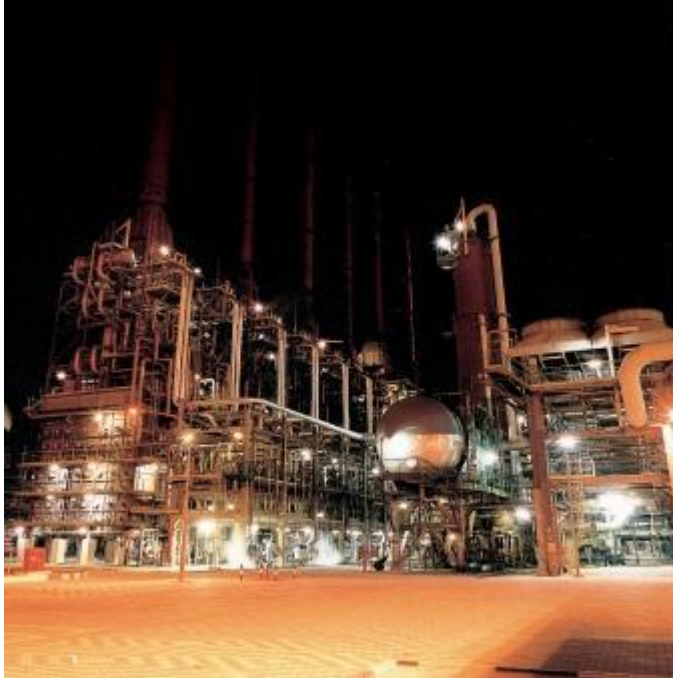
- The largest exporter of LNG in the world (77mn tonnes/y)
- The gigantic North field which was discovered in 1971
 - 15 pct of global gas resources
- Export of LNG from 1998
- Gigantic investment over 15 years
 - Norway build-up of equal piped volumes over 30 years
- May increase production capacity by 10 pct with no extra investments



North Field- largest natural gas field in the world



Qatar industrial development- petrochemicals



- **Early production of NGL from oil and gas**
- **Fertilizers from based on dry gas 1973**
- **Ethylene and olefins from 1975**
- **Polyvinyl production from 1998**
- **Production doubled from 2006-2012**
- **Strip out” plants with more than 60 derivative products**
- **Money machines with more than 50 % net profit margin**
- **National company (Muntajat) in charge of marketing of all chemical and petrochemical products from 2013**

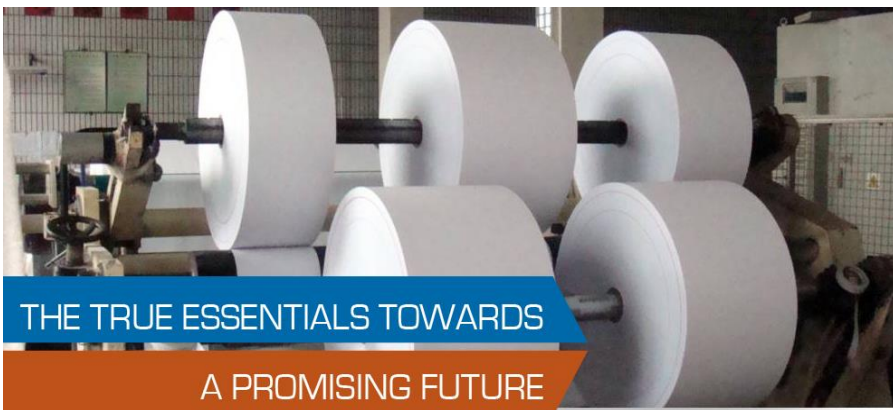
Qatar industrial development- dry gas industries

- **Largest GTL (gas to liquids) operations in the world**
 - **“Clean diesel”**
- **Gas fired power stations with 8000 MW**
 - **(1/2 of West African capacity)**
- **Power intensive industries**
 - **steel**
 - **cement**
 - **aluminium (captive power)**



Qatar Industrial Developments- adjoining businesses

- **Aluminium extrusion**
- **Metal coating**
- **Ferro alloys**
- **Bricks for construction**
- **Energy dependent industries**



Qatar industrial development- job creation

- **Construction phase huge demand**
 - **Shell GTL – 52 000 persons on site at peak**
 - **Qatargas II, LNG 30 000 person**
 - **Qatalum aluminium smelter – 20 000 persons**
- **Operations less labor intensive for direct employees**
 - **Qatalum 1700 own or contractor personnel**
 - **QAPCO with 6 petrochemicals plants altogether 1200 employees**
- **Large service industries during constructions and operations**
- **Large consumer demand created**



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Qatar industrial development- national strategies 2030

- Oil & gas from 55 pct of GDP to 25 pct
- Production of petrochemicals and chemicals to be doubled from 2012- 2020.
 - Aiming at becoming the 3rd largest in the world by 2020
- Supporting infrastructure
 - Two Industrial Cities for large industries
 - New Doha harbor
- Qatar Science and Technology Park
 - Home for more than 30 international technology companies
- Education City with branches of foreign universities
- Qataris in skilled positions («Qatarisation»)

QATAR SCIENCE & TECHNOLOGY PARK

Member of Qatar Foundation



Qatar industrial development- success factors

- **Qatar Petroleum very competent national oil company (NOC)**
- **National champion**
- **Owner of all oil and gas deposits in Qatar**
- **At least 50 % partner of oil & gas operations and related service- and industrial activities**
- **Size of North field allows for composition of multiple LNG partnerships**
- **No need to compensate foreign partners for finding the resources**
- **QP developing part of the North Field for production of gas solely for domestic use**
- **Careful selection of partners**
- **Often the same partners for upstream and downstream ventures**
- **Allows for alignment of downstream interest between QP and partners**
- **Partners with technological-, project management-, operational capabilities**
- **Partners with market outlets**
- **High score for combating corruption**

Qatar industrial developments- «strategic alliances»

- **Qatari LNG and derivative industry benefits from the presence of some of the largest international companies**
- **Exxon Mobil, Total, ConocoPhillips, Shell, Marubeni, Mitsui partners in different Qatargas LNG trains**
- **ExxonMobil sole «strategic partner» in Rasgas**
- **Shell as partner in Qatargas LNG and GTL**
- **Total as partner in LNG and petrochemicals**
- **Customer representatives from Japan and Korea as partners in production and transportation of LNG and construction of platforms and shipping fleet – Marubeni and Mitsui**
- **Careful selection of non- LNG partners in gas and power based industries, Kobe steel, Chevron, Gulfstream, Air Liquide, Norsk Hydro**
- **Hydro invited to become partner on two occasions; North Field oil; aluminium**



Qatar industrial development - QP owner strategies

- **Majority ownership in all partnerships**
- **Equity partner on equal terms**
- **Export finance and project finance**
- **QP in the driver's seat, wants to "own the company"**
- **Chairman of the Board of Directors and CEO**
- **Foreign partner**
 - **technology, operating experience and market outlet**
 - **secondment of personnel**
 - **not «operator»**
 - **project manager on contract**
- **Qatari petroleum engineers and other professional educated in the US and Europe operating across the value chain**
- **No own research departement until 2009**

Joint learning from Qatar and Norway

- **Importance of ownership models upstream and downstream**
- **Oil and gas in ground belongs to property owner, often national states**
- **Oil and gas streaming from wellhead belong to concession holders, sometimes for defined period of time**
- **Royalties may be paid in kind**
- **Concession owners normally own all products which can be derived**
- **Provisions for “landing” of oil and gas onshore host country**
- **Oil companies regularly require certainty wrt right to dispose of oil&gas**
- **Try to establish onshore partnerships with license holders**
- **Option agreements as part of PSA’s for certain volumes or percentage of gas discoveries with pricing mechanisms allowing for domestic use of gas**

West Africa geography and demography

- 15 countries
- 11 countries bordering the ocean with potential oil and gas resources
- New petroleum discoveries in Niger
- 300 million inhabitants



West Africa- Norsk Hydro' presence in the region

- 2005 : Hydro wanted to explore seabed outside Ghana
- Considered whole basin to be very prospective
- Evaluated area of Jubilee field
- Expertise in oil & gas and production and transportation of electricity
- Co-owner of gas fired power station in Norway
- West-African oil & gas and electricity attention later diverted
- Building Systems through 50 % owned Technal of France
- Previous HydroChem fertilizers now owned by demerged Yara



West Africa- natural gas resources

- Presently large quantities of natural gas only in Nigeria
 - 18 million tons of LNG per annum, 25 pc of Norwegian or Qatari exports
- Potential new discoveries in other coastal states
- Important to develop strategies for domestic use of gas early on
- May influence how the exploration licenses are drafted for alignment of interests
- How should natural gas resources be utilized?
- Mosambique and Tanzania more like Qatar with huge deposits
- West African associated or non-associated gas resources expected to be smaller

West Africa- employment in industrial projects

- Onshore more bricks and mortar
- Onshore construction and civil works need more local content
- Offshore oil and gas platforms, often constructed piece by piece abroad
- Recent steel platforms with topsides towed from Asia
- Assembled onshore production country and towed to offshore location



Doha, Qatar - 14 September 2013: Four offshore platform topside modules, started their long journey by sea from Ulsan, South Korea to Qatar's North Field

West Africa- industrial use of wet gas substances

- **NGL need not be separated from oil before offshore or onshore loading**
- **NGL need to be separated before LNG can be exported**
- **NGL may look to be a profitable business on its own, or as LPG**
- **NGL or LPG can be exported or used for domestic gas based industries**
- **Demand for petrochemical and chemical products expected to increase**



West Africa- use of dry gas for LNG or industrial ?

- **Economies of scale may require that volumes are not separated**
- **Expectation of LNG supply glut in the late 2020's ?**
- **US may become a very large exporter of LNG**
 - **application for exportation close to 80 % of present global exports**
- **Australia, Mozambique, Tanzania, Iran and Russia with plans**
- **China with shale gas for own consumption by 2030 ?**

West Africa- dry gas for fertilizers

- **Smaller volumes requirements for ammonia/ fertilizers than for LNG**
- **Community effects larger than for LNG plants**
- **Supplies to domestic agriculture**
- **Opportunities for support industries and suppliers**
- **Variety of derivative products, like industrial gases**
 - **Fertilizer project in Gabon coast for 1.1. million tons per year**
- **Nigeria announced a combined refinery and fertilizer project of \$9 bn**
- **Partner selection important**
 - **Qatari example**

West Africa- dry gas for electricity

- **ECOWAS,- the West African region has a potential for hydroelectric production capacity of 26 000 MW, of which only 16% is currently used.**
- **Thermal generation necessary to move from 15 000 to 100 000 MW providing for 350 W/capita level of Brazil)**
- **Limited resource of coal**
- **Huge gas supply quantities required**
- **Import of LNG probably not sustainable**
- **West Africa Gas Pipeline (WAGP) 700 km**
- **Main purpose to provide for power generation**
- **WAGP failed to deliver the level of gas agreed by its partners due to various issues including high moisture**
- **The success of the project hinges on gas policy in Nigeria**



Electricity in Ghana

- **The Volta River Dam with 1020 MW installed capacity**
- **Bui Gorge with an installed capacity of 400 MW**
- **80 pct of Volta River Dam for Valco aluminium in 1967**
- **Aluminium smelter closed down due to shortage of supply**
- **VRD now 100 pct for general consumption**
- **Two oil fired thermal power plants**
- **Cross- subsidizing of feed tariffs hydropower and thermal power**
- **Grid system reaching 50 pct of population**
- **Benefits of industrial use as base load in power system**



Electricity in the Ivory Coast



- **Installed capacity of 1,200 MW**
- **Exporter to Benin, Burkina Faso, Ghana, Mali and Togo.**
 - **600 MW generated by 6 hydroelectric facilities**
 - **500 MW gas fired from independent power producers**
- **Over 60 new power projects**
 - **2700 MW gas fired**
 - **1000 MW hydropower**
 - **renewable energy with biogas; waste to energy; photovoltaics; and biomass**
- **Increased transmission network planned**

West- Africa- gas fired power vs solar

- **Solar cheaper per unit installed but more expensive per MW**
- **More direct solution for inland areas than a series of power plants along the coast**
- **Solar plants \$ 5 M per 1000 MW**
- **Advanced natural gas cycle plants \$ 1M per 1000 MW**
- **With Henry Hub of gas price of \$ 3.50 annual bill plus fixed cost= \$ 300 mill per year.**
- **Gas bill needs to be much lower for domestic use in Africa**
- **Gas power plants better to develop national and regional grid**
- **Solar power cannot turn these emerging market nations into industrialized economies**
- **But can be important supplement in rural districts**



Aluminium production in West Africa

- **Steady supply of electricity needed**
- **Power interruption may have catastrophic consequences**
- **Gas resources be long term**
- **Qatalum consumption of 1000 MW / 1,4 bcm per year for 600 000 tonnes**
- **Large investments - Qatalum \$ 6 bn**
- **Green field capacity of critical size**
- **Prevailing business conditions difficult**
- **Low electricity prices needed long term**
- **Reopening of Valco against alternative use of power**
- **Power efficiency of old smelter lower than new technology**
- **Remelting in new plants as alternative**

